Doctoral Thesis

THE ROLE OF NUMBERS IN ENVIRONMENTAL POLICY

The Economics of Ecosystems and Biodiversity (TEEB)

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To my parents

who introduced me to the wonders of Nature

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Abstract

This dissertation explores the central role of numbers in environmental policy and discourse, with a particular focus on the 'economic turn' in nature conservation. The aim has been to understand and explain why, despite the parallel increase in environmental problems and in quantitative information about the environment, the faith in and focus on numbers to do something about the problems seem as strong as ever. The dissertation draws on discourse analysis and insights from historical and sociological studies about numbers and quantification and combines it within a critical realist methodology. The main empirical case analysed is the UN-backed study of *The Economics of Ecosystems and Biodiversity* (TEEB), supplemented by an historical review of the development of environmental statistics since the 1970s and a review of the developments within conservation science with respect to the role of numbers.

The historical review demonstrates a change from biophysical numbers to new measures of equivalence (e.g. CO_2-equivalents), paralleling the move from central planning and administrative rationality to neoliberalism and market rationality. While monetary valuation has been much criticised in the environmental politics literature for leading to the commercialisation of nature, this study shows a more nuanced picture: the role of monetary valuation has rather been to 'bridge' the transition from administrative rationality to market rationality. It is the newly developed measures of equivalence which allow setting up new markets for financial instruments and compensation schemes for environmental damage. In the case of TEEB, monetary valuation and its related arguments of efficiency, rational decision-making etc., are first and foremost rhetorical since the main recommendations (economic incentives and markets) are taken for granted.

The centrality of numbers in current environmental policy discourse is explained by a combination of structural conditions, the search for business opportunities and actors' perceptions of money as the only possible language of communication. Some structural conditions are of a more general kind specific for modernity, while others are specific for the neoliberal era. A main problem with the number focus in environmental policy, is that it allows to not address the underlying drivers of the problems, and hence strengthens the 'actualist' perception of reality.

The study concludes that numbers have potential as evidence of environmental problems. However, change does not happen by the numbers themselves (*contra* mainstream

economics), but must achieve political support. Further research is needed to understand better how numerical information can be combined with approaches which move beyond actualism, instrumentalism and relativism.

Abstract

Diese Dissertation untersucht die zentrale Rolle von Zahlen in Umweltpolitik und Umweltdiskurs, mit speziellem Fokus auf die Wirtschaftlichkeit des Umweltschutzes. Das Ziel war zu verstehen und zu erklären, warum es, trotz des parallelen Wachstums der Umweltprobleme und der quantitativen Informationen über die Umwelt, das Vertrauen in und die Fokussierung auf Zahlen noch immer sehr wichtig ist, etwas gegen die Probleme zu tun. Die Dissertation berücksichtigt Diskursanalysen und Erkenntnisse historischer und soziologischer Studien über Zahlen und Bewertungen, und verbindet diese mithilfe des kritischen Realismus. Die wichtigsten analysierten empirischen Daten stammen aus der UN-gestützten Studie „The Economics of Ecosystems and Biodiversity (TEEB)“. Sie werden durch einen historischen Überblick über die Entwicklung von Umweltstatistiken seit den 1970er Jahren und eine Bewertung der Entwicklung innerhalb des Umweltschutzes, in Hinsicht auf die Aufgabe von Zahlen, ergänzt.

Der geschichtliche Rückblick demonstriert einen Wechsel von biophysikalischen Zahlen zu neueren Messungen der Äquivalenz (z.B. CO_2-Vergleich) und spiegelt die Veränderung weg von zentraler Planung und administrativer Sichtweise hin zu Neoliberalismus und Rationalität des Marktes. Während die Bewertung auf finanzieller Grundlage in der Literatur zur Umweltpolitik scharf kritisiert wurde, weil sie zu einer Kommerzialisierung der Natur führt, zeigt diese Studie ein differenzierteres Bild: die Rolle der Bewertung auf monetärer Basis war in erster Linie die eines „Brückenschlags“ für die Veränderung weg von einer rein administrativen Sichtweise hin zur Marktrationalität. Es sind die erst vor kurzem entwickelten Messungen der Äquivalenz, die es erlauben, neue Märkte für finanzielle Instrumentarien und Kompensierungspläne für die Umweltschäden zu entwickeln. In der Fallstudie TEEB sind monetäre Bewertungen und die damit verbundenen Argumente zur Effektivität, rationeller Entscheidungsfindung, usw. in erster Linie rhetorische Argumente, da die wichtigste Empfehlung (ökonomische Anreize und Märkte) als gesichert gilt.

Dass Zahlen in der aktuellen Diskussion zur Umweltpolitik im Mittelpunkt stehen, wird durch eine Kombination struktureller Vorgaben, die Suche nach Geschäftsmöglichkeiten und die Auffassung der Akteure, dass Geld die einzige Kommunikationsmöglichkeit darstellt, erklärt. Manche strukturellen Vorgaben sind generell spezifischer für die Moderne, während andere spezifisch für die neoliberale Ära sind. Fokussiert man sich in der Umweltpolitik auf

Zahlen ist eines der Hauptprobleme, dass die verdeckten Verursacher der Probleme so vernachlässigt werden können und somit die aktuelle Sichtweise auf die Realität festigen. Die Studie kommt zum Schluss, dass Zahlen Potential haben die Umweltprobleme darzustellen. Allerdings können sie alleine keine Änderungen herbeiführen (gegen die Mainstream-Ökonomie), dafür müssen sie die Unterstützung aus der Politik erhalten. Weitere Untersuchungen sind notwendig, um besser zu verstehen, wie zahlenbezogene Informationen mit Betrachtungsweisen kombiniert werden können, die über Aktualismus, Instrumentalisierung und Relativierung hinausgehen.

Table of Contents

List of Abbreviations

BES	Biodiversity and Ecosystem Services
BfN	Federal Agency for Nature Conservation (Germany)
CBD	Convention for Biological Diversity
CDA	Critical Discourse Analysis
COP	Conference of the Parties
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DPSIR	Driving force-Pressure-State-Impact-Response
EC	European Commission
EEA	European Environment Agency
EIA	Environmental Impact Assessments
ESP	Ecosystem Services Partnership
ESS	Ecosystem services
ETB	Economics and Trade Branch
EU	European Union
GDP	Gross Domestic Product
GIST	Green Indian States Trust (formerly)/Green Initiatives for a Smart Tomorrow (currently)
GMO	Genetically Modified Organism
HDI	Human Development Index
IEEA	Integrated Environmental and Economic Accounts
IEEP	Institute for European Environmental Policy
IITB	Indian Institute of Technology Bombay
IMF	International Monetary Fund
INGO	International Non-Governmental Organisations
ISEE	International Society for Ecological Economics
ISEW	Index of Sustainable Economic Welfare
IUCN	International Union for Conservation of Nature and Natural Resources
IUPN	The International Union for the Protection of Nature
LWEC	Living With Environmental Change partnership (UK)
MA	Millennium Ecosystem Assessment

MEDAD	Ministère de l'Écologie, du Développement et de l'Aménagement Durables (France)
NPM	New Public Management
NGO	Non-Governmental Organisations
OECD	Organisation for Economic Co-operation and Development
RS	Regulation school
SEEA	System for Environmental and Economic Accounting
SNA	System of National Accounts
SRA	Structural-Relational Approach
STS	Studies in Technology and Science
TEEB	The Economics of Ecosystems and Biodiversity
UFZ	Helmholtz Centre for Environmental Research
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
US	United States
USA	United States of America
WB	World Bank
WCC	World Conservation Congress
WCED	World Commission on Environment and Development
WCMC	World Conservation Monitoring Centre
WWF	World Wildlife Fund

1. Introduction

1.1 Introduction

Numbers have become key elements in the dominant discourses addressing central societal challenges, like environmental problems, sustainable development or, more generally, progress and well-being. There seems to be a widespread assumption that if we only have more information about our natural surroundings and environmental problems, then we will be more likely to solve the problems and save the planet. In particular, quantified information is considered important. Both current environmental policy and the dominant environmental discourses reserve a central place for numbers, and there is a constant demand for more and better ones. The production of numbers about the environment - quantitative data, statistical measures, indicators and monetary values – is therefore growing. This is reflected in the large amount of state-of-the-environment type publications or indicator reports, including quantitative policy analysis, being issued by international, regional and national organisations such as the United Nations (UN), the World Bank (WB), the Organisation for Economic Co-operation and Development (OECD), the European Union (EU), environmental protection agencies, statistical offices, ministries, as well as Non-Governmental Organisations (NGOs).

However, where earlier reports described and analysed environmental phenomena mostly in physical terms, this is today increasingly being done in monetary terms. The most prominent example of the second is probably the *Stern review on the economics of climate change* (Stern, et al. 2006), which was highly acclaimed and received wide attention from both policy makers, NGOs and the wider public. It also inspired a similar study on *The Economics of Ecosystems and Biodiversity* (TEEB 2010b).

Paradoxically, more and better information and more and better numbers have so far done little to help the global environmental situation. In most areas the situation is still getting worse. Greenhouse gas emissions are still increasing, chemical pollution is increasing, air quality is still bad in big cities, deforestation continues, and phosphorus reserves are running out.

One of the most serious environmental problem, is biodiversity loss. The changes in global biodiversity are huge and the outlook harsh (Millennium Ecosystem Assessment 2005a). According to the International Union for Conservation of Nature and Natural Resources (IUCN 2017), around 30 per cent of the 80,000 species they have assessed, are at

risk of extinction.[1] Experts have for some time already warned that we have entered the sixth mass extinction of species, and the first human induced one ever (Chapin, et al. 2000; Jeffries 1997). In Rockstrom et al.'s (2009) attempt to define a set of overall 'planetary boundaries', i.e., thresholds for environmental pressures within which they expect that humanity can 'operate safely', biodiversity fares by far the worst. The current rate of loss of biodiversity is far outside of even the upper bounds (lowest risk). The Living Planet Index, an aggregate measure for the world's vertebrate[2] population, fell by 58 per cent between 1970 and 2012 (WWF 2014). According to Díaz et al. (2005) the threshold for biodiversity loss is currently being exceeded by at least one to two orders of magnitude, indicating an urgent need to radically reduce biodiversity loss rates.

The extent and urgency of the problem has been recognised for some time. The Parties to the Convention on Biological Diversity (CBD) agreed in 2002 to 'achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth'. However, that commitment failed severely. In such a context, the call for a monetary valuation of biodiversity, such as the TEEB study (2010b), seems particularly irrelevant, neither able to grasp the scale of the problem, nor to address its source. This makes the discourse around the call for more numbers, and especially monetary valuation, of particular interest.

1.2 Background

This research project started from a broad interest in, and some wide open questions about, the role of numbers in environmental policy, ignited during the more than ten years I had been working with Statistics Norway and the OECD at the crossroads of environmental issues, statistics, economics and public policy. During my working time with these organisations, I had started to identify, in an unstructured way, beliefs that people held about the role of numbers in environmental policy or politics, such as 'more numbers (or information) will create the change needed' or 'policy makers need neutral information'. However, I was slowly starting to wonder whether these numbers really made any difference

[1] According to IUCN Red List, the estimates for species threatened by extinction are: 41% of amphibians, 34% of conifers, 33 % of reef building corals, 25% of mammals, and 13% of birds.
https://www.iucn.org/theme/species/our-work/iucn-red-list-threatened-species, accessed 30.3.2017

[2] Vertebrates include fish, amphibians, reptiles, birds and mammals.

at all. Sometimes they seemed to help to get issues onto the political agenda or news headlines, but still something else seemed to be blocking the policy change that was meant to happen by these numbers. At other times it almost seemed like the phrase 'we need more information first', was just a trick for not having to deal with difficult issues. Could it actually be the case that the demand for more numbers or evidence was just a delaying tactic to avoid taking action?

I was also wondering whether the focus on number was only about saving the environment, or whether there were other interests at stake, especially economic interests? But maybe also ideological ones? Were there underlying political objectives at play here, that were not made explicit? Who seemed to be particularly keen on promoting the number-based environmental policies? Could it be that numbers in themselves play to certain interests independently of whether they are correct or not?

Another thing that troubled me was the observation of strong links between economists and natural scientists working on environmental issues. A particular event that inspired me to explore more closely the link between physical and monetary numbers in the environmental discourse, was an argument made by a director from the Norwegian Institute for Nature Research in a debate about the economisation of nature organised by the Norwegian Research Council in 2011:

> "Objective numbers are important for environmental policy. Not only physical ones, but also economic ones."

The statement points to an important issue with respect to environmental numbers, namely the apparent lack of understanding of the difference between numbers and measurement in the natural sciences and in mainstream economics. A working hypothesis of this thesis has therefore been that the quantitative focus (and its related empiricist or positivist philosophy of science) seemed to bring together actors with initially different objectives and ambitions. [3] Hence, one topic I wanted to pursue was the conceptualisation of the difference between biophysical and monetary numbers.

The statement also points to an affinity between natural scientists and economists, with which I was well acquainted. My experience from the OECD was that the topic of sustainable development was considered covered when there were natural scientists and

[3] I suggest this despite being aware of Bhaskar's (1978) claim that natural science is often not positivist.

economists working together (plus maybe some policy analysts, but they are also usually economists anyway). There was little room for or interest in other social science perspectives or contributions. These were often seen as 'not providing solutions' and just problematising issues. However, the affinity is still problematic due to the different goals of mainstream economists and environmentally engaged natural scientists. While the latter's main aim is to preserve nature and the environment often from an intrinsic value perspective (e.g., Butler and Acott 2007; Child 2009), mainstream economics is based in a utilitarian moral philosophy with efficiency as a main concern.

This issue also needs to be considered from another perspective, namely the mainstream, i.e., neoclassical, reduction of economics to a method, instead of being a science aiming to explain the economy or the economic system (Chang 2014; Lawson 1997). In this respect, neoclassical economics provides the method to calculate the best 'solution' to any problem of choice, without the need to engage further with underlying questions of what causes various phenomena. This 'solution'-approach has many resemblances with engineering, as pointed out by for example Amartya Sen (1987).

With respect to environmental problems, however, there are many indications that the (capitalist) economic system itself is an underlying cause of environmental degradation (see e.g., Foster, et al. 2010; Jepson and Ladle 2010). If this is the case, then what we need is an economic theory that understands 'the economy' rather than an economic theory which ignores it or reduces it to a matter of (individual) behaviour and choice. We also need an economic theory which does not just promote more of the same medicine (economic rationality and efficiency) to cure the problem it has itself contributed to cause.

Hence, while more and more number crunchers are working hard on developing new indicators and more and more careers are built on calculating and crunching ever more numbers, what we really need is systematic reflection and understanding of underlying mechanisms *generating* the problems we are concerned about and aim to address. At the same time, numbers and quantification have become such a normal part of modern (or at least neoliberal) life that questioning them might seem odd. However, it is exactly the taken for granted assumptions or the normalisation of certain policy solutions which is worth considering further, especially in cases where the environment is gradually being degraded despite our immense number production. What is surprising is that neither the environmental research community nor NGOs seem to question the effectiveness of this obsession with numbers when it comes to addressing environmental issues. Instead, it seems somehow to

have been institutionalised, while the roles, and possible consequences, of the number focus go unquestioned.

Against this background, how can we understand the call for more numbers, this insistence upon numbers? What are the arguments made in their favour? How exactly are numbers meant to work or to help? And why do they - apparently - not work as expected? Or do they? It seems, the belief in the performativity of numbers might be a false belief, or, at least, one that needs to be critically assessed.

1.3 Existing literature

While there exists a body of literature about the general effect of numbers in society, no similar strand of literature exists concerning the role of numbers in relation to environmental problems or nature conservation. This took me quite some time to realise, as there is a vast body of literature concerned with discussions about what are the best measures as well as technical aspects about various measures. The amount of journals concerned with numbers or measurement issues is quite overwhelming (e.g., Accounting, Organizations and Society; Ecological Economics; Ecological Indicators, Environmentrics), but also the amount of articles debating 'what is the right indicator?' is huge (e.g., Bell and Mores 2011; Hukkinen 2003; Lawn 2003; Neumayer 1999; O'Neill 2012). Such literature engages mainly in the debate about the conceptualisation of what is to be measured, but they rarely question or problematise the wider social-institutional or economic system that such forms of information feed into or how the two are linked and interact. Neither do they engage in the potential and limits of numerical information to address underlying causes or to create the change aimed for. In general, there seems to be an implicit assumption that numbers can create change in their own capacity, that they are performative (in and of themselves). Where the literature does dig into these questions, it is often based on some loose intuitive wisdom or self-referential truth claims, such as the much quoted saying of Donella Meadows (1998: 2): 'we measure what we value, [and] we (..) value what we measure'.

The centrality and role of numbers in society is quite difficult to grasp as a phenomenon in itself since it has become all pervasive, including spheres of society such as the media, policy, politics, research, health, education, environment and last, but not least, the economy. General theories about numbers often build on historical studies of the role of quantification for the Enlightenment and the scientific revolution. They point to the development of quantitative, empirical science and to *what it made possible*. While numbers

were initially mostly applied to the natural world (physics in particular), their centrality later spread to the social sciences. August Comte (1798-1857) is of particular importance in this respect, establishing sociology as a positivist science inspired by the physical sciences. The marginal revolution within economics (or political economy as it was then called) also aimed at making economics into a 'real' science in the same way as physics was. Central to this revolution was Stanley Jevons (1835-1882) who aimed at developing a 'mechanics of utility and self-interest' (Jevons 2013[1871]). In the 20th century, the development of computer technology allowed an expansion in quantitative science (including modelling) which was beyond anyone's imagination. On the other hand, the age-old debate - going back to Plato and Aristotle - about whether numbers and mathematics can at all provide insights into the essence of things, or whether the form is all that is of interest and the only thing we can have knowledge about, is still as relevant as ever.

The quantitative revolution in science also had its counterpart in society, both within the economy and public policy. Official statistics, for example, is to a large extent produced to fill functions defined by Comte. His emphasis on a quantitative, mathematical basis for public decision-making—a kind of social engineering—is still strong today. At the same time, the quantification of society was closely related to another aspect of modernity—namely rationality. Rationality—in particular means-ends rationality—became the core of different theories of modernity (most prominently perhaps is Weber's study of capitalism and bureaucracy) as well as the more recent field of rational choice theory.

Few studies put numbers centre stage and look at their function and role in specific fields of study such as the political economy or environmental problems. An exception can be found within sociology, where a range of sub-disciplines have addressed areas such as science, quantification, economics, statistics, and more, using a similar kind of descriptive approach. This literature generally build on Foucault in one way or another, describing in detail how numbers *actually* are produced and used, as opposed to the normative prescriptions of for example rational choice theory or welfare economics. This literature treats numbers as a kind of technology with a certain function in society in terms of what it allows, for example steering, rational calculation, evaluation and more. It describes how this technology is linked to other drivers in (modern, Western) society, such as economic rationality, instrumentalism or the power-knowledge nexus. Further, it has demonstrated that numbers, or how and what we count, affect the way we perceive or 'see' the world and what we see in the world, which in turn affects the construction of society. In this respect, these

scholars generally have a social constructivist perspective concerning knowledge, but also concerning both society and nature. This then excludes any attention to or debate over the reality of what numbers point to, for example in the environmental sphere, or the functional role that numbers might play in the economic system or in the regulation of nature and the environment.

These strands of sociology have also been criticised for being too descriptive or neutral, and for not engaging critically in the practises they describe (e.g., Sayer 2009). Proctor's critique of Latour is amongst the harder hitting in this respect:

> "In the face of unprecedented environmental destruction and the militarization of science, the relations of science and society are not epistemological or historical niceties but pivotal issues in the well-being of humans on the planet. The point, in other words, is not to chronicle our madness, but to escape it. Neutral sociological 'realism' in this case may blind itself to the deeper issue – that science is at least part of the problem, and that alternatives must be sought in the theory and practice of science itself (Proctor, 1991: 225)." (in Fraser 2006: 46).

Concerning the economisation of nature[4], there might be some similar links between the economy as (part of) the problem, and the need to search for alternatives to both the theory and practice of 'the economy'.

From my perspective, environmental problems are existing material phenomena independently of humans' mere ideas. Hence, I search in my dissertation for a way to draw on the insights from these various sociologies while at the same time bringing in a critical and 'depth' realist perspective (see section 1.5). Although sociology of numbers, and Foucault in particular, does look at the consequences of the number-technology, this is not done in terms of building a solid conceptualisation about numbers, including attention to their intrinsic nature and constitutive capacities or potentials.

One problematic aspect of the quantification of society is its technocratic character, meaning political issues are being treated as mere technical issues. This problem has been debated in the environmental politics literature for some time already (see e.g. Dryzek 2005 on 'administrative rationalism'; Hajer 1995 on 'ecological modernisation'; Redclift 1988 on 'environmental managerialism'). One study which focuses in particular on the democratic aspect of numbers is Fioramonti (2014). His book is a critical investigation of numbers as

[4] For the time being, I use the term 'economisation of nature' in a loose way to refer to elements like the influence of mainstream economic theory, monetary valuation and commodification.

main drivers of decisions in current society, unveiling in particular how the prevalence of numbers links to a lack of democracy. He still concludes about numbers that, we need them and couldn't run society without them:

> "This book does not dispute the importance of statistics for the improvement of society. Without statistics, policies would be simply dominated by impressionistic considerations and rhetorical arguments. Measuring is a fundamental component of human life." (Fioramonti 2014: 8)

At the same time, he recommends to be careful with numbers due to all their problematic sides. The problems are described through various different examples, each treated in one chapter of the book: credit ratings, climate policy, ecosystems policy and foreign aid. However, since he does not try to conceptualise *how*, in a more general sense, numbers run our societies, it is also hard to understand exactly how we shall be careful.

In a similar vein, Mügge writes that

> "Much contemporary scholarship goes beyond broad claims about quantification of governance as a facet of (usually suspect) modernity (..) [because] (w)ho benefits from quantification, and how societies as a whole are affected, varies from case to case (Davis et al. 2012b)." (Mügge 2015: 8)

With respect to macroeconomic indicators, which is Mügge's area of interest, he therefore argues that it would not make sense to aim for a single integrated theory (Mügge 2015: 9).

However, these scholar leave many important questions unanswered: What are the different dimensions we can make use of and what should we be careful about? In which contexts should we be careful? With which players and why? What are the factors that decide how societies are affected by quantification or more specific indicators? The lack of generalisation is both problematic and unfortunate. To be able to answer or reflect upon such questions, theory and conceptualisation is inevitable. Hence, this is another gap in the literature which I want to address.

1.4 Aim of the dissertation and research questions

Given that so little has been written about quantification of environmental issues from a critical and explanatory social science perspective, the overall aim of the dissertation is to

explore the role of numbers and *explain* their centrality of numbers—in particular the dominance of monetary numbers—as a 'solution' to environmental problems. In section 1.1, I identified the paradox that the number production about the environment is larger than ever, while the same is the case concerning environmental challenges. In the context of this paradox, I aim to explain *the continued production and promotion of numbers about the environment as solution* to the prevailing problems.

How is it possible that numbers are promoted so strongly when they don't seem to help? This overarching research question can also be posed as a transfactual question:

- *What are the conditions for the dominance of numbers, in particular monetary numbers, in environmental policy?*

Central to this question is a concern with the nature of numbers: *what is it about numbers that make them so attractive, useful or convincing?*

Further, linked to the main research question, there is also an underlying hypothesis:

- Hypothesis: *The belief in numbers seems to be (in part) a false belief or a misleading assumption.*

To understand and explain the promotion and dominance of numbers, one needs to first look at how numbers work and which roles they can play in science and society. Their various potentials and material effects might be one reason why numbers are so strongly promoted (amongst certain social groups in particular). However, also beliefs (true or not), worldviews and values might explain the support of quantification of environmental policy.

Further, to explain the paradox one needs to understand the role(s) that numbers play or can play, alone or in combination with other conditions, and to which realm the (various) roles of numbers belong: the ideational or the material realm? One also need to understand how they are argued for and whether this 'story line' corresponds to what is actually happening.

To be able to study the phenomenon in empirical terms, I have narrowed down the topic. I have chosen to study the phenomenon through the lens of *the discourse about numbers in biodiversity conservation*. Since the 1990s, this discourse has increasingly been promoting monetary numbers, a process which culminated with the UN-backed study on *The*

Economics of Ecosystems and Biodiversity (TEEB). I have therefore chosen the TEEB study as the empirical case.

1.5 Meta-theoretical approach: critical realism[5]

This study is carried out against the background of a critical realist philosophy of science. Critical realism is often presented as a third way between empiricism and constructivism. Although it holds many similar positions to weak social constructivism, the main difference is a concern with ontology, and a philosophical apparatus that allows one to distinguish between the real and independent object of research and our socially constructed knowledge or concepts about that object.

Ontologically, critical realism is based on a depth ontology consisting of three levels of reality: the empirical, the actual and the real. The *real* is whatever exists, regardless of whether it is an empirical object to us or not. The real is also the realm of objects, their structure and (causal) powers, that is, capacities to behave in a certain way, and their causal liabilities or passive powers (susceptibilities to certain kinds of change). The *actual* is what happens if and when those powers are activated or those mechanisms are triggered. Finally, the *empirical* is the domain of experience.

To explain events or phenomena, one needs to understand what caused them at the level of the real. Further, to understand *the nature* of objects or phenomena, one needs to understand their intrinsic characteristics and their causal mechanisms, i.e., their capacity to produce effects. Critical realism therefore seeks to identify both necessity and possibility or potential, what things must go together and what things could happen given the nature of the object.

The main difference from constructivist accounts is the ability to study phenomena at the level of the unobservable through the specific methodological procedure of retroduction (see chapter 5). Positivism and empirical realism, on their side, reject ontology and metaphysics and instead treat the world as consisting of only observable atomistic objects, events and regularities amongst them. Sayer (2000: 11) calls this position naïve objectivism, as it is based on a worldview that objects have no unobservable qualities. Critical realists instead claim that ‘the world is more than our experience of it’ (Sayer 2000: 11).

[5] Some more basic features of critical realism are presented in Annex 1.

Critical realism, therefore, is concerned with *what* it is that causes things to happen, beyond the observation of regularities among sequences of events. This distinguishes it clearly from approaches searching for event regularities, since regularities are not a source of explanation. Regularities do not explain why things happen or what it is about objects and their capacities that can make something happen. Hence, critical realism rejects both the standard Humean 'successionist' view of causation and the constructivist focus on the actual. Both operate with flat ontologies that do not allow accessing the level of the real.

Critical realism is concerned with questions about explanation, i.e., why things are the way they are, what causes them to be that way, what makes it possible, as well as finding the answer to questions about what is fundamentally constitutive of the structures and relations of the object of study (Danermark, et al. 2002). What we need to understand to explain causality is the underlying structures and mechanisms of objects or phenomena.

The critical realist ontology sees the social world as both socially and materially constructed. Both abstract (and invisible) social structures and concrete social events are part of social reality. At the same time it has a nuanced position on social construction: while on the one hand construals (ideas) can have effects on how the social realm develops, the material effects (construction) is a separate issue. Unlike other philosophies of social science such as hermeneutics or critical theory, it does not claim that the natural and the social world necessarily need to be studied using completely different approaches (Outhwaite 1987). Phenomena in both can be explained by (specific constellations of) causal mechanisms.

Further, both the social and the biological worlds are open system due to the ability of living beings to learn, i.e., act or adapt under new circumstances (see e.g., Lindholm 2012). This is why all living systems are characterised by emergence. In open systems constancy does not apply, hence regularity must instead be analysed as powers or tendencies of the underlying generative mechanisms (Bergene 2005). Examples of such powers are the capacity of a person to work or the capacity of industrial agriculture to reduce biological diversity.

The social ontology of critical realism is both realist and relational. Social structures are usually considered as relations or constellations of social positions, such as the capital/wage-labour relation in capitalist economies, or that of the tenant-landlord relation. Structures are real and efficacious, and therefore material. At the same time, structures depend on practices, concepts and discourses to be reproduced.

What distinguishes the human and social world from other living systems is the fact

that humans are also volitional beings that attach meaning to the world in which they live. These systems of meaning, however, are negotiated by people in the course of social interaction. As such, they have a conventional character. The system of meaning related to money is a good example: a necessary condition for the use of money is that users have some understanding of the act of exchanging little metal discs, what it means (Sayer 1992: 21, 30-31). This is why studying the social world adds an additional layer of interpretation (*verstehen*) on top of the interpretation of the material event itself, the so-called double hermeneutic (Sayer 1992). Critical realism combines this insight with the insistence on the complex relationship between meanings and the non-discursive[6] dimension of social life (Sayer 2000).

In addition to being an open system, the social world is also always pre-structured. This means that agents always act in a world of structural constraints and possibilities which they did not create themselves, but which they in turn either reproduce or transform—intentionally or unintentionally (Danermark, et al. 2002). In this respect, the relationship between structure and agency is seen as dialectical.

Critical realism allows a way out of relativism, through judgemental rationality. This means that explanations can be assessed on its adequacy in terms of describing the world's properties and ways of functioning. Although critical realism agrees to epistemic relativism (that our knowledge is 'contingent' or historically determined), it simultaneously claims that we can still rationally judge between different models of explanation by their plausibility, i.e. their capacity to explain empirical observations and events.

Finally, critical realism is critical and committed to explanatory critique. That is, it is committed to explanations which go beyond the mere description of structures and mechanisms, and beyond the identification of logical errors (immanence) and absences within a specific problematic system, practise or belief (Puller and Smith 2017). Explanatory critique searches, in addition, to identify *the causes responsible* for the existence and reproduction of such problematic practices and beliefs. It aims to explain why people hold certain beliefs or are engaged in certain practices. This is usually because specific social positions makes it difficult to do otherwise. Therefore, it consists in identifying people's roles or positions, why they hold certain beliefs and identify contradictions. Because the social

[6] Non-discursive means those aspects of social life which exist independently of meaning and semiotics, i.e., independently of our perception or even awareness of them. Examples are institutions or economic structures (this does not mean that institutions do not have discursive aspects, but they also have non-discursive aspects).

sciences necessarily evaluate the *social practices* they study, the common positivist dichotomy between facts and values or between analysis and critique is rejected (Collier 1994: 169-204).

While different aspects of this philosophy will be explained more in depth along the way, it has some important implications at the outset. The specific perception of reality of critical realism means that I 'read' texts, discourses and scientific theories through a particular lens. Understanding the world in this way, also means a different use of certain words. The term 'real', for example, is often used in common language to refer to something that is actually existing (at the level of 'the actual'). In critical realism however, the term is reserved for the underlying reality, structures and potentials rather than being used for (actual) events or (empirical) phenomena.

1.6 Normative starting point

Critical realism combines ideals from the enlightenment such as a commitment to open, critical, reasoned debate based on observation, with a commitment to emancipation. Ultimately, the purpose is not only to describe and explain social phenomena, but—in the tradition of critical social science (Sayer 2009)—to contribute to a better world.

This, of course, requires some reflections on normative definitions of what a good world is. Stating normative viewpoints up-front distinguishes critical social science from positive social science which upholds the fact-value dichotomy. A prominent example of the latter is mainstream economics, pretending to be value free while at the same time upholding efficiency as its main goal, and therefore, a key value in itself.[7]

This dissertation takes its starting point in a concern about the destruction of nature or the biophysical world. One aspect of this, is human destruction of our own life-sustaining systems in material terms. At the same time I am worried about the human-centeredness of environmental politics and the instrumental attitude to other living species. However, I am aware that talking about this process as something 'we' are doing to ourselves is a trap. There is no one 'we', as there are those who destroy (more than others) and those who suffer the consequences (more than others), and this political ecology is central to both understanding the situation and searching for a way out of it.

[7] The most common mainstream definition of economics is that of Lionel Robbins, i.e., economics as the efficient allocation of scarce resources (Robbins 1932).

1.7 Outline of the dissertation

The dissertation is divided into nine chapters.

Chapter 2 is concerned with theories about *the social role of numbers.* I present existing literature about numbers and quantification. In particular, this literature comes from various strands of history and sociology. As a general background, I start by giving an account of the rise of statistical thinking and the (changing) role of numbers in science and society. Historically, we can reconstruct the increasing importance and pervasiveness of quantifications in society with references to both the Enlightenment, increased state power, the spread of rationalism and capitalism, and the exercise of power through numbers ('governmentality'). The chapter also looks at measurement theory, and identifies the main types of quantitative representation of objects or phenomena. It ends with a synthesis of the capacities of numbers and possible conditions for their centrality in policy.

Chapter 3 presents a brief history of modern environmental policy and related environmental numbers. It explores the role of numbers in early environmental policy and how it has changed with neoliberalism. It also presents the main models for public environmental decision-making and highlight the role of numbers therein. The chapter provides a background for understanding the developments in environmental policy and discourses, and the related kinds of numbers, and hence functions as a context for the further in-depth analysis of the role of numbers in biodiversity conservation. The chapter ends with a framework for understanding environmental statistics as part of the broader political economy.

Chapter 4 describes the development and change in argumentation for and production of quantitative information amongst scholars concerned with loss of species and 'biodiversity'. It reconstructs the history of number production from the first assessments of endangered species to the more recent trend of attaching monetary value to biodiversity (and ecosystems), and describes the move from a natural science approach to an increasingly economic approach to conservation. It shows how the argumentation has changed along the way, and describes in particular 'the economic turn' which has several nuances. The chapter provides both an historical and a conceptual background for the empirical analysis of TEEB.

Chapter 5 is the methodology chapter. It gives a thorough presentation of both discourse theory and applied method. Most importantly, it presents critical discourse analysis, which is an approach to discourse analysis that not only analyses the discourse of interest, but

also its broader social practice and relations. I present the approach to analysing TEEB as a discourse, the various data sources (reports, interviews, articles, press releases), and some thoughts about my own process of analysis.

Chapter 6 is about the background and institutional context of TEEB. It presents and describes the TEEB project, its background and birth, its organisation and actors, its three phases and their outputs, and its impacts.

Chapter 7 describes and discusses the TEEB discourse, with a particular focus on the role of numbers. I present the narrative and story line, how TEEB formulates the problems and solutions, the TEEB approach, other core themes such as economics, information and ethics. A central theme is the admittance of methodological weaknesses with monetary valuation and how this is (still) being argued for. In presenting the various themes, I also present how TEEB draws on other existing discourses, both scientific ones and others. I look at internal contradictions in the TEEB discourse (immanent critique) and also point out themes which are absent (omissive critique). I discuss some linguistic features and rhetorical aspects in terms of how they deviate attention from dealing with the underlying causes of the problem of biodiversity loss. The chapter summarises the core elements of the TEEB discourse through a scheme outlined in chapter 5, which identifies its basic entities (recognised or constructed), assumptions about natural relationships, agents and their motives, and metaphors and rhetorical devices.

Chapter 8 contains the main analysis and findings of the dissertation with respect to my initial research question: *How is it possible that numbers are promoted so strongly when they don't seem to help*? *What are the conditions of their dominance?* In critical realism, such questions can be answered through the use of the retroductive mode of inference. I recall the nature and capacities of environmental numbers to explain their role in the studied phenomenon. The focus of the chapter is on analysing whether the conditions identified in chapter 2 and 3 for understanding the dominance of numbers also holds for the TEEB study. Further, I suggest possible conditions that could explain the insistence on the production and use of numbers, in particular monetary values, to address main environmental challenges.

Chapter 9 summarises the main findings and conclusions, bringing together the various roles that numbers play and the (discursive and non-discursive) conditions for their dominance in environmental policy and politics. The findings demonstrate the need to consider environmental problems within a broader political economic frame. The chapter ends with some reflections on the political relevance of the findings including how to use

numbers critically, and how they could help accommodate environmental protection. Finally, I point to some areas in need of further research.

2 Theories about numbers in society

2.1 Introduction

I start this chapter with a brief history of statistics and quantification in Western society since the Enlightenment. The purpose is both to show the dramatic change that quantification brought to society and to present the origin of ideas about quantification which are still prevalent today. I present various perspectives about the role of numbers as a steering tool, as well as the main positions on how numbers are believed to represent reality. Finally, I synthesise the literature in a critical realist form.

2.2 Steering from a distance

Knowledge for state steering

The pre-modern state knew little about its subjects, their wealth, landholding, yields, location or density (Scott 1998). However, with modernity the state gradually got a handle on its subjects and their environment through, amongst other things, the development of official statistics. The recognition of the capacity to steer through numerical 'knowledge' about the society to govern has been central to developing statistics about society. At the same time, the kind of statistics (or 'knowledge') considered useful for the state has changed over time.

Hacking (1990) has argued that the development of official statistics was closely related to increased state power. Statistics provided the state apparatus with knowledge/information about society, with the aim of steering and planning, including controlling. Hence, state power and statistics became two sides of the same coin. The origins of the word 'statistics' comes from the German 'Statistik',[8] which was in earlier times used to refer to the branch of political science dealing with the collection, classification and discussion of facts about the conditions of a state or community (Oxford English 1993).

Contrary to what one might think, the early statistics did not necessarily consist of tables and quantitative information, but rather a mix of qualitative textual description and numerical description. German (and Danish-Norwegian) statistical-topographical

[8] According to the Online Etymology Dictionary (http://etymonline.com) the term was popularised and perhaps coined by German political scientist Gottfried Aschenwall (1719-1772) in his "Vorbereitung zur Staatswissenschaft" (1748).

descriptions, in particular, were concerned with the unique and specific characteristics of a described country. Although such accounts were sometimes supplemented with quantitative information, the real change in statistical practice came about when one started to describe social issues or phenomena based on fixed or standard schemes. That is, instead of describing what was unique about each place, all places would now be described based on categories (variables) or measures that were common to them (Lie and Roll-Hansen 2001), a one-sided reduction to taxonomy and fixed categories.

This specific Germanic tradition meant that until the beginning of the 19th century scientific accounts about states were produced in the form of broad, textual (verbal) description of states, borders, governance form, culture and nature (Lie and Roll-Hansen 2001). By the middle of the century however, this had shifted to tabular expositions of economic and social phenomena, in particular with regard to administrative use, a shift influenced by a much stronger quantitative tradition coming from France (Lie and Roll-Hansen 2001).

In France, there was, at the beginning of the 19th century, an obsession with counting 'just everything - a plain number fetishism' (Hacking 1990: 134). Later, in the years 1826-1829, there was a change from mere counting to increasingly minute and fine *classifications* of the people counted. The results were published in the tabulations of the bureaucracies. Further, Quetelet started to develop statistical measures such as the 'average individual'.

However, there was still an 'antistatistical' camp. For example, Le Play, who was a mining engineer, believed that to understand society, one must look to representative individuals, not average individuals (Hacking 1990: 135). Le Play wrote in 1840 that statistics is

> "the observation and coordination of facts that interest the social body from the point of view of government...Politics must unceasingly use statistics as the means by which to regulate its administrative activities." (Le Play in Hacking 1990: 136)

Finally, it was Quetelet's view on statistics that 'won' the debate in France about what statistics should be, and which became the basis of what we know as official (social) statistics today, in terms of the 'average individual', etc.

These kinds of statistics gave rise, in the 19th century, to a new kind of inductive social science, most prominently represented by Durkheim's study on the links between religion, capitalism and suicide (1897). Durkheim (1858-1917) built on Comte (1798-1857)

who established sociology as a positivist science inspired by the physical sciences. The insights from this new positivist social science could then be used for steering society, as a kind of social engineering.

The belief in and reliance upon numbers and statistics to help create new insights and knowledge, was (and is) strongly linked to the empiricist philosophy of science. It is, in particular, the possibilities of identifying 'laws' about nature or society that is associated with the 'quantitative revolution'. This kind of science relates strongly to Hume and a logic of induction where repeated observation of the co-variance of the same phenomena can lead to formulations about laws or regularities (later also with an attached 'statistical significance').

By 1900, a probabilistic understanding of social phenomena had won out over a deterministic one (Hacking 1981). Hence, 'the ground was prepared for statistics as tools to tackle the social problems arising from industrialization and urbanization' (Mügge 2015: 8). Although initially concentrating on tangible issues like infant mortality, the production of statistics soon buttressed a broader trend towards 'governance by numbers' and the proliferation of statistics and indicators more generally (Scott 1998).

As quantitative statistics continued to develop further in the 20th century, they led to a rise in mathematically formulated theories and methods for treating quantitative data, including probability calculations. In particular, the rise of economic modelling, required huge amounts of input data which were then produced in statistical offices. While national accounts were developed in parallel with and to inform the rise of Keynesian economic policies, the amount and form of data at the same time opened up the possibility for extensive modelling more generally. Although quantitative social science started with sociology, neo-classical economics has striven the hardest to become the physics of the social sciences (Mirowski 1989). This has set mainstream economics apart from other social sciences which are generally more aware of methodological and epistemological challenges presented in studying society.

Rational steering

The development of official statistics, was not only linked to achieving knowledge about the state or country to steer. It was at the same time strongly linked to the spread of calculative practices that the statistics (or quantitative information) allowed or made possible. Weber (1864-1920) has played a central role in theorising the importance of this kind of instrumental rationality. In his studies of bureaucracy, Weber described how bureaucracies rely on

objective information material to be able to steer (1978[1920]). His studies show a concern with the ways in which 'the ordering of public administration enabled distance, rationality, objectivity and authority – and *a calculative machinery*' (Asdal 2011a: 1, my italics). Weber was concerned about how bureaucracy made possible distance from and objectivity relative to the object to be governed over. Dehumanisation was a key factor in his process. One should get rid of all irrationality, feelings or emotion, that is, all elements that escaped calculation (Asdal 2011a).

In his model of rational planning, two elements were central: an instrumental (or means-ends) rationality and objective information. However, Weber did not consider numbers the only kind of valid information or facts (Murphy 1994: 139). In this model, any kind of information which helps bureaucrats steer by general principles, and not on a case by case basis, were useful. Weber's use of the term 'calculating', therefore, does not require quantitative operations, but rather refers to a notion of 'figuring things out' (Murphy 1994: 139).

Although instrumental rationality does not, in principle, require quantitative information, it does legitimise a (strong) focus on numbers since 'a number is a tool for rationalisation' (Desrosières 2008). This is the case because numbers are perceived as providing an objective[9] view on things. Although 'calculative rationality' can refer to 'figuring things out', I will in this dissertation reserve the term for operations involving 'numerical information', or else use the broader terms 'instrumental rationality' in combination with 'objective information'.

For Weber, the spread of rationalism, or what he called the 'rationalistic attitude', was the most significant development in the history of modern Europe. His reference was to the metaphysical outlook and methodological practice of the natural sciences which followed with the Enlightenment. This rationalisation not only influenced Western thought, but also its social organisation which became oriented to 'the efficient achievement of utilitarian objectives' (Gordon 1991: 476). Even the application of natural science was oriented at this. According to Gordon, Weber did not deny the historical importance of the market mechanism for modern society, nor as a central feature of capitalism, but considered the rationalistic character of modern economic institutions to be even more fundamental. Hence,

[9] Objective here refers to what critical realists like Sayer would rather term 'naïve empiricism'.

> "(t)he significance of capitalism in the cultural history of the West is that, through it, the rational methods of science and industry have been introduced into all areas of life." (Gordon 1991: 484)

Weber claimed rationality was the driving force of Western civilisation, as it was the drive behind development of statistics. However, ultimate underlying causal mechanisms are debateable, and identifying cause and effect is a challenge. In this case, since 'a number is a tool for rationalisation' (Desrosières 2008), it seems justified to assume that increased number production will boost the instrumental, or more specifically, the calculative, rationality and its spread. From this perspective, one can argue that there is a two-way relationship between the rational attitude, or logic, and the material basis necessary for its flourishing. This co-development of numbers and calculative rationality must therefore be seen as a central element of modernity.

We should keep in mind that Weber's studies are historical and descriptive, unlike today's normative theories of rational planning or rational choice (see chapter 3). Weber did not promote rationalism as 'the good way', although it is obvious that he was impressed with its effects (Gordon 1991). On the other hand, he was not univocally positive, as formulated in his apocalyptic imagery of 'the iron cage' (Stanford dictionary of philosophy). However, he died before seeing the possible effects of combinations of instrumental rationalism and 'a charismatic leader', or in Gordons (1991: 476) words: 'the marriage of rationalistic science and social organisation to romantic ethical and political philosophy', which for Adorno and Horkheimer (2010[1944]) was the ultimate example of the problems - and possible horrors - of instrumental rationality, demonstrating the limits of the Enlightenment.

Habermas has continued this (Frankfurt school) critique of instrumental rationality in particular with respect to the economic sphere in capitalist societies. He postulates a progressive colonisation of the 'lifeworld' by the economy (money) and the state (law), entailing a displacement of 'communicative' practices by 'strategic' practices which embody a purely instrumental (modern) rationality. This instrumental rationality means that discourses generally include promotional intent leading to a general lack of trust and authenticity in society (Fairclough 2001: 136-7).

Steering through standardisation

Porter's (1995) historical account of the ever growing authority of numbers in public life,

gives much attention to the topic of standardisation of measurement. His thesis, based on Weber, is that the development of quantification is associated with the pursuit of objectivity: numbers are associated with a high degree of universalism, they allow coordination over long distances, and they allow anonymity and impersonality. Further, numbers represent knowledge in a stable and highly conventionalised form. This quantified language has remarkable properties of transferability, representing an abstraction from personal and local ways to know.

Porter claims that impersonality and detachment began to acquire a central place in political life once *universalism* started to consolidate as a new source of legitimacy of the rising nation state authority (in Centemeri 2011: 112). Further, according to Centemeri:

> "Quantification and objectivity are consequently strictly associated, since historically objectivity emerged in our societies as a fundamental category in the construction and organisation of modern politics, to qualify a knowledge produced according to conventions (rules and procedures) supposed to guarantee impersonality, impartiality and fairness. Among them, conventions of quantification have progressively become highly valued. In fact, quantification permits us not only radically to limit the distortions produced when knowledge is transferred across time and space but it also makes reasoning 'more uniform' (Porter 1995: 5) through the recourse to formalisation (especially mathematical formalisation). This aspect shows a link existing between the quest for objectivity and the quest for transparency in public decision-making procedures." (Centemeri 2011: 110)

Porter (1995) claims that in the modern world of democracy, market economy and industrialisation, objectivity is pursued in order to make transparent. He then links objectivity and trust: Numbers and quantification are seen as objective or allowing neutrality, and are therefore used as the only way to hold accountable in settings where there is a lack of trust (e.g., corruption or nepotism). Hence, one of Porter's conclusion is that when there is nothing else to trust, it seems like people trust in numbers. Other studies, like Cohen (1982) and Starr (1987), end with a similar positive view on the rise of quantification and what it can do. However, these studies are all linked to the particular history of the United States of America (USA), and might be of less relevance elsewhere.

The role of trust in the accounts about quantification of society vary between authors, and are sometimes inconsistent. Weber (1978[1920]) points out that the modern firm became controllable from a distance and that numbers in this way replaced the former trust-based

relationships between the owner and those given responsibility in the form of key positions in the company. Hence, there was formerly a trust-based relationship in place, but replaced by numbers. Porter (1995) also demonstrates how trust in people gets replaced by trust in numbers. However, Porter goes further, claiming that not only did this happen as a result of the new rationality, but rather because numbers are especially useful *when* there is distrust. There is however a further issue here, which concerns those who produce the numbers. How can we trust them if we want to replace people with numbers in the first place due to lack of trust in people? The fact that there seems to be a lack of trust in modern society due to instrumental rationalism, as Habermas has suggested (Fairclough 2001), makes the whole reasoning around numbers and trust more complex.

However, that numbers allow steering from a distance is undisputed. One virtue of numbers, as Centemeri (2011) points out, is that they easily circulate and seem straightforward to interpret, making it possible to monitor or govern 'at a distance'. Quantification allows remote parties to check on people and things they wish to control. Colonisers have long relied on surveys and metrics of various sorts to discipline those they rule, simultaneously overcoming and maintaining distance to their subjects (Espeland and Stevens 2008: 415). Not unrelated, statistics and numbers also turned out to be useful for imperialistic purposes. Imposing the same standard of measurement everywhere, provided the imperial states with knowledge about the region of domination in a form that allowed for steering at a distance (Moreno, et al. 2015). In this respect, the expansion of the globally unified system of measurement (the metric system) was closely connected both to a specific mindset of calculative rationality, but also to the emergence of the capitalist world system (Moreno, et al. 2015).

The system of double bookkeeping is another example of how tools for control and standardisation of information also were important for the development of the larger political economic system. The historical significance of double bookkeeping is in this respect undisputed, although the interpretations differ (Lie and Roll-Hansen 2001). Chiapello (2007: 264) for example, claims that '[a]s a constitutional part of the emergence of capitalism, the invention of double-entry bookkeeping is part of a larger picture'. For Weber the double bookkeeping principle was a paradigmatic expression of the calculative rationality characteristic of modern society and capitalism. It allowed the birth of the modern firm, now controllable from a distant place via numbers. The invention of double entry bookkeeping was a key tool for 'translating the world into profits and losses' and to apprehend whether a

particular account or an entire venture was profitable or not (Mayer-Schönberger and Cukier in Moreno, et al. 2015: 49-50).

According to Werner Sombart (1863-1941), a contemporary of Weber,

> "Double-entry bookkeeping is born of the same spirit as the system of Galileo and Newton … With the same means as these, it orders the phenomenon into an elegant system, and it may be called the first cosmos built upon the basis of mechanistic thought. Double-entry bookkeeping discloses to us the cosmos of the economic world by the same method as, later, the cosmos of the stellar universe was unveiled by the great investigation of natural philosophy… One can scarcely conceive of capitalism without double-entry bookkeeping: *they are related as are form and content*. It is difficult to decide, however, whether in double-entry bookkeeping capitalism provided itself with a tool to make it more effective, or whether capitalism derives from the 'spirit' of the double-entry bookkeeping." (Sombart in Moreno, et al. 2015: 50, my italics)

Whatever the primary cause, be it the tool of double bookkeeping or the calculative spirit of capitalism, it is clear that capitalism and formalist calculation must be understood as intrinsically linked. This was recognised already quite early in the history of capitalism according to Sombart. By calculation, Sombart means

> "the tendency, habit, perhaps more – the capacity to think of the universe in terms of figures and to transform these figures into a well-knit system of income and expenditure. The figures, I need hardly add, always express a value, and the whole system is intended to demonstrate whether a plus or a minus is the resultant, thus showing whether the undertaking is linked to bring profit or loss." (Sombart in Moreno, et al. 2015: 49)

Quantification hence, is important not only for the economic discipline in its formalistic neoclassical version, with e.g., optimality models, but also for the modern, capitalist firm in terms of the usefulness of double bookkeeping.[10]

[10] The claim has also been made that the abstract category of 'capital' was constituted and made possible by the double bookkeeping framework, although this claim is disputed (Lie and Roll-Hansen 2001).

Governmentality: Making the object of steering governable (indirect steering)

Foucault linked the spread of calculative logics (or rationality) to neoliberalism in particular. In studying how these two interact, he developed the concept of 'governmentality'.[11] In his earlier studies of statistics and on how categorisation, 'normality' and numbers work, he had described how domination is exercised through numbers. Employing the concept of governmentality, he elaborates on numbers as *exercise of power*, and concludes that numbers unintentionally lead to governmentality.

