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Conceptualizing Environmental Inequalities as Ecological Debt and Ecologically Unequal Exchange

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Asymmetries:

Conceptualizing Environmental Inequalities as Ecological Debt and Ecologically Unequal Exchange

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Rikard Warlenius



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DOCTORAL DISSERTATION

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<p>In this compilation thesis, consisting of six papers and an introductory chapter, the concepts of ecological debt, climate debt, ecologically unequal exchange, and unequal carbon sink appropriation are at the centre. Their intellectual and political histories are traced to environmental justice movements, ecological economics and neo-Marxist economics. They are developed conceptually and linked together analytically using a stock-flow perspective.</p> <p>Special concern is devoted to climate debt as understood by the climate justice movement. Its claims on climate debt are identified, their normative assumptions tested and climate debt is quantified as consisting of both an emission debt and an adaptation debt.</p> <p>The last paper focus on a historical case study, where a method for measuring ecologically unequal exchange – time-space appropriation – is applied to discuss core and peripheries in the early modern world system, indicating a Sinocentric world economy.</p> <p>In the introductory chapter, sections on critical realism and mixed methods research position the thesis theoretically and methodologically. The concepts at the centre of the thesis are synthesized into what is called an ecological-economic asymmetries approach. Further, the possibilities to base the approach on ecological Marxism and historical-geographical materialism are explored and a potential future research strategy sketched.</p>		
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Coverphoto by Rikard Warlenius. Bodo in the Niger Delta, 2013. The community suffers from two disastrous oil spills in 2008 and 2009. Community members filed a lawsuit against Shell in 2012. Expected to go to trial in mid-2015, Shell agreed to a £55 million out of court settlement in January 2015.

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Content

Acronyms.....	10
Acknowledgement.....	11
Preface: The Long Summer.....	13
Introductory Chapter.....	17
1. The Scope.....	18
1.1. Ecological-Economic Asymmetries Approach.....	18
1.2 The Concepts.....	22
1.3 Research Design and Process.....	28
1.4 Aims and Research Questions.....	32
2. Theoretical Argument.....	36
2.1 Critical Realism.....	37
2.2 Some Related Ontologies.....	40
2.3 Normative Political Theory and Social Science.....	41
3. Marxist Approaches.....	47
3.1 Capitalism and the Environment.....	47
3.2 Three Stages of Ecosocialist Debates.....	48
3.3 Neo-Marxist Economics.....	53
3.4 Historical-Geographical Materialism.....	58
3.5 Sketch of a Potential Research Direction.....	64
4. (Mixed) Methods.....	69
4.1 The Methodological Chain.....	70
4.2 Mixed Methods Research.....	71
4.3 Critique against MMR.....	73
4.4 Mixed Methods and Critical Realism.....	75
5. Contextualizations.....	78
5.1 Environmental and Climate Justice Movements.....	78

5.2 Institutionalism and Structuralism.....	83
5.3 Eurocentrism.....	86
5.4 Labour Embodied in Silver – a Tentative Estimate.....	89
6. Summary of the Papers	94
7. Concluding Remarks.....	104
Post-script: The Short Fall	108
References.....	110

Acronyms

AD	Adaptation Debt
CD	Climate Debt
CJA	Climate Justice Alliance (NGO network)
CJM	Climate Justice Movement
CJN!	Climate Justice Now! (NGO network)
COP	Conference of Parties (to UNFCCC)
CO ₂	Carbon Dioxide
CR	Critical Realism
CSA	Carbon Sink Appropriation
DEFRA	Department for Environment, Food and Rural Affairs (UK)
dw	days of work
ED	Ecological Debt
E-EAA	Ecological-Economic Asymmetries Approach
EJO	Environmental Justice Organization
EJOLT	Environmental Justice Organizations, Liabilities and Trade (Research project)
EUE	Ecologically Unequal Exchange
FOEI	Friends of the Earth International
GRR	Gross Responsibility Ratio
GtCO ₂	Gigaton (1 billion tons) of carbon dioxide
HGM	Historical-Geographical Materialism
ICTA–UAB	Institut de Ciència i Tecnologia Ambiental at Universitat Autònoma de Barcelona
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-Governmental Organizations
MMR	Mixed Methods Research
NASA	National Aeronautic and Space Administration (USA)
NME	Neo-Marxist Economics
PWCCC	World People's Conference on Climate Change and the Rights of Mother Earth
RQ	Research Question
SMO	Social Movement Organization
tCO ₂	Ton of Carbon Dioxide
TSA	Time-Space Appropriation
TWN	Third World Network
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USSR	Union of Soviet Socialist Republics
USA	United States of America

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Preface: The Long Summer

I write this sentence on a sunny day in Stockholm with a feeling of late summer mildness although it is already October. Last weekend I was sailing in the archipelago wearing only jeans, a shirt and my lifejacket, while normally this time of the year, mornings are biting cold and the sky darkened by rain storms. I would not complain about a warm autumn, however, if it wasn't for the fact that every month since October 2015 has been the warmest on record. When the NASA account for global temperatures in August was presented a few weeks ago, Slate magazine reported:

N.B. If this article sounds familiar, it should. This has been happening so frequently I just copied the post for ~~March April May June~~ July and updated it ... For the ~~sixth seventh eighth ninth 10th~~ 11th month in a row, we've had a month that has broken the global high temperature record.¹

This autumn is not only unusually warm, but it also marks the 10th anniversary of my personal interest in climate change. It was in the late summer of 2006, when I was the editor-in-chief of the syndicalist weekly *Arbetaren* (The Worker), that our reporter Andreas Malm approached me with a number of ideas for articles on climate change. That summer, he had reviewed Mark Lynas' (2004) *High Tide*, which recently had appeared in Swedish translation. And Andreas wouldn't be Andreas if he hadn't thereafter read a whole bunch of books, reports, and papers about climate change before approaching me. Like most people then, I had not realized the speed with which severe climate change was approaching, and how deep societal changes were required if the world were to avoid chaos. But this general ignorance would soon vanish. During the same fall Al Gore's film *An inconvenient truth* hit the theatres, later in the autumn Nicolas Stern's review of the climate change economy got widespread attention, and in 2007 IPCC presented its fourth assessment report under massive media coverage. For a short period, global warming was on everybody's mind. Andreas wrote the stories, and he soon took a leave to write his first book on climate change (Malm 2007) and in 2009 went into academia. I too soon developed a deep interest in climate change politics that in

¹ http://www.slate.com/blogs/bad_astronomy/2016/09/20/august_2016_was_the_hottest_august_on_record.html

2011 made me a colleague with Andreas again, but now in the Human Ecology Division at Lund University.

But the reason I am going back to 2006 is not to tell my story, but because a decade is a period short enough for most to overlook but long enough for a meaningful historical reflection. There are many ways to describe this decade from the perspective of someone who has been following climate change politics. Here is one:

From hope to pessimism.

At the outset of this decade, many of us were rather optimistic about the chances of mitigating the worst effects of climate change in time to avoid runaway climate change. Even though we were in an extreme hurry even then, there was still time. And since most people had learned only recently about this potential disaster, it seemed pretty likely that things would change fast.

But hope has certainly been dashed many times during this decade. In Copenhagen 2009. In Durban 2011. In Paris 2015. On every election day in every country. Whenever a new report on escalating climate change is presented. When you can sail in October wearing only a shirt.

Finally many of us resigned, or at least became pessimists. And the main reason is not that we are at least ten years behind the schedule, but that we have now been aware of the disastrous consequences of climate change for a decade, and still so little is happening.

While the system is not changing, the climate is. But even if the struggle for halting serious climate change is lost, there are still all the reasons in the world to continue struggling for “harm reduction”: for reducing emissions and dealing with the effects in a fair way.

Here is another way to describe the last decade:

From future to reality.

A decade ago, climate change was abstract, something that would happen in the future. For a while, there was even a debate of whether global warming had halted. Now, it’s all over the place. Temperature records are broken, hurricanes appear where and when they shouldn’t, droughts spread and last so long that they provoke wars and migration.

But neither public awareness nor mounting and manifestable evidence has had any measurable impacts on the willingness of world leaders to deal seriously with the climate issue. In fact, in the last decade the UNFCCC has even regressed:

From binding targets to voluntary.

Ten years ago, the Kyoto protocol was rightly criticized for its weak and arbitrary emissions targets, its loopholes, hot air and speculative flexible mechanisms. Yet despite its insufficiency, it was nonetheless the first step to a more ambitious and fair global agreement, we thought. But what happened, and culminated in the celebrated Paris agreement, was the very opposite: the complete abandonment of an ambitious and binding global agreement, and in its place a fluffy, rhetorical deal with only voluntary pledges.

The climate policy discourse went
from visions to realpolitik.

In the 2000s there was a vivid and visionary debate of what a post-Kyoto agreement should look like. I plunged right into it myself, attracted by the chance to think about how to actually make the world a better place while simultaneously curbing climate change. My first book on climate change – *Utsläpp och rättvisa* (“Emissions and justice”, Warlenius 2008) – was a detailed account of proposed mechanisms and an assessment of their effects on climate, justice and feasibility. My favourite – among many others, such as *contraction and convergence* (Mayer 2000), *cap and dividend* (Barnes 2003), *cap and share* (Douthwaite 2006), *carbon rationing* (DEFRA 2008, Jonstad 2009), just to mention the most well-known – was *greenhouse development rights* (Athanasίου and Baer 2007), which was the model that demanded the most radical redistribution of emission rights from the global North to the global South. Probably under influence from this discussion, principled debates and calculations also of *climate debt* started to emerge.

The theme of this thesis is very much a child of that time. It was the open debate about how to best address the climate crisis, in policy circles, social movements and among researchers, that made me write my first paper on climate debt in 2010 (parts of it are included in this thesis).

After a number of setbacks, however, it became clear that the *realpolitik* was not moving in the direction of a visionary and encompassing climate agreement. Most of the enthusiasm vanished, both inside and outside the negotiations. Nothing like the 100 000 people on the streets of Copenhagen in December 2009 has been replicated outside any later UNFCCC Conference of the Parties.

The history of the last decade is not very encouraging, but there is nevertheless some hope implicit in this development:

From global struggles to local

Whereas much attention and hope was directed toward the global negotiations ten years ago, it has now become apparent that UNFCCC is not worth it, because the decisions are made elsewhere anyway. At least in North America, a shift in focus seems to have occurred to more local struggles. Hundreds of thousands are marching

against pipelines, mountain top removals, fracking, tar sand extraction and coal fuelled power plants. So far, this has not inspired similar mass movements on other continents, but it is still hopeful. It is hopeful, but not directly for the idea of a *global* approach to climate change such as climate debt.

So, after a decade of intense debate and struggles characterized by a development in the direction of pessimism, real climate change, voluntarism, *realpolitik* and a localization of struggles, I need to pose a frank question: How relevant is the concept of climate debt, which expresses hope, responsibility, visions and globalism? Is it already overrun, out of fashion, dead?

Indeed, this might seem to be the case. But I am not sure that this condition will last forever.

If the interest had vanished because the problems had been solved, I would be more certain. If other solutions to the problems of climate change and global injustice were currently being implemented, or if the problems had somehow disappeared, I would happily admit that large parts of this thesis would be outdated. But the problems are obviously still there.

What we have witnessed is not ten years of intense involvement of global elites in solving the fundamental problems, but ten years of intense and successful efforts at procrastination. Since the problems are continuing to mount, I am not convinced that their strategy will succeed. And as soon as real attempts are made at actually solving these problems, I am confident that the issues of global justice, binding targets, historical responsibility and reparations will resurface too.² The fundamental justice concerns underlying the climate debt concept will never disappear.

Stockholm, October 7th 2016

² This is also the opinion of leading social scientists in the field, such as Ciplest *et al.* (2015:17): “[W]e do not see any hope of realizing an adequate international deal without far more aggressive and ambitious social movements organizing at the local and national level, pushing states to act. However, we believe that the level of ambition that is needed to avert disaster can be achieved only if we simultaneously pursue an international process with robust forms of accountability and action at all lower levels.”

Introductory Chapter

1. The Scope

1.1. Ecological-Economic Asymmetries Approach

Four related concepts are at the centre of this thesis. Ecological debt and climate debt are thoroughly introduced in Paper 1, with regard to their history and how they have been conceptualized by different actors, including civil society and various scholars. In Paper 4, a similar introduction is provided for ecologically unequal exchange and the related, novel concept of unequal (or carbon) sink appropriation. These papers, and partly also the other papers, serve as a general introduction to the field and to the research front. In these initial remarks, the focus will be on summarizing and synthesizing how the concepts are used in the papers. From the vantage point of an extended research process coming to a close, I have the possibility and ability to take a helicopter's view of how the concepts have evolved over time and how their distinguishing features are used in different contexts. The formal relation between them is illustrated in Table 1 below, which reflects how they are linked together in Paper 4. It is meant to show that climate debt forms an integral part of ecological debt just as well as carbon sink appropriation is a component of ecologically unequal exchange. Whereas ecological debt and climate debt can be visualized as stocks, measured as a total sum at a specific point in time, ecologically unequal exchange and carbon sink appropriation are the flows that build up these stocks (or debts) over time.

Taken together, I call the application of these concepts the *ecological-economic asymmetries approach* (E-EAA). The four concepts all express asymmetries in the way that the flows referred to – *ecologically unequal exchange* (EUE) and *carbon sink appropriation* (CSA) – are asymmetric or unequal (as opposed to balanced), thus giving rise to net stocks – called *ecological debt* (ED) or *climate debt* (CD). The asymmetries are ecological since they consist of energy-matter – such as biomass, primary resources, energy or carbon dioxide – and/or some form of ecological damage. They are economic since they are often traded and always an integral part of the socio-ecological metabolism of societies. Moreover, these biophysical asymmetries are presumed to be related to or directly caused by *power* asymmetries: inequalities with regard to political power, market power, military power, discursive power, etc. A further motivation for calling it E-EAA is that I

regard the four concepts as well situated within the academic field of ecological economics, although they are hybrid concepts and thus also relevant for other fields.

Table 1. Ecological-Economic Assymetries Matrix

	<i>Stocks</i>	<i>Flows</i>
<i>General category</i>	Ecological Debt (ED)	Ecologically Unequal Exchange (EUE)
<i>Sub category</i>	Climate Debt (CD) ^a	Carbon Sink Appropriation (CSA)

^a Or, strictly speaking, Emissions Debt (EmD), since climate debt, according to the conceptualization in Paper 5, consists of both an adaptation debt and an emissions debt, and only the latter is intended here.

The theoretical framework that supports the ecological-economic asymmetries approach has many pillars, and it seems impossible to narrow them down to a specific number. As will be obvious in both the papers and in this introductory chapter, numerous theories are applied in support of the approach. This is a result of their heterogeneous origins as well as their many different uses and applications. Yet, I will here outline a five-step model where each step is associated with some theories and/or methods that seem to me to be foundational for the approach. One application of the ecological-economic asymmetries approach might entail only a few of the steps, but fully developed, all steps are included. The order of the steps is thought of as a refinement of a more basic application to a more developed study that includes all five steps, but other combinations (e.g. 1, 2 and 4) are possible.

The *first* step entails versions of *biophysical accounting*. The idea to measure flows in biophysical units – ghost acreages, ecological footprints, material flows, etc. – and to build theories around the significance of these flows, both locally and globally, lies at the foundation of the ecological-economic asymmetries approach. This step is associated with quantitative methods and theories based in natural science, but far from all applications of for instance ecological debt engage in the actual measuring of biophysical stocks and flows. Yet, when for instance ecological debt is used as an ethical or legal concept, it still builds on the *assumption* of biophysical asymmetries. Whether actually quantified or not, the concepts are all rooted in arithmetic, indicating that something is physically larger than something else. Bypassing this step is hardly possible for a study of ecological-economic asymmetries.

Biophysical accounting is merely a methodology. But in close relation to it lies an understanding of the economy that contradicts the standard, neoclassical economy with its fetishization of monetary transactions. In heterodox ecological economics, biophysical accounting is a central part of how the economy is understood. Further, the unequal exchange perspective – basically that more labour power or natural resources are exchanged for less because of asymmetric power relations manifested in terms of trade – is a heritage from what I will refer to as neo-Marxist economics

(including dependency theory and world-system analysis), which contradicts the Ricardian understanding of unequal trade as mutually advantageous. Taken together, the *second* step of the ecological-economic asymmetries approach might be referred to and is based on *heterodox economics* (which includes ecological, Keynesian, feminist, Marxist and neo-Marxist economics).

Conceptualizations of unequal exchange and, in most cases, of ecological debt are expressions of *spatially distributed inequalities* (step *three*). They often express inequalities between peoples in different locations, most often to show persisting inequalities between developed and developing countries, between the global North and South. This is not to say that differences *within* societies – according to class, genders or ethnicity on a defined territory – are less important, only that such differences are more often analysed with the use of other concepts than those under study here. While ecological-economic asymmetries are (generally) spatially distributed, they can be regarded as a subcategory to the wider discourse of environmental justice, which also includes place-bound (or spatial, but on subnational level) stratifications based on e.g. class, gender or ethnicity (cf. Paper 1). On a theoretical level, this spatial focus has made E-EAA a good fit with neo-Marxist economics and its theorizations of global cores and peripheries (see section 3.3).

Further, a *historical perspective* (step *4*) is inextricably linked to the use of the stock-based concepts, i.e. ecological debt including climate debt. What is here meant by a historical perspective is both a theoretical approach (shared by e.g. historical materialism and institutionalist path dependency) that historical experiences profoundly influence the current and future development of societies (without determining it, which is the reason I reject historicism) and the normative appreciation of accountability for past actions. The claim that states are still responsible for the emissions of many generations of citizens may seem rancorous, but is well established within climate ethics and environmental legislation (as is demonstrated in Paper 3). Fundamentally, the relevance of the historical perspective in the ecological-economic asymmetries approach is not primarily a way to seek justice for historical injuries, but to solve today's problem by offering a model for fair distribution of the future costs for climate change mitigation and adaptation. In order to be acknowledged as fair today, and therefore accepted as a possible way into the future, it must address the past.

The *fifth* and final step is *normative reasoning* (or ethics, or justice theory). A fully developed case of the ecological-economic asymmetries approach includes a moral claim based on values that I think should to be defended by normative reasoning. Thus, it is not just *any* ethics that constitute the fifth step, but one resembling what is outlined in Paper 3.

Thus, all studies of ecological-economic asymmetries build on the assumption of unequal biophysical distribution (*step 1*), although many do not actually apply quantitative methods for assessing them. The calculations of climate debt and carbon sink appropriation in Paper 5 and of a case of time-space appropriation in Paper 6 are examples of biophysical accounting, but also the other papers, which apply qualitative methods, rely on the assumption of asymmetric global biophysical flows and stocks.

In some cases, pure observations and assessments are made, without very much theoretical framing. But as long as some importance is ascribed to biophysical aspects of the economy, I would argue that they contradict the assumptions of standard, neoclassical economics, according to which trade cannot be unequal and debts are exclusively a result of monetary lending. Therefore, most quantitative studies of asymmetries tend to rely on *heterodox economics* or other social theories (*step 2*), since they are helpful in explaining these asymmetric flows and their (economic and ecological) consequences where standard economics fail. In this thesis, ecological economics and neo-Marxist economics are used to explain biophysical asymmetries, for instance in Papers 1, 4 and 6.

That E-EAA is concerned with *spatially distributed inequalities* (*step 3*) is evident in all papers of this thesis. Although non-spatial conceptualizations of ecological debt exist and are briefly discussed in Paper 1, the line of argument on climate debt and carbon sink appropriation laid out in Papers 2-5 focuses mainly on the North-South divide, while the historical study of an early modern case of ecologically unequal exchange between Sweden and China in Paper 6 is just as spatially oriented.

A *historical perspective* (*step 4*) is crucial for the stock-related concepts ecological debt or climate debt (Papers 1-5), while it is possible to apply the flow concept unequal exchange for assessing current flows without a historical perspective. Thus, the most historical paper (in the common sense of the word: a paper researching the past) has the most synchronic, i.e. non-historic, methodological perspective: it only measures biophysical flows at a few particular points in time, without summing them up into a diachronic, or cumulative, debt.

Often, there is also an implicit or explicit normative reasoning (*step 5*) in E-EAA studies. In this thesis, this is most clearly marked in Papers 2 and 3. In the first, the climate justice movement's claims on climate debt are identified, while in the latter, these claims are compared to established normative theory. But it is also possible to apply this approach without much of normative valuation. For instance, in the last paper of the thesis, a case of unequal exchange in the 18th century is analysed and the conclusion is that Sweden was a periphery in relation to China, which extracted vast amounts of iron in order to exchange it for Chinese tea embodying much less land. Although this can be regarded as unfair, the aim of the study is not to condemn the trade policies of imperial China, but rather to better understand the world

economy of that era. Thus, the normative step is absent here, although present in other papers.

1.2 The Concepts

The papers in the thesis have developed over time and in different contexts, thus the concepts at their core are used and defined in ways that are not always identical. Here, I will attempt to synthesize the concepts into a more coherent and unified understanding of them. In Paper 1, which was also the first paper to be submitted and published, the concept of ecological debt (ED), including climate debt (CD), is discussed quite thoroughly and different definitions presented. Here I state that although a consensual definition is lacking, the concept is still used rather consistently. Early on, ecological debt denoted either a relation between nature and humanity (Robleto and Machado 1992) or between generations (Jernelöv 1992). However, already at the 1992 Rio summit the dominant use of the concept was to denote a debt between socio-spatial or territorial entities; “peoples” or most often nation states or groups of states (North vs. South). In Paper 4 I propose that ecological debt can be linked to ecologically unequal exchange by adding time, so that EUE refers to the flows of matter or energy or sink services per unit of time, while the cumulative results of these flows, or the stocks, add up to ED. But even if I maintain that this formalization is possible and valuable, I do not claim that what was said above about ED also applies to EUE (with the addition of a time factor); as concepts, they have different histories, contexts and applications. Yet, it is interesting to discuss them together, as parts of the same approach, since this has not been consistently done before. Whereas the similarities between the concepts were highlighted in the previous section, I will here discuss six aspects in which there are differences between how ecological debt, climate debt, and ecologically unequal exchange are conceptualized in terms of scale, temporality, unit of analysis, quality, fields, and scope.

In the papers, I approach ED and EUE at a general level. ED is introduced and discussed mainly in Paper 1 and further developed and linked together with ecologically unequal exchange in Paper 4. Climate debt (CD) and carbon sink appropriation (CSA) are, however, conceptualized on detailed levels, formalized and calculated for most states of the world. Also, a particular method for calculating EUE – time-space appropriation (TSA) – is operationalized in Paper 6. Thus, while I do not explicitly side with any of the variations with regard to ED and EUE addressed below, I necessarily have to do that with regard to CD (as a subcategory of ED), CSA and TSA (which are both versions of EUE) in order to conceptualize and quantify them.

(1) *Scale* is one area of variation. While EUE is essentially about spatially distributed inequalities, ED is not always so. Applications of ED range from the very local to the global, although the international level is the predominant one. CD and EUE are almost entirely analysed on an international level, as relations between countries or groups of countries (often as North vs. South). In this thesis, CD and CSA are defined as relations between states on the global level. This should come as no surprise since climate change is the primary example of a global problem. Thus, while other instances of ED (and EUE) on a local level can be highly relevant it seems superfluous to further motivate the choice of a global scale for climate related measures. TSA is used in a very specific case study – the exchange of particular commodities from particular regions during a particular time. The data I collected and analysed are selected for their proximity in time and space to this particular case, yet since much data are available only on the national level and since the hypothesis is phrased in terms of an exchange between Sweden and China, the scale is perhaps best described as bilateral.

(2) Further, *temporality* varies. On the creditor side, ED and CD conceptualizations always have a historical perspective in the sense that they are cumulative, but debtors can either be regarded as today's population suffering from historical abuses (synchronic), or future generations suffering from past and current abuses (diachronic), or some combination of the two. EUE is, on the other hand, essentially non-cumulative and synchronic, i.e. concerned with simultaneous comparisons, although EUE studies can also be conducted in historical time (as in Paper 6) or summed up to be cumulative (which I would refer to as ED). CSA and TSA are here conceptualized as non-cumulative and synchronic, while CD is defined as both synchronic and diachronic: the debt is partly owed to current generations for the historical unequal distribution of atmospheric space, and partly to future generations for the general overuse of the global carbon sinks which will impose climate change on them.

(3) The *unit of analysis* also varies, largely depending on the choice of scale. Thus, consistent with the predominant international scale, nation states are the most typical unit; such as when creditor countries demand the debt repaid by debtor countries. In more local studies, individual corporations are categorized as debtors and the local population affected by their operations as creditors. Commons also play a key role in this approach. An ecological debt can, for example, be seen as arising when country A is importing large quantities of fish from coastal areas in country B, perhaps resulting in overfishing and malnutrition, without a comparable return or compensation. A then owes B an ecological debt. But if the (over)fishing instead takes place off the coast, on international water, it can still be an instance of ecological debt accrual. If the oceans are regarded as commons, fishing should ideally be regulated through fair and sustainable national quotas. If some countries are responsible for overfishing beyond their fair and sustainable quota, then these

countries are accumulating a debt. Typically, it would be oversized fishing fleets from country A that are responsible for overfishing of the commons, thereby appropriating the fair and sustainable shares of ocean fish belonging to country B (and C, D, E, etc., who also have claims on the common).

This is what Paredis *et al.* (2008:149) refer to as debt accrual through use at the expense of the equitable rights of others. In the special case of climate debt, which is the cumulative stock of the use of the absorption capacity of the global sinks at the expense of others, the debt is entirely earned as a result of the appropriation of global commons (the oceans and the atmosphere), *viz.* CSA. Thus, the climate debt is a measure of the historical appropriation of states of the global sinks beyond what was rightfully theirs; “for their appropriation of the planet’s capacity to absorb greenhouse gases above their fair share” (Paper 2).

In our operationalizations of CD and CSA, nation states are not only the unit of analysis but also the unit ultimately held *accountable* for debt accrual and repayment. This is not to say that individual firms or persons cannot be responsible for climate change and climate debt accrual. Nation states are clearly not homogenous entities, and I admit that using the nation state level risks blurring the internal divisions of countries. For instance, there are undeniably large numbers of poor people in the North and large segments of wealthy people in developing countries. To highlight these internal divisions and contradictions is crucial in the pursuit of climate justice, but I do not think that the climate debt concept is the best tool for doing that. As will be shown throughout the thesis (particularly in Paper 5), however, there are substantial geopolitical differences with regard to climate change responsibility, and as discussed in Paper 3, there are still good reasons to emphasize this territorial division and to ascribe accountability to nation states – not least because of the way the global community is organized. But for a more complete understanding of environmental inequalities, both spatial and internal social differences are, indeed, necessary.

Choosing the nation state as the unit of analysis might merely reflect practical considerations, such as when it is the only level for which relevant data are obtainable. In the TSA analysis in Paper 6, the active part in the exchange is clearly not a state but a private firm, The Swedish East-India Company, and the commodities exchanged (iron and tea) were produced by many actors (dozens of Swedish iron mills and thousands of Chinese farmers). Yet, the comparisons are nonetheless partly made at the level of the nation state; this is because that is often the level where data are obtainable, and also while it is often on this level that a discussion of the general conditions of production are possible and meaningful.

(4) A further variation regards the *quality* of the debt or exchange, which partly boils down to which unit is used for measurement. At the foundation of the ecological-economic asymmetries approach there is always a biophysical aspect, an

observation (and often a condemnation) of more natural resources of some kind being exchanged for less, but beyond that, the unequal exchange or debt can be expressed and measured in terms of different qualities. In Paper 4, I identify three qualities of ED: *biophysical debts*, *underpayment debts*, and *punitive debts*. The first category refers to a cumulative negative “physical trade balance”, greater imports than exports of natural resources measured in some physical unit, such as ecological footprints, ecological damage, time and space requirements, tons of carbon dioxide, or various other physical units. These debts can be expressed in money through some form of pricing (such as the price of carbon in the EU emissions trading scheme), but they can also be conceptualized directly as underpayment debts; then, the focus is not ecological damage or extraction itself, but rather that the payment is too low, either in relation to an understanding of what would be a fair price, or expressed in terms of the social cost (price does not account for external costs, such as the restitution of ecological damage). In the case of climate change, a similar approach could be expressed in the tendency of wealthy countries to disproportionately utilize environmental space without paying for it. Finally, punitive debts are accrued through unmitigated damage to ecosystems abroad or the appropriation of resources or sinks that rightfully belong to others; they are examples of qualitative phenomena, wrongdoings, or even crimes in political, ethical or legal terms. They escape precise quantitative measurements, but might be repaired more or less symbolically.

In Paper 2, I suggest that climate “debt” is actually not an ideal metaphor for what should rather be regarded as a violation of rights and territories – the imposing of detrimental climate change and the colonization of commons sinks – and that climate indemnity or reparation would be better expressions of what is actually meant by climate debt. This links CD to the punitive debt category, but I would still claim that the overuse of common sinks also should be considered as a biophysical debt. The debt metaphor works better for ED. It is more often regarded as a result of a “negative balance of trade” or a “trade debt” in biophysical terms. Also, when conceptualized as cumulative underpayment, the debt metaphor is logical.

An important debate concerns whether quantification and monetization risk reducing the unique and basically non-quantifiable qualities of ecosystems, and even promoting a marketization of natural “values”. As argued in Paper 1, this risk can be avoided by drawing a sharp line between expressing debts in monetary terms, and actually commodifying it.

In this thesis, I define CD as two-fold. One part is the *emission debt*, which is expressed in tons of carbon dioxide and therefore entirely biophysical. The second part is the *adaptation debt* owed for the “incremental costs caused by the adverse effects of climate change” (Paper 2) and expressed in monetary terms. I would, however, not call it an underpayment debt. Doing so would imply that emissions

leading to catastrophic climate change would be quite alright if only the responsible parties pay for the extra costs, which would be an absurd interpretation. Rather, it is a punitive debt – an estimation of the reparation costs for the damages and adaptation measures that follow from climate change – but not a just compensation. In contrast to ED, the EUE concept is not used for legal processes or political reasons; it is primarily biophysical. TSA and CSA, as applied in the papers, are expressed, respectively, in time-space (work days and annual hectare yields) and tons of carbon dioxide per year.

(5) Further, the concepts are applied to several *fields*. The field is inextricably linked to the quality of the debt, but it is not the same thing. The field should be understood as a *social arena*, such as an academic discipline, within which the concepts are applied. In Paper 1, I provide three cases for how ED/CD is applied: as a measure of biophysical accounting in ecological economics and the environmental sciences; as a legal instrument attributing accountability for past actions in legal theory or international relations; and as a distributional principle, in which responsibility for e.g. climate change is constitutive for the future allocation of burdens to mitigate climate change, and as such part of debates within normative political theory and the UN climate change negotiations. The list is not exhaustive but offer prominent examples.

The conceptualization of CD and CSA in this thesis is an attempt to measure biophysical realities and distribute the responsibility between countries (Paper 5); a sketch of how this responsibility could translate into a global allocation scheme is also presented (Paper 3). The possibility of pushing climate in the legal system is mentioned (Paper 1) but not elaborated on. As pointed out in Paper 3, an allocation system can be interpreted as either proportional, when there is a direct and full transmission of debts into obligations, or conceptual, where historical debt is merely a soft mechanism for deciding future allocations.³ The conceptualization of climate debt as used in this thesis and derived from the climate justice movement (CJM) is clearly proportional: as shown in the argumentation analysis in Paper 2, it should be repaid in full through the freeing up of atmospheric space in proportion to former overuse. As shown by Rice (2009), the NGO claims on ED are just as clear on the matter of repayment, but the argument is closer to the conceptual type. A likely explanation (mentioned in Paper 1) is that ED is a more complex concept than CD, and to establish a detailed account of it is hardly possible. Therefore, ED policies tend to be more indicative and conceptual, as in the proposals to cancel third world external debt as a reversal of the ecological debt.

³ See Friman and Strandberg (2014). In Warlenius 2013 I referred to the same phenomena as strong or weak climate debt.

Table 2. Conceptual Variations on Six Factors

	<i>ED</i>	<i>CD</i>	<i>EUE</i>	<i>CSA</i>	<i>TSA</i>
<i>Scale</i>	Local Global	Global	Global Bilateral	Global	Bilateral
<i>Temporality</i>	Diachronic	Diachronic / Synchronic	Synchronic	Synchronic	Synchronic
<i>Unit of analysis</i>	States Corporations Inhabitants	States	States	States	Corporations States
<i>Quality</i>	Biophysical Economical Punitive	Biophysical Economical	Biophysical	Biophysical	Biophysical
<i>Field</i>	Biophysical accounting Legal instruments Distributive principle	Biophysical accounting Legal instruments Distributive principle	Biophysical accounting	Biophysical accounting	Biophysical accounting
<i>Scope</i>	Narrow Wide	Narrow Wide	Narrow Wide	Narrow Wide	Narrow

EUE is generally used in a narrower way than ED/CD, mostly confined to socio-environmental studies where the studies are either quantitatively oriented and include calculations, or more qualitative and philosophical (Paper 4). Yet, these assessments are seldom used for political mobilization, legal procedures, or policy proposals aiming at stopping or reversing the unequal exchange. In line with that, TSA is also an example of biophysical accounting.

(6) Finally, the *scope* of the conceptualizations varies: either as biophysical measures, which I call the *narrow scope* version, in contrast to the *wide scope* version, which also includes further claims of some kind, typically about a correlation or a causality between biophysical asymmetries and levels of ecological degradation and/or of economic development. The scope of CD and CSA, as quantified mainly in Paper 5, exemplifies a narrow version of the concepts. Further implications of CD are discussed in other papers (especially in Paper 2), and generally the wider scope versions of ED and EUE tend to be qualitatively oriented. The TSA analysis in Paper 6 is directly linked to hypotheses of world system core and periphery status and therefore an example of a wide-scope conceptualization.

Even when correlations seem to confirm claims with wide scopes, more work needs to be done on identifying causal mechanisms and explanatory factors in order to better understand why, when, and how ecological-economic asymmetries and levels of economic development are correlated. This is also the area within the ecological-economic asymmetries approach that I regard as having the greatest potential for further research, and I will return to it in section 3.5.

1.3 Research Design and Process

The original research plan for this thesis was to focus on historical and contemporary cases of ecologically unequal exchange, and not to say very much, if anything at all, on ecological debt and climate debt. So, readers would ask themselves, how come these very concepts are at the centre of what is now advanced as my PhD thesis? To answer that question, and indeed to be able to articulate the aims and research questions that guided the work, I would need to lay out the process of conducting the research. So allow me a digression.

The PhD position I was granted was partly financed by the EU FP7 research programme EJOLT (*Environmental justice organizations, liabilities, and trade*), a unique five-year research program involving both universities and environmental justice organizations (EJOs) from Europe and around the world, coordinated by the environmental science centre ICTA at the Autonomous University of Barcelona (UAB). The Human Ecology Division at Lund University was responsible for its Work Package 10 on "Consumption, ecologically unequal exchange, and ecological debt". Professor Alf Hornborg served as the WP leader and two PhD candidates – Martin Oulu and I – were hired. Our research was thus not entirely open but framed by our responsibilities to EJOLT.

My initial plan was to develop the notion of ecologically unequal exchange both theoretically and methodologically and apply it to several case studies. My master thesis in economic history was a historical case study of ecologically unequal exchange (EUE) between Sweden and China in the 18th century⁴, the first version of what became Paper 6 in this thesis. Now I wanted to expand the case and construct new, historical as well as contemporary cases of EUE.

However, soon after starting my PhD studies I noticed an interest from EJOLT participants in elaborating the concepts of ecological debt and climate debt. In fact, "ecological debt, including climate debt" was singled out as a particularly relevant concept in the EJOLT (2010) application. And since I had also written a thesis on climate debt during my master studies (Warlenius 2010), I thought I could contribute with my understanding of the concept. Already in my first participation in an EJOLT meeting, in Durban in December 2011, I presented some figures and methods for calculating climate debt. I developed the presentation into a paper that was presented at the biannual conference of the *International Society for Ecological Economics* in Rio de Janeiro in June 2012, and I also presented it at a summer course organized by UAB in Barcelona the same summer. The calculations were later used

⁴ Which, to my great pride, earned me *Samhällsvetarpriset* ("Social science award"), established by the civil servant trade union Jusek and the weekly news magazine Fokus, for the best master thesis in social science in Sweden 2011.

in EJOLT's online Environmental Justice Atlas, which includes a page showing the climate debt of most countries.⁵ When I started calculating these figures, it was not with the purpose to include them in my thesis, but the more I worked on the topic, the more it seemed like a waste not to develop it into a full article, and in the end, it entered this thesis as Paper 5.

Because of my interest in climate debt, I received a request from EJOLT, in the fall of 2012, to prepare an answer to a critique of the climate debt concept written by the French economist and philosopher Olivier Godard (Godard 2012). Unaware of the magnitude of the challenges it would present me with, I agreed, and after an intense involvement with political theory and environmental ethics I presented the lengthy working paper *In Defense of Climate Debt Ethics: A Reply to Olivier Godard* (Warlenius 2013a). Three years later I rearranged and updated it into a normal-size article and submitted it to a peer-reviewed journal. It is included in this thesis as Paper 3.

Meanwhile, I was asked to prepare a more general introduction to ecological debt for a workshop, organized by EJOLT and its Nigerian partner organization Environmental Rights Action, held in Abuja in March 2013, and did so with the input from Lund colleagues that also attended the workshop (Gregory Pierce, Vasna Ramasar, Martin Oulu, and Andreas Malm). Later, this paper developed into an article published in the journal *Global Environmental Change* (Paper 1⁶) and formed the backbone of a report published by EJOLT (Warlenius *et al.* 2015).

So until the end of 2013, I had been persuaded to spend the major part of my PhD research time on ecological debt and climate debt, subjects that I did not originally intend to include in my thesis. As mentioned, my plan was to focus on historical and contemporary cases of EUE. I especially wanted to expand my previous study of the early modern Sino-Swedish trade. Applying Hornborg's (2006) concept of time-space appropriation, I had assessed the amount of land and labour embodied in the most important commodities traded by the Swedish East India Company, i.e. bar iron from Sweden and black Bohea tea from China, and drew the conclusion that this exchange resulted in a considerable net flow of embodied land and a moderate net flow of embodied labour from Sweden to China. On a theoretical level, this indicated that China was more central than Sweden in the early modern world-system. But in order to reach that conclusion, I had to deal with the complicating fact that the Swedish iron was not directly exchanged for tea, but sold in Cadiz for (Spanish-American) silver pesos, which were used to purchase the tea in

⁵ <https://ejatlas.org/featured/climate-debt>

⁶ I can honestly declare that the research in the article is almost entirely mine. The influence of the co-authors is however clearly visible in the beautiful English that the paper is written in and also in some of the more philosophical reflections. They were also crucial in the editing process of the article, this being the first paper I have submitted to a scientific journal.

Guangzhou. I had thus previously treated the silver as money, and was now interested in conducting an expanded study in which the silver was instead treated as another commodity and the Sino-Swedish trade as a triangular one also including Spain. I therefore studied historical sources on early modern silver production in Potosí (now Bolivia) and Zacatecas (Mexico) and on the extraction of mercury, which was a necessary input in the refinement of silver ore. The aim was to assess the amount of labour and land embodied in the silver and compare that to the Swedish iron and the Chinese tea in order to figure out how these trilateral flows of energy and matter benefitted the three respective states. I presented the preliminary assessment of the flows of embodied labour at two conferences in 2013 (Warlenius 2013b), *Critical Perspectives on World History* in May and the *Tenth Swedish Economic History Meeting* in October 2013, both at Lund University. The editors of the proceedings from the first conference, Arne Jarrick and Janken Myrdal, asked me to develop my presentation into a chapter for a peer-reviewed book (Jarrick *et al.* 2016), which is the same as Paper 6 in this thesis.

As explained in the paper, however, silver was not included in the analysis. The main reason was theoretical: I could not construct a falsifiable theory on what the result signified for my overarching research question, whether China or Europe was the centre of the early modern world economy. The prime reason is that even the most ardent advocate of a Sino-centric world view, Andre Gunder Frank, regarded the Spanish silver as the “exception to the rule”, the only commodity that the Europeans could produce more efficiently than the Chinese. Thus, a result pointing to a net transfer of labour and land to Spain would not falsify his claims, and to fulfil the empirical study therefore seemed pointless. Still, I include the tentative results for labour embodied in Mexican late 19th century silver production in this Introduction (section 4.2.3).

Somewhat dislocated after my partly failed attempt to construct a further historical case study of ecologically unequal exchange (EUE), but instead with a pile of papers on ecological debt (ED) and climate debt, it might in hindsight seem unsurprising that I intensified my thinking about the relation between these two concepts – if a firm connection could be established, it could open up for a new direction for my thesis. Both EUE and ED are theories or tools used for conceptualizing or measuring global ecological asymmetries and injustices, but the former is an academic concept while the latter is used mainly by social movements and in politics. They were both singled out as important for EJOLT and both occurred in the title of the work package that we were responsible for, but very little had been written about their relation. The only example, to my knowledge, is a few sentences in which Martínez Alier (2002:214) identifies EUE as part of the ecological debt.⁷ So for an EJOLT workshop organized in Lund in March 2014, I prepared a presentation that aimed at

⁷ Later I also found a similar linking of the concepts in Rice 2009a.

linking ecological debt and ecologically unequal exchange via a stock-flow perspective, where the former constitutes the stock and the latter the flow. The paper was later developed considerably into an article published in *Journal of Political Ecology* and is included here as Paper 4.