Governmentality is hence about the exercise of power or a specific way to perform power. Foucault often defined governmentality as 'the art of government' in a wide sense, that is, an idea of 'government' that is not limited to state politics alone, but which includes a wide range of control techniques (of which numbers are one), and that applies to a wide variety of objects, from one's control of the self to the 'biopolitical' control of populations. Governmentality is hence about the indirect means through which government exercises power:

> "the rule by numbers is more complicated than simple top/down coercion: it involves a significant degree of complacency and fundamentally shapes the way in which subjects behave. In short it is a system of voluntary acquiescence." (Fioramonti 2014: 20)

A central aspect of both Foucault's governmentality concept and his power analysis (power-knowledge) is the formation of subjectivity: both development of the self as well as disciplining people through consent (Hammer 2008), in the sense of a particular way of 'seeing'. A reason for this might be his original interest in disciplinary power, and the particular ways this is happening in the neoliberal area. Foucault (1977) investigated discipline as a mode of modern power that is continuous, diffuse and embedded in everyday routines. This formation of subjectivities is referred to as 'biopower'.

Foucault's view is that numbers exert discipline on those they depict (Espeland and Stevens 2008). In this way, what was initially meant to describe, can be used to judge or control. The statistical categorisation of 'normality' is particularly telling in this respect: In *The History of Sexuality* (1976), Foucault shows how statistics gave input both to systematic planning as well as interventions in society for specific goals, hence had social implications. This work was the forerunner to the governmentality studies.

[11] Foucault started developing this topic in his lectures on 'governmentality' at the Collège de France (1977-79).

From a different perspective than Weber, Foucault was also interested in steering. However, contrary to the general approaches of historians and political scientists, Foucault focused on practice rather than on institutions. A consequence of the difference in Weber and Foucault's focus on steering, is that where Weber focuses on state power, Foucault instead focuses on the technologies of governance. In this way, he was trying to link analysis of power at a macro and micro level with the idea of pervasive power. Still, there is a link here between Weber and Foucault concerning the technical or material instruments (statistics/numbers/knowledge) that makes steering possible. In Weber's view, 'the significant trend is the modernization of the state's exercise of coercive power by its adoption of rationalistic methods and the staffing of its departments with people who are skilled in the art of efficient administration' (Gordon 1991: 484). Here he shares Foucault's view that the modern state uses less direct repression.

The governmentality concept has been and is widely used in studies on the role of quantification and number technologies in society. These studied are however in general linked to neoliberal practises like the (Anglo-American) practice of managerial/cost accounting, New Public Management (NPM) or benchmarking in general. They focus on the spread of theories of governance and management, which were originally applied to businesses in the market sector, but which through NPM have become the standard way of running any kind of organisational activity, whether departments of state, municipally owned enterprises or Non-Governmental Organisations (NGOs).

Management practices, also referred to as micromanagement or 'audit culture', reserve a central place for quantitative information, both for planning and evaluation purposes. According to Gaukroger (2012), micromanagement is based on a rationality that 'only the measurable is manageable.' Therefore everything that shall be managed, must be counted. Targets must be quantified and success rates calculated. Gaukroger claims that in the 1980s, Britain became the most regulated country in the non-communist world due to the extent of micromanagement. One of the characteristic feature of this kind of management is its lack of consideration for the subject matter that it is managing. Another feature is the related abdication of responsibility. The most striking consequence is probably how it generated new forms of practices that conform in artificial ways to the statistical norms, which is where we find a clear link to Foucault's governmentality concept.

The spread of management practices, is closely linked to the increase in use of performance measures. In this respect, the neoliberal era is characterised in particular by a

wealth of indicators and in assessing performance. Although distance and objective criteria are not new in governance or steering, the particular focus on performance is. Performance is both associated with the widespread use of numbers and the particular kinds of numbers specific to the neoliberal era (Desrosières 2008).

However, studies from the 'Anglo-Neo Foucauldian' perspective, such as Rose and Miller's show that calculative practices as part of state rationality and steering, spread long before the neoliberal era. This may not be surprising given the insights from Weber's research. While on the one hand, the spread of instrumental rationality and the increase in number production have reinforced each other, they have on the other hand also been accompanied by a spread in (quantitative) calculative practices. Miller has extensively studied how calculative practices (e.g., cost accounting), and their associated managerial logic, has spread to 'every sphere of society, both state, firm and other' (Miller 2001).

These authors have elaborated the concept of governmentality further by focusing on calculative technologies, especially the emergence and roles of calculative practices of accounting. On the one hand statistics 'renders reality into a calculable form' (Rose and Miller 1992: 15), and at the same time one of the virtues of numbers is that they easily circulate and seem straightforward to interpret, which is what makes it possible to monitor or steer from a distance (Miller and Rose 1990, Cohen 1982, Scott 1998).

Rose and Miller (1992) launched the concept of 'technologies of government' - analysing calculative practices as 'the mechanisms through which programs of government are articulated and made operable'. They point out the (intricate) inter-dependencies between political (or particular) rationalities and governmental technologies (apparatuses). Calculative practices spread due to a problem or dynamic that Rose (2004) illustrates nicely with a quote from Robert Musil: 'once the machine is there, it has to work'. This gives associations to Weber's idea of the 'iron cage'.

Due to Foucault's relatively narrow concept of (pervasive) power, Foucault-inspired studies on numeracy and quantification give little attention to the broader question of whether new calculative logics and specific number technologies or kinds of numbers are in the interest of some groups or ideologies rather than others. To investigate this issue one needs to address a wider range of power question (including actors and their motivations). This has been done by, for example, Hajer (1995) who successfully combined such questions with

Foucault's concept of power-knowledge in his extensive study of the environmental discourses related to acid rain policy in the United Kingdom (UK) and the Netherlands.[12]

Disciplining and the performativity of numbers

A main distinction made within the governmentality approach is that of abstract rationalities (e.g., ideas, knowledge formation) vs. concrete practices (e.g., steering technologies, number technologies), although the main focus is on how the two interact. The starting point is that using numbers as steering tools relates to a certain perception of what they can do - their *performativity*. For Foucault, performativity is linked to steering and power, for example disciplinary effects.

Inspired by Foucault, a strand of studies has developed around this concept of 'performativity'. The concept has been important in science studies (usually called Science and Technology Studies, or just STS), as well as in studies of accounting and economics. What these studies have in common is a preoccupation with representation, which is problematised due to its simultaneous effect of representing and constructing (i.e., disciplining) society. The critique put forward has been that while the mainstream of these academic disciplines claim to be descriptive of the world, they actually work to bring the world they describe into being. In general, the claim is that the way we understand, represent and describe the world we live in, affects or constructs our social reality in the next round.

With respect to statistics and numerical description of society, one effect of the mainstream representation has been the spread of calculative rationality and the development of quantitative science. In this sense, statistics is both descriptive and performative. This interaction between representing and constructing of the world has also led to the claim of the 'mutual constitution of statistics and society' (Saetnan, et al. 2011).

The way we measure, count and categorise society and what we measure, actually contributes to shaping society in the next round. Measurement, therefore, is much more than a numerical representation of reality; it also produces social effects. These effects can be both material and discursive. An example of a discursive effect would be perceiving an ecosystem as something that can have a monetary value, an idea which has been totally foreign to most people until recently. Ultimately, the effects might also be material, if or when the new ways of seeing becomes institutionalised in society.

[12] However, as Ester Turnhout kindly pointed out to me, this might be easier done in areas with clear confrontations, than in messy discourses like TEEB.

The concept of performativity has close links to postmodernism through the argument that society defines and constructs reality through experience, representation and performance. Butler (1990), for example, has analysed gender as something that one ‘does’, rather than something one ‘is’. MacKenzie (2009) and Callon (1998) have studied the performative aspects of economics, i.e. the extent to which economic science plays an important role not only in describing markets and economies, but also in framing them. Callon has suggested similar thoughts as Butler concerning the economy, i.e., economists 'perform the economy'. This is because economics is something one does, rather than the economy being something that is. Callon has labelled this processes 'economisation', i.e., that economics and economics-inspired disciplines shape the (political) economy (e.g., Çalışkan and Callon 2009).

Similarly, accounting is, through its realist perspective, often seen to be descriptive and to measure common objective ground uninfluenced by values. However, 'the constitutive turn' in the 1970s and the emergence of a new strand of critical accounting acknowledged that accounting also helps bring the world it is meant to describe into being, rather than only describing it or relating to it in an objective way (Hopwood 1976). The claims to ‘represent reality’ by telling us ‘the true costs’ and ‘the bottom line’, at the same time helps constitute what is seen as legitimate performance. In this way accounting becomes a pervasive force in modern society, strongly connected to pressures of economic rationalisation affecting decision-making by governments, corporations and individuals (Power 1993). The constitutive turn also aimed at debunking how the 'neutral' approach to accounting showed no recognition of different interests, social (structural) conflicts or compromises.

Latour, in his book *Science in Action* (1987), focus on the practical uses of numbers and how they get embedded in networks of people who make and use them (Actor-Network-Theory). The argument is that numbers link users with investments in numbers, so that calculation become ‘epistemic practices’. Latour, like Foucault, is neither concerned with the reality that the numbers (potentially) point to nor with their truth content, but only with how practices gain legitimacy through the networks of which people are part. Although these studies provide many important insights, they also have many limitations of which some are become particularly visible in these times of ‘post-truth’.

Further, from a realist perspective, the problem with the concept of performativity and its critique of representation, is its ideational grounding and lack of real (material) referents or objects in the world. Callon’s perception of economics, for example, is restricted to the

sphere of ideas. There are no independent (material) economic structures, only discursive structures (economic rationality etc.). Hence, while providing important insights, the lack of material referents in the 'performativity' perspective is limiting and ultimately inconsistent with a realist understanding of the social world.

Ecogovernmentality

The field of 'ecogovernmentality' applies Foucault's concepts of biopower (disciplinary power) and governmentality to the analysis of the interaction with the natural world, studying power issues in the environmental discourse and the social construction of 'the environment'. Although not necessarily denying the reality of an independent nature, the focus is on how the social construction of nature is (actually) happening.

Ecogovernmentality began in the mid-1990s with a small body of theorists (Luke,[13] Darier, and Rutherford), then grew as a response to the perceived lack of Foucauldian analysis of environmentalism and in environmental studies. The studies focus on how government agencies, in combination with producers of expert knowledge, construct 'the environment', not as mental constructions, but in physical terms. This construction is viewed both in terms of the creation of an object of knowledge and a sphere within which certain types of intervention and management are created and deployed to further the government's larger aim of managing the lives of its constituents. This governmental management is dependent on the dissemination and internalisation of knowledge/power among individual actors, hereby creating a decentralised network of self-regulating elements whose interests become integrated with those of the State.

Scott has described an example in Mexico of how 'the social construction of nature' happened through forest management schemes where measuring nature in terms of concepts of production and natural resources 'allowed the state to impose that logic on the very reality that was observed' (Scott 1998: 14). The complex natural systems of a given place was first depicted as simplified sites of managed resource extraction. A (material) effect of this new management practice was that the ecological composition of these places changed (through types of planting, harvesting and extraction) and the sites resembled more closely the simplified statistical systems with which they were measured. The physical environment was adapted to the simplified measurement system.

[13] Timothy Luke had already theorised this as 'environmentality' and 'green governmentality' earlier.

Examples of this method of analysis can be found in Rutherford (1999) (on Environmental Impact Assessments (EIAs) in the United States of America (USA)) and in Agrawal (2005) (on local forest governance in India). These works illustrate how the production of specific types of expert knowledge (statistical models of pollution or the economic productivity of forests) coupled with specific technologies of government (the EIA assessment regime or local Forest Stewardship Councils) can bring individual interest in line with those of the state. This does not happens through the imposition of specific outcomes, but by creating frameworks that rationalise behaviour in particular ways and involve individuals in the process of problem definition and intervention.

Within a geographical context, this type of analysis provides insight into how territory is brought under state control, and how the regulation of human interaction with this territory is achieved. Focusing on the evolution of techniques of cartography, systems of natural classification, and early attempts at scientific resource management in the 18th and 19th centuries, Braun (2003) and Scott (1998) show how new systems of knowledge extended systems of governmentality into the natural world. Core to this analysis is a connection between the abstract utilitarian logic employed by states and the shape of the territory under their control.

Ecogovernmentality is seen as a subset of concerns within the larger Foucauldian concept. However, implicit in this is an important claim: that the types of knowledge produced in the process of making nature intelligible to the state have an important influence on the evolution of state rationality itself, an influence not adequately covered in Foucault's original formulation. They seek to add to Foucault's discussion of population and the operation of systems of knowledge-power that normalise certain ways of acting and being and marginalise others. Building on Foucault's brief references to 'resources, means of subsistence [and] the territory with its specific qualities', their contribution is the investigation of the parallel systems of measuring and assigning value to the natural world and to give these their due attention in discussions of the formation of state rationality and structures of governmentality. In Scott's example from Mexico, the 'crop' and the 'weed' (Scott 1998: 13) act as homologies to categories like 'sanity' and 'insanity' in Foucault's work.

Asdal (2011a) has contributed to the performativity debate by pointing out that numbers rarely work on their own, despite the performativity thesis having contributed to making such assumptions widespread amongst STS scholars. In a study of an aluminium

plant in Norway and the never-ending negotiations on where to set its emissions ceiling, Asdal focus on the *in*ability of the pollution control agency to govern by numbers due to a belief that finding the right (emission) numbers would in itself be sufficient 'to move the factory'. Ultimately, the number nevertheless came to have effects due to a formation of an 'environmental interest' within the agency. She therefore concludes that the formation of interests was a condition for the number to have effect.

While Asdal's (2011a) study certainly confirms the hypothesis of a link between interests and the effect (or performativity) of numbers, she does not attribute this to the number being of any specific kind. I would argue, that beyond describing the way descriptions contribute to create (social) reality, the topic of power requires also asking whether *particular forms of representing reality* (or ways of knowing) serves certain interests, certain practices, certain rationalities or maybe even serves to reproduce a certain system? Linking power to representations of reality in this way, and to numbers in particular, we can see how certain numbers or ways of representing reality might be more useful for some groups (or interests or values) than for others. At the same time, *what* and *how* to count – or even *that* one should count – is most likely influenced by power and powerful groups in the first place.

Steering the political economy

Desrosières (2008) challenges the picture of the rational state prevalent since Weber, which include standardisation and anonymisation of the social world, development of bureaucracy and the increasing role of experts. In the Weberian account, rationality is something coming from the outside and contributing to progress, and science is seen as a linear and cumulative process. Desrosières challenges these assumptions, and shows that the history of the tools for rationality, in terms of ways to think of society and politics, has been tumultuous and non-linear. There is not just one given development of statistics as 'a natural evolution' of scientific description of the world, a technical thing living its own life. The numbers have been developed in close connection to the given state rationality at each point in time.

Desrosières looks at how statistics perform 'the society' in various configurations. This account is inspired in particular by Callon's (1998) work on how economics create or perform the political economy, although Desrosières explicitly claims that his is not a relativist exercise. He explains his position in the following way:

> "statistical work not only reflects reality but, in a certain sense, establishes it by providing the players with a language to put reality on stage and act upon it." (Desrosières 2001: 352)

To do this he studies the relationship between the statistical tool, the types of arguments and the nature of the problem. He then demonstrates how, historically, numbers have not played only one, but several and different roles depending on the societal and political organisations of their time.

As pointed out above, the pre-modern state knew little about its populations and their wealth, landholding, yields, location or density. The first attempts at establishing aggregate quantified information at the state level, were first and foremost linked to warfare, involving population censuses and national income calculations. The first attempts at measuring national income were done for England in the 17th century, with the purpose of determining possible tax revenues to support warfare, hence - one could say - the purpose was a very particular kind of state steering.

The kind of statistics (or 'knowledge') considered useful for the state has since then changed over time. Desrosières has examined the different kinds of statistics arising within different kinds of state regimes since the 'engineering state' (in France) in the 17th century until the current neoliberal period. Because statistics as a tool for evidence and as a tool for steering usually belong to two different fields of expertise, they are rarely examined in combination. By studying the two together, Desrosières has compiled a stylised division of five types of states (stylised articulations of positions about the relationship between state and market) and the kind of statistics they made use of. He adopts a broad understanding of statistics, comprising different techniques and ideas, styles of reasoning, practices, technologies and institutional contexts (Desrosières 2008). These are presented in table 1, showing how the different époques, with their different ideals and values (or different 'ways of thinking about society and the economy'), including different modes of action (i.e., policy), also produced different types of statistics that fitted the needs of these various concerns of society, the related policies, and the modes of action of the state.

Table 2.1. State regimes (stylised) and their associated types of statistics

Stylised types of states	**Ways of thinking about society and the economy**	**Modes of action (policy)**	**Types of statistics**
The engineering state	Hierarchical institutions, rational organisation	Optimisation within constraints. Central planning and technocracy. Long term visions	Demography, production in physical units. Tables of flows between industries. Material balance sheets
The liberal state	Physiocrats. Free competition	Free market exchange. Against corporatism (anti-trust laws)	Statistics by economic sectors
The welfare/social state	Protection of the workers (needed since labour had become marketed)	Laws regulating working hours, health/safety, unemployment, pensions. Compulsory insurance, securing social rights	Labour statistics: salaries, work, unemployment. Inequality measures. Consumer price indexes
The Keynesian state	The market cannot function on its own without leading to crisis. Needs regulation, or boosting demand.	Monitoring the possible gap between supply and demand, intervention via monetary and budgetary policies	National accounts. Conjuncture analysis. Macroeconomic models
The neoliberal state	Free competition. Financialisation. Decentralisation of decision centres in networks	Transition from regulation to incentives, e.g., the market of pollution rights	New measures of equivalence. Indicators to evaluate performance. Benchmarking

Source: adapted from Desrosières (2008), my translation (from French).

Desrosières' (2000) main purpose with his study is to show that statistics are not 'given' as an objective representation of reality that evolves independently of social and

political circumstances, but rather is something to study and problematise in relation to the political economy. He shows, for example, the difference between the 'engineering state' (or technocratic state) having certain resemblances to socialist centrally planned economies, versus the Keynesian state which did not question the market economy, but rather intervened in the macroeconomic structure which by then had been made into a manageable or 'a graspable object' through the national accounts.

Similarly, the kind of statistics developed in many Western countries, starting in the 1880s linked to the poverty of the urban, industrial working class, came to have constitutive effects on the way the state operated. These statistics were based on surveys, which created much controversy at the time, as they were not considered rigorous like one would expect from statistics. However, they ultimately led to the introduction of such societal arrangements as pensions, social benefits, unemployment relief and general social security. From the perspective of the state-market relation, this is interesting because of how labour had been turned into a commodity regulated by the market, and the problems that that had caused.

For this dissertation, the change in modes of action by the state and the related types of statistics during the neoliberal period is of particular importance. They differ from the earlier 'liberal state' which produced statistics on economic sectors as proof for the need to implement anti-trust laws or for the purpose of making markets more transparent to its participating actors. With neoliberalism, it is instead the public sector which is subject to strong pressure of transparency and accountability[14] through NPM and the introduction of performance measures such as indicators and benchmarking, a kind of data or statistics associated more with management than with traditional state steering.

Another type of statistics characteristic of the neoliberal state is the introduction of new measures of equivalence, such as CO_2-equivalents. This kind of statistics is strongly linked to the transition in policy from direct state regulation to economic incentives. Here we see the affinity with and/or inspiration from (neoclassical) microeconomic theory with its concepts of rational actors, preferences, utility, optimisation, externalities, etc. (Desrosières 2000: 10). The most telling example of public policy based on microeconomic thinking is the creation of a market for pollution rights including an overall pollution ceiling (called cap-and-trade), perceived and promoted as more efficient than general regulation. Although

[14] The purpose of these indicators are debated. Although transparency and accountability are legitimate concerns for democratic governance, the extent to which they are used have also been criticised as being excessive micromanagement (Gaukroger 2012).

Desrosières does not draw this conclusion, one could say that the efficiency-criteria replaces earlier direct steering—at least rhetorically—, or alternatively, that efficiency becomes the way to steer, most prominently through markets and planning for competition.

Another lesson from this historical account is how the use of the same statistics can change. While national accounts where produced specifically for the purpose of carrying out Keynesian macroeconomic policy, they have not been made obsolete by leaving Keynesian theory behind. Instead, with the turn to neoliberal policies, but also within the discourse of sustainable development, Gross Domestic Product (GDP) has recently become a measure of wealth and a much used sustainable development indicator (Desrosières 2014).[15]

In a similar vein, regulation theorists have tempted to provide explanations of the various periods and crisis in capitalism (starting with the crisis in Fordism and the Keynesian welfare states in the 1970s). The basic assumption of the regulation school (RS), distancing it from neoclassical theory, is 'that capitalism is not a self-equilibrating process, but requires intermediation from external structures' (Petit in Durand and Légé 2013). The explanatory and analytical framework developed by the regulation school is built around two main concepts, those of the 'accumulation regime' and the 'modes of regulation'. With the help of these two broad concepts, the regulation school then explains historical change of the political economy.

By mode of regulation is meant the set of institutional laws, norms, forms of state, policy paradigms, and other practices that provide the context for the operation of the accumulation regime. Generally speaking, modes of regulation support the accumulation regimes by providing a conducive and supportive environment, in which the accumulation regime is given guidelines that it should follow.

Further, the RS looks at how social compromises in each accumulation regime is necessary for its securisation. These are achieved through modes of regulation. The point is that an institutional compromise is needed to secure growth. The main focus is therefore on the regulation of capital accumulation through economic and political procedures as they change to secure the reproduction of capital in successive stages of capitalism (Jessop 1990: 330).

[15] This has lead to many discussions even within the mainstream, where it is pointed out that GDP is a measure of flow or annual income, not a measure of wealth in the sense of stocks, resources or capital. Still, in the latest version of the UN Sustainability Development Goals, GDP was again chosen as a sustainable development indicator.

Although regulation theory is not specifically concerned about statistics, one can combine the two frameworks by linking the periodisation of statistics with the various periods and related procedures identified by the regulation school. Desrosières has identified new measures of equivalence and indicators for evaluating performance as typical of neoliberalism. Since, he does not use regulation theory, he does not look into the ways in which the statistics produced link to the specific accumulation regime or what kind of economic growth it induces. By interpreting Desrosières within a RS framework, we see that the production of statistics was a decisive practice—or institution—for supporting the operation of the various accumulation regimes. In the current neoliberal times, when growth is not secured and new possible imaginaries are being suggested and promoted (Sum and Jessop 2013), one must ask: what kind of numbers or statistics is of relevance?

2.3 Measurement, representation and commensuration

According to philosophers Chang and Cartwright (2008), it is not easy to say what measurement actually is despite it being one of the most distinctive and pervasive features of modern science. Philosophers commonly define measurement as 'the correct assignment of numbers to physical variables' (Chang and Cartwright 2008: 367). A key question of interest for assessing measurement practices is then whether they *refer correctly to the object of interest* or not. But how can we know that a measurement is made correctly and that the measurement operation really measures what it purports to measure? There are different views on the extent to which it is *possible* to represent something objectively or realistically (in numerical terms).

Measurement in natural science

Chang and Cartwright (2008) have identified two main positions regarding the nature of measurement in the natural sciences: nominalism and realism. Realism sees measurement as a method for finding out about objective (real) *quantities* existing independently of the measurement. Nominalism, on the other hand, treats measurement methods as definitive of the concept. The milder version of nominalism (conventionalism) does not conflate meaning and definition but allows a convention, for example an agreed measurement operation, to regulate the use of the concept. From a critical realist perspective, this kind of 'realism' corresponds to empiricism or naïve objectivism, conflating the real and the actual, while

'nominalism' would correspond to social constructivism and the missing distinction between the transitive and intransitive realm (i.e., the distinction between *knowledge* about an object and the independent *object* of knowledge).

Measurement in social science

In the social sciences, measurement becomes more problematic since social phenomena are often unclear. This is what has been referred to as 'Ballung' concepts (Cartwright and Bradburn undated). Therefore, in the social sciences, it is more common to depend on agreed procedures - i.e., intersubjectivity - instead of objectivity. Quantification and adjustment of concepts are part of the process of getting to know the phenomenon one studies better.

Desrosières (2001: 339) suggested that the ways that producers and users of statistics talk about reality is 'informed by the fairly unconscious intermingling of several attitudes to reality'. He has demonstrated the variety of attitudes concerning the measurement process in the social realm and the understanding of the end result of that process, and from this identified four attitudes or positions to reality held by producers and users of official statistics. The first attitude is metrological realism, derived from the theory of measurement in the natural sciences. The second attitude relates to national accounts in particular. National accounts are not 'proper' statistics as they combine business statistics into a balanced accounting framework. According to Desrosières, national accountants justify this on pragmatic grounds, based on purpose and what was 'needed for policymaking'. The third position is that of the users of data, typically researchers or people in the administrative, political or economic social sphere. Normally, such users take the data as "reality", they want to be able to trust the database as blindly as possible to make their arguments. The last position admits measures as constructed and negotiated, hence a nominalist or constructivist view. However, this position does not result from a specific theoretical or philosophical theory, but arises from experience with situations marked by controversy, crisis, innovation and changes in the economic, social and administrative context.

One can try, like Desrosières, to classify different people or groups of people into categories of different attitudes to reality. I think this is an important step in the process of creating understanding of the role numbers play in environmental politics and in society more generally. However, what we see already at this stage (starting from Desrosières), is that some of these attitudes are not only about the representation itself, but about the usefulness of representing reality quantitatively. It is as if the two cannot be separated, but rather are

internally and necessarily related. However, we should not give up the analytical distinction. Further, we must also aim to assess the truth of the representation independently of its usefulness.

Hence, from the very beginning, what a number actually represents is a quite complicated question (especially in the social sciences). However, it is interesting to note that the social constructivist or nominalist aspect of statistical or measurement categories does not only concern phenomena of social nature. Also formalisation of measurement of the physical world has been controversial, e.g., Porter (1995) (weight) or Chang and Cartwright (2008) (temperature).

Still, the basis remains of trying to assign numbers *correctly* to physical or social variables. One can say that the purpose is to try to grasp a phenomenon through numbers, making the numbers the (concrete) representation of the (abstract) concept. This is not unproblematic though, since numbers are in themselves abstractions with no physical existence (Higgins 2011: xi). Despite being abstractions themselves, numbers are often perceived as concrete representations of concepts (which also are abstractions). The numbers are meant to refer to something real and actual.

Commensuration: abstract and universal representation of reality

Like concepts, numbers can express empirical phenomena in an abstract way. However, this abstraction (numbers) has a specific form or format, which is what provides numbers with their particular 'powers' or capacities to make things happen (be performative) or *allow* certain things to happen. Samiolo (2012: 1-2) argues that numbers represent reality in an abstract and universal format, which is why they can be used for acting or steering from a distance. It is the basic assumption of an equivalence space that allows numbers to circulate and be further calculated and re-formatted, which in turn is what makes it possible to act on an object from a distance (Latour 1987, Rose 1992, Porter 1995).

Creating such an equivalence space, however, depends on commensuration. Centemeri has suggested defining commensuration as:

> "an *operation* that allows for the existence of spaces of equivalence in which a common metric guarantees the comparison of objects that are usually qualified according to a plurality of forms of evaluation (potentially conflicting)". (Centemeri 2010: 15, my italics)

As she also points out, the usual plurality of forms of representation and evaluation are potentially conflicting. Commensuration is therefore a creative process. It is a way to overcome the gap separating different forms of evaluating things which accounts for them being incomparable. Therefore,

> "in the creation of the conditions for comparability not only the objects involved undergo a transformation (usually in terms of a reduction of the moral complexity they bear) but new objects emerge as well, that participate in the construction of our world in common, thus becoming part of the objective world we agree upon." (Centemeri 2010: 15)

According to rational choice theory, the operation of commensuration is needed in order to be able to make rational choices or trade-offs in public policy. Others hold the exact opposite position: Things that are incomparable cannot be compared by pretending one can use the same measurement rod. Instead, one must use reasoned argument and judgement (see e.g., O'Neill 2007b).

A recent quantitative phenomenon linked to commensuration, is that of indexes or aggregate statistical indicators. An index is a lumping together of elements of various kinds, like for example the Human Development Index (GDP, literacy and child mortality) or the consumer price index ('a basket of' representative consumer goods). GDP is probably the most well-known aggregate statistical indicator. All these measures are important in government steering or policy today (although HDI probably for the most part in developing countries).

That things and people can be acted upon and governed on a large scale by virtue of statistical aggregates is today often taken for granted, although the history of statistics shows that this was not always the case. Historically, the realism and meaning of statistical aggregates have been the object of fierce disputes. Statistical categories have been challenged and sceptics have argued that the 'homogenization of infinitely diverse units' fail to do them justice or produce misleading insights (Desrosières 1998). In a similar vein, Sayer (2000) has pointed out that the phenomena that social science studies are often complex and messy. Therefore, much rests upon the nature of our abstractions:

> "if they divide what is in practice indivisible, or if they conflate what are different and separable components, then problems are likely to result." (Sayer 2000: 19)

Sayer claims that many categories used in official statistics are based on bad or incoherent abstractions. The 'service sector' is an example of a category whose activities does not have a lot in common and hence do not behave in the same way. Therefore,

> "the category cannot bear the explanatory weight many researchers have been tempted to put upon it – for example services as the basis of 'post-industrial society'." (Sayer 2000: 19)

For neoclassical economics, however, this is not a problem, as the discipline does not aim for (causal) explanation, but rather for prediction or policy advice.

The most in-depth description of the various aspects of commensuration is probably the one given by Espeland and Stevens (1998). For them, commensuration is a way to make things visible, by highlighting some aspects of an issue and downplaying others. Besides a thorough critique of various aspects discussed above, they also point to what they perceive as the inevitability of commensuration in modern politics. Even when moving away from numbers, one instead moves to abstract comparativity:

> "[p]olitical negotiation entails seeing one's own interests as comparable to the interests of others. Our conception of interests as a basic unit of political analysis implies commensuration. (..) Making qualitatively unlike interests comparable can be a formidable cognitive achievement." (Espeland and Stevens 1998: 336)

According to Espeland and Stevens (1998), commensuration can be understood as a technology of inclusion, valuable for democratic, pluralistic societies. In this perspective, commensuration offers an adaptive, broadly legitimate device for conferring a formal parity in an unequal world, and is hence a hopeful device for pragmatic reformers (Espeland and Stevens 1998: 330).

However, commensurative politics has its limits, which is why some social movements and radical political activists choose to stay outside of it. One position is that the structures of the current political institutions are morally flawed, since they require trading-off between inviolable interests (for example those of the working class) and illegitimate ones (for example those of the capital class). The New Left's refusal to participate in normal politics has hence been perceived by some as its greatest moral accomplishment (Breines in Espeland and Stevens 1998) and by others as a cause of its ultimate political weakness (Gitlin in Espeland and Stevens 1998).

Opposing commensuration is however not only a left-wing position, but is equally widespread on the right, for example in conservative Christian attitudes. Espeland and Stevens (1998) suggest that this opposition to commensuration on both side of the political spectrum implies an awareness as to the transformative potential inherent in commensurating disparate values: 'When we opt to negotiate with parties who do not share our vision of the world (..), we risk alienation of our interests. Negotiation requires commensurating with the enemy' (Espeland and Stevens 1998: 337). Hence, movements that stake their identities or values on incommensurables face a dilemma even coming to the bargaining table.

The accounts of commensuration presented here, again show how sociologists of quantification tend to overlook the real objects that numbers and various measures aim to refer to, as well as the materiality of those objects. If the way unemployment is measured do not do justice to the amount of people without an income, social unrest might occur no matter what the numbers say. Another distinction which is key to the topic raised in this dissertation, namely the different between monetary and physical numbers, is also overlooked in these accounts.

Measurement and representation in accounting and neoclassical economics

The specificity of mainstream accounting and neoclassical economics is that they are based at the outset on a logic of numerical assignment where numbers are meant to represent reality in an abstract and universal format, i.e., using the same measurement unit for everything. To achieve this, an 'equivalence space' composed of a *general equivalent* must be established (Desrosières 2001: 342). This general equivalent is usually money.

The idea and spread of this general equivalence space and its related rationality is the reason why Meyer (1986: 345) suggests that accounting and economic calculation are at the core of a process of 'cultural rationalisation' happening at the world level. Also Desrosières, has pointed out that accounting and economics, and their specific number system (which is not measurement in the strict sense), are based on an underlying aim of spreading such a calculative reasoning (Desrosières 2001).

In economics, this goes back to the marginal revolution of neoclassical economics at the end of the 19th century. The marginal revolution built on a particular version of utilitarian philosophy 'one for which human behaviour is exclusively reducible to rational calculation aimed at the maximisation of utility' (Screpanti and Zamagni 2005: 166). The basis for this new theory was the substitution of an objective theory of value for a subjective one.

Purpose and kinds of representations

As Higgins (2011) has pointed out, the basic nature of numbers is quite simple: numbers are abstractions. It is the specific *form* of the abstraction, that allow numbers to be combined with each other and used for various purposes. We can distinguish between at least three main purposes of numbers:

1. Numbers *as* knowledge[16] (numerical representation can provide information, or 'evidence', about the extent, size or distribution of various phenomena or attributes thereof)
2. Numbers as a *tool for* knowledge (input to quantitative scientific analysis, in particular , identification and analysis of patterns, co-variance, etc.)
3. Numbers as a *social technology* (for steering, control, power, decision-making etc.)

In simpler terms, one could say the three purposes are: description, scientific analysis and steering. In any case, number 2 and 3 always relies on 1 being carried out first. To which extent they can be considered independently is a matter of dispute. Foucault, for example, would hold that 1 simultaneously implies 3. For the purpose of the discussion here, it is helpful to keep the three purposes distinct, at least analytically, as this allows dwelling further on issues related to 1, i.e., description or representation. As discussed above, there are several theoretical positions concerning the extent to which numbers can *refer correctly* to the object of measurement (e.g., realist, nominalist, conventionalist).

As Desrosières has pointed out, there is an additional aspect related to measurement, namely what the number or measurement is meant to refer to: whether it is a concrete phenomenon in space/time, or an abstract phenomenon. As I have shown above, number are not necessarily used to refer to a physical quantity in time/space. In accounting and in neoclassical economics, numbers represent an equivalence space whereby all things are measured using the same universal equivalent. In this case, the object of reference is itself an abstraction.

Desrosières has not elaborated much on this aspect, beyond pointing it out. However, for this dissertation, researching a phenomenon at the intersection of ecology and economics,

[16] 'Knowledge' is here used in a loose and broad sense here, more in line with positivism and maybe lay notions of the word. Critical realism, on the other hand, reserves the term for explanation, not simply description or representation.

the distinction is central. I will therefore operate with two main ways in which numbers can and are *used to represent*, i.e., two overall categories or kinds of numbers or numerical representations:

1. **Realist or concrete representations**, i.e., the object of reference is (considered) real and existing in space/time. In empirical sciences, it is generally important that the number refer correctly to the object of interest (which is to be described). Only then can we learn about the quantitative aspects of the object in question. This allows the use of numbers as a tool for creating knowledge about the objects, or it can provide 'evidence' or allows observing patterns concerning the object. This allows using the numbers for steering or control.
2. **Abstract representations**, i.e., the object of reference is an abstraction beyond space/time. Neoclassical economics and accounting aim at creating an equivalence space whereby all things can be measured by the same unit, independently of their specific qualities or properties.

Related to these two categories, one could also say that numbers have two distinct powers with respect to representation:

1. The capacity to express **compact information** concerning quantitative dimensions of the physical world; and
2. The capacity to express **commensuration**.

It is important to note, however, that universal representation as described in section 2.1 is not the same as abstract representation. Standardised and universal measures, such as the metric system, still have concrete, physical objects as their object of reference, even if aiming to universalise the measurement system. At the same time, abstract representations exist which are not aiming to use the same measurement unit (general equivalent) for everything, but still aims at general equivalents that commensurate things beyond their physical properties. An example of this is the CO_2-equivalent. Again, although pointed out by Desrosières as being a 'new measure of equivalence', he does not elaborate any further on what this means. With respect to the CO_2-equivalent, the measure was first invented by climate scientists to allow comparison of the various gases and their greenhouse enforcing potential. This was considered important for policy purposes. Later only, was it used for establishing markets for emissions trading. In this case the equivalent allowed setting up markets for objects for which there was not already a market and a price (i.e., no use of the general equivalent money).

2.4 Statistics: a 'tool for the weak' or the strong?

Are statistics and numbers a tool for liberation and enlightenment, or a tool for domination? In general, there is little focus in the critical numbers literature on where numbers can be useful for the democratic project and when or where it can be repressive. However, Desrosières (2014) reminds us that there are many historical examples of numbers being used to oppose authority, contrary to more recent account of numbers being in the hands of the powerful. He claims that social critique often relies on statistical arguments: just like the state have used quantification to get a grip on things and make things visible, so must social critique to make visible injustice and inequality. Having himself been at the forefront of producing historical and sociological accounts about statistics, he still feels that these studies have weakened the scope of statistics: 'they robbed it of the efficacy linked to its image of objectivity and impartiality' (Desrosières 2014: 349). Having earlier written from a descriptive and non-normative position, his latest work seem to have become explicitly realist and emancipatory:

> "For a statistic to play its social role as a neutral reference, above the conflicts of social groups, it must be instituted, guaranteed by democratic procedures, themselves legitimate. It then contributes to making reality and not simply reflecting reality. *This idea is not relativist*, in that it does not deny the existence of inflation or unemployment. But it draws attention to the fact that inflation and unemployment can be thought, expressed, defined and quantified in multiple ways, and that the differences between these ways of doing are not simple technical details, rather always have an historical, political, and sociological meaning." (Desrosières 2014: 352).

In the same article, Desrosières refers to Porter's (1995) concept of 'statistics as a tool of weakness', and agrees that statistics is not always a tool of power. Porter suggests that the hegemony of traditional classes often is founded on implicit and unchallenged evidence, perceived as 'natural'. The conditions of success for statistics as a tool of weakness, however, depends on (the justness of) the argument, but even more on managing to mobilise support for the argument across political and social networks (Desrosières 2014: 357). An example of a statistical innovation 'with spectacular success', according to Desrosières, is Thomas Piketty's new measure of inequality that zoomed in on the richest centile (1%). This measure was later converted into to the Occupy Wall Street slogan 'We are the 99%'.

Although Desrosières might in principle and historically be right, it is still a question whether the conditions in today's society are favourable to these kinds of arguments in the same way as earlier. It is not only historical accounts of statistics that might have contributed to erode the trust in statistics as objective evidence, but even more so explicitly relativist accounts (most prominently Latour's) and post-modernist (including post-political) attitudes. If the statistical argument was to be favourable, there might also be limits to the kind of social issues that it can address. We saw above that statistics provided strong arguments for doing something about the situation of the poor working class at the turn of the last century, i.e., a case can be made about minimum standards or social or economic human rights. The Picketty example points to a distributional issue between the masses and a small privileged elite, i.e., relative income.

But what about emancipation beyond a fair(er) or more equal distribution of income, i.e., issues such as freedom from exploitation, coercion and oppression? Such topics are harder to illustrate with statistics or numbers. In general, it seems that reformists are relatively positive about numbers (see e.g., Espeland and Stevens on commensuration above), while more radical thinkers or system critics (e.g., Adorno and Horkheimer 2010[1944]; Gorz 1989) rejected them or are more sceptical about their emancipatory potential. This scepticism, however, is to a large extent linked to the rejection of or opposition to the strong role of instrumental rationality. Many social theorists are trying to find alternatives to this modernist kind of rationality. Examples of alternatives are Habermas' (1984) 'communicative rationality' and Roy Bhaskar's (in Hartwig 2011) 'emancipatory rationality'.

Further, a central question in thinking of numbers in terms of systems change, relates to what is to be considered useful knowledge for the kind of changes which are seen as needed. Can the system be changed through technical fixes or must the change be more substantive? If the change has to be more substantive, then it is questionable whether or in what way numerical information contributes the required knowledge (Sanyal 2008).

Finally, the question is whether what could work for social critique would work as well for 'ecological critique'. This will be an underlying question in the analysis.

2.5 Synthesis

In this chapter, I have brought together the core literature about the role of numbers in modern society. I showed how quantitative information led to increasing and centralised state power. First, this happened both through the increasing control of wealth and people within

repressive societies. From around 1800, a change happened whereby power was increasingly exercised through indirect means, and here, quantification and statistics played a central role.

As Foucault was the first to theorise, statistics is not just about describing reality, but can also be used to judge and control. Coercion also happens through individual internalisation of specific ways of classifying and counting - or specific ways of 'seeing', by creating specific discursive structures. Impacting how we perceive the world or specific phenomena in it, eventually also has a range of consequences. In the social realm, it influences for example institutional structures, while in the physical or material realm, it can influence 'the face of the earth', such as landscapes, ecosystems etc.

The role of rationalism in modern society is also important when discussing the role that numbers have had. For Weber, rationality was the main driving force behind modern society. In combination with increased amounts of information and statistics, firms and bureaucracies could be steered from a distance in an 'objective' and rational way.

Foucault has however disputed that policy and decisions are actually made in a rational way. Despite the actual practice being disputed, rationalism as a policy ideal seems somehow undisputed. A consequence of this ideal has been a spread of both managerialism and, more generally, a specific cultural rationalisation process. This rationality then prefers to have reality (the world) presented in a calculable form, to be able to carry out whichever tasks are at hand.

Finally, Desrosières has proposed another focus for the study of statistics. He has pointed out that the statistics produced, depended at any time on the current concerns or thinking of the state. Therefore, the kind of statistics produced should be analysed in relation to the specific political economy of the period and the prevailing social concerns. I have combined his scheme of various kinds of state regimes with a regulation school understanding of the (capitalist) economy. The regulation school has periodised capitalism as having developed through periods (and crises) of accumulation regimes. The apparatus for producing statistics and numbers that feed into the state steering system, can in this way be understood as part of the mode of regulation (part of the institutions) that stabilise each accumulation regime for a certain period.

This dissertation is about what this means for the environment. I have already shown how measurement practices can have substantive impact on the natural landscape (ecogovernmentality). Even 'deeper', the way we categorise objects to be able to measure them, starts impacting on how we see nature, for example as a sink for pollution which must

be ‘filled up’. This is how indirect coercion or exercise of power through hegemonic categories and numbers work. Hence, measurement is not innocent, but is power laden.

To conceptualise what it is about numbers that allow them to play the role they do in society, we have to start with the nature of numbers and their characteristics or ‘powers’.[17] This further points to the potentials of numbers beyond their actualised uses. The perception amongst the sociologists of quantification cited in this chapter, is that numbers cannot be studied independently of the related rationality.

Rose (2000) has explicitly stated that he does not perceive numbers to have intrinsic properties with regards to the political, and he believes there is no essential unity between politics and numbers. Instead, he believes that the effects of numbers depends on the particular rationality with which they are combined and how numbers align with certain rationalities and technologies. Foucault also held that numbers (as knowledge) are not independent of the related rationality. Therefore his studies focused on how the two interact.

Similarly, Desrosières looked at the combination of state rationalities and statistics or the combination of the statistical arguments of social critics with their innovative, new measures. Desrosières, however, points to another quality of numbers in his historical study: numbers can both be used for steering through or by, or they can be used for help or support, to inform policy or decision-processes. This, again, partly depends on the kind of numbers, but also on the state rationality itself.

Unlike Rose, who doesn’t look at how certain kinds of numbers combine more easily with certain rationalities or purposeful use to produce specific effects or allow specific practices, Desrosières points to different types of statistics. However, he does not go any further, in the sense of building a typology to differentiate different kinds of numbers according to similarities, or generalising across types of statistics. In this chapter I have aimed to go beyond that. I have identified and defined various categories which I expect to be of analytical and explanatory use in the rest of the dissertation. I have distinguished between numbers used for the purpose of description, scientific analysis and steering. I have also distinguished between concrete and abstract representations, and their related capacities to express scale or extent (concrete representation) and commensuration (abstract represenation).

[17] Powers, here, is used in the critical realist sense to refer to what it is about an object that can make something happen, i.e., be efficacious.

Although the mathematical abstraction of numbers can be used for many things, it does not produce phenomena by itself. Other structural and contingent mechanisms (conditions) are therefore key to explain the functioning and effects of numbers in society, including their role in environmental policy. This also means that different kinds of numbers might work differently in different contexts. In this respect, the critical realist account is in line with the constructivist one.

The capacities of numbers are necessary for certain usages, but not sufficient on their own to make things happen. On the other hand, certain phenomena cannot be produced without the help of numbers. In this way, numbers (or certain kinds of numbers) are necessary conditions for certain phenomena to occur and exist, although not sufficient on their own. Trading of rights to emit greenhouse gases (so-called 'carbon trading') is an example of an activity or phenomenon which would not be possible without numbers, and more specifically their capacity to create and express abstract spaces of equivalence or commensurated elements (various greenhouse gases and their estimated warming potential). Similarly, Keynesian macroeconomic policies relied on representing the economy in numerical terms in a specific way, i.e., in the form of national accounts (supply and demand tables).

Although most literature cited in this chapter comes from a tradition of sociology which aims for description rather than explanation, various elements presented can be combined to form the basis of an explanatory model for the dominance of numbers in environmental policy. I will here highlight four elements which will be further used for analysis in chapter 8:

- The functional role of numbers as part of the mode of regulation of each political-economic period (cf. Desrosières and RS)
- The 'rationalistic attitude' and instrumental rationality (cf. Weber)
- The general wish to manage and control both nature and populations, e.g. the spread of management practices to ever new areas (cf. Rose/Miller) and, more generally, the exercise of power and governance through numbers (cf. Foucault)
- The prevalence of positivism and empiricism in science and economics (cf. Bhaskar and Lawson)

3 The emergence and use of numeric information about the environment

3.1 Introduction

This chapter presents a brief history of modern environmental policy and related environmental numbers. I explore the role of numbers in early environmental policy and how it has changed with neoliberalism. I show how environmental discourse, environmental policy and the use of numbers have co-developed with each other over time, and some of the arguments made in favour of producing and using quantitative environmental information. Finally, I present the main models for public environmental decision-making and highlight the role of numbers therein. The purpose of the chapter is to give an overview of the developments in environmental policy and discourses, and the related kinds of numbers. This historical account is then combined with the theoretical insights from chapter 2, to see how and whether the general theories about numbers confirm what we see with respect to the development of environmental statistics.

3.2 The rise of environmental politics and environmental monitoring

The rise of modern environmentalism in the 1960s and 70s, including both environmental science, the environmental movement and environmental politics, covered several environmental aspects. The increasing awareness of pollution was helped by a range of publications, of which Rachel Carson's book *The Silent Spring*[18] (1987 [1962]) is maybe the most famous. However, many countries had more 'local' publications creating awareness at a national level.[19] Besides awareness of pollution, there was also a general concern about resource scarcity, stimulated by the 1973 oil crisis. Nature conservation on the other hand, had already been on the agenda since the turn of the previous century (see e.g., Righter 1982).

At the beginning of the 1970s, a more overarching worry came to the forefront, most prominently expressed in the *Limits to Growth* (Meadows, et al. 1972). The book raised fundamental questions about our economic models and ideals promoting the belief in eternal

[18] This book was about pollution and risk of modern chemical agriculture.

[19] For example, in Norway the book *Future in our hands* by Dammann (1977[1972]), and in France, Gorz' *Ecologie et politique* (1975).

(economic) growth. The concern was with growing populations and consumption, and the associated pollution, soil degradation and depletion of natural resources. The possibility that there were limits to growth generated a public debate about the need for systems change, but did not gain much traction in political terms. Mainstream economists rejected the thesis about resource scarcity based on the assumption that scarcity will be reflected in rising prices, and therefore the system will eventually adjust itself. Still, the widespread assumption that the natural environment provided an unlimited resource base and could assimilate ever-growing quantities of waste and pollution, was challenged.

At this time, economic growth and development were generally perceived as negative for the environment, and one could observe, from the very beginning of modern environmentalism, conflicting interests between economic actors and those defending the environment. This was clearly expressed, for example, at the first United Nations (UN) Conference on the Human Environment taking place in Stockholm in 1972, where economic development and nature conservation were held to be contradictory or mutually exclusive (United Nations 1972). At the conference, this raised fear amongst the G77-countries that the discussions on the environment might be used as an excuse to restrict development and curtail flows of aid, and that increasingly rigorous standards of environmental protection would become a form of disguised protectionism (Vogler 2007).

Despite the tension between environmental and economic concerns, the environment became strongly present on the political agenda. 1972 saw the establishment of the world's first environmental ministry in Norway, with many other countries following shortly after. The UN conference in Stockholm led to the establishment of the United Nations Environment Programme (UNEP). Hence, 'the environment' had made it to the political level, both nationally and internationally.

Initially, environmental policies consisted mostly of laws and regulations to limit pollution. As Dryzek (2005) has pointed out, environmental issues came to prominence in a period when public policy involved a high degree of expert rule within strong bureaucratic structures. Many countries therefore established monitoring programmes to track the development of the environmental pressures of concern, and environmental data started to be collected as part of such programmes. This was the beginning of large-scale and systematic number production about the environment. Data were collected to assess and clarify the size or extent of the emissions, or the quality of the recipient (water, air, soil). Over time, such collection of data was expected to allow decision-makers not only to follow the development

of environmental problems, but also to link them to the policies put in place and therefore permit evaluation of the effectiveness of these policies.

The environmental information produced at this early stage was more focused on pollution than on resource scarcity, even though the latter had become a core concern in the environmental movement and in books such as the *Limits to Growth*. This was probably also due to pollution being increasingly recognised as a widespread problem. In contrast, resource issues were still regarded as a concern mostly in resource rich countries such as the USA, Canada, Norway or Australia (Lie and Roll-Hansen 2001).

In Norway, the newly established Environment Ministry was particularly concerned about resource scarcity (Lie and Roll-Hansen 2001). It therefore financially supported the development of resource accounts (statistics) as a basis for producing resource budgets along with the ordinary (financial) state budgets. In this way, Norway became a forerunner in resource inventories. The aim of the resource budgets was that distribution of and access to physical resources should lay important parts of the premises for economic activity. Physical accounts were considered a different aspect than monetary value, i.e., the two were incommensurable (*contra* monetary valuation) and had to be treated and assessed separately using different measurement units. In the beginning therefore, monetary valuation was not on the agenda. The idea of resource budgets was however an issue of conflict with the Ministry of Finance from the very beginning. The Ministry of Finance was both sceptical about and worked against the attempts to let the resource accounts play a role in economic planning. The change from social democrat to conservative government in 1981, put a final stop to the project (Lie and Roll-Hansen 2001).

Different environmental fields were subject to different monitoring. Although environment ministries covered the field of nature conservation (in addition to pollution and resource scarcity), such issues were in the early days approached from a different policy angle. Quantified environmental policies were at this time to a larger extent related to pollution and monitoring of pollution than to nature conservation. Nature conservation was mostly about setting aside land for national parks or other kinds of protected areas. National parks and protected areas were in general subject to (qualitative) management plans and tools, rather than to quantitative management. Hence, although some inventories of species, for example (as will be demonstrated in the next chapter), were under development, these did not form part of public environmental monitoring or official statistics.