The article is a theoretical piece based on a reading of the literature on unequal exchange and ecologically unequal exchange, and I believe its way to link the concepts is novel (although indebted to Martínez Alier's first connection of the dots). This linking facilitated my thesis plan, because together with an article presenting the link between EUE and ED, it made more sense to assemble papers on both topics without the risk of losing focus. Thus, for the final outlook of this thesis, it is a crucial text that opened up for the inclusion of my work on ecological debt. My hope is that it contributed some analytical and theoretical confirmation that EUE and ED are related concepts⁸, and that mixing papers on both concepts in one thesis is not far-fetched.

Further, it also helped me develop a conceptual innovation – that of carbon sink appropriation (or unequal sink appropriation). The concept of ecological debt had developed within the environmental justice movement to also include what was called carbon or climate debt, and eventually, as climate change rose to the top of the list of global environmental problems, climate debt overtook much of the debate. However, no corresponding development had occurred among those elaborating and writing on EUE. Carbon emissions had no doubt been included in some of the published research on EUE, but not in a clear and consistent way. Just as climate debt required other methods and concepts than ecological debt, yet still formed a natural part of it, there was a need for a corresponding concept that singled out the particularities of carbon emissions, yet forming an integral part of EUE theory. After some consideration I decided to call it CSA – carbon sink appropriation.⁹ While developing my earlier calculations of climate debt, this provided an opportunity to actually quantify CSA, which is done in another submitted article (Paper 5). I also came to realize that the assertion that my quantification is based on the climate justice movement (CJM) needed to be backed by a rigorous inductive analysis of its statements on this issue. The (chronologically) last paper in this thesis is thus an argumentation analysis of nine central manifestos issued by the climate justice movement in order to identify the CJM claims on climate debt. Only thereafter did I have a solid ground for the assertion that the calculation of climate debt in Paper

⁸ The synthesizing ambition is furthered in this introductory chapter through the concept E-EAA.

⁹ My first list of potential candidates included: pollutant sink appropriation, green grabbing, waste assimilation, exhaust sequestration appropriation, unequal sink sequestration, fume sink, offsets, air pollution sink appropriation, environmental space occupation, absorption capacity appropriation, and environmental load displacement.

5 is based on what the CJM has proposed on this matter. The paper, here included as Paper 2, is therefore another cornerstone of the thesis.

The last intellectual endeavour in the research process is, however, what is placed first in the thesis: the introductory chapter to the thesis, the so-called *kappa*. To summarize, reflect on and try to make some theoretical and methodological sense of such a long and dynamic research process and also look beyond it has been both exciting and challenging. Given journal requirements on word limits, my ontological persuasions, epistemological assumptions, and theoretical reflections are absent or only very briefly described in each paper, as are most of the thematic and methodological links and connections *between* the papers. I hope I have managed to integrate these individual papers into a fairly coherent whole.

1.4 Aims and Research Questions

In sum, my research became more closely related to the wishes and demands of the EJOLT participants than I had originally anticipated, and one consequence of that was a stronger emphasis on ecological debt/climate debt. I was guided by an explicit aim of EJOLT: “to empower Environmental Justice Organizations (EJOs) by a transfer of scientific methodologies of use in their struggles.” More specifically, “ecological debt, including climate debt” was identified as one of these key concepts and methodologies, and “[t]here is a demand from international EJOs and also from government officials for the instruction of the methodology of such calculations in terms that activists and citizens can understand” (EJOLT 2010: 20). Although it did not influence my research it is significant that Pope Francis (2015:37) a few years later echoed this belief in his *Laudato Si*: “There is a pressing need to calculate the use of environmental space throughout the world for depositing gas residues which have been accumulating for two centuries and have created a situation which currently affects all the countries of the world.”

I have definitely tried to respond to this “demand” from EJOs and my hope is that my research, as a part of EJOLT, has been or will be to some degree helpful in their struggles. I am of course aware that this aim can be viewed as external to the research process and that it cannot be evaluated through the intellectual tools reviewers and examiners apply to doctoral theses. The reason why I anyway count it as a key aim for the thesis is that it has guided me in my work. I have, for instance, had the ambition to stay close to the definitions used by the EJOs in operationalising key concepts, and to use methodologies that are both scientifically motivated *and* accessible. This ambition is also expressed through the following, more concrete, and numbered aims (see below), which are chosen because I believe that they can contribute to the strengthening of the EJO claims and thus potentially to empower

them. Further, I have attempted to go beyond a one-way “transfer of scientific methodologies” to EJOs; as is discussed in Paper 1, it is as much an attempt to turn activist knowledge into science, and to develop key concepts – mainly ecological debt and ecologically unequal exchange – to be more useful in their struggles, while still rooted in the original intentions of the EJOs. I conclude the aims below with a sentence that states, very generally, some epistemological foundations in which they are to be pursued.

The aims of this thesis might thus be stated in the following way:

To empower Environmental Justice Organizations (EJOs) by responding to their demand for scientific methods that can be used to enhance their struggles, to do so by (1) exploring the historical development of the concepts of ecological debt, including climate debt, and ecologically unequal exchange, (2) developing the concepts further, (3) linking them closer together, (4) justifying their fundamental normative points of departure, and (5) finding valid methods to quantify them, and by pursuing these aims while respecting the original intentions of the EJOs, without diminishing their original ecological and egalitarian radicalism, yet independently and with due regard to scientific rigour.

Does this mean that the research has been constrained by the demands of being “useful” for the EJOs instead of being intellectually non-committed? Is there a risk that the conclusions are shaped by “political correctness” rather than as a result of an unbiased examination and analysis of data? The short reply is: I certainly hope not. Or: Not more than in other research, anyway. *All* researchers assume ontological standpoints that are coloured by their preconceptions, consciously or unconsciously, and I am most likely no exception to this rule. But by being as explicit as possible about our aims, loyalties, assumptions, theories and methods, we can facilitate an examination of whether our inferences are sound or not. I have tried to pursue my research in accordance with this principle, and am confident that any biases are revealed in the scientific review process. The chapters in this thesis are, I hope, deeply respectful of the experiences and beliefs of people and movements struggling for environmental justice around the world; yet when my own, independent analysis of the data drives me to conclusions that diverge from theirs, I do not hesitate to declare so.

These aims pertain to the thesis as a whole, and in what follows I will relate the individual papers to the overall aims and to the specific research questions posed in the papers. Some of the papers state the research questions, while others summarize the research process in the introduction. Here, however, all research questions are explicitly presented.

The focus of Paper 1 is to analytically juxtapose the two concepts environmental justice and ecological debt. Ecological debt, including climate debt, is broadly

presented, its roots in the environmental justice movement laid bare, and the potential use of it for the pursuit of environmental justice is discussed. The paper responds to the following research questions:

1.1 What is the origin of the ecological debt/climate debt concepts and how did they develop over time?

1.2 How have the concepts been used and defined by civil society and academia, respectively?

1.3 For what purposes and in which contexts have the concepts been utilized?

1.4 What are their potentials in the struggle for environmental justice?

In Paper 2, I apply the method of argumentation analysis to nine central climate justice movement manifestos in order to identify their claims on climate debt. The stated aims are to investigate how the climate justice movement has conceptualized climate debt and to analyse the shift of emphasis from ecological debt (which was analysed using a similar method in Rice 2009a) to climate debt. The following research questions guided the examination:

2.1 What claims, data and warrants are used when CJM mobilizes for climate debt repayments?

2.2 How is climate debt defined by CJM?

2.3 How do the claims identified by Rice (2009a) for ecological debt relate to the analysis of climate debt conducted here?

2.4 What does this indicate about potential changes in the radical justice discourse on ecology and climate?

In Paper 3, the CJM claims on climate debt are defended against its critics by mobilizing arguments from the scholarly literature on normative political theory. It responds to these research questions:

3.1 Is the climate justice movement's climate debt claim ethically defensible, with what arguments, and, in cases where its claims are hard to defend, what would a climate debt ethics look like?

3.2 What would an international allocation model based on climate justice and climate debt look like, prefiguratively?

As explained in Paper 4, the linking of ecological debt to ecologically unequal exchange is subordinated to the overarching aim of the thesis. While ecological debt is mostly an activist concept, ecologically unequal exchange is rooted in Marxism and ecological economics. Linking the two can serve to strengthen both the theoretical foundation of the concept of ecological debt and its intellectual

credibility, which might also serve to empower EJOs. Here, the following research questions are addressed:

4.1 How has ecologically unequal exchange been defined and conceptualized?

4.2 How can this concept be linked to ecological debt?

4.3 Given that climate debt forms part of the wider concept of ecological debt, how could the climate equivalent of ecologically unequal exchange be conceptualized?

Paper 5 is the one that most directly responds to the movement “demand” for calculations of climate debt by presenting an original methodology and data on the climate debt of 154 countries. The stated aim is to find a method for quantifying climate debt that is a) in line with the definition of climate debt emerging from the climate justice movement, b) scientifically accurate, c) applicable to existing data, and d) user friendly. The research questions match the overall aims:

5.1 What would a method for quantifying climate debt that matches the aims look like?

5.2 How can carbon sink appropriation (cf. Paper 4) be quantified and related to climate debt?

The historical case study presented in Paper 6 has a weaker connection to the goals of EJOLT and the overarching aim of this thesis. Yet, social-science theories on e.g. Eurocentrism and interdisciplinary methods to estimate EUE such as the assessment of time-space appropriation, applicable to the identification of economical hierarchies in the world system, are important considerations also for the environmental justice discourse. The main research questions of this paper can be expressed as follows:

6.1 Was China or Europe more central in the early modern world system, or was it characterized by polycentrism?

6.2 Can time-space appropriation, as a method for calculating ecologically unequal exchange, be used as a determinant of world system hierarchy?

2. Theoretical Argument

In principle, a fuller understanding of the concepts at the core of this thesis demands an acquaintance with the theories that underpin them, the theoretical building blocks upon which they rest. But which are those theoretical foundations? Long lists of candidates have been suggested. Paredis *et al.* (2008:72-81) propose that ecological debt should be recognized as resting on four theoretical building blocks: biophysical accounting systems, ecological economics, environmental justice and human rights, and theories on historical injustices and restitution. In a sympathetic critique of this proposal, Rice (2009a) recommends the addition of a fifth component, a broad, ecologically-oriented world system analysis. In Paper 3 of this thesis, climate ethics, normative political theory, and justice theory are further used to analyse climate debt.

With regard to ecologically unequal exchange, Brodin (2006) suggested a reconnection to Arghiri Emmanuel's theory of unequal exchange, which in turn is based mainly on Marxism and dependency theory. Foster and Holleman (2014) set out to fill the theoretical gap with Odum's emergy approach as well as Foster's Marxian theory of the metabolic rift (Foster 1999, 2000). Jorgenson's (2006) structuralist theory of unequal ecological exchange is rooted in dependency theory and world system analysis, while Bunker (2005) and Rice (2009b) use Schnaiberg's (1980) Marxist-influenced theory on the treadmill of production. Alf Hornborg (1998, 2001, 2009, 2011, 2014) has developed a synthesized theory that combines elements from world system analysis, thermodynamics, ecological economics, semiotics, and a profound critique of technology.

For a more theoretically-concerned environmental history, Jason W. Moore (2003) has suggested inspiration from James O'Connor's theory of the second contradiction of capital, Foster's theory of the metabolic rift, Wallerstein's world-systems analysis, Bruno Latour's actor-network theory, and political ecology.

To different degrees, I have been inspired by all of the mentioned theories, alongside e.g. Sandra Harding's (1997) feminist standpoint theory, the critical realism of Roy Bhaskar (2008) and Andrew Sayer (1992, 2000), the critique of Eurocentrism as developed by e.g. Blaut (1993) and Frank (1998), David Harvey's (1996, 2003, 2006, 2014) Marxist geography, among others. Summing up all these theoretical perspectives in a section in the introduction would be an overwhelming task, and not very constructive. In the theoretical chapters as well as in the methodological

one, I will therefore not focus on the specific theories referred to in the individual papers, both because they are so many and because they are presented at least briefly in the papers, but rather on the fundamental perspectives that underlie the thesis as a whole. This means to briefly outline my ontological and epistemological points of departure and then explain the theoretical argument of the thesis in a more concrete way. I begin by introducing critical realism, which is mainly concerned with ontology, and continue with paragraphs on the relation between normative theory, standpoint theory and critical social science. The next section is devoted specifically to Marxist theories that are important for the ecological-economic asymmetries approach.

2.1 Critical Realism

Philosophy of science, particularly with regard to social science, has for long been divided between two camps: one basically post-positivist/empiricist, one constructivist/interpretivist, where the first is related to a methodological preference for quantitative methods, and the latter a preference for qualitative methods (although there are of course exceptions).

To a non-negligible degree, however, the so-called science wars were fights between “straw men” in the sense that the arguments of the other were caricatured. There are not many scientists, and certainly not many social scientists, who are naïve positivists who believe that the empirical reality is immediately and fully accessible to our scientific methods; neither are there many researchers who entirely deny the existence of an extra-discursive reality (not even Derrida, the author of the slogan “there is nothing outside the text”). But even so, there are still considerable and real disagreements between the positivist/empiricist and interpretivist/constructivist camps over ontology, epistemology, and methodology. There are also attempts at finding mediating or “third” positions in these wars, and one such philosophy of science is critical realism. Originally developed mainly as a critique against positivism in natural science (Bhaskar 2008), it has gradually shifted its edge towards the idealism and relativism of postmodernist and poststructuralist theories (Sayer 2000).

Summarized as ontological realism coupled with epistemological constructivism, critical realism postulates the existence of an outside world independent of our senses, discourses, or general knowledge of it. This goes for the natural world, but largely also for the processes and phenomena studied in social science. The degree to which a researcher influences the social world under study is normally very limited, and to claim that she or he is “constructing” social reality would thus be misleading (Sayer 2000:45).

However, to say that something exists "out there" independently of our assumptions does not mean that it is immediately accessible to our senses or instruments. Where empirical realists or empiricists presuppose either that all reality is empirical, i.e. observable, or that the observable is all we can ever learn anything about, critical realists claim that what is empirically accessible is only one domain of the stratified reality, and that science is basically about finding out about the events and causal mechanisms that are concealed. Thus, Bhaskar distinguishes between three domains: the real, the actual and the empirical.

The empirical is the domain of experience and sense impressions, that is, the part of the world that is open to observation. The actual consists of events that are not always experienced. The real is the domain of structures and causal mechanisms that produce events.

Table 3. The Stratified Ontology of Critical Realism

	<i>Domain of the...</i>		
	<i>Real</i>	<i>Actual</i>	<i>Empirical</i>
<i>Mechanisms</i>	X		
<i>Events</i>	X	X	
<i>Experiences</i>	X	X	X

Source: Bhaskar 2008:13

Reality is complex and in open systems, as opposed to the controlled environments that only exist in laboratories or models, many causal mechanisms are at work simultaneously. Their joint effects can create events under some contextual conditions but different events under other conditions; they can also balance each other out so that no event occurs under certain conditions – even though the same causal mechanisms are still at work.

There are therefore good reasons for epistemic pessimism. Critical realism (CR) is critical of the positivist assumptions that we can learn about causal laws only by looking for regular events in the empirical domain. Our knowledge is doomed to be partial and fallible. Science is, in this sense, a social construction, a product of human minds. We can never be sure that our theories are a full and "objective" reflection of the "truth". Yet, CR is also critical of constructivism, because even if our knowledge is partial and socially constructed, this is not the same as saying that there is no reality independent of us, or that we are caught in discourse and unable to know anything about what is outside of it. As noted by Bhaskar (1986:72), "epistemic relativism" should not be mistaken for a "judgemental relativism": to acknowledge that our knowledge is partial and uncertain is not the same as saying that "anything goes", that any theory is as good as the other. An important

assumption in critical realism is that there are superior and inferior theories, theories that are more or less in accordance with the outside objects and structures under study. If theories were fully intra-discursive, socially constructed and without any relation to the extra-discursive objects and powers they refer to, scientific progress would be hard to explain. Yet, our modern lives seem to rest upon scientific breakthroughs in a number of disciplines, both in natural and social science. If objects were not responding to causal powers more or less as predicted by scientific theories, we could hardly cure diseases, fly aeroplanes, or reduce unemployment.

So even if the “objective truth” in its entirety is concealed for us, we can often find out whether the objects are responding and acting in accordance with the predictions made by theory. The criterion by which a theory should be judged, according to CR, is therefore its explanatory power; how competent it is in explaining and predicting events. We can assume that it is not “true”, in any absolute sense, but that it should be judged by its practical adequacy (Sayer 1992:65-71, 2000:43).

This is, incidentally, also in accordance with what Marx once wrote to Engels:

The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. Man must prove the truth, i.e. the reality and the power, the this-sidedness of his thinking in practice. The dispute over the reality or non-reality of thinking that is isolated from the practice is a purely scholastic question (Marx 1975:422).

I should perhaps clarify that this thesis is not an attempt to conduct research directly in the tradition of critical realism. I have not adopted its terminology or the methodological praxis developed within it by, for instance, Sayer (1992). The thesis is a methodological and theoretical hybrid. But my work is nonetheless inspired by and largely in accordance with the fundamental ontological and epistemological assumptions and positions taken within critical realism. This is probably not easy to discern since very little is said about ontology and epistemology in the papers that follow. But in accordance with CR, a reality independent of our knowledge is assumed in this thesis. It is, as prescribed by CR, characterized by an epistemic relativism in that its conclusions are carefully assessed, but simultaneously by an assumption, contra judgemental relativism, that some theories describe the real better than others. Paper 6, for instance, is largely an attempt to test historical social theories and to see to what extent their predictions fit the empirical material. The methodological design perhaps resembles a post-positivist, deductive quantitative analysis rather than a reflexive, critical realist one, but again I would argue that the fundamental ontological and epistemological assumptions are in accordance with those of critical realism.

2.2 Some Related Ontologies

Assumptions similar to those made in critical realism are also expressed within other philosophies of science that I have been inspired by. To exemplify, the standpoint theory as suggested by Sandra Harding (1998) is also appreciated by critical realists (Sayer 2000:51-55). Harding and CR share the basic assumption of ontological realism and epistemological constructivism, but she emphasizes even more clearly that power interests and “standpoints” influence and may even skew science. The examples are numerous, including racist ontologies, Eurocentrism and persistent “biologist” explanations of gender inequalities.

According to Harding, the remedy for these biases is an even stronger demand for “objectivity”. Objectivity, like truth, is one of the trickiest notions within the philosophy of science. On one hand, the strong urge for “neutrality” and “objectivity” in scientific method has likely worked as a protection against the direct influence over science by strong interest groups, such as governments, churches, and big business. Yet at a more profound level, science is, like all social practices, influenced and shaped by the existing political and institutional hegemony. Urges for “objectivity” always risk taking the hegemonic ideology for granted, while branding criticism of the dominating paradigms as “political” (as opposed to “scientific”). The “objective science” discourse thereby undermines an examination and analysis of the assumptions underlying the current hegemony, which in effect makes science less objective, not more. While postmodernists and social constructivists generally share this epistemological understanding of science as skewed by power and standpoints, they embrace an indifferent position toward the possibilities of correcting biases, and thereby escape into epistemological and ontological relativism. Harding rejects such apathy and instead calls for “strong objectivity”: a science that critically assesses whether truth claims are biased by the contextual standpoint of the researcher(s) (Harding 1998:140-143). The problem with racist, Eurocentric or “biologist” science is not that they are “ideological”, but that they are plainly wrong. As pointed out by Sayer (2000:54), however, there are also limits to standpoint theory and the claim that knowledge is “situated”. For instance, to say that all knowledge is social and contextual does not mean that it is only applicable to particular groups; an awareness of standpoint does not mean that all truth claims by “privileged” groups are necessarily wrong or biased, nor does it mean that all members of particular groups share the same standpoints. In short, standpoint theory should not be conflated with identity politics.

Another theoretical approach that has influenced this thesis and that I also find compatible with the basic assumptions of critical realism is the anti-Eurocentrist historical approach. While philosophical post-colonialism is associated with constructivism and ontological relativism there is an (under)current that applies

empirical methods to prove that the Eurocentric paradigm is flawed and ideological rather than historically correct. Andre Gunder Frank's late work, especially *ReOrient* (1998), greatly inspired Paper 6 in this thesis, but several other historians were also important. What will overthrow Eurocentrism, according to Frank, is "the historical evidence itself which disconfirms received historiography and social theory" (ibid.:44) and the goal is a "more realistic social theory" (ibid.:322; my emphasis). Although he does not quote or refer to Harding (or any critical realists), the similarity between their approaches makes me think that he would have supported a standpoint epistemology for stronger objectivity and more realism.

In the field of environmental sociology, Foster *et al.* (2010:340-43) have developed a synthesis between realism and constructivism which they refer to as "realist constructionism". It underlies the important work by John Bellamy Foster, which has also greatly inspired my research. I am, however, not convinced that a new term is needed since the outlook, defined as "ontological realism and historical constructivism, synthesized within a critical-realist perspective" (ibid.:291), is hard to distinguish from critical realism (the influence from CR is in no way hidden, see ibid.:192.)

The tendency within constructivist social science to deny even the theoretical possibility of achieving objective knowledge is even more surprising within environmental social science. Here, awareness of the different epistemological conditions for social and natural science is absolutely crucial. The difficulties within social science to conduct repeated experiments in a controlled environment make inferences less secure. But there is a long way from there to the denial of the possibility of any inferences, even in natural sciences. I find it quite astonishing that some social scientists, as concerned observers of politicized environments, question a) the mounting evidence for serious human-made interference with the ecosystems, such as climate change, and b) that social science can provide knowledge on how such environmental changes affect societies, and how effective responses can be designed and applied. Theories that do not accept a) and do not contribute to b) are, frankly, pretty worthless in a warming world (cf. Malm forthcoming).

2.3 Normative Political Theory and Social Science

An academic field that is not closely associated with critical realism or critical social science in general is normative political theory. Normative political theory is partly about scrutinizing and refining the arguments for a political or ethical standpoint. Since critical social science often entails decisive political standpoints, it should be in no less need of sophisticated normative theories than e.g. political liberalism. Nonetheless it is liberals, such as John Rawls and Robert Nozick, who have taken

the lead in normative theory, while only a few Marxists, such as G.A. Cohen, have followed.

For this thesis, the relation between empirical science and normative theory is of particular interest, as is the similar but not identical relation between “objective”¹⁰ science and explicit political and normative standpoints. The aims of the thesis are both objective and normative; to develop “scientific methods that can be used to enhance their [the EJO’s] struggles.” This is done by elaborating concepts that are simultaneously objective, normative and political; ecological debt and ecologically unequal exchange are used as rigorous measures of biophysical trade flows, as normative concepts indicating that these flows are unequal and often morally wrong, and as political slogans aimed at mobilizing against injustices. In Paper 3, the results from a standard social science method are assessed against normative theory in a way that I believe is rather unusual; again objectivity and normativity are mixed. What might be thought of as a confusing mix is, however, based on the conviction that objective science and normative standpoints are *not* necessarily antagonistic approaches.

Toward the end of this section, I will present some guidelines for how these approaches can be combined and how I apply them in this thesis. But first I will discuss reasons for why normative theory is not as popular within social science, and why that is a problem. In doing so, I will rely heavily on Andrew Sayer’s final chapter in *Realism and Social Science* (2000), called “Ethics Unbound: For a Normative Turn in Social Theory.”

Sayer actually sees a normative awakening in critical social science, and especially in radical science related to the “new social movements” such as feminism, environmentalism, anti-racism and post-colonialism. This development is related to the breakup of the “Old Left”, whose one-dimensional concern with issues of class and distribution did not have much use for advanced ethical reasoning. In the multidimensional world of the new social movements, however, different interests have to be related and weighed against each other. Take for instance economic growth, where inevitable environmental loads must be weighed against rising material welfare. It is not only a matter of how resources are distributed between classes, but also of spatial and intergenerational distribution. The complexity necessitates sophisticated ethical theories.

As argued by Cohen (2000), another reason why the “old” Marxist socialism was in less need of normative reasoning was because of its determinism; what he calls the “obstetrical metaphor” at the centre of the Marxism of the old communist parties, according to which capitalism is “pregnant” with socialism, and all communists need to do is wait and be ready to midwife its birth. After abandoning Marxist

¹⁰ What I mean is simply non-normative science, sometimes called positive science.

determinism but renewing his commitment to egalitarianism and social justice, Cohen came to see it as necessary to actually argue for socialism, and hence to develop an egalitarian justice theory (most circumstantial in Cohen 2008). Another more direct reason for the left's scepticism regarding ethics was Marx's own dismissal of moral questions. But as pointed out by Sayer (2000:174), Marx's criticism was not consistent with his own works, which were written in "strongly condemnatory terms and continually detail the reproduction of avoidable suffering by capitalism."

Despite the increasing interest, resistance against normative reasoning within social science is surprisingly strong. Sayer has a long list of common objections, and uppermost is the prevailing belief in the desirability of a "value-free" social science. His response to this argument is that social phenomena are influenced by beliefs and norms and ideologies, and to study society is to explain those beliefs and expose them as false if they are false. Exposures are often dependent on a critical, normative standpoint. Take the reproduction of gender relations, which has been based on ideas of biological differences that have been exposed as false. To expose these influential ideas as false is highly relevant from a scientific perspective, but would not have happened without a critical stance toward the received ideas; yet such critical stances are nonetheless regarded, by some, as "values" that contaminate "objective" science. To similarly criticize hegemonic beliefs about human nature that underlie disciplines such as economics is routinely dismissed as "political".

The claim that particular norms are always embedded in particular social forms is often used as an excuse to "contextualize" or "sociologize" away normative concerns by making them particular and relative. But according to Sayer, even contextualized norms must be open to valuation against universal norms. A variant, popular among postmodernists, is the argument that since ethical standpoints are always contextual, universalizing them will always be a violation. And worse, universalizing contextual norms is the privilege of the privileged; it is typically the norms of white male academics, relevant only in limited contexts, which are universalized. But although this is often true, criticism should be directed at illegitimate universalization, not at universalization as such.

Postmodernists do not only see norms as context dependent, but justification as purely internal to the discourses associated with them. Norms are therefore seen as immune to external valuation. This relativist rejection of normative valuations "allows each to disqualify the criticism of others by claiming that there are no common grounds for argument" (Sayer 2000:176). But just as in the case of epistemology, this is no reason to apply judgemental relativism. There is no ultimate foundation for normative theory, but that does not mean that all normative claims are equally good. There are common referents and principles to base sophisticated, normative claims on.

Sayer's case for a stronger integration of normative theory in social science does not mean that he is uncritical of current normative political theory; he notes, for instance, that normative goals are often detached from questions of feasibility. A goal may be desirable in theory but likely to be ill-functioning in reality. Congenial with the liberal origin of normative justice theory, it tends to assume atomistic individuals and rational behaviour in an overly non-social, naïve way.

If I understand Sayer correctly, not only is social science in need of normative theory, but normative theory is also in need of social science, i.e. of connecting its theoretical reflections to social reality. This is an inspiring challenge and partly what I attempt in Paper 3. The normative analysis of climate debt conducted in that paper is not primarily related to what is considered good or bad arguments within the justice theoretical discourse, as is so often the case. Instead, the objects under normative scrutiny – the claims on climate debt – are derived from outside, from the climate justice movement as a sphere of social life. This encounter between climate justice as understood by the social movements and as conceived in political theory is, I believe, quite unusual and should be in line with Sayer's recommendation.

I agree with both Sayer and Cohen that the complexity of modern capitalism makes it necessary for critical social science to engage more profoundly with normative theory. This is especially so with regard to climate change, which philosopher Stephen M. Gardiner (2011) has referred to as a “perfect global storm” of interacting global, intergenerational, and theoretical problems that all need to be addressed normatively. The ethical complexity of climate change is also an argument for defending the possibility of normative universalism against the postmodernist and sociological rejections of norms as always context dependent. A normative theory of climate change has to take both intergenerational and global interests into consideration, and it is hard to see how this would be possible without assuming some degree of normative universalism. Not doing so opens up the door for more narrow perspectives, which may all too well go hand in hand with e.g. economic valuations or a relativizing of human rights.¹¹ Because of the truly global and long-term character of climate change, it is important that climate ethics is developed inclusively and with regards to universal interests. The normative claims made by environmental justice organizations, analysed in Paper 2, ought to be a crucial input into the academic discourse on climate change, as well as into the UN negotiations. Therefore I attempt, especially in Paper 3, to both inject the situated ethics of EJOs into the equally situated academic discourse and to scrutinize the EJO arguments from the perspective of normative theory with the purpose of enhancing their strength and influence in global policy formation.

¹¹ The problem with cultural relativists is that they are often “liberals at home and conservatives abroad,” or as put by Sayer (2000:176), “they are fallibilist about their own knowledge and foundationalist about the knowledge of others.”

As exemplified by both Sayer and Harding, taking a clear standpoint can increase scientific relevance. In my case, conceptualizing ecological debt from the perspective of environmental justice organizations results in the demand for a set of policy measures for combating climate change that is very different from the weak and North-biased policies that characterize the climate policy discourse. They might be considered as infeasible or utopian, but if so, I hope to show, this is not because they are based on unrealistic assumptions or unreasonable ethical claims, nor would they have unbearable consequences for the climate debtors. If they are utopian, it is not in the sense that they would not work, but in the sense that they are very unlikely to be accepted by the Northern powers. But as indicated in the introduction, they share this feature with all proposals that would have a realistic – in the true sense of the word – chance of defeating climate change.

I have described why I believe normative political theory is important for social science, and especially so in the case of climate change. I have also briefly discussed how taking a personal political standpoint can increase scientific relevance rather than the opposite, which is often presumed. (It goes without saying that taking a stand is no guarantee for scientific relevance; bad research is made under all banners.) I am aware that taking this position opens up for a traditional positivist criticism for letting “values” contaminate “objective” science, and that therefore your credibility risks being diminished. This risk is therefore a good reason to increase the transparency, independence, and objectivity of your research:

- *Transparency.* Declaring funding and conflicting interests is a standard procedure within scientific publication. The reason is transparency: results that favour the interests of the funder can then be scrutinized to exclude any bias. The same argument could motivate the declaration of one’s standpoint. If the reader knows how the author relates to the subject matter, she or he knows where to be particularly attentive to any bias. Transparency about subjective preferences is therefore a way to foster stronger objectivity. By declaring that this thesis is fundamentally in agreement with the claims for environmental justice, I assume that reviewers will consider this relation carefully. Since I do not want to be accused of one-sidedness, this gives me good reasons to be particularly rigorous and to uphold my independence.
- *Independence.* A clear standpoint is *not* the same as obeying an external program. Even in joint academia-civil society projects (such as EJOLT), where researchers and activists are likely to share foundational values and where the whole point is to let activists take the lead in defining the problems and proposing solutions, researchers should never abandon their academic integrity. This is important for two reasons. First, the point of including researchers is because of our expertise in particular fields, and it cannot be accurately applied without ensuring autonomy. Secondly,

submission undermines scientific credibility. Thus, the best way to serve the standpoint taken is to remain independent and critical. An example from my work regards the conceptualization of climate debt. Although my intention has been to stay close to the definitions made by the climate justice movement, I found that I had to deviate from it in one respect. Where the CJM often states that ecological/climate debt is owed by the North to the South, I could not include North/South-affiliation among the variables. In an “objective” study, whether the North owes the South should not be a premise, but a hypothesis. If it was included among the variables, it could not be falsified. By testing and largely verifying what had been presumed by the movement, I was better able to support their arguments than if I had used its literal definition.

- *Strong objectivity*. As observed by for instance Sandra Harding, taking a critical standpoint and questioning the taken-for-granted might be the only way to discover, analyse, and avoid hegemonic biases, i.e. the false premises that are part of dominant paradigms, and thus ensuring a stronger objectivity than self-proclaimed “a-political” science. From Bruno and Galilei over Marx and Einstein to de Beauvoir and Carson, science has been revolutionized by critical scientists, just because they have dared to challenge the falsities in the taken-for-granted. The truth should be regarded as an ally of human emancipation; if it is not, it is not my revolution. As Antonio Gramsci wrote in 1919: “To tell the truth, to arrive together at the truth, is a communist and revolutionary act.”¹² I would not put it exactly in the same way, but the quote reminds us that lies and biases tend to serve ideological purposes. There is no contradiction between scientific rigour and critical perspectives.

¹² *L'Ordine Nuovo*, 21 June 1919, Vol. 1, No. 7. Cited at <http://quoteinvestigator.com/2013/02/24/truth-revolutionary/> [Oct. 7, 2016]

3. Marxist Approaches

In the following, I will explore existing attempts at basing ecological debt (ED) and ecologically unequal exchange (EUE) – jointly referred to as the ecological-economic asymmetries approach (E-EAA) – on Marxist theory and also consider new ways forward. I will introduce ecological Marxism and note that while current theories on ED and EUE are often based on “neo-Marxist economics”, there is a potential also to alternatively use Harvey’s “historical-geographical materialism”.

This section is an attempt to discuss and construct theoretical approaches that are relevant for and build on the papers in this thesis, but I am also going beyond the theoretical perspectives in the papers. It is therefore not primarily an introduction, but a first attempt to take the conclusions one step further. My position was and still is that the ecological-economic asymmetries approach can be based on other theories than Marxism, but Marxist perspectives have nonetheless been an important (partly implicit) influence in my papers, and I have been increasingly convinced that a closer engagement with these theories could strengthen the approach.

3.1 Capitalism and the Environment

The perspective on how society and nature are related in this thesis is profoundly inspired by what is often referred to as ecological Marxism. This is primarily because almost all other encounters with the society-ecology nexus – in environmental movements, environmental politics and policies, in various academic disciplines and fields, whether natural science, social science or the humanities – have a disturbing tendency to omit an analysis of capitalism. It is disturbing because it automatically leads to the exclusion of important factors or explanations from their analysis, primarily the fact that the current economic and social system is a result of historical struggles, which means both that it has a particular logic which is not easy to overcome, and that this logic is not nature-given: it is contingent and perpetually under renegotiation. If we believe, as I do, that the evolving global ecological crises are not just “problems” like other political problems that are dealt with on a daily basis, or simply “market failures” that can be fixed *via* price corrections, but somehow emanate from the operation of the economic system, then

we need a theory about that very system. What merits Marxism an important role in environmental policy and science is thus *not* primarily its continuous analyses of social ecologies (although these analyses are significant in themselves), but its unique analysis of capitalism.

If “ecological modernization” is an appropriate term for the dominant environmental paradigm – pro-growth, pro-market, pro-technology – and “degrowth” a term for its main contender – against growth, ambivalent to markets, pessimistic about technology – they both share a reluctance to enter into a profound encounter with the workings of current capitalism. In ecological modernization, capitalism is made invisible by being taken for granted, as the unstated but solid frame within which solutions are searched for. In much of the discussion on degrowth, capitalism is instead ignored, its existence and influence neglected in policy prescriptions.¹³ Then why is a Marxist theory of capitalism so important for understanding the society-ecology nexus? Because ecological modernization is correct in that capitalism determines what is possible to do in the short term, but due to its commitment to the system it is unable to solve “environmental problems” if this requires transcending its limits. The degrowth movement is thus right in not limiting its explorations of what a sustainable welfare society would look like to the narrow confines of current capitalism. But in order to design effective policies for the short term and to challenge and eventually transcend the present, it also needs a profound understanding of what capitalism is, how it is related to the societal use of natural resources, and where its limits lie. Some of the most relevant analyses of these topics, I would argue, have been produced within the eco-Marxist and ecosocialist debate, which I will introduce briefly.¹⁴

3.2 Three Stages of Ecosocialist Debates

Following the “stages” approach proposed by Foster (2001; see also Burkett 2006, Foster 2014), the ecosocialist debate has now entered its third stage. In the first stage, green theories substituted central parts of the Marxian heritage while the second stage represented a restitution and reconstruction of a Marxian ecological

¹³ There are exceptions within degrowth theory, but there is a widespread reluctance to analyse capitalism and how it affects the policy proposals for degrowing the economy. I have discussed economic degrowth in other contexts (e.g., Warlenius 2013c, 2014, Holgersen and Warlenius 2016), and will just add that I share the degrowth movement’s concern over the consequences of economic growth, while questioning some of its theories and strategies.

¹⁴ I have presented this debate more thoroughly in other contexts. See Warlenius 2012, 2014, 2016. I have also applied ecological Marxism to the challenges of a renewable energy transition (Warlenius 2015) and to the need for destroying fossil capital (Holgersen and Warlenius 2016).

theory. In the recently proclaimed third stage, this integrated Marxist theory is employed to explore eco-disastrous capitalism and construct socialist alternatives.

Starting in the 1970s and lasting through the 1980s, the first stage consisted of the early Marxist and socialist responses to the growing environmental and green movements challenging the old Left for its one-dimensional focus on production, material welfare and class struggle and its disregard for the detrimental environmental effects of capitalism. Since the post-war labour movement was so entangled in industrial development, it was predictable that the green movement emerged in opposition to, rather than in alignment with, the social democratic and communist Lefts. The green criticism of the Left was not restricted to its praxis, however, but was also aimed at the ideologies of Marxism and socialism. Marx was regarded as a productivist “Promethean”, and the chief example was his labour theory of value, according to which only labour can produce value – not, for instance, natural resources (Soper 1996).

The first stage of ecosocialism was rather defensive. While defending socialist egalitarianism and the use of Marxism as a tool for analysing capitalism, it was critical of the productivism of the Marxist heritage and struggled to exclude such biases or replace them with influences from other theoretical traditions, yielding a new, ecological-Marxist synthesis. Important contributions were Martínez Alier and Naredo’s (1982) article on the Ukrainian *narodnik* Sergei Podolinsky’s attempt to convince Marx and Engels to integrate energy into the labour theory of value. Their refusal to do so marked the split between Marxism and ecological economics, according to Martínez Alier and Naredo. Another important contribution was Ted Benton’s (1989) work on natural limits, in which Marx was criticized for disregarding the physical, ecological limits of the economy and for developing a social-constructivist view of nature. Benton suggested that the reason for this was that Marx associated natural limits with the reactionary priest and economist Malthus, whose repulsive arguments on demography generated Marx’s antipathy. The most widely applied theory belonging to this first stage of ecological Marxism is probably the approach outlined in James O’Connor’s (1988) article on *the second contradiction of capitalism*. In brief, it posits that in addition to the main contradiction of capitalism between increasingly complex *productive forces* (production techniques and organization) and increasingly polarized *relations of production* (the social relations, including the ownership of the means of productions), there is also a second contradiction: one between *capitalist production* and the *conditions of production*. According to O’Connor, Marx defined three production conditions: 1) external physical conditions, i.e. external nature, 2) the labour power of workers, and 3) ”the communal general conditions of production.”¹⁵

¹⁵ It should be noted that this list of production conditions is compiled by O’Connor, referring to scattered comments by Marx in *Grundrisse* and *Capital*.

Where "normal" capitalist crises are a result of overproduction of capital, O'Connor sees another type of crises arising from *underproduction* of capital due to deteriorating conditions of production. He expects this type of crises to become more common as capitalist expansion approaches the limits imposed by nature: the ecological crisis.

During the 1990s a contrasting way of relating Marxism to ecology began to mature. Instead of adopting the environmentalists' view of Marx and Marxism as essentially anti-ecological, it initiated a sort of ecological Marxist restitution. The two leading figures, Paul Burkett and John Bellamy Foster, were able to show that Marx, Engels and the first generation of Marxists actually had quite a lot to say about ecology; in fact, Foster (2014) argued that there is no real need for the notion of ecological Marxism, since Marxism itself is ecological. They reviewed and criticized – in extraordinary detail – the accounts offered by their "first stage" predecessors, and also made constructive and ambitious contributions to Marxist ecological theory. For instance, their meticulous inquiry into the exchange of letters between Podolinsky, Marx and Engels on energy calculations led to the conclusion that Marx was right to reject Podolinsky's proposal (Foster and Burkett 2004; Burkett and Foster 2006, 2008; see also Martínez Alier's [2011] response). They have also debated Marx and Malthus with Benton (Burkett 1998a, 1998b; Benton 2001) and criticized James O'Connor's concept of a second contradiction (Burkett 1999a). Burkett's main point was that O'Connor missed the most fundamental capitalist contradiction, which is that workers and society have been alienated from the conditions of production. Both the first and the second contradictions are thus symptoms of an even deeper contradiction between society and nature, Burkett argued, and the solution is a system where the associated workers assert democratic control over the social use of these conditions.

Burkett is primarily known for his book *Marx and Nature* (1999b), where he demonstrates an inner logic, coherence and analytical force in Marx's ecological perspectives. This applies not least to the criticized labour theory of value, which he regards as descriptive while most environmentalists have misinterpreted it as normative. Marx argued that under capitalism, value is only attributed to abstract labour and natural resources are treated as a free gift of nature. This is actually a crucial explanation for the ecological destructiveness of capitalism. Marx himself repeatedly said that wealth has two sources: labour and nature.