Interestingly, we can see some similarities between the rise of social statistics in the

1880s and the rise of environmental statistics in the 1970s. Both are dealing with and pointing out problems generated by the industrial-capitalist economy, and both times the suggestions for relieving the situation by putting in place regulation were countered by economic arguments. Still, as described in the previous chapter, statistics demonstrating the extent of poverty of the industrial working class ultimately led to the introduction of a range of societal welfare institutions, such as pensions, social benefits, unemployment relief and general social security. Similarly, environmental statistics (or 'evidence') provided strong arguments for doing something about the environmental situation despite the (perceived) burden put on economic actors and/or the overall economy. At the same time, there is a difference between the two topics. The problems identified around the end of the 19th century were related to labour as an unregulated commodity, and has been interpreted as a partial 'ex-commodification' of labour (Burawoy 2015) happening due to the countermovement taking place at the time (Polanyi 1944). The environmental problems identified in the 1970s on the other hand, were associated with industrialism rather than with commodification of nature.

Numbers were also linked to the work of quantitatively identifying or determining pollution thresholds and defining standards. As Asdal (2011a: 2) puts it: 'What are 'emissions' if not the quantification of pollutants?'. For this reason, she claims, the focus on both numbers and facts were prominent in environmental politics from the very beginning. Despite the strong role of experts in the bureaucracy especially in the early days of environmental policy, these numeric limits, standards, targets or thresholds were not set without controversy. Rather, they were usually subject to severe negotiations, often behind closed doors.

Asdal (2011b) has described in detail one such case from the early 1970s where the Norwegian Pollution Control Agency had decided to limit the emissions of fluoride from Årdal aluminium factory to 20 kilos per hour, but ended up accepting 50 kilos per hour. The result came after long negotiations about how much nature to 'sacrifice' to pollution (forests were affected) and how large the economic burdens put on the factory would be. Hence, the determination of 'scientific' thresholds and the setting of related emissions limits, were to a large extent negotiated. This case supports Foucault's writings on the power-knowledge nexus presented in the previous chapter.

3.3 Changing discourses, changing policies and changing numbers

In the roughly 50 years which have passed since the environment became an institutionalised political object, we can observe some major changes within environmental policy and hence also with respect to the role of numbers. These changes, of course, did not happen in a vacuum, but were part of a broader societal change. The tension between economic issues and the environment meant that the course of environmental policy was part of the wider political economy. The environment emerged as a political object at the same time as the post-war Western capitalism was entering into challenging times of reduced economic growth. In addition, soon after environmental policy appeared, the general policy discourses of society started to change towards what we later came to know as neoliberalism. As a result, environmental policy changed from the early focus on laws and regulation to being about economic incentives and market solutions, what has also been labelled 'market environmentalism' (e.g., Bakker 2007), or with respect to nature conservation 'market conservationism' (e.g., Gómez-Baggethun and Ruiz-Pérez 2011). Starting with sulphur trading in US and strongly influenced by the discipline of (neoclassical) environmental economics, this new kind of policy has been increasingly implemented since the 1980s.

However, the move to and support for the use of market mechanisms to deal with environmental problems, cannot be explained solely by the general neoliberalisation of society. In the environmental field, a so-called ‘implementation deficit’ had been identified by the end of the 1980s (e.g., Weale in Dryzek 2005). This refers to the gap between the quite extensive legislation put in place in many countries, and the many problems which were still far from being resolved. There was also a substantive gap between the expectations created as to what legislation *could* achieve, and what was *actually* achieved. Hence, in this period there was a general search for new models or ‘solutions’. The expert-based and bureaucratic paradigm was challenged both by a call for more participation and deliberation, and by its weak performance (the implementation deficit) with respect to certain environmental problems.

In addition to the turn to the market, there was also a turn to more participation and involvement of civil society, in particular in some areas of environmental policy. Both ‘turns’ objected to the extensive authority of experts and the state (central planning). This change came about partly as a response to the implementation deficit, but also as a response to the perceived lack of democracy in the administrative rationalist regime. At the 2nd United

Nations Conference on Environment and Development (UNCED),[20] held in Rio in 1992, public participation was high on the agenda (Vogler 2007). This led some countries (e.g., Sweden) to construct a national sustainable indicator sets through a deliberative and participatory process.

An important discursive change happened with respect to the topic of 'environment vs. economic growth'. A key document illustrating this change is the World Conservation Strategy published in 1980 and initiated by the International Union for Conservation of Nature and Natural Resources (IUCN), UNEP and the World Wildlife Fund (WWF). A shift in argumentation occurred as opposed to what had been expressed at the Stockholm conference. The focus was now on how economic development *relied* on maintenance of the Earth's living resource base, instead of the earlier focus on the *negative impacts* of economic development on the biophysical environment. The term 'sustainable development' was used for the first time: Sustainable development could be achieved through conservation of the environment as a living resource base (IUCN, et al. 1980).

By the mid-1980s it became clear that many wanted to play down the possible contradictions between environment and development. The Brundtland report (World Commission on Environment and Development 1987) placed sustainable development firmly on the international political agenda. This time the argument was slightly changed again. The Brundtland report claimed that not only was economic growth and environmental health compatible, but further that economic growth was *necessary* to solve environmental problems. This view was repeated in the documents adopted at the UNCED in Rio in 1992. Principle 12 of the Rio Declaration reads:

> "States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation." (United Nations 1992)

In the (voluntary) action plan from the conference, called *Agenda 21,* the role of economic growth in developing countries is highlighted:

> "the promotion of economic growth in developing countries is essential to address problems of environmental degradation." (UNSD 1992: Paragraph 38.1)

[20] Also referred to as the 'Earth Summit'.

Problems with earlier environmental policies were explained in various ways. One explanation that came to have effect on environmental statistics production, was that of blaming policy failures in the environmental (and developmental) sphere on fragmented and eclectic policies and strategies (Uno and Bartelmus 1998). In policy terms, a shift towards more integration of environmental issues into economic policies was paralleled by a call for more integrated data, and development of a system for integrated environmental and economic accounts (Uno and Bartelmus 1998). *Agenda 21,* for example, called for an integrated approach, both in terms of (integrated) policy and in terms of the information needed for such policy (i.e., integrated information) (UNSD 1992: Chapter 8).

One of the big projects set up to answer to this call, was the Integrated Environmental and Economic Accounts (IEEA), a set of satellite accounts to the System of National Accounts (SNA). Methodologies for how to make environmentally adjusted national accounts and alternatives to GDP had already been explored for some time prior to the Earth Summit. This work had started from a criticism of GDP for its neglect of scarcity of natural capital and of the social costs of environmental degradation. It took another eleven years before the first full compendium was published as a large cooperative project between the UN, the European Commission (EC), the International Monetary Fund (IMF), the OECD and the World Bank (WB) (United Nations, et al. 2003). The System for Environmental and Economic Accounting (SEEA) handbook included both physical accounts and monetary accounts, organised in a common framework (of goods and sectors) whereby they could be linked (so-called hybrid accounts).

The SEEA also introduced stock accounts (natural capital) in the 2003 manual. Many environmental economists (see for example Asheim 2016; Pearce 1993) later came to support such stock accounts which became the mainstream economics model for sustainability. This 'capital approach' to sustainability was mainly driven by interest in monetary conversion of nature to achieve commensurability and hence substitutability between different kinds of capital. The approach is defined in the following way in the SEEA manual:

> "Sustainable development is development that ensures non-declining *per capita* national wealth by replacing or conserving the sources of that wealth; that is, stocks of produced, human, social and natural capital." (United Nations, et al. 2003: 4)

These accounts would allow detailed and systematic analysis of the interaction between the environment and the economy. The analytical possibilities included for example

evaluation of an economy's dependence on certain resources (or environmental inputs) and assessments as to what extent a country's economic growth (in GDP terms) is dependent of the consumption of its natural resources. Such integrated information was also meant to provide a tool for improved policy design, for example by helping decision makers choose, e.g., quantify trade-offs, help allocate resources, and maximise policy's objective function (Cervigni, et al. 2005). A central assumption with respect to what such information can achieve is expressed by Cervigni in the following way:

> "The better the information available to the decision maker, the higher the quality of the decision process." (Cervigni, et al. 2005: 72)

The claim that better information automatically leads to better decisions will be a central point of discussion in my analysis (see chapter 7).

Ecological modernisation: Science, markets and economic rationality

More generally, the 1980s saw the emergence of the discourse on 'ecological modernisation'. Hajer (1996) introduced the term which has since become the most used label on the neoliberal discourse about environment and sustainability (Everett and Neu 2000), and which is taken to be the dominant environmental discourse today (Dryzek 2013). In short, ecological modernisation is characterised by emphasis on win-win solutions (e.g., via economic efficiency), the need for universal regulation and appeals to science (Everett and Neu 2000).

The discourse admits that economic activity systematically produces environmental harm (Harvey 1996), but holds that economic growth and development can be reconciled with the resolution of ecological problems (Hajer 1996). This can happen with the help of scientific solutions or inventions and through managing global resources in a more rational way. Rational management here links closely to the notion of economic rationalisation, which should be attained through the reform of fiscal structures and through 'economising' the environment—that is, placing economic values on nature (Everett and Neu 2000: 9). A fourth aspect that is often added to the three above is the focus on win-win solutions (Dryzek 2005; Harvey 1996). Placing an economic or exchange value on environmental 'goods' or 'services' is usually done exactly in the hope of identifying win-win solutions (Everett and Neu 2000: 11).

According to Dryzek (2005) and Hajer (1996), the discourse of ecological modernisation has been associated with the OECD, because of the discourse's first noticeable effect around 1984, the year of the OECD's first Conference on Environment and Economics. Both the placing of a monetary value on nature and the reform of fiscal structures required specific data input, and the OECD has been a strong promoter of monetary valuation techniques and cost-benefit analysis of environmental issues (e.g., OECD 2006). The OECD Environment Directorate was established already in 1971 and one of its first tasks was

> 'to develop economic principles and analysis to help governments decide on the best policies to tackle emerging environmental challenges.' (OECD 2011: 12)

Its first book – *Problems of Environmental Economics* – (OECD 1972)

> 'laid out the theory for the efficient allocation of environmental costs and gave birth to the Polluter Pays Principle (the PPP).' (OECD 2011: 11)

The OECD's Environment Directorate has since been an important think-tank for the development of applied environmental economics (i.e., mainstream economic theory and thinking to the environment) in policy analysis.

The OECD has also promoted other policies associated with neoliberalism, such as the spread of market mechanisms, economic efficiency or NPM. In their own words

> 'The OECD has long championed efficient decision-making using economic analysis.' (OECD 2006: 16)

One part of neoliberal governance, strongly related to NPM, has been about increasing the transparency and accountability of the state (and other public bodies). In this context, environmental statistics are seen to be of relevance not only to the policy-makers, but also to the wider public, at the same time fulfilling the purposes of holding politicians accountable while also informing public debate.

In terms of numbers and data needs, efficient environmental decision-making relies strongly on monetary environmental measures, while the setting up of new fiscal institutions, such as carbon trading (or—more precisely—a market for trading with rights to emit greenhouse gases) required creating new measures of equivalence (as well as creating new

markets).[21]

Certain statistics or indicators are designed with transparency and accountability as the main purpose (Hovland 2010). In the environmental field this has led to the development of benchmarking indicators and other measures fulfilling the task of comparison across sectors, with other organisations or countries, or for assessment of (environmental) performance relative to quantitative targets (see table 1, chapter 2).

A final point worth making with respect to the role of numbers after the 1980s, is the inclusion of quantitative reporting obligations and quantitative targets as part of almost all international treaties, conventions or strategies (e.g., the Montreal protocol, the Kyoto protocol, or the Convention for Biological Diversity). In the European Union (EU), statistical reporting from member countries are secured by various EU directives.

3.4 The stated purpose of environmental statistics and indicators

Originally, publicly produced statistics were mainly meant to inform and support government policy, and were fed into the policy-making process. This has changed during the neoliberal era, with its demands for transparency and accountability in the public sector (while the private sector has not been subject to similar measures of transparency). Further, access to statistics about society is considered key for democracies to function. Eurostat puts it this way:

> "Democratic societies do not function properly without a solid basis of reliable and objective statistics." (Eurostat 2017)

Hence, today justifications for statistics are that they must be produced and published both for the public (incl. media) to evaluate the performance of politicians, and to fulfil the administrative purposes of enabling the definition, implementation and analysis/evaluation of public policy.

Sometimes we also find references to a belief that more and better data will produce better decisions and have better outcomes. This was clearly formulated by the slogan

[21] In addition, relying on market mechanisms for dealing with environmental problems requires conceptualisation of nature in terms that can work in the market place, including the creation of categories of goods and services.

prepared for the UN world statistics day 2015: 'Better data. Better lives'.[22] In *Agenda 21*, there is a similar positive connotation about what sustainable development indicators can achieve:

> "such indicators are needed to increase focus/attention on sustainable development and assist decision-makers at all levels to adopt sound national sustainable development policies." (UNSD 1992: Chapter 40)

A reading of the introduction to the main environmental statistics publications of the biggest international organisations, suggests that neoliberal attitudes are widespread. Reoccurring arguments concern *measuring* progress rather than *creating* progress. Key words are measuring performance, reporting, planning, clarifying objectives, setting priorities, supporting policy analysis, evaluating policy, increasing accountability, getting attention, communication and debate.

As noted, the SEEA handbook was produced as a result of a call for more integration of environmental and economic data, and for integration of the environment into existing economic models. The argument for more systematic and effective integration of environmental and economic decision-making is also repeated in the OECD statistical compendium on *Pollution Abatement and Control Expenditure,* which forms part of the SEEA accounts (OECD 2007). However, in its *Environment Data Compendium 2006-2008* the arguments are of a more general neoliberal kind. Here the aim is to

> "strengthen countries' capacity to monitor and assess environmental conditions and trends so as to increase their accountability and to evaluate how well they are satisfying their domestic objectives and international commitments. In this context, environmental indicators are cost-effective and valuable tools." (OECD 2008: 4)

The usefulness of producing environmental information that is more responsive to policy needs and public information requirements is highlighted, including the evaluation of objectives and cost-effectiveness.

However, one challenge which is pointed to, or addressed, in several publication, is the current overload of information, and the problems of getting the messages across to the relevant actors. It is in this context that indicators have gained a new meaning; not only

[22] https://worldstatisticsday.org/ (accessed 28.9.2016)

should they point to something (i.e., indicate), but more importantly, *communication* should be their main function. Already in 1999, the EEA wrote that:

> "It is becoming more and more difficult for policy-makers to grasp the relevance and meaning of the existing environmental indicators, given the number and diversity of indicators presently in use." (European Environment Agency 1999: 4)

The OECD has also pointed out the need for

> "easily understandable information, not only from the environmental community but also from other public authorities, businesses, the general public, environmental NGOs and other stakeholders." (OECD 2008: 4)

To some extent this overload of data has led to the production of even more indicators of an aggregate type, aiming to cover ever more dimensions in one indicator. This then involves processes of commensuration. In its project *Beyond GDP*, the EC recommends that one single overall environmental indicator be produced to broaden the perspective of policy beyond the dominance of GDP. Such a single measure for the environment, it suggests,

> "would help foster a more balanced public debate on societal objectives and progress." (EC, 2009: 4)

Such composite indexes are yet another way to commensurate beyond monetary valuation (or measures) or the use of measures of equivalence (e.g. CO_2-equivalents).

3.5 Environmental numbers and the underlying models of decision-making

Within environmental discourses and environmental policy, three competing themes form the main foci of various policy positions or strategies for institutional change: i) more public sector/government, ii) more market or iii) more civil society or democracy (Vatn 2015). Although the history of environmental policy to some extent has involved a change (in some areas) from expert opinion to more democratic or deliberative processes of decision-making, its main features is a change from administrative rationality as the dominant paradigm, to more use of market mechanisms. Each perspective, in turn, relies on numbers to a different *extent* or in different ways, but also relies on different *kinds* of numbers. As this chapter has

described, mainstream economic theory has played an important role in this shift. To clarify this further, I will here present the theoretical basis underlying the different approaches and show what they depend or rely on with respect to numbers. This also provides a background for assessing the extent to which the rationalities claimed to be relevant are so.[23]

Administrative rationality: regulation and expert knowledge

Dryzek (2005) has labelled the nexus of science, professional administration and bureaucratic structure 'administrative rationalism'. This is a model with clear links to the Weberian model presented and explained in the previous chapter. This paradigm holds that environmental problems must be dealt with through public action, for example in the form of laws and regulations to help limit problems or in form of expert calculations to provide input to rational decision-making.

As outlined in chapter 2, rationalism is closely associated with numbers. The Durkheimian or Comptian belief that if society can be understood in law-like terms, then we can intervene to create the wanted effects (i.e., social engineering), falls in this category. In the economic sphere, Keynesian policies or other macroeconomic interventions fall in the same category. For macroeconomic policies of the (post)Keynesian type, numbers are necessary in a very direct way, as the policies are about adjusting and triggering specific patterns of monetary flows in the economy. Although administrative rationality sometimes makes use of arguments from welfare economics and its techniques, it does not rely on monetary values as the only metric. Other kinds of information or data, for example biophysical measures, can also be used.

The rational planning model, or rational decision-making, is based on the belief or assumption that there exists 'a clearly defined public interest' which can be conceptualised and measured in monistic terms (one-dimensional), for example money (Dryzek 2005). This allows for political issues being treated as merely technical problems (see e.g Hajer 1995; Redclift 1988), i.e., as a system where decision makers and experts claim to know (from calculations) what is best for all, hence sometimes the use of the label 'technocracy'. The Driving force-Pressure-State-Impact-Response (DPSIR) model, provides a good example of such technical or a-political framing. Svarstad et al. (2008) demonstrate how the 'facts' and

[23] That is, it allows elaborating in the Foucauldian sense of discourse analysis of going beyond the rhetoric of rationality to see what actually happens, to discover possible inconsistencies, but also to understand the underlying theoretical basis for various arguments.

understandings of environmental issues provided in applications such as the DPSIR are presented as scientific truths, while discursive interpretations are not revealed. By deconstructing indicators as a tool of neutral knowledge, they demonstrate the limits of quantitative frameworks when interpretations of the problems and solutions differ, and show how it delimits scientific knowledge production.

Underpinning the model of administrative rationality lies the notion of commensuration: the process whereby different qualities are measured with a single standard or unit to derive a common metric through a series of aggregations (Espeland and Stevens 1998). Here lies one of the powers of numbers, namely its capacity to express commensuration in a form that can be further used for calculative purposes. Hence, the centrality of numbers in this approach.

While, money is the typical example of such a metric, and welfare economics probably its main representative in the academic field, the assumption is not unique to neoclassical economics. It is also at the core of Weberian type of bureaucratic rationality. Both economic and bureaucratic rationality is based precisely on the assumption that disparate things can be ordered in terms of value and utility, where value and utility are never absolute, but derived through comparison.

The ideal of rational decision-making in welfare economics is based on the same monistic value system and the belief that experts, i.e., here economists, can calculate what is optimal for a society as a whole. Within this approach, instrumental rational thinking, based on a monistic value system, is promoted as the best way to make public decisions. Such an approach allows a central role for numbers in public choice making, since changes in human well-being can be *measured* as economic values. Welfare economics does not only make (axiomatic) claims about how individuals act (self-regarding), but also about how society should organise itself and make its decisions. Most number production and use is about making trade-offs (in a 'rational' manner), i.e., economic rationality (see chapter 2). The most prominent example of such a decision-making technique is cost-benefit analysis.

In summary, administrative rationality is based on expert knowledge as its key feature. Depending on the kind of knowledge required, different kinds of numbers might be of relevance. In the early period of environmental policy for example, scientists would monitor environmental problems and measure them in (bio)physical terms. Welfare economists on the other hand, would want to express the various elements in monetary terms to be able to carry out cost-benefit analysis. What is common for the role of expert knowledge in this model,

however, is the assumption that there exists a clearly defined public interest. It therefore seems reasonable to believe that the reason mainstream economists have had increasing influence on environmental policy, is due to their specific 'tool' which can calculate optimal solutions within such a one-dimensional framework.

Market rationality

'Market environmentalism' is a term used to denote the kind of environmentalism which has adapted to neoliberal thought in terms of strong private property rights, free markets and free trade, including expansion of market exchange to new products/services, and at the same time reduction of state intervention. This approach has foundations in the (environmental) institutional analysis of Coase (1960) and Hardin (1968), as well as the general economic approach of the Chicago school. The claim of 'market environmentalism' is that the market is the best way to coordinate environmental issues, because it is most efficient in allocating resources. It is on this theoretical basis that, for example, carbon trading has been set up.

Bakker (2007) claims that the advocacy of valuing ecosystems in monetary terms is embedded in the same logic. The argument is that the creation of markets for environmental services represents huge values, and that by making them into commodities we can secure their delivery. From this perspective, payment (or the estimated 'willingness to pay') should decide what resources to protect and which services to produce, instead of political processes for specifying common goals (Vatn 2015). This is a different argument than the welfare argument behind doing cost-benefit analysis. From a market rationality perspective, demonstrating nature's values in economic terms simply demonstrates the possible market value or business opportunities. Such thinking has been adopted and promoted by the OECD Environment Directorate.

Closely linked to market rationality, is the theory of rational choice. Spohn (2002) has pointed out, that modern theory of rationality has become so large and rich that it has grown into a science of its own. However, while both the concept of rationality and more specifically the theory of rational choice are constantly being contested (Spohn 2002), re-evaluated and developed further (Weintraub 2017), the ideal of how to use rational choice models in public decision making seems quite stable. For example, although the simplistic view of rationality as maximising individual utility is increasingly being challenged (see e.g., Weintraub 2017), it is still a core assumption within mainstream economics (including microeconomics, social welfare models and environmental economics), probably because so

much of the modelling depends upon it. This formalisation both permits and promotes the use of numbers to make optimal use of the model's potential. In these theories, the role that the numbers can perform is central.

Mainstream economics, between administrative and market rationality

Administrative rationality has historically relied on laws and regulations, as well as expert knowledge and expert opinion. In the environmental field, there has in recent decades been a strong impact from welfare economics, and the dominant perspective today is that environmental problems are due to externalities and failing markets (Vatn 2015). Although welfare economics is on the one hand linked to the calculation of socially optimal policies from a perspective or administrative rationality (e.g., using cost-benefit analysis), it is at the same time increasingly promoting market rationality. This happens through the focus of correcting market failure through internalising externalities, and then let the market work.

Although legal regulation is still a central policy instrument, economic incentives play an increasingly important role. In practice this means that welfare economics is split in two camps, where the current dominant perspective clearly supports market rationality rather than administrative rationality. However, the original assumption of markets as the most efficient allocator of scarce resources, makes it difficult to draw a clear line for identifying when welfare economics supports government intervention and when markets are appealed to. This has led many observers (see e.g., Harvey 2005; Mirowski 2013) to point out that neoliberalism is not about withdrawal of the state as it was first claimed, but rather about government interventions to facilitate markets and business opportunities.

3.6 Synthesis and outline of a conceptual model

In this chapter I have analysed how the production of environmental numbers has changed since the environment first became a political object in the 1960s and early 1970s. In the beginning, data were collected through direct monitoring of pollution and environmental quality. The administrative rational state was mainly interested in statistics that showed the size or extent of the physical-environmental problem (and how it changed over time). In addition, there was a concern with defining and identifying thresholds, standards and pollution limits in quantitative terms (with an associated strong role for natural scientists). The assumption (going back to Weber) was that with objective information at hand, the

administrative system could solve the environmental problems through rational decisions and the implementation of the right regulations. We can also draw a line to Desrosières' model (chapter 2) where numbers provide evidence, and hence argument, for the need to act, for example if certain pollution levels are exceeded.

In the neoliberal period, starting in the 1980s, arguments for number production were linked to several discourses, including sustainable development, ecological modernisation, environmental economics and NPM. Although deliberation has been recognised and to some extent adopted in some areas of environmental policy, the currently dominant environmental discourse draws mainly on elements from administrative rationalism and market rationalism.

I have identified four kinds of change with respect to environmental numbers in this period. First, integrated environmental and economic accounts were promoted both at the Rio conference in 1992 and by environmental economists who wanted environmental issues integrated into already existing economic models. Second, the call for market mechanisms to deal with environmental problems or to secure the delivery of environmental services, required conceptualising nature in economic terms and establishing new spaces of equivalence. Third, monetary valuation of nature was promoted for the purpose of efficient decision-making. Finally, the environmental field was, just like most areas of governance, subject to the requirements of NPM, i.e., to the production of indicators for transparency and accountability such as performance indicators, benchmarking etc.

What is striking in the neoliberal period, is the increasing influence of microeconomics and how it affected the 'turn' in environmental number production. The shift to the abstract notion of 'economic efficiency' as a key criteria for public policy created a need for both measuring environmental variables using money as the measurement unit and for new measures of nature/environment conceptualised in economic terms. At the same time rational decision-making has changed content from being about simple means-ends thinking, to referring to decisions where 'efficiency' is the central criteria. The change of focus did not wipe out the kind of numbers produced earlier, but mostly came in addition. Both monetary numbers and new measures of equivalence built on the foundational categories of environmental statistics, although they were also converted to fit the need of (mainstream) economic analysis and policy. Finally, the 'neoliberal turn' is present in the introductions to environmental statistics publications from this period: Main environmental data reports now argue for the importance of transparency, assessment, comparison, communication etc., rather than arguing that the data can help in problem solving. The associated explosion in number

production then contributed to the overload of data also characteristic of this period.

The findings from this chapter seem to fit well with the analysis Desrosières did between state rationality, policies and statistics. In table 3.1 I have taken the basic framework from table 2.1 and plotted the findings from this chapter. Each column from table 1 has its corresponding 'environmental' version. An interesting finding from the field of environmental statistics, which we do not find in Desrosières' original scheme, is the role of monetary valuation in helping the transition from the administrative rationality of the Keynesian period, to the market rationality of neoliberalism. While monetary valuation does not have any role in Desrosières' scheme, this seems to be a key factor in analysing the development of numbers in the environmental field.

At the same time, I believe understanding the role of numbers with respect to 'solving' environmental problems and challenges, requires looking into how the capacities of numbers apply in the environmental field (i.e., their function), in combination with what rationality and to what purpose. I have therefore added one column common to both the general political economy statistics and the environmental statistics, which draws on the insights from the capacities of numbers or the modes of numerical representation presented in chapter 2. Beyond highlighting the concrete policy, ways of thinking and statistics in the Keynesian and the neoliberal state respectively, the kind of numerical representations used can indicate some aspects of the change in policy in a more general way.

If we first look back at Desrosières' historical overview of the combination of state rationalities and different kinds of statistics (table 2.1), there is one overarching and striking difference with respect to the change in kind of numerical representation: while abstract representations are typical of neoliberalism, the four other periods presented by Desrosières have all made use of realist statistics with real, or physical, referents. Some claim that national accounts were already a (pragmatic) deviation from the realist focus of statistics (see Desrosières 2000), which is correct if we focus on capital accounts or the adjustments done to fulfil the requirement of balanced accounts. However, with respect to the main input-output tables and the flows of money in the economy, which was the main use of national accounts for Keynesian demand-induced policy, the numbers clearly falls into the category of 'concrete' representation. The real referent of (the input-output tables of the) national accounts is the actual flow of money in society. Hence, although the measurement unit is money, the referent is an actual and concrete happening, unlike using monetary measures as the most convenient monistic unit for measuring utility or value.

Table 3.1 Political-economic periods, environmental policy, environmental statistics and kinds of numbers

Periods of capitalism	**Ways of thinking about society and the economy**	**Modes of action (policy)**	**Types of statistics**	**Ways of thinking about the environment (environmental discourse)**	**Modes of action (purpose/use)**	**Types of environmental statistics**	**Kinds of numerical representation**
Fordism (the keynesian state)	The market cannot function on its own without leading to crisis. Needs regulation	Monitoring the possible gap between supply and demand, intervention via monetary and budgetary policies	National accounts. Conjuncture analysis. Macroeconomic models	Environmental monitoring. Regulation and management by experts (administrative rationality)	Steering and regulation	Physical, material	Concrete ('realist')
(transition)				Integration of economic and environmental concerns	CBA, trade-offs, optimal allocation	SEEP (integrated accounts), monetary valuation	Abstract (commen-surated)
Post-Fordism (the neoliberal state)	Free competition. Financialisation. Decentralisation of decision centres in networks	Transition from regulation to economic incentives, e.g., the market of pollution rights	New measures of equivalence. Indicators to evaluate performance. Benchmarking	Economic growth and environmental protection compatible. Ecological modernisation combining science, 'rational' management of resources and market incentives. Environment subject to market rationality	Create new markets	Measures of equivalence	

We can draw some other lines of comparison as well. In the Keynesian period, statistics were used for intervening (directly) in the economy to limit unwanted effects of the market. Hence, numbers were used for steering purposes.

At the end of the 18th century on the other hand, statistics had a different function as 'evidence' of the misery of the urban, industrial working class. This 'evidence' led to the protection of worker though regulation of the labour market. In this way, numbers had the exact opposite function of what is happening today in the environmental sphere, where instead of more strict regulation to protect nature, regulations are in general removed and instead converted into economic incentives or financial instruments.

As pointed out in chapter 2, Rose and Miller has traced the shift from concrete to increasing use of abstract numerical representations further back than the start of neoliberalism, implying that today's economic-instrumental rationality and its management systems have been gradually spreading to more and more spheres of society for a long time. This means that there has simultaneously, been a transition to increasing use of abstract kinds of numerical representations.

Table 3.1 will provide the conceptual model for studying number production within biodiversity and the TEEB project in the rest of the study.

4 'Biodiversity' – its birth, quantification and monetarisation

4.1 Introduction

This chapter analyses the development in arguments for and production of quantitative information amongst scholars concerned with loss of species and 'biodiversity'. The chapter describes the birth of the concept 'biodiversity' and of the science of protecting biodiversity, i.e., conservation biology. It traces the history of number production from the first assessments of endangered species to the more recent trend of attaching monetary value to biodiversity (and ecosystems), and describes the move from a natural science approach to an increasingly economic approach to conservation. This has paralleled a change from protecting nature for its own sake (its intrinsic value) to thinking of nature as 'natural capital' important for economic growth and instrumental for human well-being.

The chapter provides both an historical and a conceptual background for the empirical analysis of TEEB.

4.2 Early conservation

While modern environmentalism is usually seen to have started in the 1960s and early 70s, organisations promoting the conservation of nature were created already at the end of the 19th century. Examples are the Boone and Crocket Club (US) in 1887, the Society for Preservation of the Wild Fauna of the Empire (UK) in 1903, Natuurmonumenten (NL) in 1905 and the Norwegian Society for the Conservation of Nature in 1914. Although these early conservation organisations worked from different value perspectives, they in general focused on species and landscapes and worked in similar ways, promoting legislation to protect land, acquiring land for conservation purposes (*in situ* conservation) or promoting the protection of species in zoos, botanical gardens and museums of natural history (*ex situ* conservation). The world's first national park - Yellowstone, USA - was established already in 1872 (Righter 1982).

The first international conservation organisation, The International Union for the Protection of Nature (IUPN), later renamed the IUCN, was created in 1948. The explicit aim of the organisation was to raise the policy profile of nature conservation by integrating conservation into the administrative structures of governments. They focused in particular on protecting species and assisting in the preparation of national conservation plans in

developing countries (Jepson and Ladle 2010: 23-24).

The IUCN had started collecting data on and documenting threatened mammals and birds already in the 1950s. In 1964, the first comprehensive list of mammals and birds threatened by extinction was compiled and published.[24] These comprehensive documentations, together with campaigns focusing on specific species, often species from far away, like the cuddly panda or the powerful tiger, are believed to have raised concern with the loss of species, making it one of the central issues on the environmental agenda in the 1960s.

Early policy measures to protect species, were mainly limited to legislation and protected areas. The notion of 'protected areas' however, cover a range of different limitations on the land use. While national parks or nature reserves are usually characterised by prohibition or restriction of activities, protected areas can also be subject to less rigorous restrictions through, for examples, zoning or regulation of certain activities. According to Jeffrey (1997: 161), the first species specific law was drawn up in the Swiss Canton of Zug in 1911 to regulate collection of the Edelweiss (*Leontodon alpinum*). Internationally, a range of influential conventions to protect nature were signed during the 1970s, covering wetlands (RAMSAR), world heritage, endangered species (CITES), migratory species and the sea (UNCLOS) (Jeffries 1997).

4.3 Conservation as a science

In parallel with environmental problems becoming a more prominent policy issue and species extinction receiving increased popular attention, conservation also became a scientific field of research. In the USA, it developed into an academic discipline of its own under the label of 'conservation biology'. The first international conference of conservation was held in 1978, and in 1986, the USA-based Society for Conservation Biology was founded. A year later it launched its own journal, the *Journal of Conservation Biology*. According to Jepson and Ladle (2010: 52), the society has been instrumental in legitimising conservation as an academic discipline and providing 'the hard data' and 'strong concepts' on which modern conservation practice is founded.

Conservation's broad aim is 'to save species, habitats and ecosystems from destruction' (Jepson and Ladle 2010: 34). More specifically, this has meant a concern with

[24] IUCN web-page accessed 29.9.2016.: https://www.iucn.org/content/celebrating-50-years-iucn-red-list.

the conservation of natural resources, avoiding the extinction of species and other forms of biological diversity, the protection of sites and landscapes with cultural and scientific value, and the maintenance and restoration of ecosystems (Jepson 2013). Core priorities of the discipline have been to develop new concepts, to document and measure species, to understand relationships and the causes of species extinction, as well as developing applied conservation management (of protected sites etc). Conceptually, it has drawn on theories from ecology, population biology and natural resource management. However, due to its broad aim, it has also been interested in perspectives from the humanities and the social sciences, especially economics, as will be demonstrated below.

The 'hard data': Inventory of the world's existing and lost species

Early on, in the work of conservation biology, it was seen as paramount to bring together existing information to create an overall picture of the global situation in terms of already documented species, their numbers and geographical spread. While well-studied taxonomic groups (or just *taxa*) such as vertebrates and flowering plants where considered well covered, other groups, in particular insects—the most species rich group—still had wide gaps in the knowledge base. An early, important account was the edited volume *Synopsis and Classification of Living Organisms* published in 1982 (Parker in Wilson 1988), indicating that about 1.4 million living species have been described worldwide. Later the estimate was presented in terms of an interval, to be between 1.4 and 1.7 million (Jeffries 1997: 88-89). One reason for the uncertainty (or interval) in the calculation, is that there is still debate over the number of species versus subspecies. In addition, for less known taxa, nominal species[25] often turn out to be specimens of the same species.

Another task that was given considerable attention was to estimate the actual number of species existing, i.e., an overall number including the species not documented. Since such numbers cannot be calculated using any conventional probability measures, they must be based on expert opinion, i.e., experts providing their best guesses. Such guesses have varied greatly over time, but consistently estimates have been revised upwards every time. An expert opinion from the seventeenth century believed there to be between 10,000 and 20,000 species worldwide, while Hutchinson in 1959 guessed 1 million (Jeffries 1997: 89). A much debated study by Terry Erwin from 1982, suggested the minimum estimate to be 30 million species.

[25] I.e., described species with an attached scientific name.

More recently, such estimates are now given as an interval with minimum and maximum values. Terry Edwin's study has in this respect been interpreted by many as the maximum estimated value. For example, Wilson (1988) suggests that the total number of organisms lies between 5 and 30 million.

There was also a concern with developing ways to quantify threatened species, extinction rates and loss of ecosystems. First, it is worth remembering that in evolution 'the natural fate of all species is extinction' (Jeffries 1997: 29). Such 'natural' extinction due to evolutionary mechanisms is usually labelled 'background extinction', to distinguish it from 'mass extinctions', i.e., sudden, global mass extinctions. Experts have identified five such mass extinctions in geological historical time,[26] with extinctions estimated to range from 70-95 per cent of all existing species at the time. Natural background extinction rate is estimated to about 250 species per 10,000 existing species every 100 years (Common and Stagl 2005).

It is however not so easy to draw a clear line between background and mass extinction, and it might even be an artificial divide of a gradient of varying rates. The effects of mass extinction in terms of affecting many species, having global effects and happening within a, geologically speaking, short time period, are simply increases in rate and scale rather than being qualitatively different from background losses (Jeffries 1997: 30-31). Still, although data are uncertain, there seems to be agreement that the current rates of extinction are much higher than normal, and that we are now in a sixth wave of extinction in Earth's history. According to Mace et al. (2005), current extinction rates are 100-1000 times higher than the background rates which have been typical over Earth's history, and they are projected to increase another 10-fold. The consensus also extends to the causes of the extinction which are, unlike for earlier mass extinctions, being attributed to human activity.

Understanding the causes of biological diversity erosion

To help prevent extinction of species, scientists believed it was necessary to develop knowledge or understanding of processes which had not been given much attention in science earlier. This included addressing questions such as: what do we mean by 'rare' species; how much habitat does a species need; what is a healthy ecosystem; or what happens to a species when there are only a few individuals left? Based on such knowledge, the methodology developed by IUCN, under the name of 'Red list', is still a much used and even officially

[26] I.e., since Cambrium, 500 million years ago.

adopted approach in many countries for classifying the intensity of the threat to individual species.

Causes for extinction were identified at several levels. One focus was on understanding the 'final' causes for extinction when population sizes are already small. This included 'drivers' such as genetic problems, natural disasters, demographic variation and diseases (Jepson and Ladle 2010).

However, identifying human activity as the main cause leading to the current rate of extinction of species, moved conservation biology into looking more generally at the relationships between humans and nature, often framed as human-nature systems in natural science terms. Overall, loss of biological diversity in terms of biophysical explanations were attributed to four so-called direct ('proximate') causes, or 'pressures' (Jepson and Ladle 2010):

- habitat change/fragmentation/loss/destruction (the predominant cause)
- overharvesting of species/renewable resources
- environmental pollution, including greenhouse gases (climate change)
- spreading of species and disease introduction

However, since the main responsibility for species extinction was attributed to humans and human activity, the direct causes of degradation and extinction were further attributed to underlying pressures or indirect causes located in the social realm. One such pressure was (human) population growth. This explanation gained wide support, especially with the publication of ecologist Paul Ehrlich's (1968) book *The Population Bomb*. Also Wilson (1988: 3) talks of 'exploding human populations that are degrading the environment at an accelerating rate, especially in tropical countries'.

As conservation biology started to draw on other disciplines to shed light on the social, cultural, political, or economic dimensions of nature conservation (or nature destruction), the one-dimensional blame on population growth became difficult to sustain. However, the variation between different accounts of indirect causes or pressures is huge, unlike the general agreement concerning the direct causes. Some conservation books just list various indirect causes without any further explanation of how they have been identified (or, in some cases, what the implications are). Jepson and Ladle (2010: 53), for example, present a diagram of 'extinction drivers', where they list population growth, capitalism, poverty and economic development as underlying causes (they call them 'ultimate'). How these four underlying causes are identified is not explained. Neither are they picked up in the further

analysis. If capitalism and economic development, which is core features of our current societies, are amongst the underlying causes, then one would expect that to raise some serious questions from the side of the authors. This is however not the case, as these two causes are hardly address in the rest of the book.

Also Jeffries (1997) lists four underlying causes: resource use (including population growth), cultural attitudes, institutional failure (including lack of knowledge) and economic failure. Economic failure, or 'the failure of existing economic systems to capture the value of biodiversity fully', is, he suggests, ‘perhaps most pressing of all’ (Jeffries 1997: 129). Again, it is not clear how he concludes like this, or what it means.

Nunes et al. (2003: 13-14) present an analysis of causes fully in line with the neoliberal turn of environmental policy discussed in the previous chapter: the social value of the goods and services from biodiversity is not (or insufficiently) reflected in market prices leading to undesirable levels of provision of these good and services (hence no Pareto-optimal situation). They discuss two ‘important fundamental causes’ associated with the conditions within which biological resource use and land use decisions are made, namely i) market failure (or 'unpriced scarcity') and ii) lack of property rights. In this case the implications are directly related to dealing with the causes identified, which theoretically is straight forward, since the causes are identified as specific lacks that can then be corrected with the right policy measures (see also chapter 3 on ‘administrative rationality’).

While one approach to identifying the underlying causes of biodiversity loss, consist in disentangling and listing different types of pressures which could then be targeted by policy, some accounts or approaches are more systemic. The Root Cause Project of the WWF, for example, suggests that in order to halt biodiversity loss, we need to start by understanding and articulating ‘the basic conflict that exists between the promotion of growth and consumption on one side, and activities and incentives promoting sustainable development and conservation of biological diversity on the other’ (Wood, et al. 2000: 2). Other kinds of systemic critique also exist, e.g., Marxist accounts, attributing causal responsibility to the capitalist system or dynamic (e.g., Foster, et al. 2010; O'Connor 1994) rather than to economic activity in general. However, these accounts are rarely considered or cited in the conservation biology literature.

4.4 The motives for conservation: from intrinsic value to economic opportunities and human well-being

As presented in the previous chapter, a change took place in the environmental discourse in the 1980s leaving behind the idea that environmental protection was in conflict with economic growth and development (this discourse came in two versions: sustainable development and ecological modernisation). A similar change took place with respect to the protection of biological diversity, or what came to be called simply 'biodiversity'. The term was coined in 1986 to cover a broad array of perspectives on the issue of biological diversity, as they were presented and discussed at the much referred-to National Forum on BioDiversity (USA).[27] While the term 'biological diversity' had for a long time been used synonymously with the concept of the diversity of species (Brand, et al. 2008: 56), 'biodiversity' represented something new, including the totality of genes, species, and habitats/ecosystem in a defined space (Jepson 2013).

The National Forum on BioDiversity and the report that came out of it (Wilson 1988) were seen as instrumental in raising the policy profile of biodiversity conservation by both quantifying the rate of biodiversity loss and establishing the contribution of biodiversity to society and the economy. The 500 page report includes contributions of some 60 authors from the fields of ecology, economics and other social sciences, of which 20 were making an 'economic argument' for biodiversity and ecosystem conservation. The economic argument challenged the earlier perception of the oppositional relationship between nature and the economy, where economic development was seen as generally destructive for the environment.

Changing the perspective around, focus was instead given to nature as a premise for, or even the foundation of, economic development. In the foreword to *Biodiversity* Wilson (1988: v) pointed to the growing awareness of the close linkage between the conservation of biodiversity and economic development. He claimed that while the two are often seen in opposition, the opposite is true in developing nations where

> "(..) the immense richness of tropical biodiversity is a largely untapped reservoir of new foods, pharmaceuticals, fibres, petroleum substitutes, and other products." (Wilson 1988: vi)

[27] According to Wilson (1996: vi), Walter G. Rosen at the National Research Council/National Academy of Sceinces (USA), is the originator of the term.

This argumentation suggested that, strategically, the potential economic gain from conserving biodiversity is worth demonstrating or estimating, as it might create an (economic) incentive for conservation. It was from this line of argumentation that Wilson further claimed the 1986 Forum represented

> "a new alliance between scientific, governmental, and commercial forces - one that can be expected to reshape the international conservation movement for decades to come." (Wilson 1988: vi)

With these suggestions, conservationists took on the language of sustainable development and ecological modernisation, where development and environment are no longer considered contradictory. The growth critique is all gone and instead replaced by win-win solutions.

Economic utility and the Convention for Biological Diversity

This way of thinking about biodiversity and conservation became prevalent during the end of the 1980s, and also found its way into the Convention for Biological Diversity (CBD), negotiated during the 1992 'Earth Summit' in Rio and signed by 150 government leaders. Together with the Kyoto Agreement, the CBD (1992) represented the international community's recognition of the importance of sustainable development, and its willingness to enter into legal obligations to tackle the challenges that it represents. The CBD came into force in December 1993 when enough (20) countries had signed it. By June 2006, 188 member states had ratified. Within mainstream policy, biodiversity conservation finally became a concern following the ratification of the CBD.

Originally conceived as an 'umbrella' convention, the CBD was aiming to align the many already existing conventions related to biodiversity. Therefore, in the first draft made by IUCN in 1989, economic aspects (including distribution conflicts and their regulation) did not play any great role. However, the interest in genetic resources had significantly increased during the late 1980s, and there was an interest from several actors to include this perspective into the convention. Also the idea of 'reconciliation' of North and South as well as of ecology and economy, characteristic of sustainable development, influenced the CBD to a high degree. In the course of complex and difficult negotiation therefore, the CBD increasingly changed its appearance, and became much more than a conservation convention (Brand, et al. 2008).

In the end, the convention covered three different kinds of purposes:

1) the conservation of biological diversity
2) the sustainable use of the components of biological diversity
3) the fair and equitable sharing of the benefits arising from commercial and other use of genetic resources.

The CBD offered a new direction for conservation strategies, because compared to earlier agreements, a variety of ecological, social and economic aspects were taken into account, 'creating one of the most comprehensive environmental agreement of the past century' (Brand, et al. 2008: 53). One can say that the CBD addresses not only the loss of biological diversity, but also its economic, social and political implications. It is not purely an environmental agreement designed for conservation of endangered species, but deals with issues ranging from protection of ecosystems over rights of local people, the economic value of genetic resources and the handling of technologies related to their commercialisation, intellectual property rights and the fair sharing of benefits arising from the use of biodiversity. According to Brand et al. (2008), environmental concerns became strongly connected to both the regulation of economic and technological processes, questions of justice, as well as international and domestic power relations:

> "Above all, it becomes obvious that the CBD, in general, expresses a tendency towards a view of biodiversity which is primarily concerned with its economic utility and (exchange) value." (Brand, et al. 2008: 53)

The social argument for conservation: the importance of biodiversity for human well-being

The 'economic argument' for biodiversity conservation presented above was strongly focused on nature as 'a largely untapped reservoir' of resources (Wilson 1988: vi) for future economic gain (business opportunities, economic growth). In the CBD this was explicitly expressed in the clause about fair sharing of the income derived from the use of genetic resources, but also in the tendency to focus on the economic utility and exchange value of biodiversity. In this line of argumentation, conservation is linked to possibilities for future economic development, without questioning the system or model of economic development (or growth) itself. The argument made by conservation biologists such as Wilson was that demonstrating the potential economic gain from conserving biodiversity, would create an (economic) incentive for conservation.

Appealing to the economic value or opportunities of biodiversity did not sit easily with everyone. Scientists working in the field of ecology and nature conservation were more motivated by and interested in diversity itself (Monfreda 2010), and generally express an intrinsic value position with respect to nature: that is, nature has a right to exist in its own right (Butler and Acott 2007; Jepson and Ladle 2010; Juniper 2012). Therefore, the new more or less direct appeal to the instrumental value of nature for humans' economic gain was at first seen as problematic.

At the same time, from a functional societal perspective, loss of biodiversity is about much more than economic gain or loss. The loss of biodiversity has to do with overall 'planetary health' (Jeffries 1997), the carrying capacity of the earth's ecosystems (Nunes, et al. 2003), or the 'life support services' of our societies (Common and Stagl 2005: 526). Loss of biodiversity can also be linked to worsening health, higher food insecurity, increasing vulnerability, lower material wealth, worsening social relations, and less freedom for choice and action (Millennium Ecosystem Assessment 2005a: 30). From this point of view there was therefore an increasing frustration amongst conservationists about the lack of understanding in society concerning how biodiversity directly and indirectly affect human society and human well-being, or that biodiversity issues were not prioritised, heard or taken seriously. Therefore, there was a move towards focusing on why biodiversity is important for humans' survival, livelihood or well-being, i.e., an anthropocentric framing of the issue.

4.5 Communicating the importance of biodiversity

While it is possible to simultaneously hold an intrinsic value position with regards to nature, and at the same time be aware of human's dependence upon biodiversity and well-functioning ecosystems, the anthropocentric framing of the importance of biodiversity (or its 'services') took an increasingly instrumental turn. The focus moved from a preoccupation with describing and explaining humans' dependence upon nature, to a pre-occupation with *how to* communicate this knowledge and having an impact. The question was how to communicate the importance of biodiversity so that people understand, and also so that decision-makers would take it into account. These questions led ecologists and natural scientists to search for new strategies, 'solutions' and partners.

In this respect, the institutional history of the International Society for Ecological Economics (ISEE) is quite interesting. Røpke (2004) has described how it started with a small group of Swedish ecologists who had problems making themselves heard by decision

makers. They decided to approach economists, having the impression that economists were especially powerful in this respect. While economists were seen to be generally anti-environmental, the ecologists thought that if it was possible to have economists take on the environmentalist cause much would be won. From this motivation, they arranged (in 1982) a symposium to integrate ecology and economics. Carl Folke (now leader of Stockholm resilience centre), who was part of this initial group, admits that it would have been interesting to cooperate with other social scientists (like anthropologists, sociologists or political scientists) to achieve a deeper understanding of the relationships between society and nature, but claims that it would not have much effect. He believes it was much more effective to go for the economists in the first place (Røpke 2004). In conclusion, the cooperation with economists was not so much based on the contents of their theories or discipline, but rather on the perception that they were a powerful group that decision-makers listen to. By association came the belief that 'economics' is the language that decision-makers listen to, the language one needs to speak to communicate with decision-makers. This position seems to resonate particularly well with natural scientists, who further claim that expressing value in monetary terms is something most people can readily understand, whether they are decision-makers or general public (e.g., Carpenter, et al. 2006: 258; Costanza, et al. 2014: 153).

Others share the concern about communication without having entered into monetary valuation. Ecologist Ten Brink (2006: 4) describes the problem as a communication gap between scientists concerned with reliability and accuracy and politicians interested in the broad picture, 'preferably a value of biodiversity condensed in one figure on a scale from 0 to 10.' He notes that for economists this is not a problem because 'economists and policy makers speak the same language'. Ecologists on the other hand 'appear to be in a different world, governed by different rules.' Further, key words describing the world of policy is 'quick, headlines, simplification and >30% accuracy OK'. The policy gap is widened by the concepts used by ecologists which policy makers (and the public) don't understand. He therefore advocates (composite) indicators as a 'vehicle of communication' (ten Brink 2006: 6).

A similar argument in favour of the language of (aggregate) numbers as a communication tool, has been expressed by ecological economist Herman Daly and co-author Cobb. In defence of the Indicator for Sustainable Economic Welfare (ISEW), presented in an annex to their book *For the Common Good* (1989), they claim that '[i]n the Middle Ages holy

thought had to be expressed in Latin: today it must be expressed in numbers' (Daly and Cobb Jr. 2007: 288). This is despite acknowledging that many of the topics treated in the book can either not be quantified at all or they consist of incommensurable dimensions, and therefore, the index cannot really capture what the book tries to promote.

Some ecologists have linked up with economists and economics as a way to address the indirect causes of biodiversity loss, rather than out of a concern with communication. After all, the underlying causes driving biodiversity loss were to be found in the social realm. Gómez-Baggethun and Ruiz-Pérez (2011) identify what they term 'a crisis' in traditional conservation. In this respect, Folke (2006) criticised the conventional biodiversity conservation for being a discourse characterised by the logic of 'conservation *versus* development'. Instead, in line with Wilson above, he argued for 'conservation *for* development'. Similarly, Armsworth et al (2007) had pointed out that the conservation movement had failed to reverse biodiversity and habitat loss, despite numerous achievements. The point is the same as that of the 'implementation gap' diagnosis presented in chapter 3. Gómez-Baggethun and Ruiz-Pérez conclude that '[a]rguably, this failure cannot be understood without connecting it to the long-established reluctance of much of the environmental movement to mix economics and conservation' (Gómez-Baggethun and Ruiz-Pérez 2011: 614). However, they do not pursue the topic with respect to what 'economics' to mix with conservation. As often in this literature and debates, 'economics' is not defined. Challenging the hegemonic position of mainstream economics could have lead to completely different kinds of analysis and approaches.