The most widely recognised scholar of the second stage is, however, John Bellamy Foster, mainly due to his elaboration of the theory of metabolic rift (first presented in Foster 1999). The starting point for this theory was the most alarming environmental problem in 19th century Europe, namely the decreasing fertility of agricultural land. It was so severe that farmers plundered the battlefields from the Napoleonic wars for human bones to grind and spread on their fields. According to

Marx – following the German chemist Justus von Liebig – capitalist agriculture was the cause of this crisis, because it had spatially separated the soil from the consumers of its harvests. Through its productivity increases, farm-workers became superfluous, were evicted and drifted toward towns and cities where they eventually formed the industrial proletariat. Thereby, the metabolic exchange between humans and soil was broken. The nutrients in the food no longer returned to the fields and soil fertility declined. In *Capital*, this separation of humans from soil is called an “irreparable rift in the interdependent process of social metabolism” (Marx 1981:949). Marx’s analysis of metabolism was not confined to soil exhaustion but used in a much wider sense, “as constituting the complex, interdependent process linking human society to nature” (Foster 1999:381). The key to this interpretation lies in the description of the labour process in *Capital*: “Labour is first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature” (Marx 1976:283).

Although the rift is “irreparable”, from time to time capitalism is temporarily able to alleviate it through metabolic shifts (Clark and York 2008). Returning to the example of the sterile European soil, a relief was found on the Pacific coast of Peru. There, guano – fossilised bird excrement rich in phosphates and nitrogen – was mined and shipped to Europe. But after the first shipload arrived in Liverpool in 1837, it took only until the 1860s before the guano reserves had been depleted, the industry leaving a social and ecological disaster zone behind (Clark and Foster 2009). The original rift was not repaired. Rather, the shift to guano gave rise to new and wider rifts. But during the guano boom, scientific discoveries in soil chemistry enabled the production of artificial fertilizers that converged with fossil-fuelled farming machines to revolutionize agricultural production and generalize the separation between humans and land. This shift was obviously an important step in the instigation of the worst ecological rift we now know of: climate change (Clark and York 2005, 2008). Capital seems unable to repair the widening metabolic rifts. For every metabolic shift, the ecological crisis has deepened.

Foster’s metabolic rift theory has at least two merits: First, it reconstructs an integrated theory implicit in Marx’s scattered comments on the relations between society and nature, spread out in different texts written over 40 years. It has been criticized for over-emphasizing Marx’s interests in ecology (a recent example of such critique, well-known to a Swedish audience, is Sven-Eric Liedman’s (2015) biography over Marx), yet it leaves no room for doubt about Marx’s serious interest in the nature-society nexus, and certainly debunks many of the prejudices about Marx long held by environmentalists. It has also been criticized for being overly focused on what Marx wrote on the subject, which is of limited interest. But more important is that it now serves as a theoretical framework for highly relevant

research on the relation between (capitalist) society and nature, which is its second (and more important) merit.

Foster's and Burkett's theories were a condition for the recently proclaimed *third* stage of ecosocialist analysis. The other condition is that the main project of the second stage – the battle with the first generation of eco-Marxists over Marx's ecological heritage – could be declared victorious. This was recently done by Foster (2014) in his foreword to the new edition of Burkett's *Marx and Nature*. In the third stage, Foster declares,

the goal is to employ the ecological foundations of classical Marxian thought to confront present-day capitalism and the planetary ecological crisis that it has engendered – together with the ruling forms of ideology that block the development of a genuine alternative (ibid.).

Foster's colleague Hannah Holleman (2015) clarifies that these three stages should not be regarded as a linear periodization in which all ecosocialist debates fit, but rather as a description of the main tendencies within the eco-Marxist debates. This argument could be drawn further, as debates belonging to all three stages are held simultaneously. Although I agree that the “second stage ecosocialists” have been successful in formulating a more Marxist ecological Marxism, the debate between “green” and “red” perspectives is ongoing and continually give rise to new theories and hybrids, most recently e.g. the world-ecology perspective suggested by Moore (2015) and the fossil capital hypothesis by Malm (2016), while simultaneously several theories are used to confront capitalism's war on Earth, create ecosocialist alternatives, and to try to establish a red-green hegemony over socialist movements. Rather than stages in a chronology of ecosocialist debates, perhaps we should talk about three (main) fronts where ecosocialists and eco-Marxists are seeking to delineate their territory: on one front, the borders with regard to non-Marxist green ideologies are being negotiated; on another front, the hegemony over the broader socialist movements is contested, both intellectually and organizationally; and on a third front, the struggle against ecologically disastrous capitalism itself is taking place – and at the same time, as in all vital struggles, an intense internal debate on ideology and strategy is taking place among ecosocialists. This thesis is involved in territorial struggles on all these fronts as well as in the internal debate.

However, Marxists outside the inner circles of the ecosocialist debates have also developed theories on the nature-society relation under capitalism. Marxist geographers such as Neil Smith (2010) and David Harvey (1996) are particularly relevant in this context. Smith pioneered the concept *production of nature*, consciously defying the received separation of nature and society. Under capitalism, “no God-given stone is left unturned, no original relation with nature unaltered, no living thing unaffected” (Smith 2010:8). The sheer volume of David Harvey's book (1996) *Justice, Nature and the Geography of Difference* renders any short summary

difficult; it is however partly an extension of Smith's argument that the environment is now inseparable from the social and the political and has been criticized, e.g. by Foster (1998), for reproducing a traditional Marxist underestimation of the severity of the ecological crises. Elsewhere, I have (Warlenius 2014) similarly criticized Harvey's (2014) more recent *Seventeen Contradictions and the End of Capitalism* for underestimating the risks of a climate collapse. Harvey argues that environmental crises are unlikely to bring down capitalism, and thus fails to admit that the current eco-destruction is actually a threat to global society as such – and thereby also to capitalism. As discussed below, however, I have partly reassessed my previous opinion on this text.

3.3 Neo-Marxist Economics

Practically all attempts to base ecological-economic asymmetries approaches on Marxism lean toward the broad current of thought that is sometimes referred to as neo-Marxist (development) economics (NME), which includes dependency theory, world system analysis and Baran and Sweezy's (1966) theory of monopoly capital. This is no coincidence, since both perspectives share an emphasis on territorial conflict dimensions. According to neo-Marxist economics, one of the fundamental aspects of capitalism is that it divides the world system spatially into core, periphery, and semi-periphery. Wallerstein (2004) holds these notions to be not primarily territorial but referring to production processes that are peripheral (often resource-intensive, export-oriented, adding comparably low amounts of value, and subject to intense competition that puts pressure on prices and profitability) or central (characterized by high value-added, quasi-monopoly status on the world market and yielding extraordinary rents). Peripheral and central production processes tend, however, to cluster in certain countries and thus legitimize the spatial use of the terms, where countries in which the two types of production processes are roughly even in importance are called semi-peripheries. International trade between these entities is characterized by transfers of surplus value¹⁶ from the periphery to the core, or, with another term, by unequal exchange.

The modern discourse on unequal exchange was elaborated in the neo-Marxist economics current through the work of Arghiri Emmanuel and Samir Amin, yet was described already by the classical political economists, including Ricardo and Marx, and further developed by Marxists such as Otto Bauer and Ernest Mandel (see Paper

¹⁶ For Marx, surplus value was not the same as value added (sales value minus production costs) but related to labour: it is the new value created by workers above labour costs, derived from the use-value of labour-power appropriated by the owner of the means of production and realized as profit.

4). What was later termed *ecologically* unequal exchange also largely arose out of NME traditions in the 1980s and 1990s, with explicit references to world-system analysis in e.g. Bunker (1985), Hornborg (1998, 2001, 2011), Foster and Holleman (2014), Jorgenson (2006), and Rice (2007). Even though this term is of a later date, the core meaning of ecologically unequal exchange – a net transfer of biophysical resources from poor to rich parts of the world – also goes back to the 19th century political economists. For Marx, the early modern resource robbery of the colonies was part of the ”primitive accumulation” which made industrial capitalism possible:

The discovery of gold and silver in America, the extirpation, enslavement and entombment in mines of the indigenous population of that continent, the beginnings of the conquest and plunder of India, and the conversion of Africa into a preserve for the commercial hunting of blackskins, are all things which characterize the dawn of the era of capitalist production (Marx 1976:915).

The extraction of natural (including human) resources continued as a part of the expanding social metabolism of the capitalist cores and turned entire countries, such as Ireland, into suppliers of land-based products for England. The ”main industrial countries ... convert one part of the globe into a chiefly agricultural field of production for supplying the other part, which remains a pre-eminently industrial field,” Marx noted (1976:579–80). The depletion of Peruvian guano in the mid-19th century to fertilize European soils is another example of what we would now call ecologically unequal exchange and ecological debt and is, as noted above, the most emblematic case of the Marxian metabolic rift theory, developed by Foster.

Foster is active within the Marxist tradition of Baran and Sweezy’s theory of monopoly capital and thus also included among the neo-Marxist economists. In different contexts, he has related both ecological debt and (as he prefers to call it) ecological unequal exchange to the theory of metabolic rifts through the use of the notion of *ecological imperialism*. Foster and Clark (2003) seek to disconnect this concept from Crosby’s (1986) strictly biological definition and to relate it to the terminology of neo-Marxist economics. Ecological imperialism is defined as “the growth of the centre of the system at unsustainable rates, through the more thoroughgoing ecological degradation of the periphery” (Foster and Clark 2003). Ecological degradation in the periphery is primarily related to capitalism’s perpetual growth. The ecological debt approach is regarded as an important platform for mobilization against ecological imperialism (and growth). The struggle for ecological debt recognition “has certainly given a new practical meaning to the concept of ecological imperialism” by highlighting “the larger ecological curse of capitalism” (ibid.).

A decade later, Foster and Holleman (2014) wrote an article on ecological unequal exchange, again invoking ecological imperialism as the overarching approach and relating it to neo-Marxist terminology. It starts by observing that the “search for a

meaningful theory of ecological imperialism has become in many ways the holy grail of the ecological critique of the capitalist world system” (ibid.), and it identifies metabolic rift and ecological unequal exchange as the two main theoretical responses. The article is partly an attempt at merging the two by relating UE and EUE to what Foster and Holleman refer to as a “Marx-Odum dialectic”, referring to the systems ecologist Howard T. Odum.

Foster’s definition of ecological imperialism is close to what I call the ecological-economic asymmetries approach, and both Foster and Clark (2003) and Foster and Holleman (2014) are suggesting ways to integrate this approach with Marxian metabolic rift theory. “Ecologically”, Foster and Clark (2003) write, “capitalism operates globally as a particular social metabolic order that generates rifts in underlying metabolic relations between humanity and the Earth and within nature itself.” Extraction of resources from the periphery – in the process causing bleeding rifts – enables the cores of the world system to expand their social metabolism beyond what is sustainable, an order called ecological imperialism; ecological debt and unequal exchange are ways to conceptualize the ecological asymmetries and inequalities inherent in ecological imperialism.

A further integration of EUE and the social metabolism school¹⁷ is proposed in Paper 4. EUE is commonly founded in heterodox, anti-Ricardian trade theory, as developed by dependency theorists such as Emmanuel, which strictly confines its applications to the trade dimensions of exchanges between core and periphery. If instead regarded as physical transfers of energy-matter to feed the overall social metabolism, the scope of unequal exchange can be widened from traded goods to also include non-traded (but economically very significant) types of environmental displacements, such as pollution. The development of the concept of unequal (carbon) sink appropriation, which considers (mostly non-traded) environmental problems such as pollution and climate change as a part of ecologically unequal exchange, is dependent on the theoretical reorientation from trade to metabolism.

This shift toward social metabolism also solves another problem. Resources are not only extracted and exported through the “normal” circulation of capital, including trade, but sometimes through violent or at least extra-economic forms of extraction such as colonial robbery or the enclosure of commons – parts of what Marx called primitive accumulation and Harvey calls accumulation by dispossession (described below). Such cases are often included in ecological debt conceptualizations and certainly do form part of the metabolism of the capitalist core, yet are not always traded and therefore disappear from trade-based conceptualizations of unequal exchange.

¹⁷ Social metabolism is also a widely used concept within biophysical accounting and ecological economics (see e.g. Fischer-Kowalski 1998).

What I find slightly problematic with Foster's theory is, however, the identification of imperialism and the emphasis on economic growth as the ultimate cause of ecological rifts. Foster is certainly not the only Marxist to use imperialism without a clear delimitation vis-à-vis "normal" capital accumulation in the global sphere (cf. Malm 2004:42-47). Yet I believe imperialism should be reserved for a more specific phenomenon, i.e. the use of state force in foreign territories – ultimately "putting boots on the ground" – with the aim of securing vital economic interests, often related to natural resources. Ecological imperialism would then imply ecological aspects related to imperialism in this sense. Foster obviously intends a more general description of ecological inequalities in the world system. It also remains unclear whether it refers to an ecological feature inherent in imperialism or another type of imperialism in its own right. Using imperialism in this context is probably a way to imply that the world system is still rigged to favour the core and based on state power even when it is not directly exerted. Yet, I would prefer a more general term for such a general claim, such as simply global capital accumulation.

In Foster's analysis, economic growth is not only the driver of ecological imperialism but the main explanation for why capitalism as a whole is ecologically disastrous; capitalism is a "grow-or-die system", and since neither sustainable growth nor stationary capitalism is possible, "a sustainable or steady-state economy (in countries that have reached a sufficient level of development) is only possible ... under conditions of rational, socialist planning" (Foster *et al.* 2010:163, 164). I certainly agree that capitalism necessitates economic growth, and that such growth is an important explanation for expanding social metabolism, which in turn tends to enhance ecological pressures. But before concluding that capitalism is inherently unsustainable, some disaggregation needs to be done. First, economic growth must be distinguished from profit maximization. They are not the same, and it is the latter, not the first, that drives capital accumulation. Growth is an aggregated consequence of profit and accumulation, and although capital will always prefer high profits over high growth (which explains why a reserve army of labour pressuring wages and increasing profits is preferred to full employment, which would maximize growth but not profits), I think Foster, alongside e.g. Schumpeter, convincingly shows that capital without growth is a self-contradiction. Second, economic growth has to be disaggregated from increased social metabolism. There is a strong correlation historically between GDP and ecological indicators such as carbon emissions, but also great variations between economic sectors and technological paradigms. With an economic-political system that implemented a fast de-carbonization of the economy, sustainable (in terms of CO₂-emissions) growth would most likely be possible. Not forever – there is a compelling logic in sayings such as "eternal growth is impossible on a finite planet" if you assume that all economic activities require a minimum use of energy or matter – but for a long time still. The most urgent environmental problem of capitalism is therefore its inability to phase out fossil

fuels, or put more generally, its inherent instinct to prioritize profit maximization over any other concerns, including the long-term survival of human civilization. Compound growth clearly intensifies the ecological problems under capitalism, but is not the main driver, as I see it. I am therefore not as convinced as Foster that capitalism is determined to destroy the Earth (unless abolished). At least in theory, accumulation could be steered towards more sustainable operations.

While the spatial/territorial focus of neo-Marxist economics makes it a good fit with the ecological-economic asymmetries approach, it should be noted that it is also contested. In general terms, its focus on conflicting interests between nation states might conceal other contradictions, related to e.g. class, ethnicity or gender within territories, and also to conflicts on other spatial levels (between regions, cities and rural areas, or within cities). In a world that is almost entirely opened for surplus value production, and with increasing class antagonisms *within* both developing and developed countries, the importance of such internal divisions is likely to increase and the rather strict territorial division of countries into core and periphery risks becoming increasingly anachronistic. As is discussed more thoroughly below (section 5.2), the importance of spatial dimensions of capitalism is a defining difference within the Marxist debate on the origin and development of capitalism. The debate had two camps, emphasizing “exogenous” versus “endogenous” explanations for the birth of European capitalism. Very briefly, Sweezy (1976), Frank (1969), and Wallerstein (1974) emphasized that capitalism arose partly in response to international trade and colonialism. Profits from long-distance trade were part of the development toward occupational specialization, the resurgence of cities and, over time, productive investments both at home and overseas. Dobb (1946) and Brenner (1976), among others, attributed the origin of capitalism almost entirely to domestic factors in England, especially the peasant struggles that were successful in abolishing serfdom but not in distributing land, which remained in the hands of the lords. This situation eventually gave rise to capitalist agriculture and wage labour, which is considered the main innovation of capitalism: paying wages for labour gave incentives for mechanization and the productivity increases that exploded in the Industrial Revolution. Thus, Dobb and Brenner regard capitalism as primarily a *mode of production*, defined as a system based on the real subsumption of labour (as opposed to formal) and production of surplus value, while neo-Marxist economists – especially world system theorists – define capitalism mainly in terms of *endless accumulation*, largely extracted in the sphere of commodity exchange. Generally, then, political Marxists such as Brenner tend to give less weight to territorial conflicts within capitalism, including imperialism.¹⁸ The debate is complex and several Marxists have proposed syntheses that make the birth of

¹⁸ Brenner (1977) criticized Wallerstein for applying “Arghiri Emmanuel’s conception of ‘unequal exchange’” on early modern condition where no equalization of profit rates could take place. This was not a dismissal of the concept as such, to which he seemed ambivalent.

capitalism dependent on both endogenous and exogenous factors, and would also acknowledge the dual character of mature capital accumulation: both the “normal” economic processes, when “peace, property and equality prevail,” *and* the less glamorous expropriation praxis of “force, fraud, oppression, looting” (Luxemburg 2003:432).

To conclude, the marriage between unequal exchange (and similar concepts) and neo-Marxist economics is largely a happy one. The latter’s focus on territorial conflicts and both endogenous and exogenous accumulation makes it a seemingly better match than e.g. Brenner-type political Marxism, and the social metabolism/metabolic rift analysis provides E-EAA with a Marxian and ecologically concerned theoretical framework. There are, however, some problems with the neo-Marxist approach; not in its relation to E-EAA, which seems free of friction, but in relation to other theoretical challenges. These problems include an imprecise use of the concept of imperialism, as well as an overemphasis on growth and on the spatial dimensions of capitalist development, which is difficult to reconcile with a Marxist analysis of capitalism as a mode of production that (also) generates place-bound class (and other) antagonisms. Perhaps there are other spatially concerned Marxisms that could potentially display the same merits but avoid the problems? One obvious contender would be David Harvey’s synthesis of geography and Marxism.

3.4 Historical-Geographical Materialism

One of the most central concepts in Marxist geography is uneven development; it is “the systematic geographical expression of the contradictions inherent in the very constitution and structure of capitalism” (Smith 2010:4). Uneven development is an expression of capitalism’s flexible ways to accumulate in shifting landscapes, both physically and culturally. Uneven development is a pattern of capital accumulation relevant not only to the international spatial scale, i.e. between core and periphery or developed and developing countries, but also to regional and local scales. This theorization of social and economic differences is of a more complex and dialectical nature than in the world-system analysis of Wallerstein. Uneven development is viewed as the result of “an opposition between countervailing forces” (Harvey 2006:417). On the one hand, capitalism is always striving towards universality of the value form, always seeking to expand and integrate its outside, using similar technologies and institutions. But contrary to standard economic assumptions, this does not result in an equalization of the economic levels of societies. This is because, on the other hand, capital acts and responds differently to the variegated and complex physical and social aspects of places. It accumulates through development

at one pole and through underdevelopment at the other.¹⁹ Sometimes, capital is locked in geographically, and is thus bound to produce and realize surplus value within a closed region, giving rise to greater spatial differences. But isolation is seldom more than partial and temporary, and differences are themselves a source of accumulation:

Regional boundaries are invariably fuzzy and subject to perpetual modification ... regional economies are never closed. The temptation of capitalists to engage in interregional trade, to lever profits out of *unequal exchange* and to place surplus capital wherever the rate of profit is highest is in the long run irresistible (ibid.:417; my emphasis).

Thus, Harvey's "historical-geographical materialism" is less binary and static and more dialectic than neo-Marxist economics. It makes it less suitable as a framework for the territorial claims of the climate justice movement that regard climate debt as a relation between fixed categories: something which developed countries owe to developing ones. But it acknowledges the existence of unequal exchange or ecological debt if defined as quantitative relations, dependent on specific patterns that exist to different degrees, as conceptualized in this thesis (Paper 5).

For Harvey, imperialism is one way of exploiting the uneven geographical development. The uneven spatial concentrations of wealth and power in the geopolitical area arise out of what he calls "asymmetries". Nation states will try to "preserve that pattern of asymmetries in exchange over space that works to its own advantage"; this pursuit is even one of the "state's key tasks." Even though uneven development exists at many scales and is not always dependent on state involvement, Harvey reserves the use of the term imperialism for "a property of inter-state relations and flows of power within a global system of capital accumulation" (Harvey 2003:31-33). This use of imperialism is restricted to the use of state power and thus more precise than Foster's.

The way Harvey uses "asymmetric exchange" refers primarily to trade under asymmetric power relations, mainly the opening of national markets for foreign-based capital by political means, such as under the threat of denying access to U.S. or EU markets, or as conditions for credits or aid (ibid.:129-130). The asymmetry is expressed through "unfair and unequal exchange, spatially articulated monopoly powers, extortionate practices attached to restricted capital flows, and the extraction of monopoly rents" (ibid.:31). Yet, even if unequal exchange is an expression of asymmetries, Harvey refers to power asymmetries rather than to asymmetries in terms of transfers of embodied labour or matter-energy.

¹⁹ The dialectics of these processes is perhaps better captured by the notion "uneven and combined development", coined by Trotsky, but it is not used by Harvey who rather prefers to call it "uneven geographical development".

Further, Harvey shares with neo-Marxist economists the view of capital accumulation as both endogenous and exogenous. He has developed that perspective through the concept of accumulation by dispossession, which is an extension of Marx's notion of primitive accumulation.

Although Marx's main focus in *Capital* is the endogenous expansion of capitalism through development of productive forces and the expansion of markets for labour and commodities, he importantly also, shows how capitalist development is dependent on a first stage of exogenous expansion. Through primitive accumulation – plundering, enclosures, colonial extraction, enslavement, etcetera – the necessary capital for productive investments was piled up and competing modes of production destroyed, the latter a precondition for the creation of an army of “free” labourers, robbed of their means of subsistence and therefore dependent on wage labour and market exchange.

Later Marxists argued that primitive accumulation was not only a phase of the pre-capitalist past but an ongoing process under 19th and 20th century imperialism and capitalist spatial expansion. As noted above, Rosa Luxemburg distinguished between two interlinked methods of accumulation: Through the economic process – as surplus value production based on wage labour and market exchange – and through expropriation. Marx's notion of primitive accumulation belongs to the latter category, but Luxemburg argued that capitalism is in constant need of expanding into non-capitalist forms of production. According to her, capitalism has an underconsumptionist tendency (lack of demand in relation to supply) and therefore needs non-capitalist societies “as a market for its surplus value”, but also “as a source of supply for its means of production and as a reservoir of labour power for its wage system” (Luxemburg 2003:348-349). What she calls “natural economies”, where peasants rely on the fruits of the land and thus remain independent of wage labour and commodity markets, constitute barriers to capitalist accumulation, and “capitalism must therefore always and everywhere fight a battle of annihilation against every form of natural economy it encounters” (ibid.:349).

More specifically, the first aim of the battles was: “(1) To gain immediate possession of important sources of productive forces such as land, game in primeval forests, minerals, precious stones and ores, products of exotic flora such as rubber, etc.” (Luxemburg 2003:349). In order both to access these resources in the pace demanded by the expanding capitalist industries in the cores and to expand demand for their industrial products, an army of wage labour must be created. And since subsistence farmers are unlikely to volunteer for wage labour, they have to be forced from their lands.

If Marx placed exogenous, “primitive” accumulation in a pre-capitalist past and Luxemburg noted that it was repeated every time capitalism penetrated its outside, Harvey argues that exogenous accumulation “by other means” is omnipresent, a

core feature of capitalism, and to mark this difference he suggests renaming it *accumulation by dispossession* (Harvey 2003:ch 4). Instead of Luxemburg's focus on underconsumption, Harvey understand the crisis propensity of capitalism as related to overaccumulation: the problems of finding enough profitable investments for the exponentially growing capital. If endogenous investments in productive areas are not available in sufficient amounts, surplus capital will be directed toward exogenous opportunities; exogenous not in an exclusively geographical meaning, but as economic sectors previously unavailable for capital. It might thus enter into natural economies as described by Luxemburg, but in current times more representative examples would be the privatization of public schools or financialization of pension funds.

Overaccumulation is Harvey's main explanation for the neoliberal turn after the crises in the 1970s. Neoliberalism is essentially a broad program for financialization, privatization of commons and opening of new markets with the aim of restoring profitability for overaccumulated capital. Intensification of (ecologically) unequal exchange lies at the centre of neoliberal restoration. In fact, the concept of ecological debt is inextricably related to this process. It was originally expressed as a response to the financial debt crisis of the 1980s (see Paper 1), which was in turn the result of financialization and neoliberal monetary policies. OPEC's substantial raising of oil prices in the 1970s generated enormous amounts of surplus capital in times of a general recession and hostile investment environments, so for lack of better alternatives, these petro-dollars were largely recycled, via London banks, as cheap loans to governments in developing countries. However, the transition from Keynesianism to monetarism in the early 1980s – also related to the neoliberal turn – meant a drastic increase of interest rates, and suddenly the loans were not at all cheap anymore. Following Mexico, which cancelled its debt repayments in 1982, country after country in the global South came under the economic control of the World Bank and the IMF, which forced so-called Structural Adjustment Programs upon them. These were largely programs for accumulation by dispossession (Harvey 2003:ch.4). The forcible opening of markets and privatizations of state assets provided ample investment opportunities for foreign surplus capital. Slashed subsidies and welfare cuts provided means for debt repayment schemes. "Strategies" for export oriented production focused on sectors where developing countries are seen as having advantages due to low wages and weak environmental and labour regulations: mostly cash crops for export, minerals or simple manufacturing. Enforcing roughly the same programs throughout the southern hemisphere simultaneously increased competition, exacerbated the terms of trade and forced countries into even more intense extractivist policies in order to meet the demands of the lenders. On the international arena an intense push for liberalization of trade policies was forged (but partly halted in Seattle 1999), including agreements on "intellectual property" such as TRIPS, enabling profiting

from e.g. biopiracy and commodification of local cultural expressions. About the same time, and at least partly because of the debt trap, world market wage labour supply doubled when the ex-Soviet empire went through a “shock therapy” and many other countries, including China and India, opened up their previously protected economies. As a consequence, wages and levels of unionization were pushed down globally.

This intensification of dispossession and unequal exchange also led to an increase in the reverse flows of carbon sink appropriation – carbon dioxide remains the “main effluent of affluence” (Martínez Alier 2009) – and contributed to making climate change into the most pressing issue of global society. Thus, while dispossession solved problems of lack of investment opportunities and thus increased accumulation, accumulation drives further dispossession through the effects of climate change. As noted by Malm and Esmailian (2012), accumulation by dispossession precedes dispossession by accumulation.

This is not the only attempt to apply Harvey’s categories to socio-ecological analyses. Yet as far as I know, Harvey has never himself related uneven geographical development to socio-ecological consequences in a systematic theoretical framework. I find this somewhat surprising. Such a perspective could have been expected, for example, in his book *Justice, Nature and the Geography of Difference*, which devotes one part to ecology and another part to space-time, but never merges the two into an ecological theory of uneven development. Nor has Harvey presented an encompassing theory for why capital accumulation is ecologically detrimental. The book is rich in reflections and recommendations, but also of caveats and reservations. The section “Towards an Ecosocialist Politics”, for instance, is largely a dubious dismissal of Foster’s (1994) book *The Vulnerable Planet*, and the rest is merely an identification of five key areas where ecosocialist thinking needs to be advanced, in order to “produce conceptual clarifications” (Harvey 1996:204).

In my opinion, the closest Harvey has come to a general theory on the “contradictory unity of capital and nature” (Harvey 2014:250) is in a chapter in *Seventeen Contradictions and the End of Capital*. When I first read it in 2014, I was struck by how it seemed to underestimate the risks of ecological collapse, especially with regard to climate change. But when I later reread it I realized that it also contains interesting leads for a theory on what Harvey calls “capital’s ecosystem”.

At the heart of the analysis lies capital’s inability to view nature as anything else than “a vast store of potential use values – of processes and things – that can be used directly or indirectly (through technologies) in the production and realisation of commodity values” (ibid.:250). Amplified by its strive for exponential growth, this compulsive capacity of capital to commercialize nature while ignoring ecological concerns is accelerating the trend of “commodifying, privatising and incorporating

more and more aspects of our lifeworld ... into circuits of capital” (ibid.:253). This shows how one way for overaccumulated capital to find profitable outlets ends in accelerated dispossession (and consumption) of natural use values, causing ecological distress.

Capital’s ecosystem is global and held together by uneven, ecological transfers, which makes it “riddled with inequalities and uneven geographical development” (ibid.:256). While ecologically destructive practices of exploitation and extraction are the rule in one place, more benign forms prevail at another. Harvey holds that it is next to impossible to account for the state of the planet and for the ecological transfers of use values occurring through trade, but “the uneven benefits and losses nearly always redound, however, to the benefit of the rich and powerful while leaving the vulnerable and the poor far worse off than before. This, after all, is what an extractive imperialism has always been about” (ibid.:258). Clearly, what others refer to as ecologically unequal exchange is a central component of Harvey’s analysis, although he questions whether meaningful quantifications are possible.

What ought to be more provocative for many ecologists is Harvey’s rejection of natural limits and constraints, if not in principle then at least for the time being. His current judgement is that “humanity knows just about enough to ameliorate or manage the threat of most (though never all) environmental catastrophes” (ibid.:259). The problems are thus entirely internal to capital, related to political, institutional and ideological factors, not to external nature. Capitalism has been able to solve serious ecological problems in the past, such as phasing out DDT or CFCs. But that is no guarantee for current problems, such as climate change, to be solved. There are intense struggles between different factions of capital, and currently, the factions that regard climate action as a threat to “their profitability, competitive position and economic power” are fully able to prevent mitigating actions (ibid.:256). This is of course deeply troublesome, but in contrast to Foster’s view, Harvey asserts that capitalism is not determined to either run into ecological disasters or die. “We cannot maintain that capital has the power to destroy its own ecosystem while arbitrarily denying that it has a like potential power to cleanse itself and resolve or at least properly balance its internal contradictions”, he concludes (ibid.:259).

It turns out that the Luxemburg-Harvey understanding of global capital accumulation can provide interesting insights about the concepts under study in this thesis. First, it underlines the relevance of focusing on the *exchange* of commodities between cores and peripheries (or the cumulative net transfer, as in ecological debt). Capitalist expansion is not primarily a “raubwirtschaft” of unidirectional extractivism, but just as much about expanding commodity markets. But even if the economic relation between the coloniser and the colonized was formally organized as a trade exchange, in reality we know that this exchange operated far from the

conditions assumed in standard economics – perfect competition, perfect information and reliable private property institutions – and also far from the assumed mutual advantages of Ricardian trade theory. So, if core-periphery relations cannot be easily dismissed as “robbery”, we still need theories and tools for exposing, explaining and measuring the *inequalities* and *asymmetries* hidden in the exchange, and this is where the concepts under study come into use.

Secondly, a Luxemburg-Harvey analysis of capitalist expansion emphasizes that resource extraction is dependent on wage labour (and thus on the annihilation of pre-capitalist economies altogether). This suggests a closer relation between unequal exchange and ecologically unequal exchange than is often acknowledged or demonstrated in the EUE discourse. The main exception (see further Paper 6) is Hornborg’s *time-space appropriation* (TSA), which conceptualizes ecologically unequal exchange as the net exchange of *both* labour time and annual hectare yields. That aside, conceptualizations of EUE and ED rarely discuss this close relation.

Thirdly and related, the view that capitalist expansion fulfils several aims, of which access to natural resources is one, further blurs the borders between the economic and ecological aspects of capitalism, or, as posed above, between ecological imperialism and just plain imperialism. Is there an imperialism that is *not* ecological in the sense of damaging or overusing ecosystems and/or accelerating the extraction of resources? Is there, even, a capitalism that is not ecological (and if not, is there any Marxism worth its name that is not ecological)?

Finally, despite the lack of a comprehensive ecological theory of uneven development, Harvey offers perceptions of capitalism’s spatial configurations, imperialism and economic growth that are interesting alternatives to the neo-Marxist approaches.

3.5 Sketch of a Potential Research Direction

This exploration of historical-geographical materialism (HGM) as a potential theoretical framework for E-EAA is indeed tentative; it is a first attempt at solving some of the problems identified in neo-Marxist economics (NME), not a ready proposal. I will first compare the approaches more systematically, before proceeding with a few notes on a potential, Harveyan theoretical framework for E-EAA.

- Both NME and HGM are highly concerned with spatial aspects of capitalist development. While the NME division of the world into rather fixed categories is attractive for those who aim to politicize the North-South

divide, it comes at the cost of less theoretical sophistication and analytical flexibility than HGM.

- Both NME and HGM acknowledge the dual character of accumulation: as an endogenous economic process and as exogenous expropriation. This is related to the spatial interest of both theories, and important for the conceptualization of ED and EUE as related not only to trade but also to extra-economic activities within the totality of the social metabolism.
- While parts of the NME approach might be accused of over-emphasizing the importance of accumulation based on exogenous activities and trade, thus failing to acknowledge the central characterization of capitalism as a mode of production, this is hardly the case for other parts. Especially the monopoly capital tradition, including Foster, apparently grants much significance to endogenous aspects of capitalism, while the world system approach has been accused of being Neo-Smithian rather than Marxist (Brenner 1977).
- I have criticized Foster for overemphasizing the importance of economic growth and expressing too great certainty, in my opinion, about the unsustainability of capitalism. I therefore prefer Harvey's less deterministic analysis, where capitalism's inherent growth is definitely important because it amplifies several capitalist contradictions, but where the basic problem in capital's relation to nature is that it must regard nature primarily as a source of profits. In Harvey's view, capital can sometimes cope with ecological problems, but whether they do it or not depends on the outcome of struggles – both between different factions of capital and between capital and those who are concerned over the environment.
- I also prefer Harvey's more specific definition of imperialism as the use of state power to maintain or enhance benefits from asymmetric territorial exchanges, compared to Foster's quite vague use of "ecological imperialism" as a description of the global inequalities following from expanding social metabolism in the core of the world system.
- There are some interesting insights for E-EAA provided by a Luxemburg-Harvey understanding of global capital accumulation. It reinforces the importance of *exchange*, since capital's interest in the periphery is not only to exploit cheap resources and labour for import, but also to create markets for export of surplus commodities. This integrated perspective also links resource extraction and labour exploitation closer, since the first is impossible without the second. Moreover, it further blurs the borders between the economic and ecological aspects of capitalism, at least in terms of causation.

- Yet, when compared with Harvey's tendency to trivialize the gravity of environmental problems of current capitalism, especially in his earlier texts, I definitely side with Foster's stronger concern over the huge risks involved in current metabolic rifts.
- The analysis of metabolic rifts and shifts is, in my opinion, the most elaborated and useful Marxist theory on capital's relation to nature. It is also important for the attempted reorientation of EUE to include non-traded flows of energy-matter. I might have some questions, such as whether to regard metabolic rift as a theory, an analysis, a tendency, a metaphor, or a method. As pointed out by e.g. Harvey, capital has been able to solve some environmental problems seemingly without simply shifting them to other areas. Although I think Harvey has provided interesting sketches of an alternative Marxist theory of nature, I believe Foster's approach will be an important part of any eco-Marxist synthesis.

This tentative comparison points towards a possible synthesis of E-EAA, metabolic rift, neo-Marxist economics and Harvey's uneven development. A starting point for such a merger can be found in Paper 4, where it is argued that "global terms of trade" probably can explain unequal exchange of *both* labour and of energy-matter. This indicates that there is a common ground for both kinds of unequal exchange and that, as suggested above, there is a tight connection between ecological-economic asymmetries and capital accumulation. In Paper 4, several joint explanations for the unequal exchange of surplus value/labour and energy-matter between core and periphery are raised: Different levels of organic composition, competition in the periphery versus monopolistic tendencies in the core, or self-perpetuating wage differences. They would all encourage labour *and* resource intensive activities, such as agriculture and mining, in the periphery. These explanations deserve further research, and to this picture, Harvey's understanding of political asymmetries – the use of market power and political power to enforce asymmetric trade relations – could be added, as well as his insistence that not only price relations and trade, but direct, expropriative tendencies – accumulation by dispossession – is an equally important source of capital accumulation and profits. An E-EAA analysis of Harvey's theories could perhaps show that the political asymmetries and the dual character of accumulation are likely to give rise to biophysical asymmetries in the form of (ecologically) unequal exchange. If nothing else, this would be an interesting contribution to EHM.

Even if ecological debt and ecologically unequal exchange are regarded as caused by capital accumulation and profits, they would still be distinct categories that focus on, measures and theorize biophysical aspects of the global social metabolism, and would still be clearly separated from traditional Marxist understandings of unequal exchange or imperialism. But in terms of causation, the drivers would be regarded

as basically the same. The proposal thus rejects Malthusian, physical or culturalist explanations of these phenomena. Simply put, capital accumulation would be regarded as the driver behind a global regime of production. This regime will inevitably have ecological effects, and those can be measured and analysed by E-EAA.

An example is when Malm (2016) convincingly argues, against conceived wisdom, that neither scarcity of land or water nor population growth caused the turn to fossil fuels in 19th century England – Malm proposes that causes were instead entirely endogenous to the needs of capital accumulation. Yet it seems obvious that coal and colonies *made possible* the unprecedented economic growth that accompanied the Industrial Revolution (and therefore, ecological categories need to be studied separately and in the larger context). This is shown by for example Hornborg's (2006) time-space appropriation assessment of the ecologically unequal exchange between England and U.S. in the mid 19th century. But the hypothesis here is that ecologically unequal exchange and the turn to fossil fuels was not the *cause* of industrialization: it was capital's inherent drive to profit that led the way, which thereby also laid the foundation for climate change. As so often, the full consequences of human acts are disguised at the point of acting and the results largely unintentional.

Another consequence is that the often assumed causal relationship between ecologically unequal exchange and underdevelopment may need to be re-evaluated. If we reject physical explanations for ecologically unequal exchange, should we also reject physical explanations for underdevelopment? Uneven development theory implies that capital accumulates through development in one pole and underdevelopment at the other, all depending on the shifting physical and cultural geographies. Interestingly, this explanation includes physical aspects but gives equal weight to social factors – and above all, to the need of capital to profit under any circumstances. If underdevelopment is an effect mainly of power asymmetries and uneven development, it is nevertheless likely to, in turn, deepen metabolic rifts and ecologically unequal exchange. A loop of low wages, weak internal demand, export dependency and lack of capital is likely to intensify exploitation of both natural resources and labour, resulting in ecologically unequal exchange. This would also seem to explain how some countries with extractive economies can be highly developed. Even though they sell off their resources at competitive world market prices they are not economically drained (which could be explained by high levels of organic composition). The decoupling of resource extraction and underdevelopment might also explain why some poor countries (I guess that Vietnam, Bangladesh and China belong to this category) are not mainly extractivist, but highly industrialized and as such net importers of natural resources applied in the industries.

In sum, this chapter started with a call for a better understanding of and critical engagement with the role of capitalism in socio-ecological change, and the theoretical approach sketched here – although rough and tentative – is my attempt to respond to it.

4. (Mixed) Methods

The Human Ecology Division at Lund University is passionately concerned with the power dimensions of human-environmental interaction, but eclectic when it comes to academic disciplines and methods. In that sense, human ecology is truly focused thematically *and* truly interdisciplinary. This is also the spirit in which this thesis was written. The topics of study are indeed limited: all six papers develop and apply the related concepts of ecological debt and ecologically unequal exchange. Yet they are published in or submitted to journals and books within several different academic disciplines: environmental studies, philosophy, political ecology, sociology, and history. The different papers apply historical methods, argumentation analysis, normative reasoning and statistics. As we have seen, the range of theories referred to in the papers is diverse. This thesis might therefore appear as either highly consistent or deeply fragmented, depending on the perspective; for human ecologists in Lund, however, it is quite normal.

This interdisciplinarity is also inherently generated by the character of the concepts under study, which are themselves complex and multifaceted; they simultaneously represent theories and methods, ethical claims and quantitative measures, and are used by EJO activists, politicians, natural scientists, social scientists, economists, and law practitioners. To be more precise, the concepts in focus in this thesis have at least three implications. They are 1) political concepts, used by politicians, diplomats and social movements; 2) theoretical concepts elaborated within political science, sociology and philosophy, often in relation to environmental and climate justice discourses; and 3) quantitative measures of biophysical flows applied within the spheres of natural science and ecological economics.

These three dimensions of the concepts are not disconnected, but have developed relatively autonomously. In the thesis, I try to deal with all three of them and attempt to tie them together more closely.

The point of departure is the political sphere: how climate debt is articulated by the climate justice movement. This is not to suggest that the other uses are less important, but a conscious choice and a reflection of the aim of the study, which is to empower the environmental justice movement. After 1) the climate justice movement's claims on climate debt have been identified, it is 2) related to the *theoretical* debate, especially in normative political theory, and finally 3) quantified as a biophysical measure.

To be true to the aim of developing these complex concepts means, almost by necessity, to be promiscuous when it comes to methodological approaches. The different papers thus apply both qualitative and quantitative methods. They include both case studies (N=1) and statistical analyses (N=154). They are inductive, deductive or perhaps iterative (where data and theory develop in a dialectical process).