Monetary valuation of nature

The focus on communication in combination with economic framing led researcher to look for ways to express the value of nature in monetary terms. A much cited study in this respect, is the paper by Costanza et al. (1997) titled *The value of the world's ecosystem services and natural capital*. This paper estimated the value of the world's ecosystem services to an amount of US$ 33 trillion/year (in 1995 US$), almost twice the value of global GDP at the time. The estimations were based on 17 ecosystem services for the entire biosphere, and the assessment was conducted by a large group of mainly biologists/natural scientists. The main technique used to get to the number was benefit transfer, assuming a constant unit value per hectare of ecosystem type (i.e., an equivalent), and multiplying that value by the area of each type to arrive at an aggregate total.

According to the authors, the paper's underlying argument was a critique of neoclassical economics. Pure neoclassical economics largely neglect the economic contribution of nature to human society by restricting its scope of analysis to those ecosystem goods and services that bear a price. Hence, the systematic undervaluation of the ecological dimension in decision making can be partly explained by the fact that the services provided by natural capital are not adequately quantified in terms comparable with economic services and manufactured capital (Costanza, et al. 1997).

The exercise was subject to severe critique of several kinds, from those who questioned the 'wisdom' of the exercise (see Costanza 1998) to those who questioned the validity of the methods used or the meaning of the numbers produced. In the journal of Ecological Economics a whole special issue was published the following year dedicated to the topic (Ecological Economics 1998).

One critique related to this kind of exercise concerns the over-extension of the basic economic theory, which then questions the validity of the output (Spash and Aslaksen 2015). First, economic value measures only *marginal change* in economic welfare. Second, the whole methodology of benefit transfer is questionable and is an extension far beyond previous methods in environmental economics (Spash and Vatn 2006).

Another criticism relates to the meaning of the numbers produced. For example, Chaisson (2002) has argued that estimating the global value of ecosystem services is a meaningless exercise, since if all ecosystem services were lost, human life would end. Hence, their value must simply be infinite.

Fioramonti (2014) claims that such huge numbers are meaningless to most people anyway. Is twice the value of the annual global GDP really a lot? If anything, the effect might be the opposite of waking people up to the importance of ecosystem services. Given that GDP has already doubled several times the last decades due to productivity growth and technological innovation (at least that is the conventional explanation), economic growth will surely make up for the value lost through loosing nature.

Costanza admitted to several of the critiques, for example the crudeness of the estimates. However, this is not a problem on such an aggregate level, he claims, since '[g]lobal aggregates are useful for raising awareness and emphasizing the importance of ecosystem services relative to other contributors to human well-being' (Costanza, et al. 2014). Costanza et al. also admit that such estimates are not useful for policy:

> "Global estimates expressed in monetary accounting units, such as these, are useful to highlight the magnitude of eco-services, but have no specific decision-making context." (Costanza, et al. 2014: 152)

Despite being aware of the many weaknesses and pitfalls of such exercises, the argument still goes that economic valuations will ultimately convince politicians and business leaders to take conservation of biodiversity seriously (Costanza, et al. 1997). The main purpose of producing such global numbers 'was clearly an awareness raising exercise with no specific policy or decision in mind' (Costanza, et al. 2014: 154). They sum up the exercise in the following way:

> "Their [ESS] value in monetary units is an estimate of their benefits to society expressed in units that communicate with a broad audience. This can help to raise awareness of the importance of ecosystem services to society and serve as a powerful and essential communication tool to inform better, more balanced decisions regarding trade-offs with policies that enhance GDP but damage ecosystem services." (Costanza, et al. 2014: 157)

Economic framing

The concern with communication did not only have consequences in terms of reducing 'importance' to monetary value and aggregate numbers. It also changed the framing of the issue and led to the development and use of new (economic) concepts about nature. For example, it led to a renewed interest in the idea of framing nature as a service provider and ecosystem functions as 'services', an idea which had been launched already in the 1970s with authors such as Odum and Odum (1972), Westman (1977), Ehrlich and Ehrlich (1981) and Ehrlich and Mooney (1983). In the 1990s, the idea was given renewed attention and advanced by conservation biologists (e.g., Daily 1997), environmental economists (e.g., Bateman and Turner 1993), and some scholars from the newly established field of ecological economists (e.g., Costanza and Daly 1992). According to Barnaud and Antona the objective of this concept was also communication:

> "to open the public's eyes to the degradation of ecosystems due to human activities, the significance and diversity of benefits that such ecosystems supply to societies, and how difficult and costly they would be to replace." (Barnaud and Antona 2014: 113)

The hope was that this new framing would increase public interest in biodiversity conservation (Gómez-Baggethun, et al. 2010), as well as help describe our relation to nature and build support for conservation (Daily 1997). Norgaard (2010: 1219) claims that the promotion of the concept was done in an effort to 'communicate the delusion of economic growth and the essence of environmental sustainability'. Hence, both the economic framing and the concept of 'ecosystem services' was promoted in the hope that it would communicate, gain attraction and convince about the importance of biodiversity and well-functioning ecosystem services.

'Ecosystem services' (ESS) is commonly defined as the benefits supplied to human societies by natural ecosystems (Daily 1997). The concept uses a utilitarian framing where ecosystem functions are seen as beneficial for humans. These beneficial functions are then translated into or re-conceptualised as 'services'. This kind of framing then could also be expressed in the powerful mainstream economic language by conceptualising nature as a fixed *stock of capital* that can sustain a (certain and limited) *flow of ecosystem services*. In this language, biodiversity becomes part of the stock of natural capital which in turn provides services to humans. Thinking of nature in such terms makes it very easy to link with mainstream economic growth theory.

The concept of natural capital has , counter to Norgaard's (2010) suggestion about illustration the limit to growth, been key to environmental economics' understanding of sustainable development, defined as a development which upholds the total value of capital - the 'capital approach' to sustainability (United Nations, et al. 2003). Not unrelated to this, Jepson and Ladle (2010: 5) claims that the move from protection of landscapes and species to the maintenance of ecological services has been part of a strategy to bring conservation in line with the international agendas on sustainable development and poverty alleviation.

The change in framing and conceptual model also meant a need to establish new categories of measurement. The earlier inventories for existing, threatened and extinct species, the monitoring of various elements of landscapes and habitats, and the change in direct drivers were not at the centre of attention any longer. Despite the link to economic theory, establishing new categories was not straightforward, since the categories of nature's 'services' did not exist as real entities out there, but rather was an economic construct projected onto nature. Admittedly then, such a 'classification is inherently somewhat arbitrary' (Brauman, et al. 2007: 69).

A seminal publication with respect to operationalising the concept, was the edited

volume *Nature's Services: Societal Dependence on Natural Ecosystems,* by conservation biologist Gretchen Daily (1997). This book introduced concepts and categorisations of ecosystems services and monetary valuation for the use in decision-making, concepts which according to Jepson (2013) have since come to define the field.

The work continued towards developing a comprehensive frameworks for analysis, including methods for identification, classification and valuation of ecosystem services (e.g., de Groot, et al. 2002). Another area of exploration concerned the possibilities of establishing markets for environmental services (see Norgaard 2010: 1219). Much of this work happened within the community of ecological economists and has been published in the associated peer reviewed journal (e.g., Braat and de Groot 2012).

4.6 The economic theory behind, its critique and its 'pragmatic' extensions

Originally, environmental economists advocated cost-benefit analysis as a branch of new welfare economics, based in neoclassical theory (see also section 3.5). The general position within environmental economics is that markets can allocate resources efficiently. However, since markets fail to take social benefits into account, these should be calculated by experts (i.e., neoclassical economists) and internalised (e.g., using taxes) so that price signals can work correctly. With the aim to correct alleged market failures, environmental economists have therefore developed a range of methods to value (i.e., price) environmental benefits.

However, for markets to work efficiently, *all* social and environmental costs and benefits must be taken into account. The central problem is the unpriced objects for which one must then calculate hypothetical market (shadow) prices. When all this is done, optimal resource management decisions can be made by public authorities on the basis of a comprehensive understanding of the financial consequences of all possible actions (Spash 2009; Spash and Aslaksen 2015). In this respect, such an apparatus for calculating shadow prices to allow for optimal resource management has clear associations with Weber's model of bureaucracy, the need for experts and a huge calculative apparatus, as well as with the model of administrative rationality discussed in the previous chapter.

What seems not so well understood by many natural scientists moving into economics, is that the core concern of mainstream economics is not to use economic tools to 'save nature', but rather the efficient allocation of scarce resources (framed in terms of supply and demand theory). This means that a key purpose is to not waste resources by saving too much biodiversity (Swanson 1997), an approach which Spash (2015) tellingly has labelled

'optimal extinction'. Provision of information (i.e., monetary values) is important for an optimal allocation of resource to take place in society. If the information shows that a species is not valued by people, then it is 'correct' if this species should go extinct.

The problem with neoclassical economics from an environmental point of view, is not only the allowance for optimal extinction, but the theory's lack of explanatory power. Neoclassical economic theory is based on a range of axioms or assumptions, which are rarely tested or challenged. Ecological economists have however questioned the assumptions underlying the valuation work in environmental economics (O'Neill 1993; O'Neill and Spash 2000; Soma 2006; Vatn and Bromley 1994), and have concluded that value pluralism is widespread (with respect to environmental issues), and also that values are often incommensurable. Further, Holland (2002) has pointed out the mistaken belief in the mainstream economic approach that all choices are trade-offs between competing human preferences. Another problem is the assumption of 'economic man' or what Holland calls psychological egoism, i.e., 'the claim that people are incapable of regarding as important anything other than their own interests' (1995: 30). Empirical evidence shows rather the opposite: occurrence of rights-based beliefs, lexicographic preferences, and refusals to trade-off (Spash and Aslaksen 2015). Valuation theory in social ecological economics therefore, recognising incommensurability and value pluralism, calls for multiple criteria assessment (Martinez-Alier, et al. 1998) rather than monetary (or other monistic) valuation.

Another issue which has been raised is a worry over the broader social consequences of imposing this specific economic logic whereby harm done to others can be compensated by payment. As pointed out by Vatn et al. (2011: 24), payment systems are vulnerable to various 'motivational perversions'. It has for example been demonstrated how certain types of socially responsible behaviour can be 'crowded out' through monetary pay-off (Frey and OberholzerGee 1997). Hence, choice of value articulating institutions has consequences.

'Pragmatic' number production

An central argument used in favour of monetary valuation of nature and the ESS concept is that of being 'pragmatic'. For example, Gómez-Baggethun and Ruiz-Pérez (2011) argue that many supporters of ESS find themselves in a middle position between support of valuation and market strategies as core solutions and an outright rejection of utilitarian rationales for conservation. This middle position

> "strategic[ally] endorse[s] valuation as a pragmatic and transitory short-term tool to communicate the value of biodiversity using a language that reflects dominant political and economic views." (Gómez-Baggethun and Ruiz-Pérez 2011: 614)

This pragmatic or political realist position is described in the following way by Spash (2008: 262): 'holding the view that this is what is necessary to communicate in the "real" world, often combined with an expressed belief that there are no better alternatives.' Spash identifies these arguments to be used (in particular) by natural scientists (e.g., ecologists). Such echoing of the neoliberal slogan 'there is no alternative' attributed to Margaret Thatcher, is found for example in the 1997 *Nature* article where the authors claim that:

> "Although ecosystem valuation is certainly difficult and fraught with uncertainties, one choice we do not have is whether or not to do it." (Costanza, et al. 1997: 255)

This kind of discourse has been supported by many others, both scientists and environmental campaigners. Former environmental activist, now corporate advisor Tony Juniper,[28] for example, puts it this way:

> "And it seems to me there is not a choice here. I have spent the past 25 years campaigning for nature for its own sake, because it is beautiful, because it should exist for its own reasons and because we have no right to destroy it. I have found that not everyone agrees with that though, and while I am trying to convince them, more forests are cleared, oceans polluted and greenhouse gases released.
>
> We could carry on like this, with ideological purity preserved (on all sides), or we could open a new discourse, one that requires the sceptics to meaningfully engage, and on the field where future environmental battles will be won and lost – the field of economics. After all, it is not most environmentalists who have misunderstood the realities that come with 'growth' on a finite Earth, but most economists." (Juniper 2012)

The pragmatic claim is that the moral argument has gained insufficient traction, but that economic valuation offers a source of hope. This position is also supported by Stuart Butchart at BirdLife International who claims that making the economic case often 'has more

[28] http://www.theguardian.com/environment/2012/aug/10/nature-economic-value-campaign?INTCMP=SRCH.

resonance' for decision-makers.[29]

In terms of monetary valuation, this pragmatic approach has led to an economics which has moved far beyond the admittedly problematic, but at least consistent, environmental economics. In an effort to include all the social benefits in an aggregate total environmental value, economists and ecologists have become ever more inventive at creating new value concepts (e.g., option, bequest and existence values), new valuation methods (e.g., travel cost, hedonic pricing, production function analysis, contingent valuation, choice experiments) and new objects of valuation (e.g., recreation, aesthetics and biodiversity) (Spash and Aslaksen 2015). However, because this has been done with a pragmatist purpose in mind, leaving scientific rigour behind and not addressing the criticisms raised, this raises questions about the validity of the numbers produced.

4.7 The Millennium Ecosystem Assessment

The conceptual work carried out in the 1990s and early 2000s, culminated with the Millennium Ecosystems Assessment (MA) (2005c), the most comprehensive study of the connection between ecosystem services and human well-being carried out so far. It involved more than 1000 scholars from both the natural and the social sciences, including economists. The purpose of the MA (2005c: 26) was 'to provide the knowledge base for improved decisions' and to 'provide information and clarify science concerning issues of greatest relevance to decision-makers'.

According to the MA, the outlook for biodiversity and ecosystems is bleak:

> "The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered, but these involve significant changes in policies, institutions, and practices that are not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services."[30] (Millennium Ecosystem Assessment 2005a: 1)

Hence, even if we make significant changes to policies, institutions and changes (changes which are currently *not* under way), we can only partially reverse the degradation. This is

[29] http://e360.yale.edu/feature/ecosystem_services_whats_wrong_with_putting_a_price_on_nature/2583/

[30] This is one of the 6 findings that the report presents.

because the indirect drivers are just taken for granted, not considered to be something one can do anything about. No attempt or suggestion is made concerning tackling the causes of the problem. Instead one must address the effects:

> ”Ecosystem degradation can rarely be reversed without actions that address the negative effects or enhance the positive effects of one or more of the five indirect drivers of change: population change (including growth and migration), change in economic activity (including economic growth, disparities in wealth, and trade patterns), socio-political factors (including factors ranging from the presence of conflict to public participation in decision- making), cultural factors, and technological change.” (Millennium Ecosystem Assessment 2005b: 19)

Many of the responses suggested are related to neoliberal policy, including increased transparency and accountability of government and private-sector performance in ecosystem management, elimination of perverse subsidies, greater use of economic instruments and market-based approaches, the incorporation of non-market values of ecosystems and their services in management decisions. Despite the bleak outlook cited on the previous page, it is still believed that such policy responses could substantially lessen the severity of these problems in the next several decades (Millennium Ecosystem Assessment 2005b). Although the MA does not present ecosystems services in monetary terms, but instead stays with the notion of ‘value’, the report is heavily influenced by both neoclassical economics and market rationality. Similarly, although not framed within a purely utilitarian framework, the assessment still offers ground for such a reductionist perspective as it focuses strongly on trade-offs between different kinds of use (McCauley 2006).

The MA provided an important milestone in framing ecosystems in a vocabulary of nature as (natural) *capital* providing (ecosystem) *services*, although the ‘reality’ of what these concepts refer to remains unclear. For example, in the MA biodiversity is classified as a ‘service’, while in the CBD ecosystem services is part of and a subcategory of biodiversity. These differing categorisations are not seen as very problematic, probably because they are not meant to refer to an independent object or ‘reality’. Instead, the concepts are often referred to as ‘social constructions’, whereby the importance of a connection to any ‘real’ natural object is undermined. Natural capital, for example, is referred to as a metaphor, rather than as a real existing phenomenon:

> "natural capital is an economic metaphor for the limited stocks of physical and biological resources found on earth." (Millennium Ecosystem Assessment 2005c: 26)

However, this supposed 'metaphor' is increasingly being valued in monetary terms, for example with the purpose of including it into environmentally adjusted national accounts (see chapter 3) and thereby facilitate 'sustainable management' of the economy.

Beyond this framing, a managerial perspective is also prevalent in the report, and likewise the promotion of numerical framing allowing such a managerial approach to dealing with ecosystems:

> "Documenting threshold changes in ecosystems and understanding the structural and dynamic characteristics of systems that lead to threshold and irreversible changes is clearly important in this respect and is currently not well understood. Equally important is the development of both conceptual and quantitative models that can begin to give both scientific and policy communities advance warning of when the capacity of systems is beginning to be eroded or thresholds are likely to be reached, so that action may be taken before significant adverse trade-offs have occurred." (Millennium Ecosystem Assessment 2005c: 837)

The last sentence demonstrates how the need for quantification of thresholds are linked to an idea about optimisation in terms of exploitation of nature, and a belief in the possibility of steering and managing our relationship with nature. As we identify that we are approaching limits or thresholds, we can, in a controlled manner, steer our way out of the current path so that we avoid adverse effects of nature destruction.

Because it turned out that ESS had a substantial traction with governments, many of those who had at first objected to the ESS and economic framing became convinced. Hence, the nature conservationists, ecologists and biologists came to join the system scientists (Monfreda 2010: 280). In this way, when the Millennium Ecosystems Assessment was produced in 2005, all three scientific communities were on board. With the MA, the ESS concept was developed into a full framework for scientifically assessing ecosystem change (Gómez-Baggethun and Ruiz-Pérez 2011). In the MA classification system, services provided by nature fall into one (or several) of the following categories: supporting services, provisioning services, regulating services and cultural services.

Due to its conceptual framework, and despite the lack of monetary valuation, the MA became a stepping stone for economistic framing of the problem of biodiversity and

ecosystem degradation. According to Gómez-Baggethun and Ruiz-Pérez (2011), the concept of ecosystem services was, from now on, firmly established as a central concept and common language in the international environmental policy discourse. Since then, the concept is not only used when taking about the environment in relation to economics. Rather it has become the way to talk about ecosystems in policy terms.

4.8 Summary

In this chapter I have showed how, supposedly for conservation purposes, biodiversity increasingly has been framed in anthropocentric terms, i.e., as having instrumental value and as being an economic asset. Such framing has left behind much of the knowledge from the initial phase of biodiversity conservation. Conservationists now focus on being opportunistic, i.e., using the opportunity of being heard, through framing biodiversity in the language of the dominant policy discourse. ESS turned out to be a more useful concept than biodiversity, because the flow of services that the ESS provide fits neatly into the neoclassical model of stocks and flows. The production of numbers have a central place in this strategy. Monetary numbers are perceived as being so important that scientific rigour must be compromised in the name of policy relevance. This science-policy discussion will be explored further in the TEEB analysis.

5 Methodology

5.1 Introduction

Critical realism aims for depth explanations. Generally a study starts with observation and experience of a (concrete) phenomenon, and with descriptions of the level of the empirical. To do this it combines different methods of empirical investigation to assess reality's manifold aspects. Further, *the nature of the object of study* (e.g., a discourse or practice) and what we want to learn about it, determines what research methods are suitable and also what kind of knowledge it is possible to have of it. Beyond these criteria, critical realist research is in general compatible with a wide range of research methods.

My object of study - *the centrality or dominance of numbers in environmental policy* - encompasses both beliefs and discourse about the role of numbers, and also includes non-discursive practices such as the production of environmental statistics (including many people's related jobs and careers), or the use of numbers in decision processes and in the implementation of environmental policies (for example setting up new institutions such as carbon markets). Studying this phenomenon or practice through the TEEB project, means studying and analysing the TEEB project as a concrete expression of the current attitudes and practices with respect to number production and the environment. I believe the TEEB study represents a key moment in the current type of numbers discourse, concerned in particular with monetary numbers. For this purpose discourse analysis is well suited.

A discursive analysis also allows one to question both phenomena and knowledge that are taken for granted (i.e., normalised). This is particularly relevant given that the practice studied seems to be caused by a false belief in the 'power of numbers' with respect to solving environmental problems. Besides helping to uncover the underlying beliefs and strategies that are part of the conditions for this particular discourse, discourse analysis also allows one to detect the questions which are not asked, i.e., elements that are left out.

This chapter explains some basic features of discourse analysis, both as theory and method. It then presents the specific version of critical discourse analysis which I have chosen for the empirical study. Finally, it presents how I carried out the discourse analysis in practice, including a presentation of the various data sources used.

5.2 Discourse theory

Since I use discourse analysis as the main methods for analysing the empirical data, it is necessary to first clarify some related concepts and theoretical distinctions.

Discourse theory - the basic features

Discourse analysis in not just a technique for analysis, but rather a whole package of both theory and method which are interlinked. Originating in linguistics, discourse analysis has grown to become a broad theory or field of study now being applied across most social science disciplines as well as in the humanities. However, the theories and methods vary, and so do the definitions of the term 'discourse' and the interpretations of the meaning of discourse in terms of its causes and consequences. In general, Foucault's contributions to discourse analysis has strongly influenced discourse theory.

Most commonly, 'discourse' is used as a count noun, which in general terms can be defined as a particular and shared way of looking at, talking about and understanding the world (or an aspect of the world) (Dryzek 2005; Jørgensen and Phillips 2002). A discourse can, at the most basic level, be identified through a specific set of ideas, concepts and categorisations (Hajer 1995). Discourse hence refers to intersubjective meaning worlds - a system of thoughts or knowledge claims, which assume an existence independent of the particular speaker.

Usually we have many competing discourses operating on the same terrain. Dryzek (2005) for example, has identified nine different environmental discourses (amongst them 'sustainable development' and 'ecological modernisation'). Foucault, instead, uses the term 'discursive formation' as a framing concept for the different and potentially conflicting discourses that operate in the same terrain (Foucault 1972: Chapter 2). For him there is only one discourse or 'discursive formation'.

The difference between schools of discourse analysis lies not so much in the definition of what a discourse is *per se*, as in its causes or production, its consequences and its relation to the broader social and material world. The different traditions of discourse analysis are grounded in different social theories with specific ontological and epistemological assumptions, of which some are compatible with critical realism and others are not. Differences in theoretical grounding then lead to different foci, and hence to prescribing different methods of research and analysis. An important divide is between those who perceive the social world as purely a result of ideas (post-structuralists such as Laclau &

Mouffe) and those who perceive it as also being influenced by material and social structures (critical discourse analysts such as Fairclough or Wodak). From a critical realist standpoint, both ideas and structures are considered as real and hence of relevance for causal explanation and understanding the social world.

Some features are common to the different approaches, such as the basic assumption that language matters or the perception of a discourse as (by definition) a socially constructed object or phenomenon. Social constructions are intersubjective understandings of specific circumstances, and as such, exist as structures outside an individual's mind (Benjaminsen and Svarstad 2010). Whether true or not, discoursees are 'real' phenomena in the sense of having powers or mechanisms that can generate certain effects (under certain circumstances).

A discourse is considered not only to be a representation of the world, but also constitutive of the social world and social relations. In this dialectic dynamic lies the very reason that discourses are interesting objects of study. Struggles over discourses serve both to change as well as reproduce social reality. In the Foucauldian tradition, the study of discourse usually includes analysing *how* a specific set of ideas are produced, reproduced, and transformed (Hajer 1995: 44), while critical discourse traditions are more concerned with *why* and to whose advantage.

The Foucauldian legacy

Discourse analysis in the Foucauldian tradition takes a detailed look at how discursive formations form and unfold, and how certain perspectives gain domination. Foucault challenged the basic idea that policy making is a 'rational' process based on incontestable evidence or truth. Instead, he saw evidence or information used in policy making as created within the confines of the discursive formations, so that the 'truth' conforms to the rules and norms of the discourse. Foucault terms these processes 'the will to truth', the effect of which is to mask the discursive formations. For practical research, this means that by deconstructing the (so-called) rationality of policy making, researchers can become aware of the contingent nature of the policy process, the knowledge production and rationalisation of policy options within the discourse, and hence the boundaries and limits of the discourse (Hewitt 2009).

Knowledge claims are central to discourse analysis of all schools. In the Foucauldian tradition however, 'knowledge' is seen as the output of this discursive process. Knowledge has no definition or meaning beyond the discursive understanding: 'Knowledge is created through social interaction in which we construct common truths and compete about what is

true and false' (Jørgensen and Phillips 2002: 5). This is so because there is no objective criteria on which to assess truth in this tradition. As pointed out above, truth conforms to the rules and norms of the discourse.

In the Foucauldian tradition therefore, discourse analysis is about knowledge and power. Discourses define and produce meaning, and contribute to 'steering' the ways in which a topic is being understood and discussed (Hall 1997: 44). The aim of deconstruction is to distil the rules of the discourse (e.g., norms, concepts, categories, arguments), to observe (describe) the power relations of policy making, and to highlight gaps between the rhetoric and practice of policy. The discursive order can be identified through the rules of formation, which in turn can be observed in the social practices of discourse formation or how people behave within the discourse. In this way, the discourse analysis exposes the 'will to truth' or the accustomed ways of governing (Hewitt 2009):

> "Thus all that appears to our eyes is a truth conceived as a richness, a fecundity, a gentle and insidiously universal force, and in contrast we are unaware of the will to truth, that prodigious machinery designed to exclude." (Foucault 1981[1970]: 56)

Hewitt sees as the key strength of discourse analysis inspired by Foucault in fields of public policy research, that it 'open up ways of understanding policy activity which are based neither on rational or political frameworks, but which emphasise *the contingent nature of rationality* and seek to uncover the power relations of policy making' (Hewitt 2009: 14, my emphasis).

The centrality attributed to Foucault in discourse theory, has much to do with his investigation of the qualitative shift in the nature and functioning of power between pre-modern and modern societies (Fairclough Undated). In modern society, discourse and language play an important role in the constitution and reproduction of power relations and social identities. Hence, the production and circulation of discourses are simultaneously mechanisms of social power (Stoddart 2007). Further, power relations mediated by the social practices at play in power struggles within and between discourses, are a fundamental part of Foucauldian discourse analysis. Power is reflected in language, i.e., is 'prior to language' (Hastings in Hewitt 2009: 10), but is not a consequence of it. Power and discourse are therefore intimately linked - although they can be treated as analytically distinct, they are not in reality discrete processes.

Foucault's ideas about the production of discourse raise questions about the practices

of government and how public policy is formed, shaped and reshaped, as opposed to institutional histories (Hewitt 2009). As I showed in chapter 2, these ideas have influenced studies on numeracy as technologies of government (e.g., Rose 1991; Rose and Miller 1992).

Expanding the Foucauldian approach

Foucault's analytical focus was the dynamics of public policy, hence a focus on 'how' rather than 'why'. This leads to asking questions about how the actors engage and interact, rather than what they are doing or seeking to achieve (Dean 1999). Because of this focus, Foucault has been criticised for explicitly leaving out the actors and their motives in his theory and analysis. Hence many discourse analysts are complementing Foucault by taking the actors and their motives back into the analysis.

One such example is Maarten Hajer's (1995) *The Politics of Environmental Discourse.* On the one hand Hajer builds strongly on Foucault's concepts of power relations, discourse and the 'will to truth', while at the same time advocating to focus on data collection and analysis at the sites of conflict, and on the interaction between actors, as well as taking into account actor's interests (Hewitt 2009). According to Hewitt (2009: 12), 'Hajer emphasises the significance of social practices, or the 'settings' which regulate the actions of actors, over and above language'. This has implications method-wise. To grasp this dimension, Hajer relies heavily on interviews (in addition to document analysis) to reconstruct the order of events and the rationalities as play. He then identifies the way problems are represented (the story line), how differences are played out (points of conflict), and how social coalitions on specific meanings emerge (Hajer 1995: 44). A discourse coalition can be said to dominate a given political realm if it fulfils the following two conditions (Hajer 1993):

1. it dominates the discursive space (discourse structuration) that is, central actors are persuaded by, or forced to accept, the rhetorical power of a new discourse;
2. this is reflected in institutional practices (discourse institutionalisation) that is, the actual policy process is conducted according to the ideas of a given discourse.

Another variation of the Foucauldian approach, can be found in the 'argumentative turn' in policy analysis. This turn has implied a move to focusing on the increased importance of argumentation, language and deliberation in policy-making. For this purpose the analysis draws attention to different forms of persuasion, justification, meaning, rhetoric or values (Fischer and Forester 1993).

Further, Foucault's theories can be criticised for conflating discourses and material practices (e.g., Fairclough, et al. 2002), which is the core critical realist critique. At the same time the Foucauldian contributions to critical discourse analysis are substantive. For example, Fairclough makes strong use of certain parts of Foucault's theories, especially his power theory, and Elder-Vass (2012) has elaborated on how Foucault's theories of (structural) power can be combined fruitfully with a critical realist ontology. Overall, critical discourse analysis does not dismiss Foucauldian inspired discourse analysis, but aims at taking the analysis 'one step further' by bringing in the 'critical' element. This means bringing in questions of 'why' and 'what', rather than only the Foucauldian 'how' (Sum and Jessop 2013).

Critical discourse analysis

Originating in linguistics, critical discourse analysis' (CDA) main concern is the role of language in social and cultural change. This is studied through looking at the interactions between text, discursive practise and social practice. In this way, text becomes something more than language, that is, an entry point for studying broader social and cultural processes of change (Fairclough 1992).

Although social change is not the core aspect of my object of study, CDA is still relevant because of its focus on the interrelationship between the discourse and the wider social practice. According to CDA, discourse is shaped by social structures which are then considered to be detectable in language (Hewitt 2009). Hence, a social practice can be studied and understood through the study of its related discourse(s):

> "The governing principle is that discursive practices are in a dialectical relationship with other social practices: discourse is socially embedded. (..) It is for this reason that we start with the social practice when formulating the research questions. To pin down the social practice and formulate the research questions, it is necessary to draw on the discipline, or disciplines, that studies the social practice of interest." (Fairclough 1995: 78)

The distinction between discursive and social practice is specific to CDA. CDA reserves the concept of discourse (or discursive practice) for text, talk and other systems of meaning, and in this way differentiates it from other dimensions of social practice. Whereas discursive practice refers to acts of meaning, social practice encompasses all practices. Discursive practice is hence only one part of the (wider) social practice. Examples of non-

discursive aspects of social practices are the use of national accounts to steer the gap between supply and demand in the national economy, or the buying and selling of rights to emit greenhouse gases. This is not to claim that these practices do not also contain elements of meaning. However, they clearly involve elements which are non-discursive or material.

CDA then is about investigating the dialectical relations between discursive and non-discursive practices. Discourse is seen an important form of social practice which both reproduces and changes knowledge, identities and social relations including power relations, and at the same time is also shaped by both other social practices and structures. Thus discourse is in a dialectical relationship with other social dimensions. In this way CDA distances itself from structuralism and comes closer to a more poststructuralist position in claiming that discursive practice not only reproduces an already existing discursive structure but also challenges the structure by using words to denote what may lie outside the structure (Fairclough 1992).

'Practice' is however used in a rather generic sense to refer to any act or event related to agency. [31] As described in section 1.5, critical realism perceives the social world as pre-structured, where agents always acts in a world of structural constraints and possibilities. Practice or agency is therefore studied as being in a dialectical relationship with its structural context.

'Social practice' is a concept which links structure and agency. A social practice can be defined as an ongoing (discursive or non-discursive) way of doing things which incorporates positions occupied by 'actors'. It is irreducible to the activities of the people who engage in it, and is 'so to speak, the structure at work in practice' (Hartwig 2007). This places social practice between intentional human agency and unconscious reproduction or transformation of social structures (often related to the agent's social function or position). CDA therefore takes into account that social practices are shaped by social structures and power relations, and that people are often not aware of these processes. This needs to be studied using a 'macro-sociological' perspective and going beyond interpretative analysis. Fairclough understands social structure as social relations both in society as a whole and in

[31] Sometimes reference is also made to more specific theories of practice. In Chouliaraki and Fairclough (1999), for example, it is suggested that Bourdieu can provide critical discourse analysis with a theory that can anchor the order of discourse in an order of social practice, i.e., a combination of discursive and non-discursive moments. For an overview of more specific theories of practice in sociology, see for example (Welch and Warde 2015).

specific institutions, and as consisting of both discursive and non-discursive elements (Fairclough 1992).

CDA takes into account that discursive practices are influenced by societal forces that do not have a solely discursive character. Examples of the latter are the structure of the political system and the institutional structure of the media. Hence, an important difference between critical discourse analysis and poststructuralist discourse theory is that, in CDA discourse is not only seen as constitutive but also as constituted Hence practices, relationships and identities which were originally discursively constituted, can become sedimented in institutions and non-discursive practices (Jørgensen and Phillips 2002).

In research procedural terms, this means a preoccupation with investigating the—often opaque—relationships between on the one hand (i) discursive practices, events and texts, and on the other hand (ii) the broader social and cultural structures, relations and processes.

According to Jørgensen and Phillips:

> "(c)ritical discourse analysis is 'critical' in the sense that it aims to reveal the role of discursive practice in the maintenance of the social world, including those social relations that involve unequal relations of power. Its aim is to contribute to social change along the lines of more equal power relations in communication processes and society in general." (Jørgensen and Phillips 2002: 63-64)

The idea is retained – at least, in Fairclough's critical discourse analysis – that one can distinguish between discourses that are ideological and discourses that are not, thus retaining the hope of finding a way out of ideology (Jørgensen and Phillips 2002). There is therefore a need to focus on

> "*both* the discursive practices which construct representations of the world, social subjects and social relations, including power relations, *and* the role that these discursive practices play in furthering the interests of particular social groups." (Jørgensen and Phillips 2002: 63, italics in original)

While ideology is used by some in a neutral way, more like 'worldview', Fairclough defines ideology as 'meaning in the service of power' (Fairclough 1995: 14). Hence, *contra* Foucault (and post-structuralist/post-modernist theory)—who claims that ideology critique

presupposes that the critic has privileged access to truth, whereas any such claim to truth or knowledge is really just a coded 'will to power' (Foucault 1976)—a critical view of ideology sees ideology as a means through which social relations of power are reproduced (Fairclough 1995). This disagreement, however, partly comes from different perceptions of the concept of power. In Foucault's understanding, power is a pervasive property of the technologies which structure modern institutions, not possessed by or attached to any particular social class, stratum or group. A critical perspective, on the other hand, focuses on asymmetric relations of power and domination. In claiming that discursive events work ideologically one claims that they contribute to the reproduction of relations of power.

Discursive change takes place when discursive elements are articulated in new ways (Jørgensen and Phillips 2002). To analyse how discursive practice is part of a larger social practice involving power relations, Fairclough makes use of Gramsci's concept of 'hegemony'. From this perspective discursive practice can be seen as an aspect of a hegemonic struggle that contributes to the reproduction and transformation of the order of discourse of which it is part (and consequently of the existing power relations) (Fairclough 1995).

The concept of hegemony forms the centrepiece in Gramsci's analysis of Western capitalism. Gramsci foregrounds the winning of consent in the exercise of power. For this analysis, Gramsci's focus on the shifting alliances and allegiances of intellectuals in the struggles of classes and other primary groups is interesting, although my entry point is different from that concerning classes. I will consider the role of the scientists in this light.

Power can be used to create or maintain a ruling discourse. If the ruling discourse is not challenged by alternatives, we say that the discourse has hegemonic power. Those who control most dimensions of a discourse have the most power. Power dimensions here means factors like setting a meeting agenda, participants, topics, style, rhetoric, interaction and societal structures (Fairclough and Wodak 2007: 28).

In CDA, explanatory critique is linked to questions of ideology, power and hegemony. Explanatory critique starts from a problem that can be identified by the researcher who may want to disclose a 'misrepresentation', that is, a mismatch between reality and the view people have of this reality that functions ideologically. Social constructivists generally object to this, perceiving it simply as a 'will to power':

> "The concept of 'misrepresentation' implies that the researcher has access to a more adequate description of reality than the people he or she is studying – without such access, the

> researcher would not be able to identify descriptions as misrepresentations." (Jørgensen and Phillips 2002: 77)

Fairclough (1995) answers this kind of critique by pointing out that in claiming that discursive events works ideologically, one is claiming that it contributes to the reproduction of relations of power. One is not claiming a privileged position from which judgements of truth or falsity can be made. This is not to undermine that there are structures and mechanisms in society for privileging the judgements of particular social groups. An important emancipatory political objective is to minimise such effects and *maximise the conditions for judgements of truth to be compared and evaluated on their merits*.

In addition, he claims that critical (discourse) analysis cannot remain indifferent to questions of truth in the form of omissions or falsifications for persuasive purposes or of falsifying ideological representations (Fairclough 1995).

A problem with Foucault is the lack of possibility to judge knowledge claims by their plausibility or their capacity to explain observed phenomena. In this school of thought, any view point or position is just perceived as a 'will to power'.[32] Hence, a Foucauldian perspective would not allow me to engage in the subject matter of the discourse, i.e., its truthfulness.

However, discourse analysis per se cannot judge the truth or well-groundedness of a proposition. For that it needs to draw on other disciplines which studies the social practice in question. Hence, CDA is interdisciplinary. This allows me to integrate an analysis of discursive elements with theories from other domains such as political economy, social ecological economics, sociology (of statistics and economics), philosophy of science and environmental science.

Critical discourse analysis is usually done to unveil the role of discursive practice in the maintenance of the social world, in ideology, in furthering the interests of certain social groups, or in the reproduction of relations of power (over others and over nature). This is done with the purpose of protecting weak social groups and for emancipatory purposes. However, it can also be used with respect to 'nature's emancipation' or to be environmentally critical, not just socially critical. Sometimes dominant power will dominate both weaker

[32] The problem with these kinds of arguments is that they backfire because they don't allow one to hold any general claims about anything, and would undermine all Foucault's analysis of 'discipline', 'governmentality', and so on.

social groups and the environment, but at other times it might seem that the general dominance of society over nature is key.

5.3 Knowledge creation: modes of inference

It is a widely held position that discourse analysis necessitates the researcher gaining a view of the problem both from the 'inside' and from the 'outside'. The intention, from this point of view, is to describe and understand the social world as perceived and experienced by its members from the 'inside', because - according to social constructivists - it is this which *is* the social world (Blaikie 2007). In this perspective, the view from the 'outside' is needed in order to recognise the hidden assumptions and practices that form the rules of discourse formation, while the view from the 'inside', including appreciation of the embedded norms of social practices, is needed in order to interpret the research material (Jørgensen and Phillips 2002). Fairclough's approach is different in that it starts from linguistic analysis rather than from hermeneutics, while at the same time considering the social world to consist of more than just ideas. In my case, I combine the two, because I am also interested in the view from the inside, although mostly in terms what happened behind the scene, and how the actors think about that. However, I am mostly following the CDA approach otherwise.

According to Blaikie (2007), abduction is the appropriate method of theory construction in interpretative social science. It includes what other modes of inference ignore, namely meanings, interpretations, motives and intentions, and constructs theories derived from social actors' own language, meanings and accounts. Another central feature of abduction is its iterative research process, meaning a circular process between exploration and structuring. Yin (1994) argues that abduction increases the construct validity as the dialogical relationship between data and theory helps check the relation between the research questions and what is actually investigated.

However, abduction as it was described by its originator Charles S. Peirce goes beyond interpretation, involving both redescription and recontextualisation as central elements (in Danermark, et al. 2002). Critical realism follows Peirce in the aim of showing *how* a specific phenomenon (e.g., a specific discourse) is part of a larger structure of internal relations.

Through retroduction, we then go one step further and try to identify *what* the basic characteristics are of the general structures from which we start in abduction when interpreting specific events. One aims at addressing 'why', hence to *explain the event*.

Danermark et al. (2002) recommend both abduction and retroduction as appropriate logics of inference for critical realist studies.

To investigate the relationship between discursive practices and the broader social context, CDA also makes use of such a retroductive approach, i.e., asking transfactual questions as to how 'something is possible' or 'can be the case', or more specifically concerning discourse: *What are the conditions that the discourse is shaped this specific way?*[33] Typically, power, structure and actors' interests form part of such conditions. Using retroduction as the mode of inference, one then hypothesises about possible 'conditions', which can be corroborated or dismissed through empirical analysis of concrete events. Hence, we see that to answer the question about *how* practices lead to social change or reproduction, we pose 'what' questions about the necessary conditions for this to happen. Exploring possible conditions, we usually need to investigate *why* someone or some groups have special interests in the particular event happening or in promoting false beliefs.

5.4 Discourse analysis - method

I understand discourses as placed in the realm of the 'actual', as an 'event' which in some cases may, and in other cases may not, be visible in the form of observable experiences. The unit of analysis are the narratives, beliefs, values and strategies, which are visible and accessible at the observable level of reality through spoken and written texts (for example policy documents, scientific papers or interviews) (Vadrot 2013).

Similarly, social practice is placed in the realm of the actual, while the generative mechanisms - social structure, institutions etc. are placed in the realm of the real. Because of the close relationship assumed between discourse and social practices (Fairclough 1995), one of the many ways to access practice at the observable level is through language. However, discourse analysis can only give insights into the discursive aspects of the practice and therefore has to be supplemented or combined with non-discursive or non-interpretative methods of inquiry. Non-discursive methods of inquiry typically involve structural analysis, i.e., using abduction and retroduction to explore—through thought experiments and counterfactual thinking—invisible factors which might have contributed to generate observable phenomena. Marx's study of the capitalist economic system is perhaps the most famous example of such a non-discursive inquiry.

[33] Thanks to Armin Puller for formulating this transfactual question for me.

Fairclough's three dimensional model

In practical terms, I am following the Faircloughian CDA approach (Fairclough 1992). This involves three separate, but interrelated, steps:

1. Linguistic text analysis;
2. Analysis of the discursive practice; and
3. Analysis of the social practice.

Because the main interest is in the broader social event or practice, the focus of the approach is on the two last steps.

In the text (or linguistic) analysis one studies the properties of the text which construct the discourse. The focus of linguistic (and other semiotic) analysis can be on either argumentation, narrative, modality, transitivity, nominalisation, rhetoric, vocabulary, voice, or other. For example, it can be in the choice of words or metaphors which construct a particular view of reality. Fairclough himself often uses modality, where one type of modality is truth (Jørgensen and Phillips 2002). It is the object (and objective) of research which decides the particular focus (Fairclough 1995).

Discursive practice concerns the processes relating to the production and the 'consumption' of texts. More precisely, one studies how knowledge is produced and understood relative to the text. The analysis focuses on how already existing discourses (and genres) that are built upon in the creation of the text and on how they are used in the interpretation of the texts: 'First, the relationship between the discursive practice and its order of discourse is to be explored. To what kind of network of discourses does the discursive practice belong? How are the discourses distributed and regulated across texts?' (Jørgensen and Phillips 1999:80).

Finally one studies the wider social practice to which the communicative event (or text) belongs or which it is part of. The aim here is to map the partly non-discursive, social relations and structures that constitute the wider context of the discursive practice—*the social matrix of discourse*, in Fairclough's terms (1992: 237). Fairclough distinguishes between non-discursive and discursive *moments* of a social practice and proposes that these moments adhere to different kinds of logics or mechanisms. For this purpose, Fairclough draws on David Harvey's concept of 'internalisation' (Harvey 1996). For example, 'the economy' and 'discourse' are two different kinds of mechanisms. According to Jørgensen and Phillips (2002: 71), 'the mechanisms represent moments of every social practice, which are in a

dialectical relationship with each other, but each mechanism has its own logic, and must be analysed in its own terms using appropriate analytical tools'. This means that for studying the economy, non-discursive methods of inquiry are (also) needed to help describe and analyse material elements or constellations like the flow of money, the growth dynamic or the capital-wage relationship.

Discourse analysis is however not sufficient for such an analysis of the wider social practice, since such practice encompasses both discursive and non-discursive elements. The text therefore needs to be studied in the context of the broader social practise, and needs to be complemented with the relevant social theory.

Jessop's strategic-relational approach

For the interpretation of the discourse with respect to it (structural) context, I make use of Jessop's analytical framework labelled 'the structural-relational approach' (SRA) which provides a way to structure the empirical findings and make sense of them (Jessop 2005). The approach is different from the more well-known structuration theory of Anthony Giddens, where structure and action are treated in isolation. SRA, on the other hand, does not treat structure in isolation from action since that would imply that a given structure is equally constraining and/or enabling for all actors and all actions. Giddens also exclude different forms of social agency, such as collective or corporate agency, from his account. The SRA instead allows for the recognition and explanation of the differential capacities of actors and their actions to change different structures. This is done by examining structure in relation to action, and action in relation to structure. Structures are thereby treated analytically as 'strategic' in their form, content and operation. This involves examining how a given structure favour or privilege some strategies (or actors, identities, spatial and temporal horizons, or actions) over others. Actions are treated analytically as 'structured', more or less context-sensitive, and structuring' (Sum and Jessop 2013).

How to do it?

Dryzek (2005) is probably the one who has gone most into detail in describing environmental discourses (including their history, conflict and transformation), while others focus on the discursive practice and related processes (their effect or how they were constructed). Because Fairclough's focus is mainly on intertextuality and context, he gives little advise on the

linguistic step (apart from a list of options to chose from). Since one of my concerns was with the content of the discourse, I needed to understand better how to collect data on 'worldviews', motives and beliefs. There is little to get from Fairclough in this sense, expect in terms of intertextuality. What I also needed was guidelines for what kind of 'things' to look for in the text. But there is no one way of doing this, or a list of issues to look at in particular.

Dryzek focuses on four different elements in descriptions of discourses: their basic entities, assumptions about relationships, important actors and their motives, and, finally, key metaphors and rhetorical devices. I found this description of elements helpful to get started on the practical task of reading and interpretation, even though it partly ignores the distinctions between the two first steps in Fairclough's described approach. This is not really a problem, as Fairclough often treats the two together. Despite coming from another tradition, Hajer's concept of identifying a 'story line' also seemed to me useful. In the end, I compiled my own list of elements to look for in the text analysis (Box 5.1). They are based on various readings from different traditions, but it did not seem to me theoretically inconsistent to merge them together.

Dryzek (2005) points out how a discourse rests on specific assumptions, judgements and contentions that provide the basic terms for analysis, debates, agreements, and disagreements. He claims that '[i]f such shared terms did not exist, it would be hard to imagine problem-solving in the field of the environment at all, as we would have continually to return to first principles' (Dryzek 2005: 9). At the same time, it is precisely because they are usually not explicit, but rather taken for granted or naturalised (Jørgensen and Phillips 2002), that they are important to identify and expose as part of the discourse analysis.

Discourse analysis implies deconstructing texts to expose patterns and hidden rules of how language is used and narratives are created (Hewitt 2009: 2). Richardson has noticed how 'discourse theory puts the spotlight on the boundaries of thought and action' (Richardson in Hewitt 2009: 13). This implies a need to identify how these boundaries are established and maintained, as well as the effects of this closing down process.

Box 5.1 - Elements for describing a discourse

Representation of the problem (concepts, categories, ideas)
- basic entities recognised or constructed
- assumptions about natural relationships
- which elements can change/fixed (reification)
- truth claims, assumptions

Agents and their motives
Framing
- what is in
- what is out

Problem (foundation of)/Solution (what can be done)
Means/Ends
Interdiscursivity
    Political-normative arguments
    Scientific arguments-analytic
Sites of conflict - how differences are played out
Metaphors
Rhetorical devices
Story line

Other practical guidelines also exist, for example Hajer's (2006) ten step approach. This approach involves making use of data sources such as existing literature, interviews with experts and key players, as well as relevant documents (policy documents, speeches, media coverage etc.). The stepwise approach implies an iterative process, in line with an abductive-interpretive approach, in order to build up the narrative (Hewitt 2009). The approach starts from initial desk research and so-called 'helicopter interviews' with a few experts to get an initial overview of the field. From there onwards the process moves between document analysis, interviews and interpretation in an iterative way.

In terms of tools, computer assisted analysis is becoming widely used in qualitative studies. However, while computer software can be useful for storage and retrieval of the data, Wood and Kroger (2000: 142) warns that there is no substitute for the painstaking process of doing discourse analysis 'by hand'. The reason for this is that such programs cannot do interpretation in the sense that discourse analysis requires. As Huberman and Miles point out (in Wood and Kroger 2000), all such programs have built-in assumptions about theory. Mostly they involve hierarchical relationships (and assumptions about these) that are not compatible with discourse analysis. Further, they are based on an ontology which tends to reduce reality to the empirically observable. This is problematic from a critical realist

perspective because ‘theories about fundamental structures are pushed into the background by superficial empirical categorizations and the testing of empirical hypotheses’ (Danermark, et al. 2002: 11).

5.5 Choice of TEEB

Critical realist studies, typically start in the concrete with empirical research. I chose to study the phenomenon of promoting numbers through the lens of a specific discourse - that of the current ‘economic turn’ in the biodiversity discourse. Elements of this discourse have already been presented in chapter 4. However, to fully grasp this discourse and be able to analyse it, I needed to delimit the task further.

I chose TEEB as a an empirical case for several reasons. First and foremost, because I believe the TEEB project can be seen to epitomise this discourse, in some ways the public discourse of the economisation of nature has reached a climax with TEEB. As presented briefly in the introduction, the TEEB approach is based on a strong belief in or rhetoric about the performativity of numbers. More specifically, it integrates physical and monetary numbers and uses a strong managerial rhetoric. In this way TEEB links directly to the broader object of study. Second, it is a case which easily provides links to the current economic accumulation regime of financialisation. This might be relevant in identifying aspects of non-discursive mechanisms which are not already covered in existing theory about the role of numbers in society. The project also took an interesting turn from initially being inspired by the ‘one big number’-message of the Stern review, to instead recommending the ‘TEEB approach’. Finally, TEEB being a relatively recent project has been subject to little systematic scrutiny in general.

To cover the original research question however, the TEEB project was too limiting. I therefore needed to embed the TEEB discourse in the wider environmental and economic discourses, and I also needed to understand the background for TEEB, especially the development of the argumentation in nature conservation since the modern environmental movement was born in the 1960s. I therefore ended up combining primary data collection (interviews) and text analysis from TEEB with secondary literature. In this respect, chapter 3 and 4 provide both (part of) the context that TEEB grew out of, but I sometimes also use it in the discourse analysis itself.

5.6 Data sources

TEEB documents

As the main data source for analysing the discourse, I chose the five 'study reports' coming out of the TEEB project. However, the synthesis report has been given the highest attention due to it being a much more negotiated document, full of rhetoric, legitimising, justification etc. It is in this report that the closing down processes happen, where the TEEB story line is being created, and where the 'rules of the game' becomes clear. In addition, I have made loose use of other written texts at various times, including other TEEB reports, media articles, TEEB speeches, press releases, political documents and NGO statements. In addition there was a (modest) amount of academic literature to draw on.