The methods applied are at least briefly introduced in each paper, and I will therefore not dwell very much on them here. But while several different methods are used in the different papers, one might consider whether the application of all these methods to a rather restricted topic constitutes a method in itself? Does the thesis, taken as a whole, have a methodological approach? If so, I believe it would qualify as an example of *mixed methods research* (MMR).

4.1 The Methodological Chain

In the following, I will situate the methodology used in the thesis as a whole within the growing field of MMR. First I will provide a short résumé of the methods used in the papers in order to present an overview of the methodological approach of the thesis as a whole. This means leaving out the side-tracks and instead tracing the main methodological chain of which the individual papers are the links.

Paper 1 is a broad introduction to the concept of ecological debt, applying an entirely qualitative method based on a critical study and historical analysis of primary and secondary literature, with an emphasis on intellectual history (or *history of ideas*, as it is called in Sweden). Its role in the overall methodology is to serve as an introduction to and a framing of the field, so that the reader is equipped with a basic understanding of the concepts of ecological debt and climate debt.

Paper 2 has a more narrow focus and is more methodologically advanced: here a well-defined, qualitative method – a so-called Toulmin argumentation analysis – is applied to nine central documents (primary sources) in order to identify the climate justice movement's main claims about climate debt. This is an *inductive* study, where data and theories are generated for later use. Thus, important statements from the climate justice movement's discourse on climate debt, inductively derived, lead straight into *Paper 3*, where one aspect of them is tested. More specifically, their ethical foundations are challenged by counter-arguments and defended through the mobilization of arguments from the scholarly literature on normative political theory, climate ethics and through critical analysis.

The main aim of *Paper 4* is to create an analytical link between the concepts of ecological debt and ecologically unequal exchange. It builds directly on the

definition of ecological debt established in Paper 1, and in order to establish a corresponding framing and definition of ecologically unequal exchange, it makes use of a similar, historical and qualitative method as in Paper 1. Also in Paper 4, the concept of (unequal) carbon sink appropriation is developed, and formal links established between the four related concepts.

In *Paper 5*, results from the *qualitative* research in Papers 1-4 are used in a *quantitative* analysis of climate debt and carbon sink appropriation. The conceptual introduction to ecological debt and climate debt in Paper 1 and of ecologically unequal exchange and carbon sink appropriation in Paper 4, the analysis of the climate justice movement's claims on climate debt in Paper 2, and the ethical justification of their arguments in Paper 3 are all vital for how the variables are identified and how they are formally related in equations in Paper 5. Here, the qualitative sequence of this mixed methods research study is turned into a quantitative exercise. The integrated inferences from this chain of papers are discussed in the conclusions.

The last chapter, *Paper 6*, is external to the methodological chain that binds Papers 1-5 together, but theoretically well-connected with the rest. It can be regarded as a MMR study in its own right: the hypotheses and variables are selected through historical and theoretical (qualitative and inductive) analysis, before they are formally related in equations and tested (deductively) on historical data using quantitative methods. Conclusions are drawn from both strands of inquiry.

4.2 Mixed Methods Research

The first qualification of a MMR study is that it applies both quantitative and qualitative methods for obtaining data and conducting analysis within a single research project (Plano Clark and Ivankova 2016:35). Note that the methods should not be mixed in the sense of fused into a single method somewhere between the quantitative and the qualitative; mixed methods rather means that separate methods – at least one quantitative and one qualitative – are applied and to some degree integrated in order to get a more informative result than if only quantitative *or* qualitative methods were employed. Typically, a MMR study has several sets of research questions – quantitative, qualitative, and an additional set of integrated questions, which address the overall intention (ibid.:37). Most of the research questions in this thesis would classify as qualitative, but three (5.1, 5.2, 6.2) are quantitative, and the first stated aims – (1) *exploring the historical development of the concepts ecological debt, including climate debt, and ecologically unequal exchange*, (2) *develop the concepts further*, (2) *linking them closer* – requires an

integrated approach (since these concepts are themselves both quantitative and qualitative).

The *temporal* relationship between the quantitative and qualitative parts of an MMR study might be *concurrent* or *sequential* (ibid.:39-40), while the *integration* of the parts commonly either *combine* the quantitative and qualitative results, or *connect* them (ibid.:41); usually, the latter follows from sequential timing. Depending on the temporal relationship between the parts, there are three basic mixed methods designs (ibid.:121):

Concurrent Quan + Qual Design

Sequential Quan → Qual Design

Sequential Qual → Quan Design

The first design is reserved for concurrent studies that combine the results from both studies, while the second and third are both sequential and, normally, integrate the quantitative and qualitative results through connection. The second combination applies when qualitative methods are used to search for *explanations* to the correlations that appear in quantitative, statistical regression, while the third combination occurs when qualitative methods are used to derive hypotheses that are then tested with quantitative methods (Bryman 2016:639). If mixed methods are instead used to study different aspects of a single phenomenon the first design is used. If, for instance, a researcher wants to study a phenomenon on both micro and macro levels, s/he is likely to prefer qualitative research on the micro level, while quantitative methods are often suitable for the macro level research (ibid.:418).

The method used in this thesis approximates the third design type. The methods are implemented in sequence, where the initial qualitative results are used as variables in the quantifications. Yet, I would argue that the integration of the results is both connected *and* combined. Even though the results from the qualitative research go into the quantitative study as variables, I regard them as interesting and valuable also on their own. Therefore, when the results from the qualitative and the quantitative parts are connected into figures on the climate debt, I do not regard this as the final result of the whole study. Rather, the end result is a combination of the results from both the qualitative and quantitative studies.

Plano Clark and Ivankova (2016:80-81) list a number of rationales for using MMR. First, MMR can be used to offset the strengths and weaknesses of each method (quantitative and qualitative). A second rationale is triangulation in the sense of comparing results from quantitative and qualitative methods to obtain more valid conclusions. Third, MMR can be used for complementarity, for instance using both qualitative and quantitative methods to get more complete conclusions; a fourth argument is development, that the results from one type of research in a first step are used to inform and shape the research in the next step. Finally, the social justice

rationale, where MMR is used to conduct research guided by a social justice perspective.

The mixed methods research of this thesis can be motivated both by complementarity and development rationales, since the results from the qualitative research are used to shape the quantitative research, but are also of interest in themselves, not only as input into the next step of the research process. The social justice rationale also fits the aim of this study. As examples of how mixing methods can “uncover and challenge oppression in society” Plano Clark and Ivankova mention that quantitative methods might be preferred for documenting unequal treatment of people while qualitative methods are used to give voice to marginalized groups. Further, mixing approaches can produce research that is “viewed as credible to the different relevant stakeholder groups”. While policymakers are believed to be more convinced by statistical, quantitative methods, community groups might be more persuaded by qualitative narratives (ibid.:86). I note that this is in accordance with what both EJOLT and Pope Francis have observed: that there is a “demand” or “need” for concrete numbers on the climate debt in order to persuade the decision makers. Yet, to quantify concepts developed by the movements in a way that is not only scientifically legitimate but also true to their original meaning, qualitative methods are also indispensable.

4.3 Critique against MMR

Although the mixing of methods makes sense, it is not uncontroversial. The methodological literature in social science is often strictly divided into qualitative and quantitative methods, and it is common that researchers do *either or: either* you apply qualitative methods, such as ethnography or discourse analysis, *or* you apply quantitative methods, such as statistics. There may be practical reasons for this divide, such as personal interest, training, convenience, and unwillingness to learn new skills. But there are also some theoretical challenges. Some have claimed that quantitative and qualitative methods rest on fundamentally different ontological and epistemological perspectives, which, if true, would make mixed methods a theoretically weak or even contradictory project.

As showed by Alan Bryman (2016) in his classic handbook *Social Research Methods*, there are fundamental differences between quantitative and qualitative research strategies. Quantitative research is primarily deductive, theory testing, positivist and objectivist, while qualitative research is mostly inductive, theory-generating, interpretative and constructionist. While choosing between a deductive and inductive approach, and whether to test or generate hypotheses, ought to be a strategic choice mainly depending on the aims of the particular study, to jump

between epistemological and ontological positions that are contradictory and emanate from different world views – such as from positivism to constructivism – is not convincing. Several researchers therefore warn against using mixed methods (ibid.:409). Most adherents to what is sometimes called the *incompatibility thesis* seem to come from the qualitative side, and the requirement to link a methodological choice directly to a firm ontological position is probably most clearly expressed in discourse analysis. For instance, Jørgensen and Phillips (2002:4-5) state that discourse analysis "is not to be used as a method of analysis detached from its theoretical and methodological foundations", calling the different approaches to discourse analysis "complete packages" of ontological and epistemological premises, theoretical models, methodological guidelines and specific techniques. In their view, I conclude, applying different methodological approaches is not merely a matter of research strategy but intellectually quite impossible, because it would require several ontological premises within a single research project.

Fortunately, this view of "a complete package" is not unchallenged. In Bryman's (2016:ch.:26-27) concluding section, the division between qualitative and quantitative research is blurred. While Jørgensen and Phillips would side with what Bryman calls the *epistemological version* of the debate over quantitative and qualitative research, there is another, *technical version* which is more open to combining the best parts of each and stresses the autonomy of scientific methods, regarding them as largely compatible and thus legitimizing combinations of quantitative and qualitative methods (Bryman 2016:637). Another way of referring to the same conflict is to distinguish between *purists* and *pragmatists* (Tashakkori and Teddlie 1998). The methodological *purists* argue that quantitative and qualitative research methods are *incommensurable* since they are based on ontological assumptions that are not only different but *mutually exclusive*. The *methodological pragmatists* accept that quantitative and qualitative methodologies belong to different paradigms with different ontologies and epistemologies, but propose that researchers should be allowed to jump between the paradigms. They argue that both paradigms are limited and that a combination will thus produce the best results.

Without resolving the underlying differences, however, the switching between methods will lead to considerable challenges at the epistemological and ontological levels. A more promising attempt to bridge the ontological divide is therefore the *anti-conflationist* position, which argues that the differences between quantitative and qualitative methods in many cases are not antagonistic, as asserted by the purists, and notes that much established research already crosses the divide. Within quantitative research, qualitative methods are often used in the preparatory stages. Hypothetic-deductive theory testing, associated with (positivist) quantitative research, is sometimes carried out using qualitative methods, and qualitative

research sometimes uses figures and statistical data – what Bryman (2016:630) calls “quasi-quantification”.

So, how can researchers mix these methods if they belong to different paradigms? According to the anti-conflationists, the technical aspects of a *method* should not be conflated with a *methodology*. *Methods* are not exclusively linked to specific philosophies. To conduct a field study, make interviews, or collect statistical data are methods that are compatible with several different research paradigms. *Methodologies* are more abstract and often linked to ontological and epistemological assumptions. A combination of methods – both quantitative and qualitative – is often possible without switching paradigms, and is encouraged by the anti-conflationists as long as the underlying assumptions can be sustained (which is the main difference between them and the pragmatists, who allow paradigm-shifting).

Several research paradigms seem to be able to embrace a blend of quantitative and qualitative methods. Plano Clark and Ivankova (2016:198-202) list post-positivism, constructivism, pragmatism, dialectical pluralism, transformative-emancipatory perspectives, postmodernism, and critical realism as examples of diverse ontological foundations for MMR. I will now briefly return to the last mentioned of these philosophies of science, but here viewed from a methodological perspective.

4.4 Mixed Methods and Critical Realism

Generally, critical realism (CR) prefers qualitative over quantitative methods in social science. Quantitative methods are appreciated mainly for their descriptive use – such as establishing magnitudes and correlations between variables – but critical realists are sceptical about the possibility of using statistical methods to identify causation. In positivist/empiricist science, observable and regular patterns of events are mistakenly regarded as causalities, derogatorily referred to by realists as “actualism” (Collier 1994:7-12). According to realists, establishing a regular pattern between observable empirical data is not the same as to uncover real causal mechanisms. The observable experiences are only traces of the underlying structures, and modelling and regressive analyses are therefore of limited value for explaining social phenomena. At best they touch the surface of things, at worst they are outright misleading.

To get to the bottom of causal mechanisms, critical realists prefer an approach called *retroduction*, which is basically to study the events and then via analogy, metaphor and model building hypothesize the causes. Generally, qualitative methods are preferred in this process. They are used for description, interpretation and

understanding but also for identifying structures and causalities. Some scholars, such as Zachariadis *et al.* (2013), argue that statistics and other quantitative methods can generally be used in retrodution and social explanations without violating the ontological assumptions of critical realism. It is important to restrict the research carefully in time and space (“quasi-closure”), as patterns then are more likely to reflect the real causal mechanisms (“demi-regularities”). McEvoy and Richards (2006) maintain that quantitative methods can identify patterns and associations, which in turn can be helpful in teasing out the causal mechanisms or testing theories. Thus, at least some of the critical realists are open to, or even actively endorse, a methodological pluralism which includes both qualitative and quantitative methods. Yet, although CR favours qualitative methods, it does not confine itself to interpretative conclusions, as pointed out by Collier (1994:167):

Like hermeneutic theorists but unlike positivists, he [Bhaskar] holds that the study of any social practice must start with the agents’ conceptions of it. But unlike the hermeneuticist and like the positivist, he holds that social science can go on to refute these conceptions. He holds social explanation to be both causal (like the positivist) and interpretive (as does the hermeneuticist), denying their shared premise that these two notions will not cohabit.

The MMR design that is most in line with a critical realist approach is, according to Zachariadis *et al.* (2013), to use quantitative methods to identify and establish demi-regularities within data patterns, which are then used to guide qualitative research that will uncover the mechanisms, agencies, and social structures that produce the behaviour observed. This seems to coincide with what Plano Clark and Ivankova call “sequential quan-qual” research. But other MMR designs are also possible. Zachariadis *et al.* list seven purposes for mixing methods in critical realism, and the one most closely resembling the method in this thesis is probably the so-called “developmental” purpose, in which inferences from one type of research are being used to pose questions in another type of research (in my case, sequential qual-quant). Yet, had the research here been directly inspired by the retroductive approach of CR (which it is not), the inferences in the following stage should be used to hypothesize about the specific causal mechanisms, and the results inspire another round of research, until some certainty regarding causality has been achieved.

The first five papers, the main links of the methodological chain in this thesis, are not primarily concerned with causation, however. The concepts under scrutiny are not claimed to be causal mechanisms; the political, legal and normative aspects of these concepts do not “exist” in an objective sense, independently of discourse, and it would be a case of *ontological fallacy* to project such concepts upon the natural world (cf. Foster *et al.* 2010:294). Yet, as repeatedly argued throughout this thesis, these concepts are many-sided. They are used to emphasize certain aspects of social reality, such as the unequal exchange of energy and matter between core and

peripheries in the world system. These flows are real and exist independently of our concepts, I argue consistently. Thus the concepts are useful in uncovering and illuminating a part of reality that would otherwise be more or less concealed. The concepts are certainly not perfect, and the data and regressions may be skewed or even wrong, but it would be a case of *epistemic fallacy* to take methodological or theoretical deficiencies as pretext for questioning the actually existing reality (Bhaskar 2008:16).

I repeat that this thesis is largely *in accordance* with critical realist assumptions, but had it been *directly inspired* by CR, I would have needed not only to develop the concepts under study for descriptive, normative and political purposes, but also to look deeper and with more focus for causal mechanisms. To some extent this is attempted in Papers 4, 6 and in section 3.5 of this introduction, where explanations for ecologically unequal exchange are discussed. But I admit that although biophysical measures can confirm the occurrence of ED and EUE, there is more to do in terms of explaining both their causes and their effects.

5. Contextualizations

While Papers 1-5 treat ecological debt and climate debt from a variety of perspectives, not enough is said about the movements that are the main vehicles of these concepts: the environmental justice and climate justice movements. They are the focus of the first section below. The general intention with this historiography is to place the ecological debt/climate debt demands in a proper social and political context. The sixth and final paper is distinguished from the rest since it is a historical case study. It is largely based on the same theories and methods as the other papers, but placed within a historical debate that is too voluminous to include in the paper itself, partly because of its focus on methods. I therefore take the opportunity here to position my case study within ongoing historical debates. I also want to present some further, still tentative, suggestions regarding this case study which were not part of the published paper but deserve to be discussed in this context.

5.1 Environmental and Climate Justice Movements

It is probably fair to say that the most obvious predecessor to the recent global climate justice movement is the grassroots- and ethnic minority-based environmentalism that was formed in the U.S. in the 1980s. With roots in the civil rights movement, it developed struggles against "environmental racism", i.e. the tendency to place polluting industries and to dump hazardous waste close to poor, often ethnically stigmatized communities. A number of reports by activist scholars such as Robert Bullard (1990) and Bunyar and Mohair (1992) exposed the significant extent of this tendency, and a movement for "environmental justice" was formed. In contrast to "sustainable development", the designation itself indicates that environmental problems have power dimensions. In 1991, a national meeting was held in Washington and a manifesto, *Principles of Environmental Justice*, was adopted. The concept soon spread internationally through various networks, movements and international organizations. Bullard recalls that during the Rio summit 1992, "we found that some groups had translated the Principles into Portuguese and were circulating the document to local community leaders" (Claudio 2007). This indicates that the soil for the concept was already fertile, and that grassroots environmental movements, often communities in direct struggle with

states and businesses over their very means of livelihood, had become a worldwide phenomenon. As noted by Martínez Alier (2002:ch. 1), the traditional discourses of the environmental movement – “the cult of the wilderness” and “the gospel of eco-efficiency” – were challenged by a third current, often called the “environmental justice movement” or, to use his own label, “the environmentalism of the poor”. Emblematic examples in the 1970s and 80s were the Chipko “tree-hugger” movement in India and Chico Mendes’ environmental and trade union struggles in the Brazilian Amazon, prior to his assassination in 1988.

As documented in Paper 1 of this thesis, the ecological debt concept developed in the late 1980s and early 1990s and became a central political demand proposed by the environmental justice movements. It reflects how, in the 2000s, the focus shifted towards climate debt.

In the U.S., a climate justice movement grew out of the domestic environmental justice movement. A pioneer was the San Francisco-based Corporate Watch which published *Greenhouse Gangsters vs. Climate Justice* (Bruno, Karliner and Brotsky 1999) in the run-up to the 2000 COP in The Hague, where they also arranged a seminar called *Climate Justice Summit* (Roberts and Parks 2009:394-395). Later, a number of groups attached to the U.S. environmental justice movement formed a network focusing on climate change and in 2004 adopted the *Climate Justice Declaration*. Their main concern was how marginalized, often ethnic minority communities are the most vulnerable to changing climate patterns and also tend to be disproportionately affected by *policies* aimed at mitigating or adapting to climate change (Abate 2010; Stephenson 2014).

Harlan *et al.* (2015) refer to this as the U.S. climate justice movement, as opposed to the International climate justice movement, which gathers environmental NGOs based in the global South and international networks such as Friends of the Earth International (FOEI), Northern aid organizations and the external debt cancellation network Jubilee Debt Coalition, as well as indigenous movements in both North and South America and small-farmers movements like the Via Campesina network. Important allies also include Southern think tanks such as Third World Network and Focus on the Global South and autonomous leftist groups in the North, such as the British climate camp movement and the mainly Danish Climate Justice Alliance (CJA) (Russel 2012).

The crystallization of the international climate justice movement was also triggered by the Hague 2000 *Climate Justice Summit*. In August 2002, the *Bali Principles of Climate Justice* were adopted by e.g. Corporate Watch, Friends of the Earth International, Greenpeace, Indigenous Environmental Network, Oilwatch, Third World Network and World Rainforest Movement. What would become key pillars of the climate justice discourse – its emphasis on equality between countries and social groups, its scepticism towards “false solutions” such as carbon trading and

techno-fixes, its call for the recognition and repayment of the ecological debt (later the climate debt), and its promotion of “real” solutions, such as keeping the fossil fuels in the ground, reduced consumption, food sovereignty and respect for indigenous rights, were all visible in the declaration. Three paragraphs were devoted to the recognition of “a principle of ecological debt” (International Climate Justice Network 2002).

The next milestone for the international climate justice movement was the forming of the Durban Group for Climate Justice in 2004, which adopted the *Durban Declaration on Carbon Trading*. It prefigured the formation of the *Climate Justice Now!* (CJN!) network in Bali 2007, which was first and foremost the result of a growing discontent with the endorsement of the Kyoto market mechanisms by the Northern-dominated NGO network Climate Action Network (Bond and Dorsey 2010; Russel 2012:136). The simultaneous Bali COP 15 decided that a major agreement for the second period of the Kyoto Protocol should be adopted in Copenhagen two years later, which sparked the largest climate related mobilizations so far. Calls for climate justice rang all over. The Southern-dominated CJN! planned civil disobedience actions in collaboration with Climate Justice Alliance (CJA), a newly set up network of mostly Danish leftist activists inspired by the British Climate Camps, autonomist Marxism and the (anti)globalization movement of the 1990s (cf. Russel 2012:134, 138), while the more mainstream environmental NGOs, churches and aid organizations formed the network *Tektctck – time for climate justice* (ibid.). Climate justice rang in the alternative civil society centre KlimaForum 09, whose final resolution *System Change – not Climate Change* was adopted by over 300 organizations and called for the abandonment of fossil fuels within 30 years, the recognition and compensation of climate debt, and a rejection of carbon trading (KlimaForum 2009). The acknowledgement of a climate debt was one of the strongest demands presented by the climate justice movement. In a run-up campaign, the declaration *Repay the climate debt: A just and effective outcome for Copenhagen* (TWN 2009a) was circulated and signed by 254 organizations, mainly from the global South (TWN 2009b).