Interviews

Interviews with experts and key people in the TEEB study have been an important source of information. These interviews were carried out with several purposes in mind. Initially I carried out three expert interviews of the type Hajer has called 'helicopter interviews'. They were done with two researchers and one policy maker (i.e., bureaucrat) working on biodiversity conservation (none of which were directly involved in the TEEB study). All three interviewees where critical of the TEEB study, but to varying degrees and for different reasons. It made sense to talk with people who were critical of the study as this helped broaden the horizon and ask wider questions. The arguments in favour of the study can already be found in the documents. Later in the process I interviewed two experts who were more in favour of TEEB and indicators, although not in a wholly uncritical way. This helped nuance the picture and the arguments made in favour versus against various aspects of TEEB.

After the initial phase, I carried out five interviews with TEEB participants. These interviewees were chosen from across various levels of the TEEB organisation, including advisory board, coordination group, project management group and authors contributing to the reports. Some interviewees filled several of these roles in one person.

These interviews had a different purpose from the expert interviews. On the one hand, interviews with persons who had been involved in TEEB could provide a better understanding of the organisation of TEEB, various choices which were made along the way (but not made explicit in the written material) and their own perception of the study's recommendations. Examples of such issues were the choice of study leader, or the

controversy around not producing one overall number as the main output of the study.

However, through interviews I could also investigate unclear aspects of the discourse as it appeared during reading and interpretation of the text, as well as identifying motivations and sites of conflict, which are hard to grasp through textual analysis. While the dominant perspective can be identified in the formal presentations from TEEB, interviews could provide insights into what had been going on behind the scene, how conflicts played out (if they did) and which voices were silenced (if they were). This provided important information for synthesising the 'rules of the game'. I was therefore mostly interested in talking with people whom I perceived did not (fully) support the dominant points of views of the study. Hence, although part of the TEEB study, the interviewees were not chosen to represent TEEB, but where chosen only to represent themselves.

The choice of informants was done through my already existing networks. From my former job in Statistics Norway and the OECD, I had a wide network of people working on statistics and indicators related to environmental issues. The interviewee in the Austrian Ministry of Life, was chosen from amongst this group of people. The two other researchers were part of my own professional research network. Another expert (researcher) was recommended to me by one of the members of my doctoral committee. Later in the process I interviewed two more experts: a policy maker from the European Commission, who again was already familiar to me through my (former) professional network, and another researcher whom I came to know about through one of the first expert interviews.

Similarly, four out of the five TEEB participants that I interviewed were people I knew about through my research community within ecological economics. I assumed people within ecological economics would in general be more on the cautionary side of the line of argumentation in TEEB, while at the same time having a 'pragmatic' attitude since they actually got involved in the study in the first place. A fifth person was interviewed later, as I saw a need to speak also with a natural scientist (all my first four TEEB informants had been ecological economists[34]).

At the outset I had set up a list of 30 potential candidates for interviewing, 20 of whom were involved in the TEEB process and report writing. In drafting the list I had aimed for spread in (type of) organisation and academic background, as well as in their assumed position vis-a-vis TEEB and monetary valuation of nature. Since, in qualitative analysis

[34] Although ecological economists are not like other economists. One said he didn't describe himself as an economist, and another has a back ground in natural science.

statistical representation is not an issue, the sampling strategy could be shaped by the evolving study. The initial list was therefore not meant to be conclusive, but could be altered or enlarged according to the evolving study.

At the beginning of the study, my understanding of discourse analysis was still relatively immature, and I had planned the study following Hajer's suggestions. As the study developed, my understanding of my object of study and how I could study it through a critical discursive approach improved. At the same time, I came to realise that Hajer's approach would lead me into studying the *process* and dynamics of the discursive formation rather than focusing on its content and potential effects. Therefore, as I came to understand critical discourse theory better, texts and documents became the central unit of analysis, and interviews only secondary. Downplaying the role of interviews as a data source, was also a consequence of realising that 1300 pages of TEEB study documents was in itself a lot of data to handle.

Some of the information provided in the interviews is delicate given the situation of participants disclosing their own views or details about the process of TEEB which is otherwise not public. Hence, at several times in the interviews did people ask me not to cite them on certain things. One informant explicitly wanted the whole interview to be anonymous. Given this situation, and that it could at times be easy to recognise who the informants are, I have chosen to keep all informants anonymous throughout. When citing the interviews therefore, I am not disclosing who they are, but rather just referencing with the general notion 'Interview'.

5.7 Analysing the discourse

In analysing the data material I followed Fairclough's three dimensional model which involves first highlighting the text, then the discursive practice, and finally the social practice through a discursive perspective, and combined it in particular with Dryzek's descriptive scheme. However, I have not simply read through the documents once according to this methodological scheme. I tried several entry points for my empirical material.

As noted, I started by making use of Hajer's ten step approach, but realised that it didn't point me towards the focus of my research. His focus is much on the process and formation of the discourse, and how power is played out. It was only quite a bit into my own research process that I realised clearly the distinction between his focus and a CDA approach in particular because of CDA's concern with the truthfulness of the discourse as well.

One of the traps that I entered several times while reading the documents was forgetting that I was not studying TEEB as a case study, but as a source to understand the number-discourse about biodiversity more generally. Hence, I did not need to understand everything about TEEB.

Reading the TEEB documents was a challenging task, especially since I had already extensive knowledge of the field covered and the existing controversies. I struggled to keep the distance necessary to be able to describe first without entering straight into the critique. It was easy to get lost in details, argumentative ones as well as rhetorical ones. 1300 pages of text was clearly impossible to read with full attention to all details. After screening and flipping through all reports to give a general overview of what was covered, I decided to completely leave out some of the reports from the analysis, while in other reports I concentrated only on certain particularly relevant chapters. I read the foundations report, but mostly it covers 'old' ground of the environmental (and some ecological) economics already presented in chapter 4. Hence, the main focus is on the synthesis report and the 'translation' done in terms of converting the scientific language in the foundations report into something more lay or at least easily understandable for policy-makers and non-experts.

It was a only after several tries that I compiled a more specific list of things to look for in the discourse, beyond general, basic questions in discourse analysis like: what are the concepts used, how do they argue, etc. One of them was how TEEB formulates and communicate the problems and issues related to the loss of biodiversity, and the focus on the role of numbers therein. Further, what kind of research do they build their arguments on, which scientific disciplines and theories? Which perspectives are highlighted in the texts? Who are the main actors that make up TEEB and express themselves on behalf of TEEB, and which actors do TEEB appeal to?

I tried a more structured and 'disciplined' approach, first reading and analysing the documents with a particular focus on central concepts like numbers, quantitative information, calculation, rationality. In which contexts were these concepts presented, how were they used and what understanding of the concepts could I read from their context in the text?

One of the challenges was to navigate between analysing the content (arguments etc) and the linguistic features, or rather the problem was that I didn't manage to keep them apart. So I had to do several readings and analysis where I screened certain things out.

As I read on, I understood that I was at first too concerned with concepts, and hence the analysis became very much a linguistic analysis. I am interested in *arguments*, so I had to

read the documents in a different way. I decided to look for themes which came to the fore in the material and which reoccurred throughout the documents. In that way, the analysis became different from a literary text analysis. My analysis of the text is therefore not just concerned with the properties of the text, but also with production and interpretation processes. To analyse the production and interpretation processes in TEEB, I carried out an analysis of the discursive practice (Fairclough 1992: 73).

To read the TEEB documents as a discourse in my case meant to look in particular at the argumentation and how certain points of view were promoted at the cost of others. I read the TEEB discourse as a discursive formation, i.e., a system of text, practice and institutions which contributes to setting the premises for what it is possible to talk about when it comes to biodiversity loss. A critical discourse approach allows studying both how various groups (e.g., economists and scientists) contribute to define the understandings of the problem field and the wider power implications.

The analysis presupposes that one goes back and forth between textual and discursive analysis since these are strongly intertwined. Text analysis means looking at choice of words and connection between sentences which constructs discourses and genres linguistically. Afterwards I analysed which other discourses the text builds on or links up with to construct (produce) a text, but also how the receivers might use other discourses in their interpretation of the text. This was one of the most challenging parts: how to interpret the text when words are often not defined or when it is unclear whether different words mean the same thing.

However, some of the textual uncertainties could be left unresolved, as they were often complemented in other places of the text by clear messages/recommendations. These were often used as the basis upon which the broader analysis was carried out.

The last step of the analysis—the broader social practice—is related to explanation and the critical realist mode of inference called retroduction. Here I went beyond analysis of the discourse/text and the discursive practice, and had to draw on non-discursive modes of inquiry (i.e., beyond interpretative/hermeneutic analysis). In CDA one often makes use of existing social theory for this step. I had however synthesised and elaborated my own explanatory framework in chapter 2 and 3, which I then applied to step 3 of the discursive analysis. I analysed the relationship between social and discursive practice, and how the discourse might be influenced by the wider social practice of which is if part and in which it is embedded. This meant analysing how the wider structural context—i.e., both ideational and material structures—might have had an influence on the discourse. I focused on whether

the discursive practice (or the participating actors) were conditioned by the structural constraints or whether they find ways to go beyond the structural constraint. For this purpose I made use of Jessop's structural-relational framework. This third step of the discourse analysis represents the core analysis of the dissertation in that it links directly to the research questions in chapter 1. It is therefore presented separately in chapter 8.

6. The institutional context and conduct of TEEB

This chapter presents and describes the TEEB project: its background and birth, its organisation and actors, its three phases and their outputs, and its impacts.

6.1. The birth of TEEB

In March 2007, the environment ministers from the governments of the G8+5[35] countries endorsed a proposal to carry out an independent global study on the economics of biodiversity loss. More precisely, the purpose of the so-called Potsdam initiative was to

> "initiate the process of analysing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation." (TEEB 2010b)

In other words, the mandate was to carry out a global cost-benefit analysis on biodiversity. The proposal was launched by the German environment minister at the G8 summit held in Potsdam, Germany, during the German G8 presidency, and was endorsed three months later[36] by the G8+5 leaders at the Heiligendamm Summit (Markandya, et al. 2008).

The Potsdam-initiative was inspired by and modelled on the global cost-benefit analysis of climate change (Stern 2006, see also Box 6.1) which was released a year earlier (TEEB 2010b). The Stern review had sparked some debate amongst neoclassical economists about issues of discount rate or how to treat uncertainty or technology within existing models, but was generally received with wide applause from politicians, the business community and civil society (NGOs). The case for action against climate change had been made quantitatively very clear: protecting the climate goes hand in hand with economic growth and new business opportunities. Since this was a win-win solution including huge opportunities for business, both those concerned about the environment and those concerned about the economy should now be able to act together. There was therefore little interest in or attention given to the few critical voices outside of the climate sceptic camp (such as Foster, et al.

[35] G8: Canada, France, Germany, Italy, Japan, Russia, UK, USA. +5: Brazil, China, India, Mexico, South Africa.

[36] 6-8 June 2007

Box 6.1 - The Stern Review

The Stern Review had been commissioned in by UK's Minister of Finance, Gordon Brown, and was conducted under the joint auspices of the Cabinet Office and the Treasury.

The conclusions from the review can be summarised in three parts:

- The risks posed by climate change are serious. It is urgent to act.
- However, there is still time to act, and if we act now the benefits will outweigh the costs (5:1).
- The shift to a low-carbon economy is a pro-growth strategy which will bring huge opportunities for business

The second bullet point is usually considered the main conclusion of the review, and is also presented as the main conclusion in the introduction to the review's executive summary: 'The benefits of strong, early action on climate change outweigh the costs' (Stern et al. 2006). This conclusion is based on a global cost-benefit analysis, weighting greenhouse gas control costs against the (economic) benefits of avoiding damages at the global scale. By estimating and adding up the cost of (a narrow range of) the effects of climate change, the reviewers arrive at a number which equals at least 5 per cent of GDP each year. Taking a wider range of risks and impacts into account (e.g., giving higher weight to the monetary value of the lives of poor people), the estimated damage costs could be as much as 20 per cent of GDP or more. In contrast, they estimate that the costs of action to reduce greenhouse gas emissions to a level where we can avoid the worst impacts of climate change, can be limited to around 1 per cent of global GDP each year.

2010; Spash 2007b) raising serious concerns about the Stern approach. Hence, the Potsdam initiative came into being with the euphoria from the release of the Stern review still in mind.

Within the European Commission, some groundwork on framing biodiversity in economic terms had already started before the publication of the Stern review. Commissioner Stavros Dimas had mentioned several times the close link between the economy and biodiversity.[37] In a stakeholder conference organised by the EU in 2004, Dimas argued that the growth of Europe's economy depends on the maintenance of biological diversity (Duke 2005). Formally, the concept of ecosystem services and a strengthened attention to the monetary value of nature were already introduced in the *2006 EU Biodiversity*

[37] See e.g., http://impetuseurope.com/news/index.cfm?ID=267&xMonth=All&xYear=All&xPage=186

Communication and Action Plan whose main purpose was to halt the loss of biodiversity by 2010 (in accordance with the goal set by the CBD). Hence, already on the 27 June 2007, only about three months after the Potsdam initiative and a couple of weeks after it had been endorsed by the heads of states, a brainstorming meeting was held at the European Commission to discuss what a 'Stern-like Biodiversity Study' could look like.[38] The German government together with the European Commission launched the TEEB project later the same year.

6.2. Setting up the TEEB: key people and organisations

An Advisory Board was set up early in the process to support the EC and Germany in launching the project. The board consisted of 18 persons from research/academia, policy-making, business and (I)NGOs, including prominent persons like Nicholas Stern (by then lorded) and heads of amongst others UNEP, the CBD and the IUCN (see appendix 3 for the full list of names).

The initiators, together with the advisory board, wanted a well-known economist to lead the study. Amartya Sen was asked, but for various reasons did not want to take on the task (Interview). After some time, the two institutions decided on and employed Pavan Sukhdev, a managing director in the global markets division at Deutsche Bank, as study leader. He was not a famous economist, and he was an outsider in many respects, but he had been involved in a similar initiative in 2004 when he co-founded the Indian Green Accounting Initiative[39] and helped establish the research NGO Green Indian States Trust (GIST).[40] This initiative built on the SEEA, but at the same time claimed that the SEEA framework did not go far enough because the monetary value of ecosystem services were not included.

The TEEB project received initial funding from the EC, Germany and the UK, and later also from the Netherlands Norway, Sweden, Belgium and Japan,[41] in addition a large number of public and private donors. Further, the project has received support from large

[38] http://www.eci.ox.ac.uk/people/gduke.

[39] He founded this initiative together with, amongst others, Pushpam Kumar who later became lead author of the *TEEB Ecological and Economics Foundations* report.

[40] Today GIST stands for 'Green Initiatives for a Smart Tomorrow'.

[41] Even more recently, Switzerland and Italy also became partners.

international NGOs such as IUCN and Conservation International, as well as numerous academics and researcher being involved in different ways.

Project management and the TEEB Coordination Group

The Germans were not only leading the G8 at the time, they were also hosting the upcoming 9th Conference of the Parties (COP) of the CBD, to be held in Bonn in May 2008. They were keen to have a document ready for the Bonn meeting. However, it soon became clear that the project was too much for the European Commission to run alone (Interview).

The German Ministry therefore invited the Helmholtz Centre for Environmental Research (UFZ), Leipzig to do the project management. There had already been contact between the two institutions about half a year earlier when the UFZ had appealed to the Ministry *not* to carry out the Potsdam initiative in terms of a 'Stern-like thing' (Interview). The UFZ was still sceptical, but felt that - 'as a publicly funded environmental research organisation they didn't really have a choice' (Interview).

Heidi Wittmer at the UFZ became the project manager. To support the project management on the practical level, a coordination group was set up. The group consisted of 11 people, including study leader Pavan Sukhdev, three people from the UNEP offices, and the project manager. The remaining members of the group represented the first funders of the project (EC, Sweden, Germany, Norway and the UK) (for the full list of names, see Annex 3).

The host and the UNEP TEEB Office

The UNEP offered to host the TEEB office, which was then located in Geneva, Switzerland. During the study phase of the project the TEEB office had seven people employed. In 2017, this had been reduced to 5.[42] The TEEB office is hosted under the Economics and Trade Branch (ETB) of the Economy Division, and placed at the International Environment House.

There is no official page with information about the TEEB project or the TEEB office on UNEP's website, although they do release TEEB documents regularly. The only information that can be found there about TEEB, is press releases by UNEP at different events and also small articles written about new reports emerging from the TEEB project. There is also some information that one can come to via search for specific experts (e.g.,

[42] Accessed 15.2.2017: http://www.teebweb.org/about/unep-teeb-office/

Marc Schauer[43]). There one can also read that the TEEB Central Office is based in Bonn, Germany. Monfreda (2010) also mentioned that there is an administrative and communications hub in Bonn, Germany.

Other people and institutions involved

The amount of academics, experts, researchers, NGOs, businesses, national governmental agencies and international organisations involved in TEEB in one way or the other is quite impressive. 'Involvement' here covers contribution of expertise, money, support, offices, space for presentation and communication, advertisement, movies and more. All in all a huge network of partners. It is worth noticing, though, that despite the business profile of the project and despite a couple of corporations being involved as partners, the involvement of actors from the business and/or financial sector is not very large.

In total, 26 government agencies, ministries, organisations and companies are listed at the TEEB website as contributing to the project, probably all in financial terms (although this is not explicitly mentioned). In addition, the five host organisations of the co-ordinators of the TEEB study reports (UFZ, Indian Institute of Technology Bombay (IITB), Institute for European Environmental Policy (IEEP), IUCN and the University of Liverpool) are thanked for their support. Appendix 3 lists all of the donors and partners.

6.3. The 3 phases of the TEEB project

Phase I: Scoping studies and interim report (2007-2008)

In the first phase of the project, the EC commissioned several background studies, including scoping studies on the economics of biodiversity, on ecosystems accounting and on the cost of inaction. Also the UK and France commissioned valuation studies which were made available to the TEEB team (see appendix 4 for all commissioned studies in phase I). In addition, various other organisations contributed their resources, studies and expertise: the UK Department for Environment, Food and Rural Affairs (DEFRA), the French Ministère de l'Écologie, du Développement et de l'Aménagement Durables (MEDAD), IUCN, OECD,

[43] Accessed 15.2.2017: http://staging.unep.org/experts/default.asp?Page=profiles&ExpertID=433&ShowList=no&eName=Mark%20Schauer.

UNEP's World Conservation Monitoring Centre (WCMC) and the German Federal Agency for Nature Conservation (BfN).

A call for evidence on the topic, launched by the EC, received more than 100 submissions from 69 people in the form of reports, articles or other contributions. In 2008[44] a workshop on 'the economics of the global loss of biodiversity' was held in Brussels, where more than 90 'experts in economics, ecology and policy' participated (TEEB 2008).

The findings from the background studies and the workshop were brought together in an interim report published within a year of the project launch, and the name *TEEB - The Economics of Ecosystems and Biodiversity* was used for the first time. The interim report was presented at a high-level segment of the COP9-CBD held in Bonn in May 2008.[45] According to the same website,

> "[S]tudy leader Pavan Sukhdev presented a 'comprehensive and convincing business model for the conservation of biological diversity' which acted as a catalyst for the international demand for TEEB's subsequent reports and Earthscan volumes aimed at international, national, local and regional policy makers and business. (..) Further, the interim report laid a broad foundation where evidence and examples of valuation were collated, elements of a biodiversity/ecosystem valuation framework identified, and long standing issues such as ethics in making choices regarding future values were re-emphasized." (TEEB 2014)

The interim report itself highlights the following three main findings (TEEB 2008):

- Poverty and loss of ecosystems and biodiversity is inextricably intertwined
- Ethics and problems with discounting the future are key
- TEEB needs to be focused on the end-user (policy makers, business or citizens) - making the case (demonstrating) that economic value is not enough

The interim report admitted many challenges related to monetary valuation of nature and presented a list of nine principles for valuation of ecosystem services. This was developed further in the key study reports.

[44] 5-6 March 2008

[45] www.teebweb.org, accessed 21.3.2014.

Phase II: TEEB study reports (2008-2010)

Phase 2 was already planned before the launch of the interim report, as there was interest in additional economic analysis and reports for specific end-users groups (four end-user groups were listed: policy makers, administrators, business and citizens). In phase II, a scientific coordination team was appointed at UFZ (in addition to the already existing project management), responsible for the coordination of the work and consistency between different TEEB reports (see annex 3 for full list of participants). This included responsibility for ensuring due scientific procedures in the preparation on the TEEB reports.

The first publication from phase II, was the report *TEEB Climate Issues Update* published a few months before the Climate Summit in Copenhagen in December 2009. The publication deals with the links between climate change and biodiversity loss and also the science-economics-policy interface (TEEB 2009a: 1). According to one interviewee, this report does give some overall cost-benefit numbers which were included 'for political reasons'. The report gives recommendations on policy measures to be taken in areas of coral reefs, carbon in forests, investments in ecosystems and national accounting for forest carbon. TEEB took actively part in the conference and organised events.

Further, four key publications came out of this phase, the so-called TEEB Study reports: one background report on economics and ecology titled *Ecological and Economic Foundations* (TEEB 2010a) and three reports for decision-makers titled: *TEEB for National and International Policy Makers* (TEEB 2009c); *TEEB for Local and Regional Policy Makers* (TEEB 2010c); and *TEEB for Business* (TEEB 2010d), making up about 1300 pages in total. The first of the reports to be published was the report for National and International Policy Makers (TEEB 2009b), released at a press conference led by EC Commissioner Stavros Dimas, in Brussels 13 November 2009. The remaining reports were all launched at the time of the COP10 in Nagoya in 2010. In addition to the four study reports, there was also a shorter 40 page synthesis report named *Mainstreaming the Economics of Nature: Synthesis, Conclusions and Recommendations from TEEB* (TEEB 2010b).

The 'TEEB for citizens' part of the project was planned as a website to be launched in mid-2010. However, the citizens initiative was later converted into 'The Bank of Natural Capital'. In addition, a website www.teeb4me.com was developed to 'reach citizens and encourage viral spread of TEEB ideas and concepts'.[46]

[46] Downloaded from http://www.teebweb.org/our-publications/ on 24.2.2015

TEEB did not in the end fulfil the mandate from the Potsdam initiative which was to initiate the process of carrying out a global cost-benefit analysis for biodiversity as Stern had done it for climate change. The argumentation for why they did not do that, will be part of the analysis of the next chapter.

The ecological and economic foundations of TEEB

In the autumn 2009, draft chapters for the theoretical foundation for the economics (in particular) and the ecological thinking in TEEB were put online for public comment. This was the hence the first communicated output of phase II. A large number of people had been involved in this report, which is the largest cooperative effort on the topic since the Millennium Ecosystem Assessment (MA). 86 people were involved in terms of authors of various kinds (author, lead author, contributing author) or as reviewers (reviewers or review editors) (see appendix 3 for the full list of lead authors). In 2010, the full report was published as a (410-page) book with Routledge under the title *Ecological and Economic Foundations* (TEEB 2010a).

The aim of the report was to synthesise the state-of-the-art on the knowledge of the economics of ecosystems and biodiversity, as well as providing the scientific basis for the TEEB project (Pushpam Kumar in the Introduction chapter, TEEB 2010a: 5). This included '(assessing) current approaches for using ecological sciences and economics for informed choices and decision making' (TEEB 2010a: 392). The report/book has five main chapters (+ and introductory framing chapter) covering the following topics:

- relationships among ecosystems, ecosystem services, and biodiversity (chapter 2) - 'the science'
- measuring biophysical quantities and the use of indicators (chapter 3) -
- the social and cultural context of economic valuation (chapter 4)
- the economics of valuing ecosystem services and biodiversity: recommended methodologies for economic valuation (chapter 5) - the longest chapter by far (133 p.)
- (suggested rates of) discounting and ethics for projects having impacts on ecosystem services and biodiversity (chapter 6)

The last chapter summarises the theoretical basis in terms of key messages, links it to the needs of national and local level policy makers, addresses the main gaps in knowledge, and discusses the future research agenda.

TEEB for national and international policy makers report

The first key report to be published from phase II, was the TEEB report for national and international policy makers, launched in November 2009. In fact, only the 48-page summary report - *Summary: Responding to the Value of Nature* - was actually published as a printed document (TEEB 2009b), while the full report (429-pages) was at the time available only online (TEEB 2009c).

The summary report starts with a 2-page executive summary of the main report. The rest of the report highlights the following topics:

1. Why valuing ecosystem services makes economic sense
2. Measuring to manage our natural capital
3. Reasons to invest in natural capital
4. Improving the distribution of costs and benefits
5. Natural capital that delivers prosperity

The full report consists of four parts. The first part deals with the global biodiversity crisis and its challenges and opportunities for policy makers, including why valuing ecosystem services makes economic sense. It includes frameworks and guiding principles for policy responses. In part two, quantitative information tools for decision makers are presented, under the heading of 'measuring what we manage'. This part highlights the importance of information, in particular quantitative information, to be able to carry out 'better informed management of natural capital' (TEEB 2009b: 16). In particular, it promotes integrating monetary values of natural capital and ecosystem services into national accounts (i.e., SEEA), allowing to produce new environmentally-adjusted macroeconomic indicators. Part three deals with solutions more broadly, which are seen to lie in 'better stewardship of natural capital'. This can be done through rewarding benefits through payments and markets, reforming subsidies, addressing losses through regulation and pricing, recognising the value of protected areas, and finally, investing in ecological infrastructure. All these solutions have the value-added of creating both jobs and economic benefits. Finally, the last part looks into the future and how we should 'respond to the value of nature'. It deals with the role of biodiversity and ecosystems in the transition to a 'truly resource efficient economy' (TEEB 2009b: 5), which it claims is often under-appreciated.

TEEB for local and regional policy makers report

Over 209 pages, this report presents the opportunities (part I), the tools (part II) and the practice (part III) available for local and regional policy makers in the field of the economics of ecosystems and biodiversity. The report makes the case for the 'enormous potential' (TEEB 2010c: 6) for human well-being that lies in taking nature's benefits into account in local and regional policy making. It hopes to be a starting point for local communities to adopting ways to make their 'natural capital flourish' (TEEB 2010c: 7). In addition to the general case made in the foundations report for recognising nature's values and making them visible, the opportunities for local governments lie more specifically in saving future municipal costs, boosting local economies, enhancing quality of life and securing livelihoods. What sets the report apart from the other reports is its particular stepwise approach for navigating through the different assessment options available for appraising ecosystem services. The six steps are:

1. agree on the policy issue
2. identify which ecosystem services are most relevant to the policy issue
3. define information needs, and select appropriate methods for assessment
4. assess ecosystem services, incl. expected changes in their availability and distribution
5. identify and appraise policy options
6. assess distributional impacts of policy options

The report considers both qualitative and quantitative frameworks for describing the connections between ecosystem services and human well-being. Further, it describes three different decision support methods for valuation: cost-benefit analysis, participatory appraisal and multi-criteria analysis. It provides examples of applying 'a focus on nature's benefits' in different areas of policy, such as cities, rural areas, protected areas, as well as spatial planning more generally. It also provides examples of payments for ecosystem services, conservation banking, certification and labelling.

Business report

The business report was published in two versions (like the national policy maker one): a full 217-page report (TEEB 2010d), and a 20-page executive summary (TEEB 2010e).

After a general introduction to the issue of biodiversity loss and ecosystems decline, the full report mainly focuses on the risks and opportunities for businesses who engage in this

field. The following 'key action points for business' are presented in the introduction to the executive summary (TEEB 2010e: 1):

1. Identify the impacts and dependencies of your business on biodiversity and ecosystem services (BES)
2. Assess the business risks and opportunities associated with these impacts and dependencies
3. Develop BES information systems, set SMART targets, measure and value performance, and report your results
4. Take action to avoid, minimise and mitigate BES risks, including in-kind compensation ('offsets') where appropriate
5. Grasp emerging BES business opportunities, such as cost-efficiencies, new products and new markets
6. Integrate business strategy and actions on BES with wider corporate social responsibility initiatives
7. Engage with business peers and stakeholders in government, NGOs and civil society to improve BES guidance and policy.

These seven action points, at the same time, correspond to the chapter structure of the report full.

The synthesis report

The 36-page synthesis report does not claim to summarise all the other reports, but rather highlights certain overall perspectives, conclusions and recommendations. However, first and foremost it presents a new topic and term which is 'the TEEB approach' - a method for recognising, demonstrating and capturing value. In the preface to the report, the TEEB approach is described in the following way:

> "The TEEB approach is about showing how economic concepts and tools can help equip society with the means to incorporate the values of nature into decision making at all levels." (TEEB 2010b: 3)

A core activity in using such economic concepts and tools, is to perform economic valuation. The approach is then about how one can and should do this: how to value biodiversity and ecosystem services and how to structure such valuation (TEEB 2010b: 11). The aim is to 'help decision makers recognize, demonstrate and, where appropriate, capture the values of ecosystems and biodiversity' (TEEB 2010b: 3).

However, before presenting this specific approach, the report recalls (over 4 pages) a selection of main arguments from the other key publications: that both the quantity and quality of biodiversity are important for *human well-being*, that biodiversity and ecosystems are critical components of *natural capital*, how to link nature and the economy using the concept of *ecosystem services*, and how the concepts of natural capital and ecosystem services can help us recognise the many *benefits* that nature provides. From an economic point of view, it is suggested, one can see the flows of ecosystem services as 'the 'dividend' that society receives from natural capital' (TEEB 2010b: 3). Insights from the natural sciences are seen as essential to understand the links between ecosystems and ecosystem services, including resilience, thresholds, tipping points, uncertainty and precaution.

The main part of the report is dedicated to presenting the TEEB approach, and to showing how to put it into practice. The approach is illustrated through the application in three different cases (forests, cities and mining). In general, the synthesis report is more rhetorical and explicitly normative than the other reports. I will come back to these rhetorical and linguistic issues in the next chapter.

Phase III: Implementation phase (2010-still ongoing)

The current phase of TEEB focuses on communication and outreach activities. It is also called the implementation phase and is about 'putting the approach into practice'. TEEB puts it this way

> "Capitalizing on the momentum created from the **TEEB reports** and growing network of partners, the initiative has moved into an ongoing phase of implementation, where study findings and the '**TEEB approach**' are sought to be applied at different levels of policymaking as well as integrated into different ***biomes*** and ***sectors***." (TEEB 2017, bold/italics in original[47])

As part of phase III, TEEB encourages following up their study with country specific assessments. To guide countries in carrying out national TEEB studies, a guidance manual was published in 2013: *TEEB – The Economics of Ecosystems and Biodiversity. Guidance Manual for TEEB Country Studies. Version 1.0* (TEEB 2013). However, several countries had already carried out TEEB-inspired studies, feasibility studies or produced national reports

[47] www.teebweb.org/about/the-initiative. Accessed 16.2.2017.

reflecting on the use of the TEEB approach for their respective country contexts. TEEB defines a TEEB-inspired study as a study that 'identifies the ecosystem services that are vital to meeting the country's policy priorities and makes recommendations on how these services can be integrated into policies (..) with the aim to demonstrate the values of nature and to encourage policy-making that recognizes the values of ecosystem services and biodiversity'.[48] TEEB lists a total of 20 TEEB-inspired country studies on its web-page.

The countries that financed and supported the TEEB project are the ones that have been most eager to follow up nationally. The UK has been the most active so far. Already in 2011, as the first country to do so, the UK published a national ecosystem assessment, focusing on the services provided by the ecosystems (UK National Ecosystem Assessment 2011). They then launched a follow-up study that assessed the economic value of the same ecosystem services and which was published 3 years later (UK National Ecosystem Assessment 2014).

The other countries represented in the coordination group have also produced national reports, but not assessment reports of the same kind. Germany has a national TEEB program called 'Natural Capital Germany'.[49] The programs aim is to build on TEEB to show that it is worthwhile - not least economically - to protect nature and ensure the sustainable use of biological diversity, and to make this visible in the case of Germany. In Norway, the Government set up a public commission to explore the economic value of ecosystems and its long-term impact on human welfare, directly inspired by TEEB. The commission delivered its report in 2013 (NOU 2013) concluding that the TEEB approach can be useful for Norway and that something like the UK national ecosystem assessment should be the next step. Sweden published a national ecosystem assessment based on the MA in 2012 (Naturvårdsverket 2012). The Netherlands launched a national TEEB project in 2011, which has since produced a series of reports on health, business, cities, land use management and the Caribbean Netherlands.[50]

On the other hand, only a few of the G8 countries who initiated the Potsdam initiative have been engaged in the following-up of the initiative nationally. Besides in Germany and the UK, there has not been much activity. According to the TEEB website, the Environment Ministry of Japan produced in 2012 a TEEB Japan Brochure highlighting the relevance of

[48] http://www.teebweb.org/areas-of-work/teeb-country-studies-2/. Accessed 15.2.2017.

[49] http://www.naturkapital-teeb.de/aktuelles.html

[50] http://en.biodiversiteit.nl/teeb

TEEB in Japan's national and cultural context, and is currently translating three TEEB reports into Japanese (the foundations report, the business report and the synthesis report). France commissioned a study for the initial call for evidence-phase, but has not done any national TEEB-like studies later. Neither has Italy, despite supporting TEEB through the Italian Institute for Environmental Protection and Research (ISPRA). Several of the '+5' countries, including Brazil (in 2011), India (in 2011), South Africa (in 2011) and Mexico (in 2014), have initiated some sort of national TEEB related projects. In Brazil and Mexico this is done together with a local UNEP partner. The remaining five countries of the G8+5 have not been visibly active in the TEEB process or in TEEB related initiatives. The remaining countries/regions who have initiated TEEB studies are: the Arctic region, Armenia, ASEAN, Belgium, Czech Republic, Georgia, the Nordic Ministerial Council, Poland, Portugal, Republic of Korea and Slovakia.

The Government of Georgia volunteered to be one of the pilot countries for TEEB, i.e., to assess its natural capital, with the ultimate objective of valuing both the natural capital and services provided by the country's ecosystems (including non-monetary values). For this purpose a TEEB scoping exercise was initiated to identify policy priorities which could inform and form the basis of a TEEB Country Study for Georgia. It was carried out as a cooperative project by UNEP, TEEB, WWF-Caucasus and the Georgian Ministry of Environment and Natural Resources (TEEB and WWF 2013). The full TEEB country study itself has not yet been published.

Further, in 2012 a three-years project called *Reflecting the Value of Ecosystems and Biodiversity in Policy-making* was launched. The project aims at supporting national and local attempts to economically assess ecosystems services. Five countries (Bhutan, Ecuador, Liberia, Philippines and Tanzania) expressed interest to undertake a TEEB country study, specific to their national context. The EC finances the project and the country pilot studies, and UNEP is responsible for the implementation. Although the projects should have been finished by now, no reports are yet available on the TEEB-web (by February 2017).

The TEEB project is also producing reports in more specific fields such as a TEEB manual for cities (TEEB 2011). It has also published several reports related to water: a discussion paper on valuing the oceans (TEEB 2012b), TEEB for Water and Wetlands (Russi, et al. 2013), and a briefing note on Natural Capital Accounting and Water Quality (Russi and ten Brink 2013). In 2014-2015 it launched several reports on food, under the new

working area TEEBAgriFood[51] (e.g., TEEB 2015). The way the reports have come about and are published vary. Some seem to be financed by TEEB, but most have received funding from the various associated partner, although sometimes other partners (e.g., the Finnish Government has supported the Water and Wetlands report financially). Most reports in phase III are published by the supporting organisations. TEEB is not the sole author any longer, rather the names of the authors are stated explicitly.

Another related output from the project is the TEEB valuation database, a searchable case study database with monetary values of ecosystem services. Initially launched in 2010 within the context of the TEEB project, the database has since been further developed, both in terms of content and design and has changed its name to *Ecosystem Services Valuation Database (ESVD).* It now contains over 1350 data-points from over 300 case studies. The database, which is maintained by the Ecosystem Services Partnership (ESP)[52], is freely available online as a ZIP-file (Excel-file) to stimulate its use in public decision-making and for other non-commercial purposes (e.g., science and education). In 2013 a Valuation Database Manual[53] was published presenting an overview of the potential uses and functions of the TEEB Valuation Database.

Another output from phase III, is implementation guides for three TEEB-related Aichi-targets.[54] Guides have been produced for the following targets:

> (2) Integration of biodiversity values into strategies for development and poverty reduction, planning processes and national accounting (Rode, et al. 2012b);
>
> (3) Reforming subsidies harmful to biodiversity and promotion of incentives for conservation and sustainable use of biodiversity (Rode, et al. 2012c); and
>
> (11) Increasing the amount and effectively managing land, inland waters and ocean covered by protected areas (Rode, et al. 2012a).

This task has been carried out by the UFZ for TEEB.

The UFZ continues to support the TEEB process mainly through advising the TEEB coordination group and supporting the UNEP-TEEB Secretariat in the development of a

[51] http://www.teebweb.org/agriculture-and-food/

[52] The ESP is a "Worldwide Network to enhance the Science and practical Application of ecosystem services assessment" (www.fsd.nl/esp). The ESP service team is chaired by Rudolf de Groot, a central person in several TEEB reports and chapters.

[53] http://www.teebweb.org/publication/tthe-economics-of-ecosystems-and-biodiversity-valuation-database-manual/

[54] A set of 20 biodiversity goals agreed by governments under the CBD in 2010 as part of the Strategic Plan.

network and facilitation approach. UFZ also participates in the 'translation' of academic TEEB knowledge for capacity building. In 2012, the first TEEB Conference was organised by the UFZ and held in Leipzig. UFZ also serves as the German focal point for disseminating TEEB concepts and knowledge nationally, and it is leading and coordinating a national TEEB feasibility study (TEEB-DE).

6.4 Influence and impact

The overall influence of the TEEB study is hard to assess, and to do that is neither the purpose of this dissertation. However, it is clear that TEEB has become a main reference in biodiversity policy, both nationally (e.g., TEEB-DE) and internationally (e.g., CBD's Strategic Plan for Biodiversity 2011-2020). At the 2011 Symposium on Caribbean Marine Protected Areas the moderator even referred to TEEB as 'the international bible of socioeconomic assessment' (MacDonald and Corson 2012: 178). The topic of 'valuing nature' has become a key element of the current biodiversity discourse. In this way, TEEB has largely reached its aim of 'mainstreaming the economics of nature' (TEEB 2010b).

MacDonald and Corson (2012) argues that although the timing of the TEEB project might have contributed to its support, only a carefully planned repackaging of the whole body of ideas made this possible, what they call 'a staging to align actors'. Although their study takes a particular perspective (that of 'virtualism'), TEEB's presence at major international meetings is undisputed.

TEEB's attendance started early in the project. At the Fourth World Conservation Congress, organised in October 2008, TEEB was strongly present. Especially IUCN Secretary General, Julia Marton-Lefevre, who is (and was) on the TEEB Advisory Board, strongly promoted a pragmatic position vis-à-vis monetary valuation of nature and the need to convince policy makers about the value of biodiversity and ecosystems using money measures. According to Monfreda (2010), the Congress helped pave the way and strengthen the support for the TEEB project.

Since then, TEEB has taken actively part and organised events in a range of international meetings, for example Climate Summit in Copenhagen in December 2009, regional CBD and UNEP events, as well as more business-related events such as the annual Davos meetings of the World Economic Forum (here Sukhdev chaired the 'Global Agenda Council' on Ecosystems & Biodiversity, 2009-2011, and was a speaker at Davos in 2010 and 2011).

Most importantly, however, TEEB was present at the CBD COP 10 in Nagoya, Japan in October 2010. This was not just any CBD meeting. It was the meeting where the member countries were supposed to report on their progress in reducing the loss in biodiversity, an important target to be reached by 2010. Very few countries had met their targets. Against this background, there was a search for 'new solutions'.

At the CBD meeting in Nagoya in 2010, there was a clear breakthrough in economic thinking, both in terms of choice of topics for the main plenary sessions, and in terms of output of the meeting (the Nagoya declaration and strategy plan). TEEB released the majority of its key study reports at the meeting, including the synthesis report and became one of the main topics of the conference. According to MacDonald and Corson (2012), this success was in part due to a careful orchestration of the TEEB events taking place at the meeting. The economic approach was presented as a new way forward to reach the goal that no country had managed by then. TEEB seemed to provide the solution!

In the Strategic Plan for Biodiversity 2011-2020, adopted by the meeting (COP10 DecisionX/2), target number 2 and 3 relates strongly to the TEEB approach:

Target no 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

Target no 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

In 2012, TEEB published *Nature and its Role in the transition to the Green Economy. A Contribution to Rio +20* (TEEB 2012a). In addition to being study leader of TEEB, Sukhdev was Special Advisor and Head of UNEP's *Green Economy Initiative* until March 2011. In 2012, at the Rio+20 summit, the *Green Economy Initiative*, closely linked to the TEEB ideas, was chosen as one of two main topics for the summit.

It also seems clear that the role of Pavan Sukhdev for TEEB's success has been important. He has in own person been present at a large amount of meetings (all the one's

mentioned above plus more) and events, he gives interviews, he has recorded a TEDTalk,[55] etc. In the preface to the TEEB interim report (TEEB 2008), EC Commissioner for Environment Stavros Dimas and German Environment Minister Sigmar Gabriel write that the success of the Potsdam initiative was highly dependent on the quality of the leadership and express strong appreciation of Sukhdev's leadership. MacDonald and Corson (2012) argue that it was his credentials in the financial sector and as an 'conservation outsider' that gained him legitimacy. Although, as I presented above, it is not correct that was a conservation outsider (he co-founded a Green Accounting initiative in India), this seems to have been a prevailing perception. As for example demonstrated in this quote:

> "In many ways, the success of TEEB was tied to features that address the desire among CBD parties and other conservation organizations to engage with 'non-traditional' actors. Sukhdev's credentials as a 'conservation outsider' served to legitimate his expertise. As the UNEP media official stated: 'The success of TEEB is [that] we have someone like Pavan who's available all the time for press, for media, for interviews to get the message out, with the credibility of being a banker, right? He wasn't from an environmental NGO, so he wasn't part of the converted, although of course he has been converted'." (MacDonald and Corson 2012: 171)

That a banker is attributed such high credibility in the middle of the financial crisis is of course interesting in itself, and will be a thread to follow up in the analysis in the next chapter.

6.5 Summary

In this chapter I have presented the background for TEEB, the main actors involved and the main output and activities of the project. Despite being inspired by the Stern review, TEEB did not carry out a global cost-benefit or produce the 'one overall number' *à la* Stern. Some partial cost-benefit thinking was presented in the interim report together with the results from the controversial *Nature*-study from 1997, but these numbers were removed from the later reports. So, while the main message getting a lot of attention from the Stern-review was the by now famous "1% of GDP", the main message from TEEB became its specific approach.

[55] www.ted.com/speakers/pavan_sukhdev. Interestingly he presents himself as a "Environmental economist" on this website.

Despite lacking ‘the one big number’ which was perceived as the greatness of the Stern review, TEEB still have had wide influence on the biodiversity policy and discourse. Why this has been so will be part of the discourse analysis in the next chapter.

7. The TEEB discourse

The Potsdam initiative was about analysing the *global benefits* of biodiversity and *cost of loss versus the costs of effective conservation*. Inspired by the Stern review on the economics of climate change which had been published half a year earlier, the mandate was to present, in economic terms, the benefits human society derives from nature, and costs related to its destruction, also perceived as 'making an economic case for biodiversity conservation' (Pavan Sukhdev in Preface to TEEB 2010a).

TEEB, however, turned into a different project. Instead of calculating the economic value of biodiversity loss, the main output from TEEB was the 'TEEB approach' on *how to* use economic concepts and tools to incorporate the values of nature into decision making, through recognising, demonstrating and capturing value.

This chapter presents a description of the TEEB discourse, including its story line and main narrative, its core contents and concepts, and its focus and main themes. Further it presents the frames and rhetorics and problematises them. In particular it focuses on how TEEB presents (or represents) the problem of biodiversity loss and argue for solutions, in particular making nature's values visible economically through monetary valuation. The solution proposed relies strongly on some aspects of mainstream economic theory which are presented in-depth. However, TEEB also admits problems with this approach, and struggles to present a convincing argument for how these challenges are handled. This means there are several problematic aspects of and inconsistencies with the TEEB discourse and approach, which I explore.

The chapter contains the 2 first steps of critical discourse analysis as presented in chapter 5. I present the discursive narrative, its frames (interdiscursivity) and rhetoric, and problematise them (including omissive and immanent critique, as well as reflections on misrepresentation). Step 3 of the CDA approach, where one studies the relationship between the discursive and the wider social practice/context is left to chapter 8.

7.1 Introduction: narrative and story line

The story line of TEEB is about the 'invisibility of nature's values'. TEEB claims that this invisibility is an important driver for human societies' destruction of biodiversity and ecosystems. For this reason, there is a need to make them (i.e., nature's values) visible.

Therefore the synthesis report ends with the following vision:

> **"Vision: Making Nature Economically Visible**
> Biodiversity in all its dimensions – the quality, quantity and diversity of ecosystems, species and genes – needs to be preserved not only for societal, ethical or religious reasons but also for the economic benefits it provides to present and future generations. We should aim to become a society that recognizes, measures, manages and economically rewards responsible stewardship of its natural capital." (TEEB 2010b: 29)

On the TEEB web-site's front page, one finds the same vision or slogan slightly reformulated: 'Making nature's values visible' (i.e., 'economically' has been removed).

The full narrative that frames the TEEB project is developed over several pages in the synthesis report (TEEB 2010b: 7-10). First we are introduced to the concepts of natural capital and ecosystem services (ESS), and learn about the various benefits that nature provides to humans (their well-being). Because of these benefits it is important to sustain the stock of natural capital.

TEEB builds on the classification of ecosystem services outlined in the Millennium Ecosystem Assessment where ESS is divided into the following four categories: provisioning services, regulating services, supporting services and cultural services. The argument being made is that while many ecosystem services with consumptive direct use values (e.g. fish or crops) are traded in markets and hence have explicit prices, other services, with indirect use values are traditionally not traded in markets, hence do not have explicit prices. While some ecosystem services with direct use values which are non-consumptive (e.g. recreation) or with non-use values (e.g. appreciation of the cultural or spiritual importance of a landscape) often have been influential in decision making despite their 'benefits' rarely being valued in monetary terms, this is not always the case, especially when it comes to regulating services (e.g., water purification, climate regulation, pollination). However, regulation services have

> "recently begun to be assigned an economic value through various valuation exercises, and it turns out that when such values are calculated they commonly form the majority of the Total Economic Value of an ecosystem." (TEEB 2010b: 8)

The problem then is that these values '**remain largely invisible** in the day-to-day accounts of society' (TEEB 2010b: 8, bold in original) since they are usually neither calculated nor

reflected in the market signals. It is this invisibility that TEEB wants to challenge and do something about.

The effect of this invisibility can, according to TEEB, be for example that companies clear cut forests because market signals make that a logical thing to do, while the costs of deforestation fall on society. Assessments have shown that direct drivers of biodiversity loss are all constant or growing, hence the risk of extinction is growing. These assessments have also found that 'the failure to account for the full economic values' of nature is a 'significant' factor in the continuing loss and degradation of ecosystems and biodiversity.

The project then recommends a specific approach and presents numerous examples on how to demonstrate and take into account the economic value of nature. This includes examples on how to invest in natural capital, how to avoid undervaluing natural capital in economic forecasting, how poor (rural) people are disproportionately dependent on natural capital, how business can manage risk and discover new opportunities relating to natural capital, and finally how we all can hold governments and companies accountable for managing our common natural capital.

However, it is pointed out that accounting for nature's services is not enough on its own. The knowledge about nature's value also needs to be translated into incentives that can influence behaviour for the better. TEEB believes that

> "the framework of economic analysis and decision making described in the TEEB reports, if widely implemented, could go a long way towards making **pro-biodiversity investment the logical choice** for a much wider range of actors in the future." (TEEB 2010b: 10, bold in original)

In brief, natural capital is important, but for the most time invisible. However, if we account for nature's values and introduce new incentives, (only) then can we create new behaviour (i.e., pro-biodiversity investments). The end purpose of the narrative is hence to change behaviour.

The problem, cause and solution

While the implicit goal of TEEB, as expressed e.g., in the vision, is the preservation of biodiversity, this is not really the core issue that the study deals with. Rather, TEEB is concerned with *one* of several factors related to biodiversity loss, namely *the failure to*

account for the full economic values. Hence, the problem is framed in terms of how the invisibility of biodiversity values often has encouraged 'inefficient use or even destruction of the natural capital that is the foundation of our economies' (TEEB 2010b: 3). Non-market benefits of ecosystem services, whose value has neither been reflected in market transactions, nor in public payments, tend to be overlooked in economic accounting and decision-making. This invisibility leads to *false* trade-offs (the imperfection problem). *Therefore, the core problem addressed is not biodiversity loss, but the invisibility of nature's economic values.*

However, the vision goes beyond 'correcting' trade-offs. Instead, the solution is to make these values economically visible by 'incorporate[ing] the values of nature into decision making at all levels' (TEEB 2010b: 3). Sometimes *the lack of* the solution (as just described) is presented as the problem: the problem is that (economic) values of nature are not taken into account in decision processes. In such accounts, the solution lies in economics, i.e., in correcting the trade-offs and changing the incentives. No matter how the problem-solution issue is presented, the solution can offer a lot: jobs, economic development, reduced poverty, opportunities for business (TEEB 2010b: 10), and, even a 'new economy' (TEEB 2010b: 3). Although, the implicit goal is biodiversity preservation, the solution that TEEB offers - economic visibility - does not explicitly offer reduction in the loss of biodiversity.

Mainstreaming

While the main story line of TEEB is about the invisibility of nature's values (the problem), the aim of TEEB is presented as being about mainstreaming (the solution). Hence, the title of the synthesis report: *Mainstreaming nature's values*. From the TEEBweb we can read that while the main concern or *focus* of TEEB is on 'making nature's values visible', its main *objective* is that of 'mainstreaming'. The full text reads like this:

> "**Making Nature's Values Visible**
>
> The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on 'making nature's values visible'. Its principal objective is to mainstream the values of biodiversity and ecosystem services into decision-making at all levels. It aims to achieve this goal by following a structured approach to valuation that helps decision-makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrate their values in

> economic terms and, where appropriate, capture those values in decision-making." (TEEB 2015)[56]

This results in a shift from calculating the monetary value toward discussing policy and values more broadly. TEEB is hence expanded from being about *calculating and communicating* the (monetary) value of nature (the Potsdam mandate) to focusing on *how* these values can be taken into account in decision-making (including how to calculate them). Hence, the focus is no longer the size of value and whether it is cheaper to conserve biodiversity than to lose it (*à la* Stern), but rather *how to* incorporate the economic values of nature and economic thinking into decision procedures and processes.[57]

A definition of the concept 'mainstreaming' is not (explicitly) given anywhere in the TEEB reports. According to the Oxford English dictionary (1993) it means 'incorporate, integrate, consider'. This seems to be the meaning referred to in TEEB as well. However, it is not always clear what exactly should be incorporated. The text cited above, for example, points to the values: 'mainstream the values of biodiversity and ecosystem services (..)'. At other times, mainstreaming refers to the economics, like in the recommendation on 'mainstreaming the economics of nature' (TEEB 2010b: 28). However, this recommendation then switches to being about the values: 'Mainstreaming these values requires that *natural capital* is considered routinely' in a range of policy areas, planning, as well as corporate strategies, and private and public consumption (TEEB 2010b: 28). On another page, mainstreaming should be done through incorporating the values of nature, through the use of economic concepts and tools: 'showing how economic concepts and tools can help equip society with the means to incorporate the values of nature into decision making at all levels' (TEEB 2010b: 3). Other times again, it is the thinking that should be mainstreamed:

> "Mainstreaming this thinking and bringing it to the attention of the policy makers, administrators, businesses and citizens is in essence the central purpose of TEEB." (Kumar 2010: xxvii).

Overall, mainstreaming seems to mean incorporating the economic value of nature through both economic tools and economic thinking.

[56] http://www.teebweb.org, accessed 2.12.2015.

[57] Decision processes encompass both public policy and business.

Sukhdev's narrative

Unlike the main text of the synthesis report, which promotes incentives that make behaviour more 'pro-biodiversity', Sukhdev, in the preface to the same report, envisions the TEEB approach leading to 'a new economy' (TEEB 2010b 3). Hence, he presents a slightly different story line, highlighting different aspects and using different terms.

Sukhdev's main concern is the role of (a bad and outdated) metric in addressing the loss of biodiversity (see also Sukhdev, et al. 2014). He makes use of a metaphor introduced already in the interim report - that of the need to 'recalibrate the defective economic compass' (TEEB 2010b: 3). By this compass is meant the 'metrics which permeates all layers of society', including our national accounts and flawed measures, such as the GDP (TEEB 2008: 4).

The solution, as Sukhdev presents it, lies in applying economic tools and thinking. A central economic concept and tool is that of *monetary valuation*, seen as a tool to help

> "recalibrate the faulty economic compass that has led us to decisions that are prejudicial to both current well-being and that of future generations." (TEEB 2010b: 3)

Sukhdev further introduces the term 'sound economics' which encompasses explicit recognition, efficient allocation and fair distribution of the costs and benefits of conservation and sustainable use of natural resources. His vision is that TEEB will act as

> "a catalyst to help accelerate the development of a new economy: one in which the values of natural capital, and the ecosystem services which this capital supplies, are fully reflected in the mainstream of public and private decision-making." (TEEB 2010b: 3)

The economic conceptualisation of nature

In TEEB, nature is conceived in economic terms, consisting of natural capital and ecosystem services, i.e. a standard neo-classical conceptualisation of the economic system as stocks and flows of (goods and) services for human well-being. Natural capital, such as biodiversity, provides the flows of benefit/utility, e.g. ecosystem services. Another way to formulate this in neoclassical economic terms is to see ESS flows as a 'dividend' or 'interest' from those stocks. This conception of nature has been developed in particular by a range of ecologists for some time, and is also used in the MA 2005. TEEB builds directly on the MA and the economic turn in biodiversity conservation. The idea is that, unlike ecosystem functions, the

concept of ecosystem services can help us recognise the benefits that is provided by nature. The logic is then simple and straightforward:

> "From an economic point of view, the flows of ecosystem services can be seen as the 'dividend' that society receives from natural capital. **Maintaining stocks of natural capital allow the sustained provision of future flows of ecosystem services**, and thereby help to ensure enduring human well-being." (TEEB 2010b: 7, bold in original)

Sukhdev understands 'natural capital' to be the foundation of our economies (TEEB 2010b: 3). This capital supplies us with ecosystem services which in turn give us well-being. Hence, it is not the qualities of nature itself that needs to be identified, but the value (importance) we assign to it in economic terms, or its monetary value. By considering the 'services' that ecosystems provide for human beings, a link can be made between nature and the economy (including wellbeing).

7.2 The TEEB approach

Mainstreaming is done through the 'the TEEB approach' which is about how to value nature, that is, how to structure the valuation process and how to incorporate the results of the valuation (i.e., 'the value') into decision-making and policy. The approach is constructed as a 3-tiered approach.

Tier 1: Recognising value

This stage concerns recognising or identifying the value. It is not about processes to help recognise value or raise awareness, but rather to check whether or which of nature's values are recognised or expressed (in various ways). It is said that when and where biodiversity values are generally recognised, legislation and voluntary agreements can 'sometimes be sufficient to ensure conservation and sustainable use' (TEEB 2010b: 11). Monetary valuation might in such cases be unnecessary or even counterproductive. However, if nature's values are not recognised, then one moves to the next tier.

In exemplifying the TEEB approach, this step is described in a slightly different way: 'For each decision identify and assess the full range of ecosystem services affected and the implications for different groups in society' (TEEB 2010b: 13). This includes involving the full range of stakeholders influencing and benefiting from the affected ecosystem services

and biodiversity. In this way, tier 1 becomes about identifying what the ecosystem services and benefits are before estimating their relative value.

Tier 2: Demonstrating value

This step is about informing decision-makers and making the value of biodiversity visible. Demonstrating value here means demonstrating in monetary (TEEB uses the term 'economic') terms:

> "**demonstrating value** in economic terms is often useful for policymakers and others, such as businesses, in reaching decisions that consider the full costs and benefits of a proposed use of an ecosystem, rather than just those costs or values that enter markets in the form of private goods." (TEEB 2010b: 11, bold in original)

Demonstrating economic value is promoted both because it can be an important aid in achieving more *efficient* use of natural resources and as a help to internalise and capture value:

> "The demonstration of economic value, even if it does not result in specific measures that capture the value, can be an important **aid in achieving more efficient use** of natural resources. (..) Valuation in these circumstances enables policy makers to **address trade-offs** in a rational manner, correcting the bias typical of much decision making today, which tends to favour private wealth and physical capital above public wealth and natural capital." (TEEB 2010b: 11, bold in original).

In addition, one should demonstrate 'the value for whom', i.e., who is affected by alternative management options. Hence, TEEB introduces a distributional element, otherwise unusual in welfare economic approaches. It is stressed that economic valuations are best applied for 'assessing the consequences of changes' resulting from alternative management options rather than for estimating total value of ecosystems (TEEB 2010b: 11).

Tier 3: Capturing value[58]

This final tier is concerned with 'mainstreaming' or incorporating. Like tier 2, it also links back to TEEB's focus of making nature's values visible. The argument is that we need to change our economic instruments to make visible what is invisible. This will give the right market signals and in turn lead to sustainable use of nature. Currently the problem is that the invisible values (or the invisibility of the values) are not internalised in market transactions, and hence the costs (externalities) of private actions tend to fall on society. Therefore, the values recognised in tier 1 and demonstrated in tier 2 needs to be 'translated' into incentives which influence behaviour for the better (TEEB 2010b:10).

Although the argument has earlier been made that it is important to demonstrate the economic value of biodiversity and ESS to decision-makers (tier 2), it is also argued that simply showing the cost-benefit numbers might not be enough. Tier three is therefore concerned with introduction of mechanisms that:

> "**incorporates the values** of ecosystems into decision making, **through incentives and price signals."** (TEEB 2010b: 12, bold in original)

Examples of such incentives are payments for ecosystem services (PES), reforming environmentally harmful subsidies, introducing tax breaks for conservation, charging for access and use, or creating new markets for sustainably produced goods and services including eco-labelling and certification. Creation and strengthening of property rights over natural resources and liabilities for environmental damage is also stressed (TEEB 2010b: 12).

Tier 3 is also about 'capturing value': one should first demonstrate values in monetary terms and then 'capture them in markets' when appropriate (TEEB 2010b: 12). Hence, if the value is incorporated it can be captured - i.e., someone can benefit from, or make a profit. Capturing in markets

> "applies most obviously to commodity values such as livestock or cubic meters of timber, but can also be done for the amount of carbon storage or supply of clean water." (TEEB 2010b: 12)

In more complex situations, it is claimed, monetary valuation might be less reliable or

[58] Sometimes also presented as 'capturing value and finding solutions' (TEEB 2010b: 20). Solutions then point for example to 'overcome their undervaluation (of ESS)' (TEEB 2010b: 13).

unsuitable.

However, values can also be captured through other means than markets. A perhaps less intuitive example of what capturing value means, is compensation schemes. The synthesis report describes an example from India, where the Supreme Court drew up a scale of (obligatory) compensatory payments for converting different types of forested land to other uses. The size of the compensation to be paid was based on the values of the services lost. These values were estimated by GIST, the research NGO that Sukhdev helped establish. The compensation money goes into a public fund to improve India's forest cover (TEEB 2010b: 16-17).

Although monetary valuation of the ESS targeted by economic mechanisms can help ensure that they are efficient, it is not always necessary. Hence, tier 3 can also be carried out without going through tier 1 and 2:

> "calculating prices for natural assets and ecosystem services is not always necessary in order to set up market-based schemes." (TEEB 2010b: 12)

However, the report also points out that:

> "**valuation does not imply that all ecosystem services** must necessarily **be privatized** and traded in the market." (TEEB 2010b: 12, bold in original)

Hence, while markets are on the one hand promoted, they are at the same time not promoted unconditionally. Whether to privatise or commodify is considered a separate choice involving a range of issues besides economic efficiency, including criteria such as cultural acceptability, effectiveness, equity for the users of common resources, and futures generations (TEEB 2010b: 12).

In conclusion, one can set up markets for ESS without economic valuation, and one can do economic valuation without privatising or trading in markets.

7.3 Economics, information and science

The economics of TEEB = neoclassical economics

It is tricky to pin down exactly what theoretical basis TEEB builds on. TEEB (and Sukhdev) both leans on mainstream economics for authority, while at the same time criticising it

(Monfreda 2010). TEEB does not explicitly state what theoretical school it is based in, despite having compiled the state of the art of the economics of ESS and biodiversity into a more than 400 page long report (Kumar 2010). As one reads the various TEEB reports, one finds that neoclassical economics is both relied upon and to some extent rejected, without any clear new theoretical basis coming out of the exercise.

However, much of the economics of TEEB is of course indirectly observable through the text, and, in particular, in the TEEB approach itself, through the economic concepts applied and the tools and rationalities presented. These include central microeconomic concepts such as: 'efficiency', 'rationality', 'trade-offs', 'optimal', 'the need for information', 'lack of information', 'market failure', and more.

The definition of economics relied on in TEEB can be found in a side clause half way into the Foundations report: "Economic, *as the study of how to allocate limited resources*, relies on valuation to provide society with information about the relative level of resource scarcity" (TEEB 2010a: 187, my emphasis). Hence, the mainstream understanding of 'economics' is not questioned. TEEB follows the dominant understanding of what 'economics' is: economics is about how to make optimal choices in a world of limited resources, not about understanding the economic system.

However, neoclassical economics comes in several versions. TEEB makes use of several of them throughout the various reports. Sometimes the welfare economics arguments are heavily relied upon with its concerns for 'social welfare' or the 'social benefits' that biodiversity and ecosystems provide. A welfare perspective is also prominent when public welfare is appealed to rather than private interests. The whole invisibility argument is basically welfareist. On the other hand, arguments more in line with the market rationality of the Chicago school is also put forth, such as markets perceived as appropriate and efficient for 'delivering' ESS, and highlighting the importance of property rights.

In the introductory chapter to the foundations report, Pushpam Kumar, the scientific coordinator, frames the discussion about economics to be about 'the advantages and limits of economics'. He puts it this way:

> "In the predominant thinking on the economics of biodiversity and ecosystems, the questions that should be asked are: Why economics? What can economics deliver? and Where can economics fail?" (Kumar 2010: 1)

Kumar suggests that while ecological analysis can identify direct drivers of degradation, economic analysis can help identify the indirect (economic) drivers (e.g., subsidies, exchange rate etc.). Also, economic tools are seen as useful for understanding and predicting outcomes, but not so useful for evaluating and ranking outcomes. These are presented as two different frameworks: one positive-analytical and one normative, where economic tools fall in the positive-analytical group.

Hence, while economics as presented in the synthesis report is much linked to economic managerialism and economics as decision support tool, the Foundations report more explicitly introduces the view of economics as a positive and predictive science. That is, in terms of predicting behavioural effects. Still, the focus is on monetary valuation and its role as input to decision-making.

Sukhdev has introduced the term 'sound economics' which goes beyond the core concern of efficient allocation in welfare economics. He aims to show that 'successful environmental protection needs to be grounded in sound economics, including explicit recognition, efficient allocation and fair distribution of the costs and benefits of conservation and sustainable use of natural resources' (TEEB 2010b: 3). The distribution or fairness aspect reintroduces concerns that were present for the classical political economists and political philosophers, but which neo-classical economists has removed from the scope of economics. Still, TEEB does not look to political economy for theoretical concepts and guidelines, but stays with mainstream economic theory. Hence 'applying economic thinking to the use of biodiversity and ecosystem services' (TEEB 2010b: 3) means applying mainstream economic theory (microeconomics and the 'capital approach').

An interesting explicit critique of mainstream economics in the TEEB foundations report is a text box on 'the discontents' of neoclassical economics, written by ecological economist John Gowdy.[59] Starting by pointing out that the

> "current debates raging in economics over the Stern Review, the current financial crisis, and the significance of the findings of behavioral economics, have shown that the problem with neoclassical economics is not valuation *per se* but with the assumptions of the core Walrasian model (i.e., welfare economics)." (TEEB 2010a: 14, italics in original)

Gowdy further claims that the independence assumption has been falsified by 'thousands of

[59] who is also author of the discounting chapter in the Foundations report.

empirical tests' and 'does not make good predictions of real economic behavior and offers a poor guide for economic policy.' (ibid.) He further questions the rational economic man and wants to replace him with *real world economic behaviour*, hence an appeal to a new kind of economic theory based on *empirical evidence*, rather than the assumptions necessary to fulfil the 'mathematical requirements of constrained optimization'.

Sukhdev introduces something which is almost a new story line in his preface to the Foundations report. Here, he introduces an analysis of the causes behind biodiversity degradation. This is exposed in the following way:

> "(t)he root causes of biodiversity loss lie in the *nature* of the human relationship with nature, and in our dominant economic model." (Kumar 2010: xviii, italics in original)

First, Sukhdev reminds us that our very survival depends on nature. Then he introduces an argument about the problem with modern, urban people separated from nature, because urbanisation creates both physical and emotional distance from nature. The many current crises, he claims all share the same cause: 'our failed economic model', inherited from the Keynesian era. He claims that '[t]he history of post-war economic growth has been one of unsustainable development' (Kumar 2010: xviii). This then leads him back to the earlier concern with the metrics. The problem with the Keynesian era was the metrics which was successful then, but not any longer.

He then discusses the solutions. One question he poses is whether we can reboot or whether we need fundamental change. He concludes that we need reform in fundamental ways, such as including natural (and human) capital in the accounts of society or 'expand the reach of markets to enable payments for ecosystem services' (Kumar 2010: xix). These are big changes, he claim, but they would address the root causes of the problem.

To carry this project through, TEEB favours pragmatism over perfectionism and common sense and equity over free-market fundamentalism. At the heart of TEEB's approach lies the recognition of nature's benefits. Economic valuations can communicate this 'using the language of the world's dominant economic and political paradigm' (Kumar 2010: xix).

In summary, TEEB relies on mainstream economic tools, in particular economic valuation, and economic principles for decision-making such as efficiency. To be able to apply these to biodiversity, nature must be coined in economic terms as services and capital. This in turn, allows the application of both microeconomic theory, monetary valuation and growth theory (more specifically the 'capital approach' to sustainability, see section 3.3).

Information and science

The lack of and need for 'information' is a reoccurring theme in the TEEB reports, including the argument that environmental problems exist due to a lack of information. Although sometimes used as a loose term, 'information' is mostly used in the economic sense, hence referring to economic information or economic value/valuation.

One can say, that the core of the Foundation report, is about making informed choices. From the economic perspective of TEEB (i.e., a version of welfare economics), society needs (full) information about the relative level of resource scarcity so that it can allocate its resources efficiently or optimally. For this purpose, (economic) valuation is necessary. In economics, the right information (automatically) helps identify the best decision. This is derived from one of the axioms of microeconomics, namely that more (numbers) or full information will automatically lead to the 'correct' outcome, which is the most efficient outcome or solution or action, or simply the 'optimal' outcome. Economic rationality does not concern itself with the end apart from that, only with the means. The end *is* whatever is most efficient. Since, TEEB wants to 'better inform' decisions and mainstream valuation, the assumption of the usefulness of valuation, is not questioned.

In an 'ideal' market where all social and environmental costs have been internalised, all necessary information is condensed within the prices. This is what is meant by 'price signals'. Starting from a neoclassical basis, this is the core argument used by TEEB with respect to the need for monetary valuation. Decision-makers need, or it is useful for them, to know the full range of costs and benefits

- to be able to make rational trade-offs (tier 2), and
- so that they can internalise the information into prices and incentives (tier 3)

The lack of information argument is closely linked to the analysis of institutional failure:

> "Changes in ecosystem services have impacts on human welfare. A clear understanding of these links can provide information that can lead to the reform of institutions and better decisions that ultimately improve the state of ecosystems and the services they provide to society." (Kumar 2010: 16).

In this quote, 'understanding the links' refers to the ecological knowledge, while

'information' is monetary value. What matters is getting the information right, then the information will itself do the job. We find this assumption expressed in various ways, as can be seen in the following statements:

- "current emphasis on 'evidence-based policy making' will be held back if we lack information on what is happening to our natural capital stock" (TEEB 2009c: Chapter 3: page 5); or
- "the policy implications of available economic evidence" (TEEB 2009c: 369).

The numbers in themselves (the economic evidence) have policy implications, without any mention of politics or different interests. This is what others call technocracy or a depoliticised discourse (see e.g., Redclift 1988). It is one of the many assumptions that are not questioned in TEEB.

> "The problems of management and governance of ecosystems stem from both poor information and institutional failures. In some cases, knowledge is lacking about the contribution of ecosystem processes and biodiversity to human welfare and how human actions lead to environmental change with impacts on human welfare. In other cases institutions, notably markets, provide the wrong incentives." (Kumar 2010: 12)

Here again we see how the word 'knowledge' links to the ecology part and 'information' to monetary values.

In this perspective, many problems are just temporary, as increased information gathering will finally solve them. The is the case both concerning the scientific knowledge and the economic information which are currently incomplete (Kumar 2010: xx).

This perception of information problems as just being of a temporal character is current throughout the reports. For example, monetary values about social and cultural services provided by ecosystem (which is a controversial and difficult task to assess), is mostly presented as a matter of 'not yet' existing (Kumar 2010: 137). Also the methodological shortcomings are often presented as temporal. As summarised in the Foundations report:

> "Valuation practitioners should acknowledge that valuation techniques face limitations that are *as yet unresolved*. They should present their results as such, and decision makers should interpret and use valuation data accordingly." (Kumar 2010: 293, my emphasis)

In a similar way, science is seen as a linear knowledge accumulating process. Hence, although 'the state of knowledge is incomplete' (Kumar 2010: xx), it is just a matter of time before we are better or fully informed and thus can solve the problems at hand in the (economically) optimal way.

Ethics, inequality and poverty

Unusual for neoclassical economics, a range of ethical or moral claims are expressed in various places of the reports. Mostly they concern the way we should use economic knowledge (i.e., concepts and numbers) for policy purposes and decision making. Often ethics (or values) is mentioned as a criteria for whether a specific solution or method is acceptable or reliable. Another aspect of ethics concerns how to take future generations into account in the choice of discount rate in economic valuation of nature (a topic treated in a whole chapter in the foundations report). Ethics is also appealed to when taking the poor into account (TEEB 2010c: 31-33), or when presenting other decision support tools than monetary valuation. TEEB explicitly recognises a range of limits to economic valuation, of which ethical aspects is one limit (in addition to methodological pluralism, credibility, and acceptability in society).

Another appeal to ethics, concerns the things we have to do, such as produce numbers even when they are uncertain, so that nature can be taken into account. Despite the methodological and ethical limitations acknowledged, and appeals that numbers should be used with care,

> "TEEB argues that the right ethical choice is to compute these imperfect valuations for society to use". (TEEB 2010a: xxvi)

The justification for this particular quote is the Stern review which showed 'significant carry in quantitative evaluations (as opposed to humanitarianism and common sense), presenting an argument for change in economic terms' (ibid).

7.4 Problems with the economic theory of TEEB

As explained above, TEEB's economic theory is neo-classical economics. This is not presented as a choice amongst several possible theories. Instead, what economics is, is stated more as a fact, than as a definition: 'Economics, *as the study of how to allocate limited*

resources, relies on valuation to provide society with information about the relative level of resource scarcity' (TEEB 2010a: 187, my emphasis). Hence, there is not much reflection in TEEB about what 'economics' *is* or *can be* or *should be*, or on which economic theories to base the study. A definition of economics is not even considered necessary, and just appears as an interposed clause roughly in the middle of the foundations report.

At the same time, some weaknesses with the theory are presented in various places, and there is also some critique. Gowdy's attempt at a critique (Kumar 2010: 20) in the Foundations report however, basically cleanses the TEEB approach, by pointing to the problem of neo-classical economics not being monetary valuation as such, but the unrealistic *assumptions* of the theory (especially economic man and the independence criterion). Gowdy wants a new economic theory based on empirical evidence, which will make better predictions about e.g., economic behaviour, and will be a better guide for economic policy. The critique of the Walrasian assumptions does however not challenge the neoclassical model at its core. This critique is present in the so-called "imperfectionist" tradition, basically post-keynesian, hence still part of the neoclassical synthesis. Their argument is that given the imperfection of information in the market, the state must interfere. However, the rest of the theory stands as it is.

In addition to pluralist approaches mentioned in Gowdy's critique, heterodox approaches are also mentioned once in the Foundations report. However, this does not give much impression of them being an alternative, since it only points out that heterodox and welfare economics seem to converge on the issue of sustaining human welfare in the future:

> "Interestingly, it seems that the policy prescriptions of both those using a more conventional welfare economics approach, and those who call for an alternative, heterodox approach to environmental valuation, are converging. (..) [Both approaches imply] aggressive conservation and ecosystem restoration policies in the present." (Kumar 2010: 263)

Kumar, the scientific coordinator, frames the discussion about economics to be about 'the advantages and limits of economics' (i.e., the method), rather than what kind of economics or instead of discussing strength and weaknesses with various existing economic theories. The limits of economics are discussed (the complexity of biodiversity, tipping points, resilience), but in the end there is not much concern for it. The weaknesses are sidelined like they were in the Stern review.

Political economy concerns, but no theory

While pluralistic and heterodox approaches to economic theory are at least mentioned in the Foundations report, 'political economy' is not. This is a bit surprising given TEEB's concern with issues of redistribution of income and wealth, and even with poverty and fairness, which are core topics and concerns in political economy (but not of neoclassical analysis). Given these concerns in combination with the promotion of the market institution in TEEB, one might for example have expected a discussion about the role of markets and their distributive effects. What about the possible need to limit markets due to inequality and poverty issues? Instead TEEB, promotes markets as the key societal institutions, which in practice means dismantling other instruments and institutions. This is done without any specific justification or theoretical arguments. How neoclassical economics can be combined with redistribution and equity is not discussed.

Economics as both problem and solution

Balancing between criticising and using mainstream economics is of course no simple task. In this respect, economics plays a paradoxical role in the TEEB discourse: on the one hand, economics (the economic model) is the problem, while on the other, it is the solution. How is this argued? How does Sukhdev navigate between the problem diagnosis of a post-war unsustainable economy which needs to be changed and the appeal to the dominant economic logic? The attempt is to be both inside and outside of economics, leaning on it for authority, while at the same time claiming it needs renewal.

Monfreda (2010) has suggested that the way Sukhdev gets around this paradox is by introducing ethics into already existing economic theory. TEEB claims the methodological credibility of mainstream economics for its own, while simultaneously asserting and then distancing itself from the discipline's ethical and political illegitimacy. It is not economics which is being in need of renewal according to TEEB - far from it, it is the policy.

But it is imprecise to claim that what Sukhdev is doing is to introduce ethics into the economic theory itself. As Monfreda (2010) points out, 'TEEB deals with economic policy, not economic theory, which is probably what allows them to attack the ethics of economic practice, while leaving in the economic rigour'. However, the rigour is there only in theory. In practice, (as also demonstrated in chapter 4), the over-extension and 'pragmatism' of monetary valuation of nature is already compromising this rigour. The economic practice that

TEEB is attacking, is in particular that of not calculating monetary values, which is then called ‘unacceptable’.

Although some aspects of neoclassical economic theory are presented as problematic, TEEB clearly draws its authority and legitimacy from it, expressed for example as leaning of ‘years of economic research’. It is at the same time clear that economics is different from science, expressed in the following way: ‘getting the economics right’, but ‘when the science is clear’ (TEEB 2010b: 12). Science is knowledge, while economic is a method.

Scope of the theory: efficiency

TEEB has limited its scope to deal with ‘the failure to account for the full economic values of ecosystems and biodiversity’. In this way, TEEB has defined the problem it deals with in a way that fits well with using neoclassical economics as solution. Economics, as TEEB defines it, is based on Robbins' definition and is concerned with efficiency. As introduced earlier (see chapter 4), the focus of such an economic approach is on optimal resource allocation.

With respect to biodiversity conservation, the neoclassical approach is concerned with optimal preservation/extinction or ‘perfectly informed extinction’, not with conservation as such. This is quite clearly stated by Kumar in the introduction to the Foundations report:

> “estimates of how well-off those in the future will be is the key factor as to how much (nature) we should leave for the future.” (Kumar 2010: 6)

Basically, the main goal of the approach is to internalise costs so that it doesn’t become profitable for companies to destroy nature, except when it is economically optimal to do so. That Sukhdev makes claims such as ‘inefficient use of nature and even destruction’, as if efficiency cannot lead to destruction, means that he either hides what the economic approach is about, or he doesn’t understand it himself.

One question is of course whether relative scarcity is relevant when dealing with biodiversity, or whether we rather have to do with a problem of absolute scarcity in this case. In some ways, this is indirectly admitted by saying that natural capital is critical. On the other hand, TEEB talks about substitutability of capital, and hence, again, undermine this important point or reservation.

The role of economics: management

The economics of nature is, like any 'new' field of economics (e.g., health economics, culture economics), not concerned with its substance matter (nature and its functioning), but instead with applying a specific kind of thinking - economic rationality - to that substance matter. In this respect, neoclassical economics is more like a tool box, or a method, than a science.

The modern application of microeconomics onto ever increasing spheres of society has been likened with a move from economics to management rationales (cf. Rose & Miller in chapter 2). Neoliberalism has led to the introduction of a management logic and language (i.e., micromamangement) into all spheres of society where it was not previously prevalent, such as for example the public sector or 'nature'. We can see this in TEEB as well, whether due to the study leaders' background or as part of the general trend, maybe most clearly with the slogan: 'measure to manage'.

It is not unique for TEEB to talk about the 'management of nature'. Also the MA talks a lot about management, but there it is used much more loosely, and might still refer to old-fashioned management. However, the specific understanding of management which forms part of neoliberalism is different from the former kind of expert management associated with administrative rationality or the Weberian model.

TEEB is explicit on this, as the TEEB approach is exactly a method for *how* to do this. It promotes a change in the way we manage nature by using economic concepts and tools, but also management techniques. This is a different way to manage from for example the earlier management plans of national parks, which took many different dimensions into account, and were based on an understanding of the subject matter of conservation. Hence, we see the difference between expert knowledge and 'commensurated knowledge' expressed in the common language of the powerful.

This kind of approach also involves portfolio management of 'natural capital'. That means relating to nature as something that can be managed like a portfolio, just as we do with other kinds of capital. The approach has close affinities to that of ecological modernisation, where the promotion of rational management of the world's resources implies a form of economic rationalisation.

7.5 From 'speaking truth to power' to 'speaking their language'

One of TEEB's eleven recommendations is to '**creat[e] a common language** for policymakers, business and society that enables the real value of natural capital, and the flows

of services it provides, to become visible and be mainstreamed in decision making' (TEEB 2010b: 24, bold in original). However, money is neither a new metric, nor is it a new language. The 'language of money' has been around for a long time.

Moving to the use of money, and reducing everything to this language, means expert knowledge (for example through numerical representation of the thing in itself) gets sidelined or has to adjust to the need of monetary measures (numerical representation using the general equivalent money). As the Foundations report points out:

> "Most of the current measures and indicators of biodiversity and ecosystems were developed for purposes other than the economic assessment outlined by TEEB. They are therefore unable to show clear relationships between components of biodiversity and the services or benefits they provide to people, making them less relevant to the audience and aims of TEEB.
>
> A set of indicators is needed that is not only relevant and able to convey the message of the consequences of biodiversity loss, but must also be based on accepted methods that reflect the aspects of biodiversity involved and the service that is of interest, capture the often non-linear and multi-scale relationships between ecosystems and the benefits that they provide, and be *convertible into economic terms*.
>
> While it is possible to obtain preliminary estimates of the consequences of biodiversity and ecosystem loss using existing data and measures, these must be complemented with active research and development into the measurement of biodiversity and ecosystem change, their links to benefit flows and the value of these flows so as to realize the full value of biodiversity and ecosystem management." (Kumar 2010, chapter 3, my italics)

Basically, what TEEB is promoting is *money as the language of the science-policy interface*, as the only way that insights from science can be taken into account in either public policy, business or private life. This is expressed in terms of 'building a bridge' between the two knowledge communities (TEEB 2010b: 3). At the same time it is also admitted that this common language is not just any language, or the most useful for the purpose of protecting biodiversity, but rather that

> "[e]conomic valuation, in particular, communicates the value of Nature to society *in the language of the world's dominant economic and political model*. Mainstreaming this thinking and bringing it to the attention of the policy makers, administrators, businesses and citizens is in essence the central purpose of TEEB:" (Kumar 2010: xxvii, my italics)

TEEB wants to speak to the powerful, play to power, so the choice is to speak their language. Environmental issues must be made of interest to the economic system.

> "We show that the failure of markets to adequately consider the value of ecosystem services is of concern not only to environment, development and climate change ministries but also to finance, economics and business ministries." (TEEB 2009b: 2)

This hope, that the economic argument will provide an additional argument for conservation, in addition to those existing already (intrinsic value, cultural value etc.) was also expressed by one interviewee. However, this seems to contradict the judgement that the root cause of environmental problems is linked to the dominant economic model.

And further, what are the indications that this will have the expected effect? Interestingly, despite Stern (2006) organising 'the complexities of trade-offs between costs of action and inaction and conveyed them in an effective language to decision-makers' (Kumar 2010: 4), it has not yet had much effect in terms of reducing global emissions of greenhouse gases. Further, the possibility of the economic argument being *in opposition* to the cultural and intrinsic values, is not taken into account in this line of argumentation.

This approach is also a far cry from Wildavsky who famously said that the role of science was to 'speak truth to power'. Wildavsky's claim has been contested by critical social scientist studies in line with Foucault, questioning the 'myth' of rationality, the 'will to truth' and demonstrating what is actually going on behind the scene of rational decision-making. Also science and technology studies and sociology of science have questioned the capacity of scientists to be objective, e.g., Latour showing how scientists get stuck in their own 'epistemic communities'. Still, explicitly taking the opposite position and instead choosing to 'speak the language of power' is a relatively new stance from a scientist perspective. It is also a far cry from such social activists as Arundhati Roy who is quoted in the synthesis and the interim reports, despite her work consistently consisting in fighting power and the spread of markets and economic rationality.

7.6 Measurement and the new metric

The use of the term 'metric' in TEEB is rather unconventional. Metric usually refers to a set of properties about something, or, like the metric system, to a specific system of units used to

measure. However, there is nothing new about the unit of measurement proposed in TEEB – namely money. Rather, what is new, is to apply it to new things, such as nature's 'capital' and 'services'. Further, money is a specific measurement rod, that does not really aim to refer to the properties about something, in the strict sense. If I put a money tag on one of nature's services, it partly reflect this service's use value to me (which of course has something to do with the properties of the object itself), and partly its exchange value (its value relative to other goods/services I might buy) which has little to do with the object of measurement intrinsically.

The theoretical basis for monetary valuations stems from postulations within welfare economics based on the belief that changes in human well-being can be *measured* as economic values. These values, in turn, are *revealed* through trade-offs between scarce resources. Here lies the main role of numbers within this paradigm.

What TEEB really wants to change, is the measurement system and the main societal measures of progress. First, TEEB wants to expand the national accounts with new categories of capital, in particular 'natural capital', but sometimes human and social capital are also highlighted. Second, TEEB also wants to expand the system of industries or producers, and include 'nature' as a producer of goods and services.[60] Third, they want to expand the capital accounts of the national accounts not only to be a system based on actual money transactions, but also to include *theoretically* estimated monetary values.

Generally, the expansion of the national accounts is argued for as a way to allow policy-makers to better manage society's (the nation's) wealth, in accordance with the 'capital approach' to sustainability, to develop a metric for sustainability, and to 'measure what we manage' (TEEB, 2008: 53). This is based on the axiom that, '[f]rom an economic point of view, the flows of ecosystem services can be seen as the "dividend" that society receives from natural capital' (TEEB 2010b: 7). Although TEEB does not refer often to growth (but rather use the wording 'economic development'), this approach is based in neoclassical growth theory where income is seen as derived 'automatically' from capital (see chapter 4). The implication is that, as long as we have stable or increasing capital, our future income is secured or 'sustained'.

The attempt to expand the SEEA in this way, however, is not new. The World Bank (WB) in particular, has been trying to promote wealth account for many years. For example at

[60] As a former colleague exitedly exclaimed after attending a meeting in the UN statistics committee about revisions about the SEEA: "this makes nature the biggest industry sector of all!"

the inaugural meeting of the ISEE, El Serafy from the World Bank recommended to integrate natural capital conservation concerns in environmental accounting despite its acknowledged shortcomings:

> "The recommendations stress that we should proceed without delay to incorporate ascertainable environmental degradation into national accounting, however imprecisely, fully realizing that such an approach will remain partial, but is bound to be expanded gradually as our knowledge of the facts improves, and as we bring more environmental concerns into relation with the measuring rod of money." (El Serafy 1991: 168)

However, the WB's attempt have so far had limited success. According to one interviewee, TEEB triggered their relaunch: 'This is what UNEP keeps doing. The wealth accounting was earlier somehow swept away, but now somehow revived'.

TEEB wants to use the new national accounts for calculating new measures of progress and wealth. The old GDP should be left behind, and replaced by adjusted GDP or green GDP: 'the fundamental requirement is to develop an economic yardstick that is more effective than GDP for assessing the performance of an economy' (TEEB, 2008). As for the current version of GDP as a measure of economic performance, it is implicitly assumed that this adjusted measure of GDP will have to grow when the economy performs well.

With respect to defining new measures or targets, and hence for setting new directions for society's development, the compass metaphor works. However, again it becomes messy, as TEEB goes beyond arguing for new targets and directions, and introduces appropriate economics to repair the compass:

> "Society's defective economic compass can be repaired with appropriate economics applied to the right information. This will allow existing policies to be improved, new policies to be formed, and new markets to be created: all of which is needed to enhance human well-being and restore the planet's health." (TEEB 2008: 47)

Unlike a compass which only indicates directions, this compass also tells you *how* to go there, or at least recommends how to: by using 'appropriate economics', in other places called 'sound economics'. The 'faulty compass' applies both to our national accounting system, but also to every level of society where externalities goes unaccounted.

> "Our economic compass is defective because of unaccounted externalities at every level – national, corporate and individual." (TEEB 2008: 53)

> "[UNSD 2008] can be a starting point for preparing holistic national income and wealth accounts that reflect externalities in the areas of natural resources, health and education. At present, few countries produce holistic national income statistics on this basis, and there is no comparability because different areas are covered, different externalities captured, and there are varying degrees of granularity. (..)Sub-optimal policy choices and trade-offs are likely in the absence of a 'sustainability yardstick'." (TEEB 2008: 54)

The reference here to comparability is not really relevant for sustainability, because sustainability is not about comparing with other countries, but about tracking the development in one place or region (or at best comparing it to some baseline which is sustainable for that region).

7.7 TEEB's main challenge: Navigating between the weaknesses of monetary valuation and its promotion

I chapter 4, I presented the story about how the natural scientists were struggling to communicate the importance of biodiversity and healthy ecosystems to politicians and the general public. This was the background that made some scientists start placing monetary values on (parts of) nature and coining ecosystem functions using economic concepts (i.e., 'natural capital' and 'ecosystem services'). TEEB's initial mandate had a similar purpose: to communicate the (global) economic benefits of biodiversity in monetary terms, as well as the economic costs (value) of its loss versus the costs of its preservation. As the TEEB project proceeded, however, it took a different path.

The argumentation in TEEB concerning the meaningfulness of carrying out a global cost-benefit analysis on biodiversity (and ecosystems) also changed along the way. In the interim report (TEEB 2008), a tentative price tag was put on the loss of biodiversity. Through a so-called 'Cost of Policy Inaction' (COPI) study, some initial estimates of the economic impacts of biodiversity loss at a global scale were provided, suggesting that the cost of a business-as-usual scenario on terrestrial biodiversity loss would amount to 7% of annual consumption (GDP) by 2050 (TEEB 2008: 35). This was considered a conservative estimate. It was also highlighted at the press releases of the first report from phase II (TEEB for policy

makers) (Dimas 2009). The much quoted, but highly contested, estimation of the total economic value of the world (US$ 33 trillion per year) published in *Nature* in 1997 (Costanza, et al. 1997), was also included in the interim report together with another attempt at partial cost-benefit calculation.

However, by the launch of the key reports for phase II, all of these numbers had been taken out of the reports. There are several explanations for this. According to one interviewee, there was broad scepticism from the very beginning, at the administrative level both within the EC, the German environment ministry and the EEA, to produce a Stern-like report for biodiversity and to calculate an overall global number:

> "What then happened both at the Commission and German and EEA level (..) was to try and reframe this from trying to produce the one big number into something broader, and then it got even broader as it moved on." (Interview)

The high number of ecological economists amongst the academics involved, might be one explanation of the scepticism to such calculations. Generally, however, the scepticism was not directed at the Stern review in itself, but due to the fact that ecosystems and biodiversity are different from the climate issue. They were seen as more complex and lacking a common denominator (such as CO_2-equivalents).

According to one interviewee, Sukhdev was initially keen to carry out the task of calculating one overall number, but was convinced along the way to drop this idea. Hence, in the preface to the foundations book he has adopted the argumentation about complexity and lack of common denominator (Kumar 2010: xvii).

The interviewee explains further that despite the scepticism, there was still an aim to:

> "try on the one hand to get to some sort of numbers, but I think also to try to broaden it out a little so that it somehow makes sense and that you do justice to biodiversity being much more complex than climate change." (Interview)

> "But, I remember when I first read the call for tender for the scoping study. I thought, how can you possibly... I mean, the whole thing is totally static (..). It wasn't the call for tender first draft, just kind of assuming, who will do this and that and there was no sort of feedback or adjustments or anything in there, it was just linear projection of some strange trend. And, I think, I'm not even sure what exactly changed that, but I think a lot of people realised that this just won't work, you could pull a couple of (...), with this scoping studies and the famous 2

> point something to 3 point something billion or trillion or whatever it is, regardless of GDP loss in 2050. They definitely attracted I don't know how many journalists and they all called up to ask how is that made and that matter and I've had, I don't know whole generations of people re-reading the scoping study and trying to make sense of that, and trying to explain that to journalists who come from a different angle. So it did serve to attract attention, but I think we all realised that this, yeah, it makes little sense in trying to fine-tune what is there and go for the one big number." (Interview)

The result of this scepticism was that global figures on the value of biodiversity or on the value of its loss, were removed from the final reports. TEEB did therefore not carry out a global cost-benefit study as first mandated, with a few main figures as the main output and conclusions. Instead the main output from TEEB was the 'TEEB approach'.

The 'official' arguments given for leaving out such numbers are however formulated in quite mild terms. In the synthesis report, the choice to leave out, or not calculate, such aggregate figures is explained as follows:

> "Although such large-scale assessments may be helpful to outline the economic importance of natural capital, estimating the costs of biodiversity loss at a global scale remains a controversial and complex undertaking, and the resulting numbers should be used with care.
>
> Apart from exploring such 'big numbers', and perhaps more usefully, the TEEB reports offer **numerous case studies** of the economic impacts of biodiversity loss, and the economic opportunities from recognizing and responding better to the economic values of biological resources." (TEEB 2010b: 10, bold in original).

The reason why the task of calculating global values for biodiversity value was left out, is explained in the following way:

> "Several factors have influenced this choice, such as the difficulty of establishing the meaning or relevance of any such value given that we have no alternatives to Earth's biosphere; the plurality of ethical perspectives for valuation, its purposes, and its contexts; and, conversely, the actionability and human relevance of working at scales such as biomes, countries, regions, and communities. Instead, with 'mainstreaming' as its avowed principal objective, TEEB intends to help decision-makers recognize the wide range of benefits of ecosystems and biodiversity, demonstrate their values in economic terms and, where appropriate, suggest how to capture those values in decision-making." (Sukhdev, et al. 2014: 5)

As we can see, especially from the quotes from the interviewee above, despite the scepticism by many academics involved as well as in the administrative bodies of the institutions in charge of the project, there was still a wish to produce 'some sort of [monetary] numbers', hence, a belief in the need for numbers to make the economic case for biodiversity conservation.

When the first draft chapters of the foundations report were put online for public comments in the autumn of 2009, the plan included producing own numbers, like the Stern review had done, although not in terms of global figures or the one 'big number'.The outline of the planned report included a chapter with preliminary analysis of the costs of action and inaction for several biomes. The limitations of such an exercise were repeated, and the illustratory purpose of the exercise highlighted:

> "It should be realized up front that data and methodological limitations remain, and the TEEB assessments provided are therefore chosen to illustrate the benefits and costs of biodiversity conservation and sustained ecosystem service provision in different contexts and at different spatial scales. It is not the intention to make an estimate of the total economic value of ecosystem services at a global scale." (Draft Foundations Report,[61] Chapter 1, page 6)

The report was also meant to have a chapter on macroeconomics, exploring the state of knowledge on assessing the impacts of changes in ecosystem services and comparing the costs of inaction and action at the macroeconomic scale (Draft Foundations Report, Chapter 1, page 6). However, both of these chapters were 'quite shaky' (Interview), and were in the end taken out. Therefore, and unlike the Stern review, the TEEB project did not calculate any own numbers. Instead, it relied solely on numbers and case studies from existing studies and experiences. However, just removing the whole calculation exercise from the foundations report was not unproblematic, since

> "especially the Commission wanted some sorts of more solid numbers and felt it would be helpful to also have regional examples and also have more than just anecdotal examples. Something slightly more advocated. But then the advisory board was completely against coming up with more numbers. Even Sukhdev dropped that idea because, then the main line of argument was – we made the case that something has to happen, and now we should focus

[61] www.teebweb.org

> on what should happen and how can things happen, try and not re-cook the whole number story." (Interview)

We can see now, that the slightly cryptic explanations above, of why aggregate numbers were left out, is a kind of ex-post rationalisation of what happened. The TEEB approach, first coined in the synthesis report, can in this way also be understood as a way to come up with 'something' since they did not produce the aggregate numbers they had planned to. Although the topic of 'how to' had been dealt with extensively throughout the reports, it was only when the aggregate numbers could not be produced that the TEEB approach was highlighted as the main output of TEEB phase II.

The synthesis report therefore includes a variety of numbers, of which some are estimations of total economic value for limit areas (e.g., insect pollination), but also damage costs saved by conserving forests and benefits achieved by planting trees, or income loss from overexploitation of fisheries (this is coined as 'underperformance' of fisheries). Other monetary numbers illustrate the market opportunities represented by green products and services. Some numbers related to livelihood are not presented in monetary terms, such as the amount of people depending on coral reef ecosystem services for their livelihood. All these numbers are presented in a box called 'Some numbers' (TEEB 2010b: 8).

Despite admitting the limits of and various problems related to the approach and despite the reservations made, the call for monetary valuation in TEEB is still very strong. In the introduction to the TEEB approach, it is even expressed as 'unacceptable' not to undertake economic valuations:

> "In general, however, one should not shy away from providing **the best available estimates of value for a given context** and purpose and seeking ways to internalize that value in decision making. Indeed, the TEEB study calls for assessing and internalizing such values wherever and whenever it is practical and appropriate to do so. **A failure to do so is** unacceptable: namely, to permit the continued absence of value to seep further into human consciousness and behaviour, **as an effective 'zero' price**, thus continuing the distortions that drive false *trade-offs* and the self-destructiveness that has traditionally marked our relationship with nature." (TEEB 2010b: 12, bold and italics in original)

However, it is unclear why TEEB uses such strong language about numbers after having admitted all the problems. It is not easy to understand the switch in argumentation. Part of it

is an attempt to argue, that despite its limitations, economic valuation can provide knowledge which is indispensible (the communication or awareness argument). Another argument is that we are (unfortunately) in a situation beyond return, i.e., 'a time of consequences' (Kumar 2010: xviii), with increasing urbanisation creating physical and emotional distance from nature. Hence, many of the reservations made about local context and traditional values are perceived as relevant only for indigenous or traditional communities. Modern people on the other hand, are in a different situation:

> "Society's over-reliance on markets to deliver the goods and services we need for our well-being, along with our almost total dependence on market prices to indicate value, means that society does not measure or manage the economic value that is exchanged in ways other than through markets, such as the public goods and services that comprise a large part of nature's flows to humanity." (Ring, et al. 2010: 23)

Ideally we would respect nature and respond to humanitarian and common sense arguments, but this has unfortunately failed. So the story goes. Even, the TEEB approach, or in particular economic valuation, is not presented as an ideal solution to biodiversity loss, but rather as pragmatic, given the circumstances of our societies. Therefore, TEEB is explicitly pragmatic, that is, one must appeal to the current dominant language and what the policy makers want:

> "It has been argued that using monetary valuation of ecosystems and biodiversity buys into the very free-market system that is the root cause of biodiversity loss in the first place, or that sustainable management of biodiversity may well be possible without monetary valuation (see eg O'Neill 1997). A pragmatic response to this challenge is that policy makers usually have a strong preference for assessments that are expressed in monetary terms." (TEEB 2010c: 32-33)

The way to get around the problem or solve this dilemma then, is to present the argument for economic tools and thinking in an open way, not as *the* solution, but as one tool amongst many. It '*can* help equip society with the means to incorporate the values of nature into decision making' (TEEB 2010b: 10, my italics), or it '*can help* clarify (..) why successful environmental protection needs to be grounded in sound economics' (TEEB 2010b: 3, my italics), and it is pointed out at that 'valuation is not seen as a panacea' (TEEB 2010b: 3). Plus, the data must be used in 'the right context', only 'when appropriate' and 'with care'.

The main argument against a global cost-benefit analysis, as seen by the 'sceptics' of

TEEB, relates to the lack of common denominator for biodiversity. If such a common denominator existed one could calculate the total value of nature by multiplying the monetary value of nature per common denominator unit with the amount of nature in the same unit. This is sometimes done for specific ecosystems using a method called benefit transfer.[62] Costanza et al. (1997) for example, use this method extensively.

In addition to the methodological problems related to actually calculating monetary values for biodiversity globally, the sceptics make the argument that cost-benefit analysis does not make sense at the global level, because we have no alternative to the Earth's biosphere. This argument is hard to make sense of, since it seems not to relate to global biodiversity loss as actually being an *aggregate* problem. Do we have any more alternatives to countries biospheres if we all go down this route?

TEEB recognises some other limits as well, which are particular to monetary valuation of ecosystems and biodiversity, such as tipping points and resilience. Monetary valuation measures only marginal utility related to small changes. Hence, when an ecosystem approaches a tipping point, such values are not useful. In such cases, one must rely on another value system.

The Foundations report informs that there exists two different types of valuation systems, one based on monetary valuation and the other on biophysical properties. Despite the various weaknesses, TEEB only considers the monetary one, without further justifications.

Other limits are linked to ethics, plural values, incommensurability of values, credibility, and acceptability in society. In the Foundations report, each single presentation of a method for calculating monetary values, ends with a section on limitations. Some of this, it is argued, can be improved with more data (e.g., 'Data enrichment models as the way forward', chapter 5). The question which still arises, is how TEEB argues for this and navigates between the various arguments for and against monetary valuation.

Basically, the general message from TEEB does not question monetary valuation in any substantive way. TEEB just reminds us that there are situations where monetary valuations are less reliable or less suitable. Therefore the results should be used with care, and one must be aware of local circumstances.

Some statements are quite blunt in light of these warnings of care. One example:

[62] For example: one uses the result of monetary valuation studies in one place, and multiply it by the amount of the same kind of nature worldwide, e.g., wetlands.

> "It's hard to think about a decision not improved by money info." (TEEB 2010b: 11).

The measurement rod for 'improved' here is probably efficiency, and not biodiversity conservation, since that is the scope of the economics that TEEB applies. However, here the reservations made earlier in the text is completely forgotten: that in some cases monetary valuation can actually be 'counterproductive' (TEEB 2010b: 11).

In one respect, broadening it out, using care etc, is an attempt to shift the logic, as it does not address the main critiques put forward. If the approach has problems, does it help to use it as one amongst many tools/solutions/approaches?

Overall, the limitations are simply sidelined, similarly to what the Stern Review did (see Spash 2007b). Instead monetary valuation is promoted. There is no attempt to clearly delineate when to use or not to use monetary valuation. The only clear message given is that it is 'unacceptable' not to undertake such exercises (TEEB 2010b: 12).

Why we need monetary valuation

The first reason for producing monetary numbers is because the information is useful for both policy makers and business, and necessary for *rational decision-making*. For this purpose, the numbers must be of good quality, if not the trade-off might be sub-optimal or even inefficient.

EU Commissioner Dimas has been clear about the importance of both high-quality information and the need to assess the value of natural capital:

> "Firstly, it is not enough just to recognise that biodiversity is the world's 'natural' capital, providing vital goods and services that underpin our economies and societies. We need to go one step further and assess the role and value of this natural capital at regional and national level. Only then will it be possible to fully factor biodiversity into the policymaking cycle and put it on a par with other economic considerations. (..) Secondly, good policy depends on high-quality information." (Dimas 2009: 2-3)

Hence, not any number will do. It has to be high quality information.

TEEB, on the other hand, is clear that we should not wait for perfect information (i.e., high quality information) before acting 'because it is urgent to save biodiversity'. For this acting, numbers are still seen as necessary or useful. The precision of the numbers is not so important. The best available estimates are good enough. Ultimately, no criteria is presented

for what is 'good enough' in terms of quality. The problem, from a theoretical perspective, is that if the numbers are not correct or of good quality, then trade-offs will be wrong, or sub-optimal. However, this can never be observed or known, since efficiency is not a 'testable' phenomenon.

Then, TEEB (like Dimas above) argues that demonstrating value 'will not in itself lead to changes'. What is needed it to 'translate that knowledge into incentives' (TEEB 2010b: 10). Therefore, beyond rational decision-making there is also the main element of the TEEB approach, which is about capturing value. While markets can be created and economic incentives established without prior monetary valuation, not so for internalisation of value/externalities. For this, monetary valuation is necessary.

At other times, TEEB's arguments for producing such numbers are more in line with the conservation biologists in chapter 4: this is done in order to *communicate* the value of nature and to create awareness.

Then there are times when TEEB responds to the criticism of monetary valuation by simply stating that this is *what policy makers want.* Hence, despite the weaknesses of monetary valuation, it must be done for 'pragmatic' reasons (TEEB 2010c: 32-33). It is also justified by the usefulness for decision makers 'to consider full costs and benefits' (TEEB 2010b: 11). This is again a problematic statement, because, what is 'full' supposed to mean in a situation of many methodological weaknesses? And in any case, the monetary values do not show the full range of ecosystem services, since they can only capture what can be quantified in monetary terms.

7.8 Making nature visible as capital

In MacDonald and Corson's (2012) words, TEEB is about making nature visible 'as capital'. Both 'mainstreaming' and the TEEB approach aims at establishing a new way of 'seeing', representing and valuing nature. This is done with the help of economic tools, mainly monetary valuation, so as to make nature 'economically visible'. In this way, TEEB actually promotes seeing the world through the lens of neoclassical economics and its monistic value system. In this respect, we can consider TEEB to be an epistemic project (Ernstson and Sörlin 2013).

The specific way of making visible, also allows 'nature' to be grasped for the purpose of steering, here in the neoliberal way of steering, i.e., 'management'. In this respect, one can understand the TEEB project in light of Foucault's concept of 'governmentality'. This would

imply seeing the construction of 'nature' as an object of knowledge, made 'graspable' and hence 'manageable' through specific concepts and counting categories, and a sphere within which certain types of intervention and management are created and deployed. Interestingly, this is all explicit in TEEB.

What Foucault did not pick up on, maybe because of his preoccupation with the state and state power, was how, within a neoliberal logic, creating governable objects, at the same time lays the ground for the creation of new commodities and markets as the main institution. There is only a short distance from this kind of manageable objects to commodification. Hence, in the 'right' context, making governable is a first step to making an object commerciable or tradable. In this way, management in the neoliberal sense has some important material impacts.

MacDonald and Corson (2012) go further and interprets TEEB as virtualism, i.e., a project working to align reality with an idea (or ideology). TEEB suggests methods to 'uncover the hidden values of nature', that is, be descriptive of the world. MacDonald and Corson (2012) suggest that while TEEB's slogan is to 'make nature's values visible', what they actually aim at is making nature visible 'as capital'.[63] The title of Robertson's (2006) article – *The nature that capital can see* – hints to the same mechanism. While Foucault's governmentality concept concerns the state, one could here say that the TEEB approach helps making nature graspable and steerable also for businesses.

An ontological or epistemic project?

It could also be that the kind of approach or logic promoted by TEEB might impact on what we take to be real. TEEB sees nature through the economic concepts of 'natural capital' and 'ecosystem services'. The concept of ecosystem services has already been defended widely for its potential to create awareness of humans' dependency on nature. This is considered particularly important with respect to city dwellers (Gomez, 2015), who make up more than half the world's population (TEEB, 2010).

These concepts provide the whole basis of the project's exercise and is never questioned or problematised. The problem of fitting ecosystem functions and nature into economic categories such as capital and services, are not problematised in any way, unlike monetary valuation. The only practical problem is that sometimes nature doesn't fit easily,

[63] In a similar way, Callon has described how microeconomic theory has come to constitute the economy.

because after all the concept is a construction in the double sense (all concepts are constructions, but this one is not meant to have a real referent in the 'natural' sense). So while some (e.g. Holland) worry that conceptualising nature in terms of capital and services might have constitutional effects on how we perceive the world around us, the story that TEEB indicates, is something like this: Most of the world's population today live in cities, hence unfortunately remote from nature and immersed in markets. However, more of the same might help, because according to Sukhdev:

> "In the long run, it may even contribute to internalize a respect for Nature into western cosmology and social life, and thus help address a 'root cause' of the problem of biodiversity loss and ecosystem degradation which (..) lies in the *nature* of the human relationship with nature." (TEEB 2010a: xxv, italics in original)

7.9 The rationalities of TEEB

We can see (at least) three different rationalities at play in TEEB. First, the neoclassical economics one, strongly based in economic rationalism, which needs monetary numbers to internalise externalities and calculate economic incentives. Secondly, we find the neoliberal rationality (strongly associated with Austrian economics and the Chicago school), whose main focus is to establish markets as the main coordinating institution in society. Finally, we see a cultural relativist rationality, which assures the spaces and acceptance of other cultures, values, or ways of doing things, and holds that not one size fits all.

However, only the rationalism of neoclassical economics is really presented as rationality by TEEB itself. And it is this kind of rationality that TEEB promotes. TEEB even promotes that we transform our thinking, to become more economically rational, to become like 'rational man'. Compared to the initial mandate given by the G8, to carry out a global cost-benefit analysis of biodiversity, TEEB can be seen as a *cultural transformation project* (cf. Meyer 1986) given the way it promotes the spread of a universal rational logic globally (Ernstson and Sörlin 2013).

Given that the neoclassical rationality uses numbers to help establish new markets, the neoliberal and neoclassical rationalities merge, despite their different understandings and conceptualisation of the economic system. The cultural relativist attitude, on the other hand, legitimise the whole process, because of all the 'soft' clauses they have managed to incorporate. However, as have already been demonstrated above, most weaknesses and

limitations are effectively sidelined, and the main message that stands out is monetary valuation, markets and economic rationality. In this way, one could conclude, that those actors in the project that initially worked hard to avoid a global CBA, and instead 'broaden things out a bit' (Interview), actually became useful fools for a purpose and process they do not support. One interviewee explicitly expressed that ecological economists should never have gotten involved, because they would just legitimise neoliberal approaches.

7.10 The institution of TEEB: The market

The economic rationality in itself, is not enough to carry through the TEEB project. There also needs to be the production of numerical input. For this purpose, conventions (abstraction/standardisation) need to be established on how to cast nature in economic terms, not primarily for producing monetary values, but to be able to divide nature into parts that can be thought of and dealt with in economic terms.

As we have seen, this project is substantively advanced already. Actually, what TEEB proposes is a thorough restructuring of our institutions for regulating nature and environmental problems, by suggesting a new kind of political-economic framework strongly based on the market.

Desrosières has noted how each period of capitalism has depended on a certain kind of statistics or numerical input, with the current one relying in particular on microeconomics (new measures of equivalence) and micromanagement (performance measures). TEEB makes the case for developing institutions which support the economisation of certain social relationships. This, of course, has institutional effects, in terms of the new way to regulate nature. One such way, is to convert regulations into market mechanisms, which is exactly what carbon trading or biodiversity offsetting is about. In this respect, the TEEB project can also be seen as helping 'advance' the process of economisation of nature.

One could consider the economisation of nature, or monistic value treatment of nature, as a suggestion for a new mode of regulation. Such a mode of regulation would include exchanging public regulation with market mechanisms, such as tradable permits. In this way, nature could possibly provide the basis for the new growth regime, not only through its conversion into (objects of) 'untapped' capital that can provide a flow of services, but also through various financial instruments. Both promise to create jobs, and can in this way help make the imaginary attractive as a new social compromise. Both are also present in UNEP's

Green Economy project (UNEP 2011). Whether the imaginary of the green economy is realisable as a new (temporary) accumulation regime, is however an open question.

7.11 Lack of causal analysis (omissive critique)

TEEB does not aim to look for explanation of the underlying causes of biodiversity degradation. This is not seen as necessary since the chosen factor that TEEB concentrates on is the lack of accounting for nature's value. The problem is perceived to be simply that of 'market failure', to which neoclassical economics has already the solution: internalisation and markets. It is therefore not necessary to discuss the appropriateness of the solution. From a scientific perspective, however, one should question the proposal of solutions upfront, without a more substantive causal analysis.

On the other hand, the lack of causal analysis, is in one respect not surprising, given the economic approach used by TEEB. Neoclassical economics is not an explanatory science. It also does not aim at understanding the economic system, but concentrates on recommending economic policy based on predictions about behaviour.

The MA, on the other hand, did identify underlying drivers, of which economic activity and economic growth is one. TEEB also admits in one place that economic growth is a driver for biodiversity degradation (TEEB 2010b: 9). This is however left behind, since TEEB is only concerned with one specific factor: the lack of monetary information (TEEB 2012a).

However, contradictions appear in this theme as in many others. Sukhdev launches the current economic model to be the main problem in the Foundations report. Further, he claims that humans' relationship with nature is the root cause of our problems. Still, this is taken out of thin air, since there is no discussion or analysis anywhere about the underlying drivers. In any case, Sukhdev claims that the TEEB approach will address these root causes.

Although TEEB aligns with the MA, it is easier to observe in the MA that the underlying drivers are *not* being addressed by the actions proposed. Especially, population growth and economic growth are just taken as given, something that will happen and nothing can be done about. TEEB gives a lot of leeway to various qualifications and alternative views and contexts. However, the underlying drivers are not questioned, and—it seems—belong to the realm of topics that cannot be questioned within this discourse.

7.12 Misrepresentation and promises

Repeatedly in the TEEB reports—for example in TEEB's vision—we get the impression that TEEB is about saving biodiversity, although its main focus is to address the economic invisibility of nature. Given that the method suggested is actually about efficiency and more markets, this cannot qualify as anything but a misrepresentation.

Further, the scientific method used is questionable. TEEB illustrates the various recommendations with a multitude of examples (which they call 'case studies'), but this 'evidence' is chosen to fit the message. There is no mention of environmental conflicts arising, for example in opposition to the 'capturing' of water services by private companies or to projects for offsetting biodiversity destruction.[64] Although the report for local and regional policy makers does discuss how to handle conflicts and conflicting interests more generally, the word 'conflict' is not mentioned once in the synthesis report.

As noted already above, TEEB admits a range of weaknesses with monetary valuation, measurement problems as well as social aspects. Despite all the uncertainty admitted about such numbers, TEEB does not shy away from giving the impression that they are precise figures: 'Countries, companies and individuals need to understand the *real* costs of using the Earth's natural capital' (TEEB 2008: 47, my italics), or decision-makers need to 'consider the *full* costs and benefits of a proposed use of an ecosystem' (TEEB 2010b: 11, my italics). Such repeated wording makes it particularly easy to forget the underlying problems related to the production of these numbers.

In these respects, one must question the truthfulness of the story told and the approach promoted by TEEB.

7.13 The overall picture

Content wise, the TEEB reports build on a range of studies on monetary valuation of nature using economic concepts such as natural capital and ecosystem services (see chapter 4). In particular, it has many parallels to the MA and also builds on MA's conceptualisation and categorisation of ecosystem services. Theoretically, TEEB draws in particular on a pragmatic version of environmental economics, and also to some extent on ecological economics.

TEEB is a visionary project, in particular, due to Pavan Sukhdev. In his story line and various reflections, the scope of TEEB is much broader than just nudging behaviour by

[64] See for example www.ejolt.com for an extensive overview of environmentally related conflicts.

means of economic incentives. It aims at being both an inspiration and an invitation, as well as a catalyst for a new economy (TEEB 2010b: 3). Also TEEB's graphical design is visionary and inspirational. Apart from the foundations report, which is printed in black and white, the TEEB reports all have an attractive look. The covers have colourful pictures from various nature settings. The reports are also full of colourful illustrations (boxes, figures, tables) and photos. Some of the reports even use visionary citations from for example economist Amartya Sen, social activist and writer Arundhati Roy, or even Wolfgang von Goethe.

In many respects, the TEEB discourse resembles that of ecological modernisation. For example, it contains much neoliberal jargon such as the need for transparency and accountability, it believes environmental and economic concerns can be reconciled and suggests new pathways for economic development (or growth), and it relies heavily on rational decision making and managerialism. In all end-user reports, the global biodiversity crisis is framed both as a challenge and as an opportunity. Seeing the crisis as an opportunity, is even one of the *conditions* for mainstreaming the values of nature:

> "Including the full value of biodiversity and ecosystem services in decision making can be achieved if their sustainable management is recognized as an economic opportunity rather than as a constraint on development" (TEEB 2010b: 28).

In some respects, the discourse aligns more closely with that of sustainable development. This is maybe most obvious from its concern with poverty and inequality (which normally are not part of the discourse of ecological modernisation), but also from its concern with legitimate decision processes and with the role of stakeholder, participation and local context.

However, the TEEB discourse also has some original elements. Partly this is a result of a new way to articulate the elements of the discourse, partly some arguments are new, and partly TEEB is very open about some strategic elements of the discourse as well as explicit about weaknesses or limits of the approach. One of the new arguments, is the promotion of a new economic model. Sukhdev claims that we currently see the coming together of several crisis, and that society is in need of deep reform. The problem is 'our failed economic model' (Kumar 2010: xix) which favour private rather than public wealth, physical rather than natural capital, and which is based on an outdated measurement system. Changing this model requires us to adjust the way we account for nature economically, and to adjust our main economic measures, like GDP. According to Sukhdev such reforms would address the 'root

causes' of loss of biodiversity loss (Kumar 2010: xix).

Some elements of the TEEB discourse are not new, but are articulated in new ways. The needs of the decision-makers for information so that they can make rational trade-offs and better decisions, are taken into account, but combined with a 'soft approach' that does not push anything unconditionally. At least so it seems at first sight. The alienating language of neoclassical economics is mostly replaced by vaguer and undefined everyday words like 'economic', 'value', 'cost', etc., and both the needs of the bureaucracy and those of participation and context are taken into account. At first sight, it seems like a remarkable exercise in pulling together the needs of various groups and managing to combine more democracy, more market and more administration in a win-win solution both for the economy and for the environment. It is argued that the solutions recommended by TEEB might require some tough changes, at least for some groups, but ultimately these are outweighed by the opportunities that comes with it. A closer look, however, reveals a range of contradictions.

TEEB is very open about many of the limits and problems related to monetary valuation, be it methodological, ethical or consequential. First of all, TEEB did not want to calculate a global CBA, because of the meaninglessness of such numbers. The approach is often presented together with its limitations: the approach is not a panacea, context is important, one should only value when appropriate, etc. This gives a sympathetic and non-dogmatic impression and invites trust. However, later, certain unconditional statements sideline and undermine all the problematic elements considered. This makes it rather confusing to grasp the argument about monetary values, when they are appropriate or why they are needed. It also raises questions about the role of theory, since the strict logic reasoning characteristic of neoclassical economics is explicitly replaced by 'pragmatic' solutions.

Box 7.1 - Main elements of the TEEB discourse

1. Basic entities recognised or constructed
Democratic liberal capitalism
Markets, prices and property
Scarcity
Rationality
Nature as capital and service provider
Natural capital as the foundation of our economies
Poverty and inequality

2. Assumptions about natural relationships[65]
Nature subordinated to human problem solving (can be traded off when useful)
Nature to be managed like a portfolio of capital (when we soon get enough information-knowledge)
Win-win: economic growth/development, environmental protection, distributive justice and long-term sustainability go together
Full information => best possible action

3. Agents and their motives
Decision-makers and managers (and their need for information)
Environmentalists should strategically play to power
Everybody can contribute - we're all in this together
Motivation can be intrinsic, but 'modern urban man' is mostly economically rational
Motivated by public good, defined in unitary terms

4. Metaphors & Rhetorical devices
Reassurance
Faulty economic compass
Making nature 'visible'
'The new economy'
The authority of economics

In Box 7.1, I summarise the main characteristics of the TEEB discourse, building on Dryzek's four main categories for describing discourses (presented in the methods chapter). After describing the discourse, I have deconstructed it, demonstrating various inconsistencies, weaknesses in argumentation, implicit and explicit rationalities at play, as well as misrepresentations about the main purpose and likely effects of the TEEB approach. TEEB admits that both neoclassical economics, monetary valuation and our economic system have weaknesses, but the weaknesses are in practice sidelined. We are left with the solution which was there from the beginning - the market and economic incentives. One could claim it was a

[65] By 'natural relationships', Dryzek does not here mean relationships to nature, but relationships that are perceived as 'natural', that is, are taken for granted in the discourse.

solution in search of a problem. Biodiversity loss presented itself as a problem to which a ready made solution can be applied, in the same way as climate change had done for the Stern review.

In this respect one can understand TEEB as one of many moments in the neoliberalisation of nature. Neoclassical economics and Chicago school economics merge in a common promotion of the market as solution to the problem of biodiversity loss. One could say that CBA prepared the ground for market solutions. Although first carried out at the service of state planning, with the change to a focus on internalisation of externalities, mainstream economics and monetary valuation moved to being at the service of the market institution.

Three elements characterise the TEEB approach: instrumental rationality (with respect to nature), a monistic value system and the institution of markets. A main argument is that environmental problems exist due to a lack of information (about monetary values or the benefit of nature for humans). We therefore need to produce such information. One key element in this respect is the 'new metric', i.e., the need to implement natural capital accounts in the national accounts to allow nations to manage their national wealth. Once we have monetary values, these can further be internalised so that they are visible in the market signals. In this way it will not become profitable for companies to destroy nature except when it is optimal to do so. Internalising externalities instead of using laws and regulations to control environmental damage, creates economic opportunities. Seeing biodiversity loss as an economic opportunity, is key for the TEEB approach to be successful.

When reading the TEEB reports, one striking difference between the key messages from the project and the kind of discourse conservationists were defending when calculating the value of the world (see chapter 4), springs to mind. While TEEB suggests that calculating numbers on costs and benefits can help convince decision makers to conserve nature and to make trade-offs (tier 2 of the TEEB approach), they also explicitly claim that simply ‘showing the value might not be enough’. Therefore there is also a need to ‘capture the value’ (tier 3). This is then quite a different argument than the one used by for example Costanza and Daily for defending their valuation exercises meant to demonstrate value and create the necessary awareness and motivation for conservation.

In summary, the roles that numbers play according to the TEEB discourse are (at least) the following:

- Monetary numbers are needed for applying the (mainstream) economic method to

environmental policy issues. This method allows rational decision making, where rational refers to efficiency rather than effectiveness.

- Scientific knowledge about ecosystems and biodiversity is of key importance. However, to be able to apply the economic method to this knowledge, it needs to be coverted into 'information', i.e., monetary numbers.
- Monetary numbers are also promoted as the best common language for the science-policy interface, since money is 'the language of the world's dominant economic and political model'.
- More generally, numbers (monetary and non-monetary) are needed for management purposes, because one must 'measure to manage', for example manage the national economy as a 'capital portfolio'.

All these elements are of a discursive or ideational kind in the first instance. They refer to welfare economic thinking, managerial thinking and the language of the world's dominant political-economic model. That said, if implemented, decision-making informed by welfare economic thinking and monetary (monistic) valuation, will of course lead to specific material consequences.

However, there is also a 'non-role' of numbers in TEEB, which is just as important a finding:

- A global cost-benefit analysis is not recommended or carried out due to the meaninglessness, controversy and difficulties of such an exercise.
- Monetary numbers (valuation) are not needed to 'capture value':
    - neither to create economic incentives
    - nor to set up markets
- Instead, the *condition* for sustainable management depends on recognising nature conservation as an economic opportunity.

The promotion of monetary valuation is linked to the wider current practice of legitimising specific environmental policy through reliance on mainstream economic theory. The promotion of markets is taken for granted, and seemingly need no theoretical underpinning. This discursive practice in TEEB is part of a neoliberal practice consisting of (the state) facilitating (new) markets and business opportunities, together with the more 'traditional' promotion of job creation and economic growth or development. Chapter 8 studies the social practices in which TEEB is embedded, in more depth.

8. Analysis: Explaining the role and dominance of numbers in environmental policy

8.1 Introduction

The overall aim of the dissertation has been to *explore, describe and explain* the dominance of numbers as a 'solution' to environmental problems. I started this study from the following paradox: *the continued production and promotion of numbers about the environment as solution, even though they don't seem to help.*

The object of study can be seen as a both a discursive practice (promotion of numbers) and a non-discursive practice (production and use of number), but also as a discursive practice which is part of a wider social practice (intertwined with or embedded in the social structural context). The discourse and arguments are important to understand the production of, use of and kind of numbers prevalent in current environmental policy, and to understand their persuasiveness despite little proof of helping the situation. However, to understand the practice, it is key to first understand the nature of numbers and their functioning with respect to particular political-economic regimes.

In chapter 2, I outlined a framework for understanding the nature of numbers and their capacities (or 'powers') based on secondary literature and theories about numbers and quantification. I showed that the basic nature of numbers is simple: numbers are abstractions in a particular, i.e., mathematical, form. This abstraction has the capacity to express i) compacted information concerning quantitative dimensions of the material world (i.e., in time and space), and ii) commensuration or universal dimensions of an abstract kind. Further, these capacities or powers of numbers, correspond to two kinds of ways that numbers can be used to represent aspects of the world around us: i) concrete representation and ii) abstract representation.

In turn, quantitative representations can be used for a variety of social purposes, such as 'evidence' (to demonstrate or monitor a problem), direct steering, indirect steering (e.g., governmentality and the exercise of power and discipline through numbers), or as 'objective' information input to rational decision-making. Numbers are however not efficacious on their own. To fulfil these various purposes, they need to be combined with specific rationalities (in the broad sense, including ways of doing things, logics, or values). Therefore, the rationality or purpose with which various numbers are combined is key to understanding their

functioning and potential effects (as explained by Desrosières). Rewritten into critical realist terms, one would say that specific kinds of numbers are in a *necessary relationship* to its broader political or economic framework or system, and that their combination represent a specific structure. Hegemonic discourses must be understood in a similar way, as structurally part of the dominant political-economic system.

This chapter draws together the different parts of the analysis in this dissertation which has explored the role of numbers, its functions and capacities. It then moves to the analysis of the discourse of numbers as part of a wider social practice, i.e., analysing the production and promotion of numbers as conditioned by discursive and material structures. I then look at aspects which were specific for TEEB, and which cannot be explained by existing theories of numbers presented in chapter 2. Finally, I reflect on the validity of the findings.

8.2 Understanding the role of environmental numbers

In chapter 3 I elaborated a conceptual model for understanding the role(s) and dominance of numbers in environmental policy based on Desrosières' framework. The main element that differentiates statistics used for the political economy and for environmental policy is the central role of monetary valuation in the environmental field. This has then been further explored looking at biodiversity and TEEB.

The capacities, purposes and functions of environmental numbers

The form of the relation and interaction between nature and economics, in discursive terms, have been through three main phases in the period I have studied (administrative rationality, resource for growth (transition phase) and externalities/management). The first change was from seeing the environment and the economy as being in opposition to being complementary, and seeing nature as an untapped economic resource or ‘a problem in search of a solution’, i.e., a field onto which market thinking can be applied and where new economic opportunities exists. In chapter 3, I presented how the production of environmental numbers changed since the environment first became a political object in the 1960s and early 1970s. In the beginning, data were collected through direct monitoring of pollution and environmental quality. The administrative rational state was mainly interested in statistics that showed the size or extent of the environmental problem (and how it changed over time). In

addition, there was a concern with defining and identifying thresholds, standards and pollution limits in quantitative terms (with an associated strong role for natural scientists). The assumption (going back to Weber) was that with objective information at hand ('evidence'), the administrative system could steer or solve the environmental problems through rational decisions and the implementation of the right regulations.

In the neoliberal period, starting in the 1980s, arguments for number production were linked to several discourses, including sustainable development, ecological modernisation, environmental economics and NPM. I have identified four kinds of change with respect to environmental numbers in this period. First, integrated environmental and economic accounts were promoted both at the Rio conference in 1992 and by environmental economists who wanted environmental issues integrated into already existing economic models. Second, the call for market mechanisms to deal with environmental problems or to secure the delivery of environmental services required conceptualising nature in economic terms and establishing new spaces of equivalence. Third, monetary valuation of nature was promoted for the purpose of efficient decision-making. Finally, the environmental field was, just like most areas of governance, subject to the requirements of NPM, i.e., to the production of indicators for transparency and accountability such as performance indicators, benchmarking etc.

What is striking in the neoliberal period, is the increasing influence of microeconomics and how it affected the 'turn' in environmental number production. The shift to efficiency as the main (formal) criteria for steering in public policy, created a need for both measuring environmental variables using money as the measurement unit and new measures of nature conceptualised in economic terms. The change of focus did not wipe out the kind of numbers produced earlier, but mostly came in addition, hence contributing to the overload of data also characteristic of this period. Finally, the 'neoliberal turn' is present in the introductory texts to environmental statistics publications from this period: Main environmental data reports now argue for the importance of transparency, assessment, comparison, communication etc., rather than arguing that the data can help in problem solving.

The current discourse as observed in the TEEB study is similar, although slightly different. First, nature needs to be subject to (micro)economic thinking, i.e.; efficiency thinking and instrumental rationality. Second, environmental issues need to be integrated into the economic management systems, including our national accounts (SEEA). And finally, nature's values need to be 'captured' through economic incentives and price signals in

markets. I have demonstrated that in TEEB numbers were instrumental to promote a solution which was already given, both in terms of the 'economics' and in terms of what the study leader and the initiating and funding countries hold as current policy paradigm: facilitating markets and business opportunities.

A new economic activity has sprung out of the 'economisation of nature'-discourse. This activity depends on the new economic concepts of 'natural capital' and 'ecosystem services', and it allows middle men to help supply nature's services, such as for example water supply. This new business opportunity depends neither on producing monetary values nor on other kinds of numbers, but relies on the conceptualisation of nature using economic categories. The idea of accounting for natural capital and ESS in national accounts, on the other hand, relies on production of new kinds of numbers. These can then be based on the market value of the newly established commodity (e.g., water supply), just like all recordings of market exchange are in the national accounts.

This insight has important connotations with respect to the debate about monetary valuation of nature versus other ways to value nature's services. Some writers, e.g. Gómez-Baggethun and Ruiz-Pérez (2011), build their argument on the assumption that the route to commodification of nature lies in monetary valuation. Similarly, in TEEB, many of the 'pragmatists' argue that if we could just open up for different kinds of valuations, much would be won. At the same time, Gómez-Baggethun and Ruiz-Pérez admit that environmental science and policy has evolved within terminologies and logics that are relevant to the dominant political-economic framework of neoliberalism. They argue that this has had effect on both concepts, categories and measurement system, which now perfectly fits the needs of the market society.

Instead of perpetuating the debate on monetary versus other kinds of valuation, I argue that the foundations for commodification were already laid in the conceptualisation stage. Monetary valuation of nature is not a necessary step for commodifying nature's services, because as TEEB has demonstrated, setting up markets do not depend on that. However, conceptualising and categorising nature in a way that makes nature convertible into new tradable items is necessary for commodifying them.

Where numbers *do* play a role for commodification is with respects to new measures of equivalence, the kinds of numerical representations that are key to the neoliberal era according to Desrosières. Such measures are intimately linked to the conversion of externalities into financial instruments, such as rights to pollute and offsetting damage. These

kinds of measures allow a seemingly unlimited creativity with respect to the kind of financial instruments that can be instituted and with respect to what can be traded.

For this purpose, numbers, in terms of universal abstractions or new measures of equivalence, are crucial. The equivalence is important for to legitimise setting up the system. However, for the financial system to function (as a market), it is not important whether the numbers refer correctly or not to what they are meant to represent. Basically, what is traded or paid for in these schemes are numbers. There is no exchange taking place of any 'real' good or service, i.e., the service bought for example through carbon emissions trading is never something the 'consumer' or buyer ever comes into contact with and can evaluate the quality of, unlike other things which are bought and sold (Vatn 2010). In this lies also the enormous potential for fraud that we have already been observing.

Monetary valuation, however, which has been so central in the discourse presented in this dissertation and the road taken by biodiversity conservation policy, cannot be explained by Desrosières' scheme. Despite mentioning microeconomic thinking, the scheme does not reflect a strong role for welfare economics in neoliberal policy, neither does it even mention monetary valuation as a kind of statistics. How can we then explain its prevalence in the environmental field?

The specific functional role of monetary valuation and neoclassical economics

What is the function of monetary numbers for the current political economic regime, i.e., neoliberal capitalism? While theoretically, the purpose of welfare economics is to analyse potential trade-offs and optimal allocation, the actual use within the neoliberal regime is, as I have demonstrated, for the most part rhetorical. In TEEB, this is even explicit: although appealing to the usefulness for decision-makers of being able to make economically rational decisions, TEEB also points out that monetary valuation is actually not necessary to set up markets or schemes with economic incentives. Hence, monetary valuation and welfare economic arguments can, in the neoliberal regime, be understood as something to make use of when it serves the more general neoliberal rationalities or purposes.

Rarely does the neoliberal discourse make reference to pure market fundamentalism when promoting markets (TEEB even explicitly claim to not support free-market fundamentalism). Instead, the rationality of neoclassical economics is strongly relied on. Free-market supporters do not seem to have a problem with this since the result is the same. Again, this shows how neoclassical economics plays a rhetorical role, as it clearly does in

TEEB. Environmental economics provided and still provides a link or transition through its tools and logic which opened up for neoliberal solutions.

Although some welfare economic tools, such as CBA, can be used within the administrative state and for social welfare purposes, the fact that neoclassical economics has efficiency as a core theme, and markets as the institution that best delivers efficient solutions, neoclassical economics is liable to support the market institution rather than other institutions for dealing with societal concerns. Because markets are seen as the best coordinating institution in society, society can deal with most things through economic analysis and internalisation. Basically, neoclassical economics does not have any theoretical perception of other institutions. In practice therefore, the gap between the two schools of welfare economics and Chicago school becomes minimal, and both suggest that the role of the state is to facilitate or even plan for new markets.

From another perspective, and picking up on the historical development of environmental statistics from chapter 3, one could claim that monetary valuation and neoclassical economics have played a transitionary role towards 'market environmentalism'. This has been done through combining expert rule and social welfare arguments central to the administrative rationality of the Keynesian period, with the economic incentives and market mechanisms of the neoliberal period, and hence providing a 'bridge' from one regime and rationality to the other .

8.3 Retroducing possible explanatory factors

The question to be answered in this section is what could be the explanation for, or what causes, the continued production and promotion of numbers about the environment as solution, despite their disappointing results. Much of the analysis in this dissertation draws on the resources and literature presented already in chapter 2 and 3. The question at this stage is whether the model of explanation outlined holds for the explanation of the TEEB project, or whether it must be revised in light of the specific and concrete case described in chapters 6 and 7? It might here be in its place to remind of the critical realist approach whereby one aims at rationally judging between different models of explanation by their plausibility, i.e. their capacity to explain empirical observations and events. This means that explanations can be assessed on its adequacy in terms of describing the world's properties and ways of functioning.

The structural conditions identified in chapter 2 as causally contributing to the

dominance of numbers in society and politics were the following:

1. The functional role of numbers as part of the mode of regulation of each political-economic period.
2. The rationalistic attitude.
3. The general wish to manage and control both nature and populations, e.g. the spread of management practices to ever new areas and, more generally, the exercise of power and governance through numbers.
4. The prevalence of positivism and empiricism in science and economics.

The rationalistic and managerial attitude

Elements number 2 and 3 are probably the ones most easy to recognise in TEEB. References to the need to manage, and to managerialism in general, are prevalent throughout the reports. The study leader's favourite slogan 'measure to manage' is repeated in various different places. In this respect the spread of management practices, including micromanagement, to the environmental sphere is clear. It also has links to the specific 'economics' promoted in TEEB, that of microeconomics which has also been characterised by e.g. Chang and Sen as simply being a method for calculating solutions to given problems. This in turn means that problems solving is more about management than about understanding the economy.

This wish to manage, is however, not unique to neither TEEB nor the neoliberal period, but is something we can observe also in earlier periods as well as in reports such as the Millennium Ecosystem Assessment. The natural science approaches to handle the problems seem to be of this 'rationalistic' kind, closely associated with the Weberian instrumental rationality and what has been described as administrative rationality. Weber theorised that the rationalisation which followed the Enlightenment not only influenced Western thought, but also its social organisation which has since become oriented to 'the efficient achievement of utilitarian objectives' (Gordon 1991: 476). This also applies to the natural sciences.

A more challenging questions is that of understanding why the TEEB discourse in particular, and the economisation of biodiversity more generally, have gained such strong support from those who hold other values than those promoted by the discourse and its related policy. How can it be that the discourse actually convince so many different actors?

In the account I have given of the foreplay to TEEB, I have exposed how many scientists and environmentalists have supported economic solutions in the belief that

promoting the business opportunities related to protecting biodiversity will lead to its protection, or a belief that neoclassical economics describes and explains the world accurately, and therefore its recommendations must be followed. However, it seems likely that many of those who help the monetary valuation project in various ways, do not understand what a neoclassical approach implies. For example, extinction of species as an optimal outcome of efficient approaches are seldom highlighted by the economists themselves, something which I have qualified as a misrepresentation by TEEB.

I would also suggest that the lack of distinction with respect to various kinds of numbers, their uses and functions in the political economic system is another factor contributing to the misunderstanding of what monetary valuation and economic rationality implies. I started the dissertation with a citation from a natural scientist referring to monetary numbers as objective numbers, a position which can be explained from such an affinity. It is likely that there is such an affinity between economists and natural scientists because they both come from a positivistic science perspective, which both rely strongly on empiricist methods and quantitative analysis. [66] However, many of the actors in TEEB did not refer to objectivity, but rather to 'pragmatism' as a way to relate to a neoclassical approach to nature conservation (see further below).

Chapter 2 showed that the role of numbers is not only connected to neoliberalism. While periods of capitalism change, some other core traits of modernity might be more stable. One such factor is instrumental rationality. Few actors would object to arguments that are claimed to be rational. However, a problem with the interaction of different academic communities is the lack of definition of concepts. When (neoclassical) economists talk about rationality and rational management, they do not refer to instrumental rationality (in the Weberian sense) and effectiveness, but they mean efficiency and optimisation. This is another confusion possibly leading actors to support solutions they do not fully understand.

The argument of rational management (in the neoclassical sense), has another element to it, which is the way it plays to decision makers as actors without responsibility and in need of ready-made answers. Unlike experts in former times, and the Weberian bureaucrat, it seems like policy makers of today prefer not making any own judgements, because the numbers should speak for themselves. This is at least the message in TEEB, which is also supported by many of the ministries funding TEEB as well as the European Commission.

[66] although whether neoclassical economics really qualifies as an empirical science is contested (see e.g., Blaug 1992).

The economic structure and the need for growth

As presented in chapter 2, the French regulation school understands the economic system as institutionalised compromises between the need of capital for accumulation and the need of society for stability. From the two core concepts of 'accumulation regime' and 'mode of regulation', they theorised about varieties of capitalism and its periodisation. The theory builds on insights from Marxist theory concerning the crisis prone nature of capitalism due to its inner contradictions, in combination with institutionalism.

The unquestioned and unquestionable need for economic growth in capitalism, can be seen as both an imaginary or thought structure and a structural (i.e., material) constraint. From a regulation theory perspective, it must also be understood as a material requirement for capitalism to work in a socially acceptable way. Therefore, if we use a regulation school perspective to understand periods of capitalism, we must consider each period's need for and search for economic growth, and how numbers might play a role. This is not part of Desrosières' theoretical base or interpretation.

In one respect, the economisation of biodiversity can be understood as a structurally selective discourse. This means facilitated by the capitalist structures of society, and in particular the current neoliberal accumulation regime. From seeing environmental problems as being an obstruction to economic growth, nature has instead been turned into a new possibility for accumulation, based on financial capital, in the neoliberal period. Various imaginaries have been around for some time, such as the Green economy, Green New Deal etc., trying to spread an attractive imaginary that can (supposedly) establish a new social compromise, through renewed accumulation and also address environmental concerns. The possibility for growth in the environmental sphere lies not only in making use of natural resources to make a profit, but more obscurely to make use of pollution, stewardship and other externalities (both positive and negative) to create new financial markets (for offsets, carbon trading etc.) or new creativity (e.g. payment for the use of an environmental sink. It is not at all unlikely that the atmosphere will be up for grabs as soon as someone comes up with a calculable solution for marketing it).

Lacking elements: causal analysis and the use of numbers as evidence of problems

The lack of causal analysis, is to some extent common for both the Keynesian/planning

period and neoliberalism. The wish and belief in the possibility of steering, through amongst other things, numbers, led in the 1970s to policies which were not always successful because they did not address the underlying driver(s) of the problem of nature degradation. This is why the 'implementation gap' occurred.

In the current period, there is not a similar aim of actually solving the environmental problems. Neither, welfare economics nor neoliberal values explicitly aim at that, although the ecological modernisation discourse claims to address it.

The specific transition to environmental numbers in the neoliberal period has completely shifted the focus of the environmental discourse away from identification of and dealing with underlying drivers to only discuss market solutions. We saw this both in TEEB and in the MA. Interestingly, where the MA goes straight to markets solutions, TEEB outlines 'an economics of biodiversity' which is then sidelined due to the wish to pursue market solutions (for which monetary valuation is not needed). What is instead done is to make use of the mathematical exercises of turning externalities into equivalence spaces that can then be subject to their own markets.

However, even though concrete quantitative representations can be useful (e.g. for demonstrating problems), the problem with respect to the environment is the difficulty with respect to steering the process, either directly (steering/management) or indirectly (through regulation) because the problems are often systemic. In this respect, the number focus prevalent in both the Keynesian, the neoliberal or even the natural scientific (e.g., ecological optimisation) models take attention away from underlying drivers. These underlying drivers are mentioned in both TEEB, the MA and the conservation literature (e.g., economic activity, economic growth, capitalism), but are still not addressed.

Questioning and criticising numbers in the current economic conjuncture and from an instrumental rationality perspective with respect to solving environmental problems, does not mean that numbers cannot be useful in some areas and for other concerns. However, currently it looks as though, instead of using numbers as evidence of (continuing) problems, they are diverted and converted into monetary values, under the argument of efficiency and best (most efficient) use of resource. In the neoclassical logic, one shall not first and foremost deal with problems, but weigh them against each other and compare their relative importance. We can use monetary measures for this. This diversion to abstract referents and numbers is an obstruction to one of the most powerful uses of numbers, namely to be able to *demonstrate* the scale and extent of a problem in concrete, quantitative terms.

Explanatory critique

A central part of a critical social science analysis is to identify whether someone has a special interest in upholding the beliefs promoted in a problematic discourse, so-called explanatory critique. I have in chapter 7 disclosed certain misrepresentation identified in the TEEB discourse, and demonstrated that this is a discourse that promotes market solutions, first and foremost in the interest of the current dominant bloc of finance capitalism and multi-national corporations as well as those who support neoliberalism and the associated ideology more generally. It is not a discourse in the interest of those who wish to address the underlying causes of environmental degradation or who hold an intrinsic value position with respect to the biological world.

In analysing the arguments used in the TEEB report, the parallel to what has been described as the neoliberal discourse is striking. TEEB promoted business opportunities and markets without further justification. Due to Sukhdev's background, it would not be surprising if he had already a solution ready to be applied to the problem.

8.4 Returning to the concrete case and contingent factors: How is TEEB different?

Some of the causal mechanisms identified in 8.3 might hold in general, even though contingent factors made TEEB actualise differently.

TEEB did not produce the 'one big number' that was its mandate. Also, TEEB has many 'soft' clauses about other kinds of rationalities, cultural context etc., which is then used to qualify whether monetary valuation is always the appropriate way. Does this mean that numbers are not central or dominant in TEEB?

No, this is not the case. Despite deciding not to produce aggregate numbers for the monetary value of biodiversity, I have demonstrated that TEEB has clear recommendations in this respect: despite the many problems involved, it is seen as 'unacceptable' not to perform monetary valuation of nature. TEEB also holds that one should aim at describing nature's values first in qualitative terms, then in quantitative terms, and wherever possible also in monetary terms. Further, the central metaphor of the defect compass, gives numbers a key place in the TEEB discourse. The need to value our 'natural capital' in monetary terms is central because the whole management project for nations' capital depends on it.

The 'pragmatist' attitude

In chapter 7, I quoted various passages and interviews related to TEEB, where certain positions with respect to monetary valuation and economic conceptualisation of nature is referred to as 'pragmatic'. Usually the word is used by those who give up what they hold as their own values or principle for the purpose of achieving common goals. More concretely, this is often used with respect to the perceived need to use mainstream economic concepts and monetary valuation in environmental policy. The main problem with this approach is the lack of adequate theory with respect to why this approach would give the expected outcome. Often the adherents themselves are sceptical of mainstream economic theory. Hence, the belief in pragmatism is instead based in an undefined, implicit political theory. A particular problem with the approach not having any theoretical basis, is the perception of power. The main question in this respect is of course how playing to power and speaking their language can change the system? In chapter 4, I showed that ecologists wanted to cooperate with economists, believing they hold the key to access power. But for what purpose? Accessing power under the condition of not challenging the system, will not help. Hence, there seem to be a lack of criticality with respect to the social field, and what being 'pragmatic' entails or can achieve.

It is not straight forward to explain the cause of the 'pragmatist' attitude. In many respects it seems to be a break from the positivist scientific attitude believing in empiricism and objectivism. In the TEEB reports, for example, a word search for the word 'objective' gives zero hits. This still does not take us any closer to an explanation of this strategy or model of belief.

'There is no alternative'

Certain concepts or discourses are necessary to be believed in for the promotion of numbers to work (Schneider and Wolf 2016: 71). In this respect, neoliberal discourses have been efficacious. People have started to believe in the things it promotes, such as the need for transparency in public sector (we can't trust them, they're inefficient), 'you can't manage what you don't measure' or that there simply is no alternative (TINA). Many of these beliefs have become sedimented, naturalised and hence structuring society and the perceptions of what the possible room for action is.

It is likely that many actors have actually been convinced that there is no alternative to the market turn. As exposed earlier, natural scientists have long worked for the protection

of nature from an intrinsic perspective. This shows the strength (as well as the limiting effect) of the current structural conditions where choice is increasingly framed in a certain way.

Structures function as both constraints and opportunities, obstructing or facilitating specific uses of and kinds of numbers that serve specific political purposes. Also discursive structures limit the perception the possible (Sum and Jessop 2013). These discursive constraints impact on what is perceived as possible solutions (growth, markets), how society works (selfish, rational), or how society should work (rational decision-making). The specific solutions are structurally selected or facilitated by the hegemonic discourse or the current discursive structure.

In TEEB this is in particular expressed through the reduction of the actual, i.e., the current political and economic structures, to the real. This makes actual institutions appear as 'natural' or 'beyond return', something to which there is no alternative. In Jessop's words (SRA), we can say that they accept the strategic selectivity of capitalism. The pragmatist approach therefore instead looks at second best solutions under the current 'natural' order of neoliberal capitalism. This leaves all structures and institutions (including economic ones) untouched from critique.

This lack of critique of current institutions can also be seen in the way markets are both problematised and promoted, in a strange kind of dialectics which then ultimately promotes what it initially problematises. This is particularly so in Ring et al. (2010) who do not explicitly favour markets, but since this is the main coordinating institution in the Western world, they see no other way. Basically, the conversion to market coordination is seem as a one-way evolution, so that there is no way back. Ring et al. therefore end up ultimately promoting markets or market-based thinking and economic rationality.

In addition to a lack of understanding of power, what is maybe more problematic is the lack of imagination to perceive alternatives to the economic system, including growth and market dominance. In this respect, opposing the hegemonic discourse, would imply addressing the underlying drivers. However, naturalising the indirect causes of biodiversity loss, i.e., economic growth as inevitable, has so far put a stop to this. At the present, using up time and energy at producing monetary numbers, blocks the possibility of developing different imaginaries in the current conjuncture.

8.5 The validity of the findings

That neoliberalism is characterised by appeals to the market and by removing regulation is

uncontested in the literature. Both supporters of neoliberalism and critics will confirm this, as well as a huge amount of studies. What is more interesting is the role of numbers in this transition, and—when it comes to environmental issues—the role of neoclassical economics and monetary valuation in particular. s

My findings, in this respect, leans in particular on the analysis of the TEEB discourse. This could trigger the claim that I have a thin evidence base for my findings. However, retroduction is not built on a methodology whereby repeated observation of regularity strengthens the validity of the argument. Instead, the attempt is to 'dig deeper': to identify possible mechanisms and constellations of relationships. The 'validity' is then in the plausibility of the argument and the explanation presented. This does not exclude the need for additional studies to corroborate whether the findings also apply in other situations, i.e., other constellations of interacting mechanisms.

8.6 Conclusions

With respect to the power of numbers, I have identified two main mechanisms: the capacity to express quantitative attributes, and the capacity to express commensuration. Both can be expressed in the same abstract and compact form of numbers. This gives the impression that they are about the same thing, hence they can be further combined for various calculative or analytical purposes. However, as I have also demonstrated, two distinct forms of representation must be distinguished: 1) the realist representation of concrete physical/material things in space/time; and 2) abstract representation using a general equivalent to commensurate that which is represented.

Further, the power of numbers does not work by itself. It must be combined with a will or rationality that have in mind a possible use or certain purpose. In the current neoliberal period, numbers are produced to fit the rationality of those who promote the market as the appropriate institution for regulation of the environment.

The production and promotion of monetary numbers in the current period, has a clearly expressed purpose: internalising externalities and the use of economic instruments in environmental policy. They all spring from a theoretical frame which believes markets to be the best institution for achieving its aims (efficiency). Environmental concerns have no special status in this logic, but simply must be balanced against other things that humans value 'at the margins'.

Also, those who promote monetary values, hide certain clear possible outcomes of

this approach, most importantly that efficient management of nature does not give any priority to preserve biodiversity over other things that provide humans with ‘benefits’.

Because of its simple form, numbers can easily mislead. They seem easy to understand - a common language that everyone can grasp - but their underlying language is demanding to understand. The simplicity of the form can easily hide the important underlying distinctions and functioning.

9. Conclusions and further research

This dissertation has been about the dominance of numbers in environmental policy, with a particular focus on biodiversity and the 'economic turn' in nature conservation. My aim has been to describe, understand and explain how, despite the parallel increase in both environmental numbers and environmental problems, the faith in or the focus on numbers to do something about the problems seems as strong as ever. The dissertation draws on discourse analysis and insights from historical and sociological theories about numbers and quantification, combined within a critical realist methodology.

Theoretical basis

Theoretically, the analysis makes use of both Weber's description of modern, calculative rationality and Foucault's concepts of discipline and governmentality. However, the main theoretical inspiration is the work of French sociologist Alain Desrosières and his analysis combining numbers as a tool for both 'evidence' and steering. His studies show how different periods with different political ideals and practices have relied on very different types of numbers to implement their *political projects*. At the end of the 19th century, social statistics were used as 'evidence' to demonstrate the extent of poverty amongst the working class, and led to a series of social reforms and regulations. In the Keynesian period, macroeconomic statistics were used to directly intervene in the economic system so as to limit the perceived problems of unregulated markets. In the neoliberal period, a combination of micromanagement and microeconomics with their related concepts and numbers have become dominant. Regulation has been weakened in many areas, partly by instead being converted into economic incentives or markets (e.g., emissions trading). In other areas, in particular in the public sector, regulation has been replaced by indirect steering through micromanagement and benchmarking.

Historically, a change happened at the beginning of the 19th century, when quantification became dominant in statistical description. This involved a shift from a focus on what was unique about a place (described using language), to description of what was common across places (described using categories and numbers). Desrosières has pointed out another fundamental distinction with respect to describing or representing, between numbers as representation of phenomena in time/space (concrete) and numerical representations aiming for abstract representation of reality (using a general equivalent). This distinction is

important in my critique of neoclassical economics and the 'economic turn' in environmental policy.

Environmental policy and changing environmental statistics

Can we see parallels to Desrosières scheme with respect to the environment? Yes, indeed. A similar change in the kind of numbers produced and used can be observed during the transition from the Keynesian welfare state to the neoliberal era. One such change was the adaptation of environmental statistics to fit the economic management system and hence the establishment of integrated environmental-economic accounts. Categorising environmental statistics according to economic categories and industries allowed quantitative analysis of the interaction between nature and the economy at detailed level of economic categories/industry. It also allowed economic analysis of environmental issues within the framework of neoclassical economics, including quantification of trade-offs and calculation of optimal policy choices (e.g., cost-benefit analysis). However, the full potential of integrated environmental-economic accounts was not used as long as for example externalities such as pollution did not have a monetary value. A range of methods for putting monetary values on externalities or unpriced benefits of nature was therefore developed, including willingness to pay, willingness to accept, contingent valuation, benefit transfer, and more. Placing monetary values on those parts of the environment which were not already priced in markets, allowed *expanding* the area that could be subject to welfare economic analysis, despite simultaneously leading to an over-extension of the underlying economic theory.

Alongside these economically adapted statistics, the environmental field was also subject to the new practice of performance measuring and benchmarking in all areas of public policy, with the aim of transparency and accountability. This is usually being argued as being democratic purposes, needed because we cannot trust the state, or due to the need to increase the efficiency of the public sector. Another aspect of neoliberalism which is of relevance to this dissertation, is the explosion or overload of number production. This has led to another problem: that of not seeing the trees for the forest, which has had the added consequence of searching for production of numbers or indicators with the aim of simple, overall messages. In this forest of numbers, monetary numbers have been promoted as something 'people can easily understand'.

In the global North, the dominant environmental discourse of the neoliberal period has been ecological modernisation, a discourse promoting green growth based on a

combination of science, markets and more rational management of the world's resources. The discourse does not deny that economic activity produces environmental damage or impact, but believes in the possibility of technological innovation to relieve and outweigh the damage. Hence, the strong focus on and role of science and innovation. In this respect, economic growth and environmental protection is not considered contradictory. Internationally, the OECD and the World Bank has been at the forefront of promoting a new kind of environmental statistics to fit the needs of this new paradigm.

Within this discourse, to 'rationally manage' does not refer to the Weberian understanding of calculative rationality, but rather refers to the neoclassical economic understanding of 'economising' nature, i.e., to efficiency and optimisation. Hence, to rationally manage nature, it is necessary to place monetary values on it. The policies derived from this discourse therefore, in theory, relies strongly on environmental economics, a version of neoclassical economics, and more specifically welfare economics, studying environmental issues as externalities.

I have argued that neoclassical economics has played a ‘bridging’ role between science and markets: Through the abstract representation of environmental issues in terms of ‘economic value’, a link has between established between the concrete numerical representation of environmental issues prevalent in scientific understanding of environmental problems on the one hand, and markets on the other.

The emergence of an economic discourse about biological diversity

I have demonstrated how an economic approach to biodiversity conservation is argued for and how monetary numbers are promoted, not only by neoclassical economists, but also by a range of conservation scientists and ecologists who since the 1970s have promoted various different perspectives on the environmental-economic nexus. Some (e.g., Wilson 1988) argued that the economy actually depends on our living resource base, that nature is a source of economic opportunities ('untapped resources') and a premise for economic development and growth. Others were worried about the societal dependence on nature for life-support from a functional and anthropocentric perspective, and were struggling to communicate that dependence to the general public. At the same time, the 'implementation gap' was becoming apparent. Systematic inventories of the worlds existing and threatened species, identification of direct and indirect drivers of biodiversity loss, as well as various measures to protect species and landscapes (such as protected areas and laws to protect threatened species), did

not contribute substantially to solving the problems at hand.

Although economic growth and capitalism were often identified as indirect drivers of biodiversity destruction, these were not given much attention in discussions about solutions. Rather, the neoclassical economic framing of the problems and what to do about them appealed more to conservation biologists, and has strongly impacted on the 'knowledge' that developed within conservation biology as it broadened into an interdisciplinary field. 'Lacks' in the economic system, such as market failure and lack of (private) property rights were pointed to.

Although there was scepticism concerning this integration, the implementation deficit with respect to the environmental problems was a fact, and the economisation of nature seems to have been the only attractive alternative suggested. The limits to growth discourse, for example, was not reinvigorated despite having attracted much support from environmentalists initially. Early questions about the model of eternal growth and the contradiction between environment and the economy were left behind. Instead conservationists turned to (neoclassical) economists, perceiving them to have power and speak a language that people can readily understand. Some argued that ecologists must be willing to mix economics and conservation, but there was never any discussion about which kind of economics to draw on. The status of neoclassical economics proved hegemonic.

Putting a monetary value on the earth's ecosystems, however, was controversial. Some identified methodological weaknesses, other pointed to the likely societal (and ultimately environmental) effects of such exercises. But there was also a growing amount of (uneasy) followers to the approach, because they saw that the approach appeal to policy-makers and business leaders, hence those in power. Many scientists and environmentalists did not like the approach, but perceived it as 'pragmatic' or 'realistic' (i.e., the only alternative), a position also prevalent amongst several of the people I interviewed with respect to the TEEB study.

Discourse analysis of one particular event: The TEEB study

The initial mandate of TEEB was to carry out a global cost-benefit analysis to assess the economic benefits of biodiversity, and to compare the costs of loss of biodiversity with the costs of effective conservation. However, due to the complex nature of biodiversity, this task was considered both difficult and meaningless, and instead the mandate was (implicitly) reformulated to being about the 'economics of ecosystems and biodiversity'. TEEB's story

line is then developed around the argumentation that we destroy nature and biodiversity because their economic value is not made visible. Hence, the 'problem' TEEB addresses is the economic invisibility of biodiversity, and the 'solution' proposed is to makes these values visible through the 'mainstreaming the values of biodiversity and ecosystem services into decision-making at all levels'.

Theoretically, the 'economics' of TEEB relies on mainstream neoclassical economics as developed in the subfield of environmental economics. At the same time, TEEB promotes a 'pragmatic' approach, whereby the rigidity of the neoclassical foundations is left behind, and many other elements are considered. For example, arguments are often made about giving special attention to the poor or to distributional issues, which is outside of the theoretical framework. Also, market solutions are often promoted in themselves, without the need for carrying out monetary valuation or economic analysis. At other times, it is underlined that monetary valuation does not need to imply neither privatisation nor commodification. However, one thing is unconditional: that despite the weaknesses of the methods and the possible side effects of carrying out monetary valuation of nature, 'to do otherwise is unacceptable'.

TEEB's approach to the economics of ecosystems and biodiversity is brought together in a framework called 'the TEEB approach', which is about 'recognising, demonstrating and capturing nature's values'. Its principal objective is to mainstream economic thinking about biodiversity and ecosystem services into decision-making at all levels. An important *condition* for mainstreaming the values of nature, is seeing the global biodiversity crisis as not only a challenge, but also as an economic opportunity.

This is presented as something which would help protect ecosystems and biodiversity, despite being based on an economic theory which is about the efficient allocation of resources. This means that species, biodiversity or ecosystems should only be protected when it is efficient to do so, or else be destroyed, degraded or extinguished whenever it is (economically) optimal to do that. These things can be calculated by experts (neoclassical economists), or it can be achieved by market mechanisms (if market failures can be removed). This kind of economic rationality is therefore not about protecting biodiversity, which is repeatedly raised as a concern in the TEEB reports. In this respect, TEEB is an example of confusing and inconsistent argumentation in favour of neoclassical (welfare) economic rationality. In addition to being misleading with respect to the purpose of its own method, it is highly questionable whether the outcome of this kind of rationality will protect

biodiversity and ecosystems. It must therefore be understood as used first and foremost for rhetorical purposes.

The conclusion is that TEEB legitimises an economic approach to nature conservation strongly in favour of economic incentives and markets. While on the one hand relying strongly on neoclassical economics for scientific legitimacy, the theoretical foundations have no impact on the main solutions promoted. The TEEB approach plays to the need of decision-makers to make informed, rational decisions, while in the next moment arguing against welfare economic calculations as 'real' solutions, because they might often not be enough to change behaviour anyway. The argument then is made that monetary numbers are anyway not needed for establishing economic incentives or markets.

In many respects, the TEEB discourse resembles that of ecological modernisation while also containing much neoliberal jargon. This includes appeals to transparency and accountability, rational decision making and managerialism, and the belief that environmental and economic concerns can be reconciled within new pathways for economic growth and development (these words are used interchangeably and their content are not defined).

I have identified three main elements in the TEEB discourse: economic rationality, a monistic value system and the institution of markets. Further I have identified the roles that numbers play, but – perhaps even more importantly – the roles that numbers do not play in TEEB. One the one hand monetary valuation is appealed to for the sake of carrying out welfare economic analysis for optimal trade-offs. Natural scientific numbers must also be adapted to the need for such analysis. Further, monetary numbers are promoted as the best common language for the science-policy interface, because it is the language of the dominant political-economical models of society. Finally, numbers in general are important because ‘we cannot manage what we do not measure’. On the other hand, TEEB argues against a global cost-benefit analysis of biodiversity because this is both meaningless, controversial and technically difficult. This is not a problem, because monetary numbers (valuation) are actually not needed to 'capture value', i.e., neither to create economic incentives nor to set up markets. Instead, the *condition* for sustainable management depends on recognising nature conservation as an economic opportunity.

Main findings

In this dissertation, I have combined the insight from the discourse analysis of TEEB with an institutional account of the development (and change) of environmental statistics and with an

account of the ‘economic turn’ in nature conservation, with the objective of understanding the role that numbers play—materially and discursively—and explaining their dominance in environmental policy.

I have shown how conceptualising nature and the environment using economic concepts and categories was the first step in creating new abstract economic objects (e.g., natural capital) that could be subject to further economic analysis and economic logic (e.g., incentives) or to exchange in markets. The concepts of 'natural capital' and 'ecosystem services', required redefining natural processes from being about their internal functioning to being about what they do for the economy or for human well-being. These elements of nature therefore were measured (or rather *assigned* a monetary value) using a general, univeral equivalent, namely money.

The development of for example systems of tradable pollution rights, on the other hand, depends on creating *new objects of governance or exchange* through the development of new 'spaces' or objects of equivalence. The commensuration taking place in such creative processes, relates to the (creation of an) *object* of measurement rather than the *unit* of measurement. This insight is an extension of Foucault’s concept of disciplining through categorisation and counting. Foucault demonstrated that things can be governed indirectly through the very act of categorisation and counting. In the field of environmental policy, this dissertation has demonstrated how the same process of categorisation and counting can lead to the construction of new objects of exchange.

These kinds of objects of equivalence, however, are abstractions in the double sense. Not only because concepts always are abstraction, but because the concept does not aim to grasp a real (or even actual) object or phenomenon, but rather to create an abstract object. This is usually done through commensurating some aspects of 'real' objects. For example, with respect to air pollution, the warming potential of greenhouse gases (set relative to CO_2, i.e., measured in CO_2-equivalence) or the acidification potential of acidifying gases have been identified as the equivalence through which various kinds of pollution can be equated into a new object of governance or subject to market exchange. What was earlier an unintended side effect of production (externality) can through this kind of system, which first equates different things and then converts environmental regulation into a market for rights to do (a certain amount of) something 'bad', turn a problematic aspect of production into an economic asset or opportunity. Hence, Deutsche Bank's claim that the carbon market is currently ‘the most interesting growing market’, is an excellent example of TEEB’s appeal to

seeing environmental problems as ‘opportunities’. Further, Lohmann (2011) has demonstrated how every internalisation of externalities creates new externalities that can then be subject to new systems of internalisation. Hence, the approach provides a never-ending source of new financial instruments and markets.

In the early days of environmental politics, numbers played a role as evidence of problems and could help establish regulations. Within the same period dominated by administrative rationalism, numbers also provided input to expert decisions within the bureaucracy for steering and controlling the documented problems. In the current neoliberal period, monetary valuation of nature is sometimes used as 'positive evidence' of the market opportunities related to various ways of commodifying nature and at other times for (neoclassical) rational decision-making with respect to environmental problems ('externalities').

It was astonishing to perceive how, in the TEEB project, arguments in favour of monetary valuation of nature are just rhetorical. One the one hand TEEB makes the case for rational decision-making and rational management of resources, while on the other hand simultaneously promoting various environmental markets whereby welfare arguments are made redundant. Hence, both the call for monetary valuation and welfare economic arguments are often presented in a purely rhetorical way, as part of a discourse which primarily promotes economic incentives and market solutions.

The conclusion from this, with respect to the use of numbers in the neoliberal era, is two-fold. First, within a logic of market rationalism, the main (material) function of numbers is to represent newly created objects of equivalence, for example CO_2-equivalents, rather than simply applying the 'old' measure of equivalence - money - onto nature's various bits and pieces. However, monetary valuation can also be used for allowing destructive projects to be implemented, as long as the damage done is paid for (so-called ‘offsetting’). The secondary function of (monetary) numbers, is of a discursive kind: as TEEB has clearly demonstrated, the appeal to economic efficiency through the reliance on neoclassical arguments, can be purely rhetorical.

In this perspective it is worth noting how the debate concerning economisation of nature has been much focused on monetary valuation, while the parallel topics of measures of equivalence or numbers’ independent function in the (financial) political economy has received less attention. One can say this is a lack of attention to the *material effects* of certain practices (the production of certain kinds of numbers) in the current political economy. This

lack of attention has been characteristic of both the ‘pragmatic’ and the more critical camp of ecological economics.

In this dissertation, I have argued that although monetary valuation can show the market potential of nature's ‘goods’ or ‘services’ and therefore is part of a framing of nature as commodity, the risks associated with numbers lie not only in monetary valuation, but even more so in the creation of new objects of equivalence taking place in the name of economic efficiency and welfare economic analysis. While many well-intended people are discussing whether or not to value nature in monetary terms, strong economic interests are on their side already working hard to establish ever new financial instruments related to new objects of equivalence. One of the most recent inventions, linked to the implementation of the much praised ambitious Paris agreement from 2016, are calculative schemes that allow for the continued expansion of airports by offsetting the associated emissions elsewhere.

This creation of new objects of equivalence are used in a range of tools and incentives based on abstraction of the environmental problems they supposedly reflect. Once people are on board of this kind thinking, it allows all kinds of cunning ways to avoid taking action on the environmental problem at hand by instead setting up calculative schemes. This is a very different outcome than the hope that some attached to thinking of nature as a service provider, to help communicate humanity's dependence upon nature. Not only does it help avoid taking action, but the schemes create even further alienation to the actual content of ongoing environmental policy. In the case of TEEB, however, such measures of equivalence are not much touched upon. TEEB only refers to the establishment of incentives and markets, without going into detail about how measures of equivalence contribute to create new objects of management or exchange. Although financial instruments like biodiversity offsets are mentioned, most examples relate to physical resources.

The history of the economic turn in biodiversity conservation as outlined in this dissertation, shows the discursive-structural constraints existing in this field, and the strong influence of the neoliberal mindset. The history of the ‘economic turn’ in biodiversity conservation, is very much a history of people believing there is no other alternative than engaging in nature protection through participating in the 'economisation of nature' debate, including its foci on monetary valuation, neoclassical concepts of nature, market mechanisms, economic incentives, and the creation of new objects of equivalence. Appealing to the current, dominant logic or rationality, by using that same language is perceived as ‘pragmatic’ or the only ‘realistic’ way to influence power.

However, in this approach, ‘the economy’ itself goes unquestioned. There are at least three possible explanations for this. Either the current economic system is perceived as good or ‘the least problematic’ (Chang, 2015), or it is perceived as unchangeable, or it is simply perceived as ‘natural’.

If we connect the above insights to Desrosières’ analysis of the specific combinations of different kinds of statistics and political logics, we can better understand how different kinds of numbers combine with certain rationalities and interests to produce certain outputs. The Keynesian period with its associated administrative rationality, mainly made use of numbers aiming to measure concrete environmental problems, what I have called ‘concrete numerical representation’. In the neoliberal period, managerialism and microeconomics has taken over, with their related relative numbers and creation of new objects of equivalence. I have argued that neoclassical economics served as a ‘bridge’ between the two approaches since it has some similarities with both. First, welfare economics appealed to social goals, and to the use of public intervention and rational decision-making based on economic expert calculations. However, with the underlying assumption of the market as the most efficient allocator of scarce resources and with the whole theory being based on representation of reality in abstract terms (e.g., ‘utility’), neoclassical economics remains an argumentative basis for neoliberal policy. Because of natural scientists own basis in quantitative, empiricist and/or positivist science, the road to association with neoclassical, quantitative economics seemed short. As I have demonstrated, this misunderstood association could in part have been avoided with a clearer understanding of different kinds of numerical representations, in particular the key distinction between concrete and abstract representation. From a critical realist perspective, one would argue that there is a necessary relation between ‘concrete numbers’, a means-ends rationality and the wish for steering in the Weberian sense. There is also a necessary relation between ‘abstract numbers’, economic rationality and the belief in market mechanisms and the market institution from a neoliberal perspective.

A core critique coming out of my analysis is how both the earlier administrative rationalist use of numbers, and the current market rationalist one, both avoid addressing the underlying mechanism which have caused the problems in the first place. The pure market rationalist attitude is in any case not interested in 'solving' the problems (via politics), but rather to leaving the co-ordination of all affairs to the market. The more welfare-oriented economic attitude might argue in favour of solving certain environmental problems because of their economic extent, but since the economic theory itself is not about identifying and

addressing underlying causes, it has no other tools at hand than suggesting optimal, but only symptom curing, policy solutions 'given the current situation'. The more classical bureaucratic-Weberian approach would also take an instrumental approach in dealing with the problem, but using a broader (hence not necessarily economic) means-ends rationality approach, allowing to place environmental problems above efficiency and market concerns. However, this rationalist approach is still not addressing the cause of the problem, but rather uses numbers for 'staying at the surface', believing in the possibility of controlling and managing the input and the output parameters in isolation.

Numbers could be used as evidence (of the extent, scale, etc.) of problems, and as an argument for the need to look into what causes these problems, and how these causes could be handled. Instead, the lack of causal analysis in the field is appalling. This study has shown the centrality of the number focus in environmental policy, and how problems are conceptualised and problematised without addressing underlying mechanisms. This is the case whether with respect to physical, concrete number and attempts to manage and control pollution, or with respect to abstract, monetary numbers and attempts to manage the economy in optimal ways. In this respect, solely focusing on numbers, without adequate conceptualisation, provides a continuing deviation from looking into the real underlying causes. It is not as easily as some have suggested (e.g. O'Neill 2012, Meadows 1998), that 'what is counted usually gets done'. Therefore, the flood of newly suggested measures of sustainability, 'the new green economy' or well-being, will not help us answer the questions we need to answer the most: *how to avoid* the problems we are searching to address, and *how* to create a better economy and society which takes the environment into account.

Main contributions

In this dissertation I have problematised and questioned the effectiveness of number use in environmental policy with respect to solving environmental problems. Following a critical realist approach, the dissertation has produced three main contributions going beyond existing literature on the social role of numbers.

First, I have outlined a first attempt at a categorisation of various kinds of numbers and kinds of purposes, including relationships between the two. Inspired by Desrosières and the French regulation school, I used a periodisation (of the political economy) approach to help identify these categories. I have shown that historically and with respect to the environment, numbers have been used first as evidence to demonstrate concrete problems,

then as input to problem-solving expert regimes based on instrumental rationality. Today, abstract numerical representations have taken over, allowing calculations of economic efficiency, and most recently establishment of markets for trading with externalities or compensation schemes (e.g., biodiversity offsetting). The process of producing abstract numerical representations of environmental issues, have allowed setting up a range of calculative schemes instead of taking action to solve the problems at hand. In this development of the kind of environmental statistics relied on for environmental policy purposes, I have showed that (mainstream) environmental economics and monetary valuation of nature played a transitionary role in the move from the administrative rationality of the Keynesian welfare (or Fordist) state to the market rationality of the current neoliberal state. This could happen because of the current dominant version of environmental economics with its focus on market failure, which then links administrative and market rationality.[67] From a regulation school perspective, one could claim that the specific kinds of statistics in each period has been part of the mode of regulation of each accumulation regime.

The second contribution comes out of the discourse analysis and empirical study of the TEEB project (together with the historical review of the history of biodiversity). A study of the TEEB discourse shows that monetary valuation and mainstream economic arguments, although argued strongly for, are only secondary or rhetorical. In TEEB, like in the MA, economic incentives and market solutions are presented up front, as natural or obvious, and without any need for explanation or justification. I have therefore argued that the role of numbers in terms of new measures of equivalence, is more important in terms of setting up new environmental markets, than is monetary valuation. These findings challenge the perceived role of mainstream economics and monetary valuation in environmental policy discourse.

The third contribution comes from the analysis of the conditions for the support of numbers in environmental policy, and in particular why environmentalist support both a focus on numbers, monetary valuation and market solutions when they don't seem to help. An analysis of the causes or conditions (both material and ideational) for the support of numbers in TEEB, resulted in the identification of four structural conditions:

- Rationality, in its reductionist version of economic efficiency
- Managerialist attitude

[67] Where drivers are referred to in mainstream economics, is it only in terms of lacks, for example market failure. This is what has been called an 'imperfectionist approach'.

- An empiricist (or positivist) perception of science
- The 'needs' of the political economy (the neoliberal capitalist economy) for new markets

The TEEB approach can also be explained with actors' interests. In this respect it aligns with those in favour of market solutions and empower business and corporations within the new 'business areas' of biodiversity and ecosystems services. The success of TEEB explicitly relies on seeing the biodiversity crisis as an economic opportunity. Environmentalists, policy makers and scientists aiming first and foremost to protect the environment, are at the same time caught in a perceived situation of 'actualism', i.e., they do not see any other way to pursue their goals than aligning with what is actual: the current economic system, its 'money language' and its related and promoted rationalities. It is the combination of the structural conditions, the business interests and market opportunities as well as some actors' (environmentalists) perception of a very limited space to manoeuvre which then results in the emergence of such a discourse as the one we find in TEEB.

Political relevance

Several findings and insights from this dissertation have political relevance. First, the mainly rhetorical role of monetary valuation and economic efficiency arguments, within an overall neoliberal logic of promoting markets as the 'natural' institution to coordinate environmental issues. The TEEB discourse in particular has exposed the strange 'triangle' of reliance on numbers, market solutions as default solutions, and the lack of causal research about environmental degradation and problems. The three do not necessarily link together logically, but somehow seem to constitute a 'useful' story for promoting certain kinds of policies.

I have demonstrated the strong link between the environment and the economy. The environment has since the beginning been discussed by linking it to the economy or economic policy, although the discourse concerning their relationship has changed along the way. However, instead of investigating this relationship further, the number focus has allowed to remove attention from underlying (invisible) drivers. Instead it plays to a belief in the management of nature (both in physical and economic terms) linked to positivist science, as well as to instrumental and economic rationality, and existing power structures. Both the economy and the underlying economic mechanisms which have caused the environmental problems in the first place, go unquestioned, or – if problematised –are considered unchangeable (at least in the literature and case I have looked at). A move away from

positivism and towards a study of underlying, generative mechanisms would mean linking environmental policies to the functioning of the current economic system (capitalism) and the dominant power structures, as the three cannot be studied independently. With respect to policy, this would for example mean leaving behind the belief or rhetoric that better information automatically leads to better decisions. Although numbers can show patterns and point us to possible relationships, numbers cannot help us learn about the underlying causes of phenomena. Only through qualitative analysis can we learn about structural mechanisms and causes that go beyond the surface and the (numerical) symptoms.

Critical realism is also a philosophy of potentials which allows us to ask questions about and distinguish between different potentials of number use in society. In this respect, Desrosières' reflections on statistics as a weapon for the strong or the weak (chapter 2) is important. The most powerful uses of numbers is definitely as evidence of concrete problems. The key to success (according to Desrosières) is then to gain enough support to produce impacts based on this evidence. This is a very different insight than the expectation that the numbers will produce effects by themselves.

However, only concrete number representations can be used as scientific evidence of problems or phenomena. Any abstract representation, whether measured in money or other equivalents, is already engaged in a relativistic logic of trading-off which cannot be used for the same purpose and which does not have the same scientific standing. Conservationists and environmentalists have committed the error that when they did not manage to gain support for evidence in the form of concrete representations, they instead moved into the dominant (neoliberal) relativistic logic and kind of representations. Using numbers more critically than what is the practice today, first of all would entail distinguishing between different kinds of numbers and different purposes and interests, to avoid falling into such traps. Hence, there is definitely a potential for the use of numbers in progressive politics (against TINA). However, numbers do not produce effects in themselves. The objective of protecting the environment must still be fought and argued for, that is, form part of deliberative or antagonistic rationalities.

Both deliberative and antagonistic approaches are therefore concerned with a stronger (re)politisation of questions which from a rational decision-making view could be concluded on the basis of a presumed monistic value system and expert calculations.[68] The deliberative

[68] This is of course an idealised picture, since in reality both worldview, power, interests and scientific disagreement come into play.

position aims for a strengthening of democracy in decision-making, as opposed to the expert-based regimes of administrative rationality and later the paradigm of market rationality. The ideal of the (normative) participatory model is that real democracies would deliberate common solutions, not just calculate them. Some supporters of deliberative processes believe that deliberative rationality will lead to the most informed and legitimate decisions, while at the same time seeing reasoned argument as the best way of resolving moral conflict (Vatn 2015). That deliberative rationality will lead to the most informed decisions is a belief adopted from American pragmatist philosophy which Habermas have combined with 'traditional' critical theory to developed his theory of communicative action (Habermas 1984).

A more realist approach to non-monistic decision-making and deliberation starts from the empirical observation that people hold multiple values which are incommensurable. Hence, the idea that (subjective) judgement can be replaced by an (objective) algorithmic procedure (as in for example cost-benefit analysis) is perceived as flawed. O'Neill (2007a) has pointed out that values and judgement are part of all algorithmic procedures, thereby challenging the claim of objectivity and neutrality made by supporters of numbers or rational decision procedures. Instead, an approach is required that allows for decision-making processes to take plural values into account.

Ecological economics has been particularly engaged in developing deliberative decision-making approaches in the environmental field. A range of alternative approaches that allows inclusion of plural values have been identified. Examples are deliberative monetary valuation (Spash 2007a), multi-criteria analysis (Munda 2004) and citizens' juries (Ward 1999). This shows that deliberative approaches do not need to be purely based on argumentation. In the two first examples, numbers play a central, although not conclusive, role in contrast to the rationalist approach. While these examples are all concerned with what kind of input data or information is needed with respect to decision processes, deliberative processes can also focus on the output side. An example is the Swedish participatory process for deciding on the national sustainable development indicator set (see chapter 3).

The role of numbers in deliberative approaches is less straight forward than in rational approaches, due to the awareness of the role of framing and conceptualisation in the production of 'facts'. From such a perspective, numerical information about the environment can still be useful, but it is always seen as contextual, depending on the person or group's perspective. Often the arguments made are of a weak constructivist kind. This means that

numbers are perceived as able to illuminate some aspect of reality, but that the reality captured is only ever a partial one. Hence, where the number approach is based most prominently on commensuration, reductionism and concealing of alternative perspectives, the deliberate approach highlights incommensurable values, plurality and the importance of explicitly showing different perspectives.

Further research

Deliberative rationality and the awareness of plural values and value conflicts, must however avoid the trap of relativism. To achieve this, it should instead be complemented by objective description of the structural relations and intrinsic mechanism of objects and phenomena. The critical realist methodology provides such a way out of relativism, where instead competing explanatory models can then be judged by their plausibility. There is still room to be aware of plural values and scientific fallibilism within this paradigm, while at the same time being in favour of a more inclusive and participatory democracy. This is however a topic which requires further research.

Scepticism to numbers are for some scholars first and foremost linked to the close relationship between numbers and instrumental rationality (e.g., Adorno and Horkheimer 2010[1944]; Gorz 1989). From such an point of view, the administrative rationality of the Keynesian era was as problematic as the market rationality of today. Hence, not only is the economic system as a driving force problematised, but the very modernist rationality itself. Many social theorists are trying to find alternatives to this modernist kind of rationality. Examples of alternatives are Habermas' (1984) 'communicative rationality', Roy Bhaskar's (in Hartwig 2011) 'emancipatory rationality' or—more specifically with respect to the society-nature relationship—Ariel Salleh's (2011) synergistic rationality. What the role of numbers would or could be within such radically different rationalities is another area in need of research.

Annex 1: Philosophical and methodological foundations: critical realism[69]

Why critical realism?

Critical realism, first developed in the mid-1970s by Roy Bhaskar, is by now a well established philosophy of science having outlined a way to study the world in terms of both meaning and non-material causes in the social realm and in terms of how structures and mechanisms produce regularities or tendencies more generally. A central tenet of realism is that it distinguishes between the world and our experience of it (Sayer 2000), hence a concern with both how the world is (ontology) and how we can gain knowledge about it (methodology), as well as with the nature and objectivity of knowledge itself (epistemology). In addition, critical realism is 'critical' when applied to the social world, i.e. a social science critical of the *social practices* it studies.

The critical realist ontology sees the social world as both socially and materially constructed. At the same time it has a nuanced position on social construction: while on the one hand construals (ideas) can have effects on how the social realm develops, the material effects (construction) is a separate issue. Unlike other philosophies of social science such as hermeneutics or critical theory, it does not claim that the natural and the social world necessarily need to be studied using completely different approaches (Outhwaite 1987). The social realm can be explained by causal mechanisms in the same way as the natural realm. This position removes a barrier typically established between the social and natural sciences, making it easier to grasp both the social and the natural world in attempts to study society-nature relationships. It has the advantage, over more hermeneutic and relativistic alternatives, that it allows for the posing of questions about the relationships between human societies and non-human nature (Benton 2016). Although the comparison is not often made, one could imagine studying human and biological systems using much of the same framework. Both the social and the biological world are open system due to the ability of living beings to learn (Markus Lindholm (2012) *Evolusjon. Naturens kulturhistorie*. Spartacus Forlag, Oslo) and act/adapt under new circumstances. This is why all living systems are characterised by emergence. In open systems constancy does not apply, hence regularity must instead be analysed as powers or tendencies of the underlying generative mechanisms (Bergene 2005).

[69] This chapter draws considerably on Puller and Smith (2017).

In addition to being an open system, the social world is also always pre-structured. This means that agents always act in a world of structural constraints and possibilities which they did not create themselves, but which they in turn either reproduce or transform – intentionally or unintentionally (Danermark, et al. 2002). Structures in the social realm are usually considered as relations, such as the capital/wage-labour relation in capitalist economies.

What distinguishes the human and social world from other living systems is then the fact that humans are also volitional beings that attach meaning to the world in which they live. There systems of meaning, however, are negotiated by people in the course of social interaction, and as such they have a conventional character. The systems of meaning related to money are a good example. A necessary condition of the use of money is that users have some understanding of the act of exchanging little metal discs, what it means (Sayer, 1992, 21, 30-31). This is why studying the social world adds an additional layer of interpretation (*verstehen*) on top of the interpretation of the material event itself, the so-called double hermeneutic (Sayer 1992). Critical realism combines this insight with the insistence on the complex relationship between meanings and the non-discursive dimension of social life (Sayer 2000).

Further, critical realism is concerned with questions about why things are the way they are, what causes them to be that way, what makes it possible, as well as finding the answer to questions about what is fundamentally constitutive of the structures and relations of the object of study (Danermark, et al. 2002). This distinguishes it clearly from positivist approaches searching for event regularities, since regularities are not a source of explanation. Regularities do not explain *why* things happen or *what* it is about objects and their capacities that can make something happen. What we need to understand to explain causality is the underlying structures and mechanisms of objects or phenomena. However, to be able to study such questions we first need a theory of what exists, an ontology.

The depth ontology

A distinctive feature of critical realism is the central place given to ontology, which sets it apart from both empiricism and social constructivism. Positivism and empirical realism reject ontology and metaphysics and instead treat the world as consisting of only observable atomistic objects, events and regularities amongst them, "as if objects had no unobservable

qualities" (Sayer 2000)[70]. Also social constructivists stick to the realm of the actually happening events. For critical realists on the other hand "the world is more than our experience of it" (Sayer 2000: 11).

The stratified or depth ontology of critical realism distinguishes between three levels of reality: the real, the actual and the empirical. The *real* is whatever exists, regardless of whether it is an empirical object to us or not. The real is also the realm of objects, their structures and (causal) powers, that is, capacities to behave in a certain way, and causal liabilities or passive powers (susceptibilities to certain kinds of change). Critical realism therefore seeks to identify both necessity and possibility or potential, what things must go together and what things could happen given the nature of the object.

The *actual* is what happens if and when those powers are activated or those mechanisms are triggered. The *empirical* is the domain of experience. "(i)nsofar as it refers successfully, it can do so with respect to either the real or the actual, though it is contingent (neither necessary nor impossible) whether we know the real or the actual. (..) According to this a plausible case for the existence of unobservable entities can be made by reference to observable effects which can only be explained as the products of such entities" (Sayer 2000 12). This is the 'causal criterion' which, in addition to observation, is needed to make *claims about what exists*.

An implication of this ontology, is the recognition of the possibility that powers may exist unexercised, and hence that what has happened, does not exhaust what could happen in the future or could have happened in the past. Powers constrain and enable what can happen, but do not pre-determine what will happen. This makes it possible to understand how we can become many things which we currently are not and also to identify potentials for alternative societal pathways. Also, external factors determine whether a mechanism is realised or not, rendering the relation between the object and the realisation of its properties contingent (Sayer 1992).

The depth ontology has some implications for the studies of nature or the environment which clearly distinguishes it from social constructivist approaches. Typically, accounts of 'the social construction of nature' concern themselves only with the level of the actual, and have no conception of or way to take into account the level of the real, i.e. with underlying mechanisms or unexercised potentials or liabilities. With a critical realist approach on the other hand, it is possible to describe (and agree to) how we are changing the face of the earth

[70] Sayer calls this position "naïve objectivism".

while at the same time keeping in mind that this does not (necessarily) mean we are changing nature itself (i.e. intrinsic qualities and mechanisms).

Understanding the world in this way, means a different use of certain words. For example, in the environmental discourse it does not make sense to say that 'the environmental crisis is real enough'. In this phrase, the word 'real' refers to 'actually existing', which is exactly what one would rather say in critical realist language. From a critical realist perspective the word 'real' is hence reserved for the underlying reality, structures and potentials rather than being used for (actual) events or (empirical) phenomena. The concern with the underlying reality allows us not only to explain observed events, but it also allows us to identify the *potential* for things to be different. Identifying unexercised mechanisms could in this respect be a key contribution from critical realism to the much needed social ecological transformation ahead of us.

Epistemology: knowledge as both objective and fallible

A defining feature of both realism and critical realism is the belief that there is a world existing independently of our knowledge about it, hence an independence of objects from knowledge. The empirical support of such a proposition comes from our experience with the fallibility of our knowledge – of getting things wrong (Sayer 2010). Realism is hence a fallibilist philosophy, wary of simple correspondence concepts of truth.

Central to the critical realist epistemology is therefore the necessity to distinguish between two dimensions of science and knowledge: the intransitive and the transitive. The intransitive dimension refers to the real objects of knowledge or of our study, which can be both natural and social entities and relations. Intransitivity is considered to be a necessary condition of all scientific enquiry and does not relate to the distinction between the material and the ideational. The transitive dimension, on the other hand, concerns the thought objects of knowledge. The thought object of knowledge belongs to the transient and open epistemological process, formed by competing scientific theories and models about the world. Theories and discourses are part of the transitive dimension, although they can also be treated as objects of study (intransitive), like in this study.

Critical realism understands knowledge as produced within a social process by means of (existing) knowledge under specific socio-economic and cultural setting. Therefore our knowledge of reality is something that is always conceptually mediated (Danermark, et al.

2002). Hence knowledge is neither absolute nor timeless and science is generally understood as an always incomplete process-in-motion.

Anchored in the 'basic realist principle' (Sayer 2000: 23) of distinguishing between the transitive and the intransitive realms of science, natural and social objects are understood and studied as existing independently of the scientific discourses in which researchers engage. Because the thought object of knowledge is different from and cannot be reduced to the object of research in itself, knowledge is (in principle) always fallible.

Fallibilism, however, does not exclude the possibility of objective science. Since critical realism rejects Hume's causality and flat ontology regarding the empirical world, 'objectivity' is understood differently. Sayer (2000: 58-62) distinguishes between three different types of objectivity typically merged together in everyday - as well as in the mainstream scientific - discourse: value neutrality, objectivity concerning a truth proposition, and objective characteristics of an object/phenomenon. To describe an object or phenomena in terms of its objective characteristics is clearly possible from a critical realist point of view, and is exactly what the prescribed research strategies aim at. Hence, critical realism rejects the relativist view of knowledge which reduces knowledge production to an effect of epistemic frameworks and discourses by neglecting its referential relations to extra-discursive properties of the world (the intransitive dimension).

Within critical realist epistemology, knowledge takes the form of descriptions of structures and mechanisms causally generating observable phenomena (how events occur), as well as explanations about the causes of their existence (and persistence). The task of science, in this perspective, is to improve our understanding of reality in terms of producing explanations that reflect its ontological depth. In this dissertation for example, I am aiming at understanding the underlying and (invisible) causes responsible for the dominance of numbers in environmental policy.

Furthermore, critical realism is committed to the idea that scientific knowledge can support the enlightenment project of human emancipation by informing the transformation of social structures connected to 'unwanted and unneeded' in favour of 'wanted and needed' sources of determination (Bhaskar 2009: 171) and to realise unexercised and/or unactualised potentials and conditions for more just and sustainable societies. A good example here, is the potential for humans to behave self-centred. This behaviour is at the core of the neoclassical economics model of 'economic man'. However, humans also have other potentials which might go unexercised if society's policies promotes only the potential for selfishness.

Judgemental rationality and explanatory critique

Despite acknowledging the fallibility of knowledge and seeing knowledge as historically and socially situated (epistemic relativity), critical realism is committed to combining it with judgemental rationality to provide a (limited) sense of truth. As described above in terms of 'objective characteristics of an object or phenomenon', the social character and the theoretical non-neutrality of knowledge production is not seen as an obstacle to the development of objective (or practically adequate) knowledge. If reality is mind-independent, the (objective) status of knowledge cannot depend upon agreement, but essentially on its *adequacy in terms of describing the world's properties and ways of functioning*. Hence, even though all knowledge is socially constructed and fallible, that doesn't mean that all knowledge is equally fallible or equally valid.

Here, the distinction between epistemic relativism and judgemental relativism is important. By epistemic relativism we mean that our knowledge is 'contingent' or historically determined. Critical realism agrees to this. However, critical realists claim that we can still rationally judge between different models of explanation by their plausibility, i.e. their capacity to explain empirical observations and events. To do this we must find criteria by which the explanatory power of a theory can be evaluated on many levels: historical, emancipatory, critical, and instrumental. This position is opposite of judgemental relativism, which implies that there are no grounds for deciding when one kind of knowledge should be preferred to another (Danermark, et al. 2002: 202).

At the same time critical realism is committed to explanatory critique, i.e. explanations which go beyond the mere description of structures and mechanisms, and a critique which goes beyond the identification of logical errors (immanence) and absences within a specific problematic system, practise or belief, by also searching to identify the causes responsible for their existence and reproduction. Explanatory critique aims to explain why people believe in a specific theory or philosophy of science, e.g. because specific social positions make it impossible to hold other beliefs. Therefore, it consists in identifying people's roles, why they still hold this position and identifying contradictions. Because the social sciences necessarily evaluate the *social practices* they study, the common positivist dichotomy between facts and values or between analysis and critique is rejected (Collier 1994: 169-204).

Critical realism combines ideals from the enlightenment such as a commitment to

open, critical, reasoned debate based on observation, with a commitment to emancipation. Ultimately, the purpose is not only to describe and explain social phenomena, but – in the tradition of critical social science (Sayer 2009) – to contribute to a better world. This, of course, requires some reflections on and normative definitions of what a better world is.

Methodological issues

Many issues shape the course of research long before methods in the narrow sense of techniques for gathering and interpreting information are chosen. I therefore follow Sayer (1992) in taking a "broad view of 'method' which covers the clarification of modes of explanation and understanding, the nature of abstraction, as well as the familiar subjects of research design and methods of analysis. The terrain of the discussion is therefore the overlap between method, social theory and philosophy of social science" (Sayer 1992: 3). This means giving due attention to how *we conceptualise, theorise and abstract*. Especially in social research so much depends on the initial field of study and conceptualisation of key objects. And this in turn, brings us back to the vital task of conceptualisation. The research process of critical realism focuses on potentialities, necessary and contingent factors, context and contra-indications.

Inference by retroduction: From observation to depth explanation

As described above, critical realism directs research designs towards the generation of depth-explanations about efficacious tendencies, causes and reasons responsible for events to occur and phenomena to exist. To do this it combines different methods of empirical investigation to assess reality's manifold aspects. Generally, a study starts with observation and experience of a (concrete) phenomenon, and with descriptions of the level of the empirical. At this stage, quantitative descriptions of an object or phenomena can be perfectly in line with critical realism, although this depends on the object of study. Examples of such objects could be a food system or the loss of species (diversity) in a given region. Still, quantitative descriptions do not usually exhaust the different aspects of our object of study, since *the reality of the object is more than what can be observed and measured*. Most importantly, we want not only to identify patterns or describe empirically, but get to a deeper understanding, which means identifying underlying structures and mechanisms of objects or phenomena. These are found at the level of the real, and need to be described and understood in *qualitative* terms.

Critical realism distinguishes between the world and our experience of it, and warns

that we must be careful not to conflate the two. Because of the hierarchical structure of reality, we cannot identify the real with the empirical, that is, with what we experience "as if the world just happened to correspond to the range of our senses and to be identical to what we experience" (Sayer 2000: 11). Hence, as Bhaskar (2008[1975]) points out, "strictly speaking, it is misleading to speak of the 'empirical world'". For this reason, critical realism criticises the actualist fallacy of both empiricism and constructivism which "implies that possibility and necessity is reduced to an actuality of states of affairs and Nietzschean will to power" (Hartwig in Næss 2010).

Achieving the kind of depth-explanations critical realism prescribes, requires one to use the inference mode of 'retroduction' to establish explanatory models about the interplay of structures, mechanisms and their conditions that produces specific effects. This is done through a creative inference as to the combination of underlying mechanisms that *could have* produced a certain phenomenon. Hence, retroduction is the mode of inference linking the empirical and the real levels of reality. As structures and mechanisms are not directly observable, retroduction is a (non-formalised) mode of inference from traceable, or observable, effects to the underlying explanatory structures. Retroduction employs transfactual argumentation (contrary to generalisation) for examining the properties and the contingent circumstances that make something what it is and prompt it to act in specific ways.

"If we want to transcend purely empirical observations of social phenomena and also explain what produces them, we must instead avail ourselves of 'thought experiments'. We must seek the generative (social) mechanisms with the help of conceptual abstraction via structural analysis. Obviously this abstraction must be grounded in empirical conditions" (Sayer 1992: 203-4).

"To be able to carry out retroduction successfully we are dependent on theories. Theorizing becomes an integral part of the research process" (Sayer 1992: 204). Since a mechanism cannot be 'demonstrated', the link between theories, models and empirical investigation depends upon documenting the effects of a retroduced mechanism and upon ongoing theoretical reflection on conceptualisations and empirical findings in light of explanatory models. Sayer (2010: 162-169) refers to such research designs as 'intensive research' producing explanations by combining theoretical research on substantial relations, properties and powers of social objects with empirical research on actual events and processes as results of multiple determinations in a specific context. 'Extensive research' on

the other hand, makes inferences by generalising from empirical findings, exploring merely formal relations of similarity and producing taxonomic descriptions of variables in order to analyse the statistical representativeness of cases.

The theory-ladenness of observation and description

Hume famously declared that "All objects of human reason or enquiry may naturally be divided into two kinds, (..), *Relations of Ideas,* and *Matters of Fact*" (Hume 1990: 1), where the matters of fact do not depend on our thinking of them. That observation and experience is always influenced by our existing concepts and knowledge, was later acknowledge by the Vienna circle when they, in the 1920s, came to dismiss their own method of *verification*. Still, almost 100 years later, this awareness, of the always conceptually mediated and theory-laden character of observation is often absent or even rejected in much of current ongoing quantitative research under the headings of econometrics, experimental economics, or evidence-based science[71]. Therefore there is a constant need to criticise the empiricist/objectivist ideal of science concerning neutral empirical observations.

That knowledge is conceptually mediated means that it is impossible to make neutral observations of 'facts' about reality (Danermark, et al. 2002). However, this does not determine *what* reality is like, since reality exists independently of our knowledge about it, i.e. the importance of the distinction between the intransitive and the transitive world. While critical realism and constructivism agree that knowledge is conceptually mediated and consequently concept-dependent, critical realism always stress, unlike relativism/idealism, that there is a real world independent of our knowledge about it. Conceptualisation requires a world independent of the concepts themselves. Secondly, it is possible to gain knowledge about this real world: "facts are certainly theory-laden, but they are *not theory-determined*" (Danermark, et al. 2002: 202-203, my italics).

Because we anyway use concepts when observing the world, it is important to elaborate and reflect upon the concepts we use for observation. It is decisive that we do not merely think *with* the concepts without reflection, but that we also think *about* them (Sayer, Danermark). Hence, the significance of conceptualisation for knowledge production in general and social science in particular. This is because "within the social sciences, what other people hold to be true, and their concepts of reality, are an integrated part of the object of science itself" (Danermark, et al. 2002: 41).

[71] In qualitative studies the same phenomenon often occurs under the heading of grounded theory.

Structural analysis: The importance of conceptualisation and abstraction

Because knowledge is always conceptually mediated, conceptualisation is a central scientific activity. Critical realist studies do not make the same split between theory and method as are usually done within other approaches. Instead the two are seen in combination. Concept formation is hence considered an important research tool, in particular for the social sciences.

In conceptualising an object, we start by outlining what is interesting or problematic about the issue/object and what exactly we want to study and analyse about it. We isolate or highlight certain aspects of a phenomenon. In this process, abstraction is a way to deal with complexity.

The core function of (social science) conceptualisation, however, is (conceptual) abstraction through structural analysis, which also permits a realist causal analysis(Danermark, et al. 2002). Structural analysis investigates substantive internal relations and properties of objects or practices in order to identify their emergent powers. Abstractions should therefore 'neither divide the indivisible nor lump together the divisible and the heterogeneous' (Sayer 1992: 88). To avoid misattributing causal responsibility, we need to identify whether several mechanisms are operating 'in concert'. To do this requires abstraction, and a research design which aims at identifying such possibilities (Sayer 1992).

Causal analysis: Causation and explanation

CR reject the standard Humean "successionist" view involving regularities among sequences of events. At best, finding regularities might suggest where to look for candidates for causal mechanisms. Causation in CR does not depend on regular succession of events. Explanation depends on identifying causal mechanisms and how they work, and discovering whether they have been activated and under what conditions. Explaining why a certain mechanism exists involves discovering the nature of the structure or object which possess that mechanism or power. Structure suggests a set of internally related elements whose causal powers when combined are emergent from those of their constituents**.** Here we return to the stratified ontology: There is more to the world, then, than patterns of events. It has ontological depth. According to Sayer, the 'problem of identifying causal responsibility in complex open systems can best be dealt with by either studying examples which provide contrasts in aetiology (causation), such as the absence of an otherwise common condition, or by asking a series of characteristically realist questions' (Sayer 1992).

Causal and structural analysis

For this purpose, methods for discovering and assessing regularities are not usually considered very useful. Instead methods that can help establish the qualitative nature of social objects and relations on which causal mechanisms depend, are central (Sayer 1992, Danermark, 2002 #5785). Methods in critical realism are therefore usually approached in a different way, focusing on structural and causal analysis (Sayer 2000: 58-103). Structural analysis (including abstraction) investigates substantive internal relations and properties of objects or practices, through an iterative process between description and theoretical abstraction, in order to identify their emergent powers. The specific concept of causation advocated by critical realism implies a preoccupation with analysing reality as an interplay of manifold generative mechanisms of a variety of natural and social structures as well as social actors. Causal analysis deals with explanations about why particular events happen in terms of conjunctures of various interacting structures and mechanisms. Regarding causal explanation, social sciences can use the same methods as natural science. Critical realism then prescribes retroduction as the appropriate mode of inference. In addition, the social sciences must include interpretive understanding and deal with the challenges of the double hermeneutics (Sayer 2000). To grasp the interpretive dimension of social reality, retroduction needs to be supplemented by interpretive research strategies that are concerned with understanding social actor's discourses, motives and beliefs.

From a realist perspective, the specific link or interaction between discourse and the extra-discursive realm is of particular interest, and is a core challenge in the understanding of the structure-agency nexus. As Sayer puts it:

> "Where researchers are concerned with discourses and the meaningful qualities of social practices, understanding these is not a matter of abstraction followed by concrete synthesis, but of interpretation. However, realists would add that to interpret what actors mean we have to relate their discourse to its referents and contexts. It also needs to be remembered that social reality is only partly text-like. Much of what happens does not depend on or correspond to actors' understandings; there are unintended consequences and unacknowledged conditions and things can happen to people regardless of their understandings." (Sayer, 2010: 20)

Hence, critical realism always consider the context when studying meaning or discourse.

Annex 2: List of interviewees

1. EXP1, 10.9.2011, Economist (ecological economics), researcher, private research institute
2. EXP2, 14.12.2013, Economist (ecological economics), professor, university
3. PM1, 09.01.2014, Natural scientist, policy adviser, ministry
4. EXP3, 13.01.2014, Political scientist, researcher, private research institute
5. TEEB1, 14.02.2014, Ecologist (ecological economics), researcher, university
6. TEEB2, 17.06.2014, Economist, researcher, public research institute
7. EXP4, 07.05.2015, Political scientist, professor, university
8. TEEB3, 13.07.2015, Ecologist (ecological economics), researcher, university
9. TEEB4, 16.07.2015, Economist (ecological economics), professor, university
10. TEEB5, 03.08.2015, Natural scientist, researcher, public research institute
11. PM2, 08.01.2016, Economist, policy advisor, European Commission

Annex 3: TEEB people, donors and partners

Advisory Board (18 members)

Achim Steiner (UNEP)

Julia Marton-Lefevre (IUCN)

Nicholas Stern

Herman Mulder (independent advisor, formerly ABN AMRO Bank)

Peter May (President of the International Society of Ecological Economics)

Joan Martínez-Alier (former President of the International Society of Ecological Economics and Professor at Universidad Autònoma Barcelona[72])

Karl-Göran Mäler (Professor at Stockholm School of Economics and Beijer Institute)

Jochen Flasbarth (German Federal Environment Agency – UBA)

Yolanda Kakabadse (WWF)

Edward Norton (actor and UN Goodwill Ambassador for Biodiversity)

Giles Atkinson (Professor at London School of Economics)

Edward B. Barbier (Professor of Economics, University of Wyoming)

Ladislav Miko (EC, DG Health and Consumers, formerly DG ENV)

Braulio Ferreira de Souza Dias (CBD)

Jochen Zeitz (Kering)

Pia Bucella (EC, DG ENV)

Michael Izza (Institute of Chartered Accountants in England and Wales)

Pavan Sukhdev

TEEB coordination group

Pavan Sukhdev, study leader (UNEP)

Heidi Wittmer, project manager (UFZ)

Georgina Langdale, Marc Schauer and Benjamin Simmons (UNEP)

Aude Neuville and François Vakenhut (EC)

Lars Berg (Sweden)

Sylvia Kaplan (Germany)

Tone Solhaug (Norway)

[72]On the TEEB-web he was presented only under "University of Oxford" where he has formerly been a research fellow and senior associate member.

James Vause (UK)

Scientific coordination team at UFZ

Heidi Wittmer (leader)

Carsten Neßhöver (leader)

Julian Rode

Christoph Aicher

Johannes Förster

Carolin Kugel

Scientific coordinators for the study reports (Phase II)

Pushpam Kumar, University of Liverpool – Ecological and Economic Foundations Co-ordinator. Also part of the Indian Green Accounting project

Patrick ten Brink, IEEP – National and International Policymakers Co-ordinator

Heidi Wittmer, UFZ – Local and Regional Policymakers Co-ordinator

Haripriya Gundimeda, IITB – Local and Regional Policymakers Co-ordinator

Joshua Bishop, IUCN – Business and Enterprise Co-ordinator

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Foundations report

Coordinating lead authors (12) (position at the time of the publication of the report)

Eduardo S. Brondízio, USA, environmental anthropologist

Thomas Elmqvist, Sweden, natural resource management

Franz Gatzweiler, Germany, agricultural economist

John Gowdy, USA, ecological economist

Rudolf de Groot, The Netherlands, ecologist or environmental economist?

Timothy J. Killeen, USA, environmental scientist

Pushpam Kumar, UK, ecological economist

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Lead authors in total: 20

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Interim report

The first phase also had a working group consisting of (how were these people chosen?):

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Robin Miège (EC)

Helen Mountford (OECD)

Shaun Mowat

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Ana Rodrigues

Guillaume Sainteny

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Burkhard Schweppe-Kraft

Martin Sharman

Anne Teller

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Jean-Louis Weber (EEA)

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Donors and Partners

UNEP

German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU)

German Association for International Cooperation (GIZ)

UK Department for Environment, Food and Rural Affairs (DEFRA)

the European Commission

Norwegian Ministry of Foreign Affairs

the Dutch Central Government (Rijksoverheid)

Japanese Ministry of the Environment

Helmholz Centre for Environmental Research (UFZ)

Swiss Federal Office for the Environment

UK Department for International Development (UKAID)

Swedish International Development Cooperation Agency (SIDA)

Local Governments for Sustainability (ICLEI)

Rio Conventions (Ecosystem) Pavilion

Conservation International (Conservação Internacional) Brasil

PricewaterhouseCoopers (pwc)

HAVAS

National Confederation for the Industry Brasil (CNI)

Mofilm

Trucost

TEEB for Business Coalition

London School of Economics (LSE)

Imperial College London

Italian Institute for Environmental Protection and Research (ISPRA)

Annex 4: Commissioned studies in TEEB phase I

Commissioned by the EC:[73]

1. Cost of policy inaction (COPI): The case of not meeting the 2010 biodiversity target (ZIP file)
2. The Economics of Ecosystems and Biodiversity: Phase I (scoping). Economic analysis and synthesis. 142 p. (Published as: Balmford, A., A. Rodrigues, M. Walpole, P. ten Brink, M. Kettunen, L. Braat and R. de Groot (2008): *Review of the Economics of Biodiversity Loss: Scoping the Science.* European Commission, Brussels. Contract: ENV/ 070307/2007/486089/ETU/B2.)
3. Review on the Economics of Biodiversity Loss: Scoping the science. 12 p.

Commissioned by Germany (grant) / EEA (co-ordination):

1. Ecosystem Accounting for the Cost of Biodiversity Losses: Framework and Case Study for Coastal Mediterranean Wetlands.
2. Study on the economics of conservation of forest biodiversity (IUCN). (ZIP)

In addition, the following studies were commissioned by UK and France and made available to the TEEB team.

Commissioned by the UK (DEFRA):

1. An introductory guide to valuing ecosystem services. 65p.
2. UK Biodiversity Action Plan: Preparing Costings for Species and Habitat Action Plans. (Bad link)
3. Flood and Coastal Erosion Risk Management: Economic Valuation of Environmental Effects.
4. Valuing our Natural Environment. ZIP

Commissioned by France:

1. The economic evaluation of goods and services provided by the coral reef ecosystems. 28p.

[73] Source for this annex is: http://ec.europa.eu/environment/nature/biodiversity/economics/teeb_en.htm

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