After COP 15, which was widely acknowledged as a failure, Bolivia’s president Evo Morales convened the *People’s World Conference on Climate Change and the Rights of Mother Earth*, in Cochabamba in April 2010. This initiative was supported by over 200 civil organizations as well as by states affiliated with the Bolivarian Alliance for the Americas (ALBA, comprised of Bolivia, Cuba, Ecuador, Nicaragua, and Venezuela). The conference adopted a *People’s agreement* (PWCCC 2010). Bolivia submitted a proposal to the UNFCCC process in 2010 (UNFCCC 2010), based on the demands raised by the climate justice movement in Cochabamba.

While the years 2007-2010 signalled the global breakthrough for a new, radical discourse on climate change carried by the climate justice movements, what happened the following years is more ambiguous. CJA ceased to exist (Russel 2012:200) and the activities of CJN! more or less vanished. Climate justice activists continued to gather at the COPs, such as in Durban 2011, Lima 2014 and Paris 2015, but in decreasing numbers. One explanation is that the growing distrust in the UNFCCC process after the Copenhagen failure shifted the attention towards local or national struggles (Tokar 2013; Bond 2014; Foran 2014). This seems to be true especially in the U.S., where strong campaigns against fossil infrastructures such as the Keystone XL pipeline and mobilizations such as the 400,000 People's Climate March in New York in September 2014 occurred. In Europe, an explanation for the decline of the climate justice movement is that attention was diverted to new movements launched against austerity policies such as Occupy and Indignados (Mueller 2012). The attempts to reinvigorate the European movement in the mobilization for Paris COP 21 were seriously disturbed by the ban on climate manifestations following the November 13 terrorist attacks, but around 10,000 climate justice activists nevertheless demonstrated on Champs Elysée on December 12th. In May 2016 over 3,500 activists participated in a civil disobedience protest against the Swedish corporation *Vattenfall's* coal operations in Germany, which was part of the global action week *Break free*, according to the organizers the largest-ever civil disobedience action against fossil fuels.²⁰

The notion of climate justice is also used by more mainstream organizations, such as the Mary Robinson Foundation and the World Resources Institute (2013), and even UN bodies (Adams and Luchsinger 2009). These organizations are here not viewed as part of the climate justice movement. The distinction between the climate justice movement and a more general or mainstream climate movement is, however, not crystal clear. For instance, “the indispensable Bill McKibben and a rising 350.org” is seen as “perhaps just outside” the climate justice movement by Foran (2014), while regarded as one of the “more mainstream groups” by Bond (2012:187). FOEI and Greenpeace are other borderline examples.

The international climate justice movement is a convergence of several movements with diverse approaches to climate justice and climate debt (cf. Garrelts and Dietz 2013). The different movements advocate slightly different versions of climate justice. Thus, environmental NGOs tend to emphasize that remaining fossil fuels should remain unexploited and often have a history of campaigning for ecological debt recognition, sometimes in collaboration with Northern aid organizations and the external debt cancellation network Jubilee Debt Coalition. They have close ties to indigenous movements in both North and South America and to small-farmers movements such as the Via Campesina network, which bring perspectives such as

²⁰ www.theguardian.com/environment/2016/may/16/break-free-protest-fossil-fuel

spirituality and small-scale farming to the movement (Keller 2012). The Southern think tanks instead emphasize climate change effects related to global inequalities, development issues and the importance of repaying the climate debt. Especially the Third World Network tends to rather uncritically back Southern against Northern states within UNFCCC (Chatterton *et al.* 2012).

Although many of the movement's positions are shared with Southern governments, mainly the Latin American ALBA-states, the relation is sometimes tense. Thus, the groups that wanted to analyse the "neo-extractivism" (Gudynas 2010) of e.g. Bolivia and Venezuela were excluded from the official People's summit in Cochabamba (Russel 2012:173-175; Fabricant and Hicks 2013). It should also be noted that one of the core demands of the climate justice movement – keeping the fossil fuels in the ground – is not part of the *People's agreement*. Perhaps "Comrades Evo [Morales] and Hugo [Chavez] would not have appreciated that one" (Mueller 2012).²¹

The European CJA network was allied with the Southern-dominated CJN! in Copenhagen 2009, but has a different background and approach. According to Russel (2012:134), it became clear that although the networks both favoured climate justice, "the actual content of any climate justice discourse remained highly contested". CJA developed its own discourse based on a critical analysis of "green capitalism" (Mueller and Pasadakis 2008), in which climate debt plays no part. Later, two of its leading theorists, Mueller (2012) and especially Russel (2012:180-184), developed critiques of the climate debt concept, mainly for focusing on the geopolitical level of the "North-South" divide instead of pointing to the class dimension of capitalism as a worldwide system.

The impression is that when CJA mentioned climate debt in their statements, it was mainly out of respect for their Southern allies, for whom it was a central concept. Instead, it preferred to refer to Europe's historical responsibility for climate change and global social and environmental exploitation. CJA mentioned geopolitical inequalities and "unequal exchange via unjust trade policies", which clearly refers to the asymmetric biophysical flows resulting in ecological debt. Thus, while CJA adopts much of the theories that define and identify ecological and climate debt, the non-use of these terms is perhaps a reflection of disconnection or alienation from the Southern and NGO-based discourse in which ecological debt and climate debt is central, and of identification with a classical Marxist discourse in which unequal exchange rather than climate debt is emphasized. The aim of reconciling these

²¹ The alliance between the climate justice movement and the nation of Bolivia faded in 2011-2012, when Bolivia's UN ambassador Pablo Solón withdrew from office and the Evo Morales government decided to construct a road through the Isiboro Sécore National Park and Indigenous Territory (Fabricant and Hicks 2013).

discourses is a further reason for linking together the two concepts, as attempted in Paper 4 of this thesis.

5.2 Institutionalism and Structuralism

The theoretical argument underlying the case study in Paper 6 is summarized as "a non-reductionist, structuralist,²² non-Eurocentric, ecologically concerned global history", but because of the "strong focus on methodology, the rich theoretical and historical debate about Eurocentrism in (world) historiography is largely left aside" in the paper. It nevertheless notes the influence of the so-called "California school", notably Kenneth Pomeranz, and also structuralists (or neo-Marxists) such as Janet Abu-Lughod, Samir Amin, James Blaut and Andre Gunder Frank. It has a section on "ecological-economic history" that I see no urgent reason to expand, especially since the line of reasoning there is partly repeated and expanded in Paper 4. What I will elaborate here, however, are the historiographical debates on institutionalism versus structuralism, on internal versus external causation, and on Eurocentrism. The points of departure are two of the most read books in economic history in recent years: *Why Nations Fail* by Daron Acemoglu and James A. Robinson (2012) and *Civilization: The West and the Rest* by Niall Ferguson (2011).

Why Nations Fail (Acemoglu and Robinson 2012) is arguably the most influential world-economic history book of recent years, based on thorough studies of many parts of the world and drawing on a restricted theoretical tool box that is used to analyse much of economic history since the Neolithic. The approach is institutionalist with a heritage rooted mainly in the New Economic History and new institutionalism of Douglass North, who pioneered the application of neoclassic economic theory and extensive cliometric quantification to history. The two most fundamental analytical categories used by Acemoglu and Robinson are economic and political institutions, which are seen as either inclusive or extractive. A nation's capacity to create sustained economic growth is thus first and foremost a matter of inclusive institutions. The formation of the crucial institutions of development or underdevelopment are analysed as outcomes of domestic power struggles—peasants against nobility, merchants against the king, colonized against colonists (but rarely workers against capitalists). Acemoglu and Robinson also consider outside events, historical path-dependencies and contingency, but the various

²² What I categorized as structuralism in the book chapter are basically the same family of historical and social theories that I have here preferred to call neo-Marxist economics: theories challenging the modernization narrative, including dependency theory as well as both the world-system analysis of Wallerstein and world system analysis of Frank.

“external”²³ pressures that might influence the fate of a nation all collapse into the concept of a *critical junctures*, defined as “a major event or confluence of factors disrupting the existing economic or political balance in society” (ibid.:101). This notion remains sorely under-explored and under-theorized, and the lack of regard for “external” explanations to historical change is a fundamental weakness, particularly in the context of writing global or world history.

Another root of Acemoglu and Robinson’s analyses is the Dobb/Brenner standpoint in the Marxist debate on the transition from feudalism to capitalism in Europe (Dobb 1946; Hilton 1976; Brenner 1977).²⁴ This debate revolved around the question of “internal” versus “external” explanations for the decline of feudalism and the birth of European capitalism (and as a consequence, the “rise of the West”). On one side, Paul Sweezy (1950, reprinted in Hilton 1976), Andre Gunder Frank (1969), and Immanuel Wallerstein (1974), among others, emphasized that capitalism arose in response to international trade and colonialism. A significant example of this approach is Wallerstein’s view that the rise of the capitalist, modern world-system was the outcome of three main phenomena in the 16th century: European territorial expansion, variegated methods of labour control for different products and different zones of the world-economy, and strong state machineries in the core states (Wallerstein 1974:38).

On the other side, Maurice Dobb (1946) and Robert Brenner (1976, 1977) attributed the origin of capitalism to domestic factors in England, especially the class struggles. Dobb and Brenner regard capitalism as a *mode of production*, defined as a system based on real subsumption of labour and production of surplus value, while *dependistas* and world system analysts define capitalism mainly in terms of the sphere of commodity exchange. According to Bergesen (2011:28), to place an exchange mechanism at the heart of the system, while still calling it capitalist, remains the largest theoretical problem of world system analysis. It was soon criticized by Brenner (1977) for being nothing but “Neo-Smithian Marxism”.

On the other hand, Brenner’s “idea of capitalism in one country, taken literally, is only a bit more plausible than that of socialism”, according to Perry Anderson (2005:251), and it does not address the question that structuralism sets out to solve: how can the development and underdevelopment of different parts of the capitalist

²³ “External” events are seldom entirely external since they are also partly shaped by “internal” factors. For instance, the Black Death arrived from outside Europe, but how severely it affected populations was a result of, for instance, the general health situation and nutrient supply at its arrival. Rather than regarding external and internal causes in a binary way, they are better understood as having a dialectical relation to each other.

²⁴ The contributions to the original debate about Dobb’s *Studies in the development of capitalism* (1946) in the 1950s and early 1960s are reprinted in Hilton 1976. “The Brenner Debate” on the transition from feudalism to capitalism is reprinted in Aston and Philpin 1985, which does not, however, include Brenner’s (1977) attack on the world system analyses of Frank and Wallerstein.

world system be explained? If capitalism is narrowed down to the mode of production that developed in England based on “free”, commodified labour, how do we judge the fact that the same historical development directly encouraged “the second serfdom” in the East-European grain-exporting countries and slave labour in the sugar and cotton plantations of the Atlantic islands and in the Americas? While Wallerstein integrates these different modes of labour control as an axial division of labour within *one* capitalist world system prioritizing “endless accumulation” through the transfer of surplus value from the peripheries to the core, Brenner’s more specific definition of capitalism comes at the price of reducing the scope of interpretation, since the peripheries are excluded as alien to capitalism. Thus, to Brenner the colonies and even mainland Europe had nothing to do with capitalism until much later.

This is not a problem for non-Marxist Brennerites such as Acemoglu and Robinson since for them the mode of production—either feudalism or capitalism—is not a central category. They nonetheless share with Brenner the reductionism of looking mainly for internal, national explanations for historical change.²⁵ Attempts at resolving this heated debate on the origin of capitalism include Perry Anderson’s rejection of the “false” dichotomy that capitalism arose either by class struggle or by trade, when it was a result of both (Anderson 1974, 2005). This is also the position of both Wallerstein and his mentor Fernand Braudel, according to whom internal and external historical explanations are inextricably linked (Braudel 1985). As discussed in previous sections, also the Luxemburg-Harvey analysis of the dual character of accumulation resembles such a synthetic approach.

Some scholars, such as Kenneth Pomeranz (2009:5-14), see European capitalism as only a variant of a global, “developmentalist” pattern shared across Eurasia, while others, notably Gunder Frank (1998:330-332, Frank & Gills 1993) came to deny the relevance of the notion of capitalism altogether, considering the rise of sixteenth-century European capitalism as nothing qualitatively new from the perspective of a 5000-year-old Afro-Eurasian world system. According to Frank, what defines Wallerstein’s *capitalist* world-system—mainly a transfer of surplus value from peripheries to cores—is actually a very old feature of the world system.²⁶ Both Wallerstein (1993) and Samir Amin (1993, 2011) regard European capitalism as something qualitatively new, but their “weak” definition of capitalism as endless accumulation is vulnerable to the arguments of Frank and Gills and others. While I

²⁵ Acemoglu and Robinson are explicitly influenced by Brenner’s view on the abolishment of serfdom in Western Europe after the Black Death (Acemoglu and Robinson 2012:469) and by Brenner’s and Dobb’s view on the causes of the Industrial Revolution (ibid.:471).

²⁶ According to Wallerstein, the modern world-system (with a hyphen) is but one of several historical world-systems, which are not necessarily worldwide in a literal sense but constitutes a “world in itself”, while according to Frank, there is only one world system (without a hyphen) going back several thousand years (Wallerstein 1993).

would not go as far as renouncing the concept of capitalism, a lesson for world historians should be that in order to understand the whole, we cannot only analyse the parts, and therefore both the institutionalist tool box of Acemoglu and Robinson and the Brennerian focus on national class struggle are insufficient and thus reductionist. A better starting point would be a theoretical framework that takes both external and internal factors for historical change into consideration.

5.3 Eurocentrism

In his 2011 book and television series, *Civilization: The West and the Rest*, the renowned Scottish historian, Harvard professor and conservative columnist Niall Ferguson mobilizes the canon of Eurocentric historiography to save what can be saved of the view of Western ascendancy as a process deeply rooted in European culture and/or religion, rationality, economic institutions, polity competition, ingenuity, geography, climate, and so on. Ferguson focuses on the rise in the early modern era of six "identifiable novel complexes of institutions and associated ideas and behaviours" that distinguished the West from the rest: competition, science, property rights, medicine, the consumer society, and the work ethic (ibid.:12). Although Ferguson claims that these "killer apps" produced by the Europeans explain the divergence between the East and the West, the explanatory power of his anecdotes is limited. As for many Eurocentric authors, the problems begin already with the relevant delimitation of time and space.

According to Ferguson, "Western Civilization 1.0" arose in the Fertile Crescent and "reached its twin peaks with Athenian democracy and the Roman Empire" (ibid.:17). Thus, what is now seen as the core of the "Orient" or "Middle East", i.e. Egypt, Palestine, Syria, Iraq, and Iran are included in the Western forerunners. After Babylon, Athens and Rome and an often unexplained time lap of several hundred years, "Western history" continues its march through medieval North Italian city states, via the early modern Netherlands, to modern England, and, finally, over the Atlantic to the U.S. in what James Blaut (1993:4) has mockingly described as a "westbound Oriental Express" – from the Bible lands to Silicon valley. In modern times, the West usually also includes the former English colonies Canada, Australia, and New Zealand, while the borders inside Europe are unclear: do Russia, Eastern Europe or even Central Europe belong to the West? What about modern Greece and the Balkans? Obviously the "West" is not a geographical place,²⁷ but is better thought of as a "spatio-temporal narrative". If its spatial boundaries are blurred, this

²⁷ This is something that Ferguson is forced to admit: "'The West', then, is much more than just a geographical expression. It is a set of norms, behaviors and institutions with borders that are blurred in the extreme" (Ferguson 2011:15).

is also the case for its temporal delimitation: *When* did the West appear? Ferguson enlists the Neolithic Revolution and most early city-states as “Western”. But even if the roots of European exceptionalism are regarded as very deep, and the final global takeover historically predetermined, the question when this final takeover actually occurred is still debated. The most common view, shared by Ferguson (2011:11-12), is that Western hegemony started around 1500. This date and the prehistory of European exceptionalism are, however, increasingly challenged by global historians, arguing that European world dominance did not materialize until the industrialism and imperialism of the nineteenth century. Moreover, they claim that the reasons for this expansion were contingent rather than historically determined.

Eurocentrism is supported by what Blaut (1993:5) refers to as “tunnel history”: the historical method of looking for explanations for Western ascendance in the European tunnel of space and time, i.e. by ignoring the world outside the selected boundaries of the Eurocentric spatio-temporal narrative. It is a method underlying what Blaut has identified as the “super-theory” of the Eurocentric world view: *diffusionism*, “a general framework for many theories, historical, geographical, psychological, sociological, philosophical” which on the most general level see practically all development around the world as the result of *independent invention in the West and diffusion to the Rest* (Blaut 2000:10-13).

In world history research, “the rise of the West” is the common axiomatic premise, the event that is to be explained, and if all data are organized to fit the premise, the research is self-explanatory; it has been called telescope history (Blaut 2000:41) and anachronistic (cf. Parthasarathi 2011:8). If we only search for drivers of European ascendancy in the European tunnel of time, other potential explanations, such as events in the rest of the world, historical conditioning, contingency and conjunctures, or the existence of a cyclical world system cannot be taken into consideration. The conclusion follows from the premises. But is tunnel history necessarily Eurocentric? It is not Eurocentric to point at genuine European features; Eurocentrism is to falsely attribute exceptionality to Europe. Tunnel history can provide important analyses, but the problem is that it emphasizes internal factors, not after considered rejection of external explanations, but *by scientific design*. Even if a Euro-exceptionalist explanation turns out to be correct in the end, we will not be able to judge this unless we break out from its firm hold and try to see the whole. In that sense, tunnel history is reductionist and Eurocentric – even if it is right.

It can be argued that institutionalism, including Brenner-type Marxism,²⁸ is inherently tunnel history: to single out Western, or even British, post-Glorious

²⁸ Blaut (2000:45), for instance, dismisses Brenner’s intense focus on rural England as the womb of capitalism and Western ascendancy as “Euro-Marxism”.

Revolution, institutions of private property as the cause of economic growth and European dominance, is to say that the Industrial Revolution could only occur there. But if assumptions made by the New Institutionalism are regarded as *universal*, institutionalism can be stripped of much of its (culturalist) Eurocentric aspects and make cross-cultural comparisons whose outcome is not pre-determined. Rosenthal and Wong (2011) apply institutionalist tools in a comparison of early modern Western Europe and China. They present a good theory for explaining how Europe's *prima facie* disadvantage of a war-ridden fragmented multi-state system could, unintentionally, foster technological innovation, but it does not suffice to explain the global context generating the Industrial Revolution. Institutionalism, even when exonerated from cultural prejudice, is reductionism.

Rosenthal and Wong are part of what is increasingly referred to as the "California school", a quite heterogeneous historical school involved in what might be referred to as the *ReOrientation* of global history; i.e. in dismantling Eurocentric historiography. It draws on ideas and methods from neoclassical economics and institutionalism as well as neo-Marxism, and its most prominent work is arguably Kenneth Pomeranz' *The Great Divergence* (2000). When Pomeranz compares early modern Western Europe and eastern China he finds striking similarities as regards longevity, living standards, wages, income distribution, technological level, labour productivity, access to and quality of productive capital, ecological pressure on land, labour market flexibility, and market institutions (Pomeranz 2000:Ch.1-2). These and other factors that have been suggested to explain the "Great Divergence" between Europe and China actually show surprising resemblances. The roots of the divergence must thus be sought elsewhere.

Without neglecting the importance of the California school, it was to an even greater extent structuralist (or neo-Marxist) scholars, including Janet Abu-Lughod (1989), Samir Amin (1989), James Blaut (1993), and Andre Gunder Frank (1993, 1998), who pioneered the "ReOrientation" of world history (see Paper 6). According to these scholars, the standard historical view of European economic superiority already around 1500 or earlier does not stand up to a critical examination. It is street lamp historiography, focused on the already well-explored European history, and often based on prejudices against Asian and African societies.

While both structuralist and institutionalist analyses are often Eurocentric they can both be used in non-Eurocentric ways. This nevertheless does not remedy the lack of holism in institutionalism, which leads me to hold that neo-Marxist economics remains a better theoretical framework for global history research.

5.4 Labour Embodied in Silver – a Tentative Estimate

Paper 6 includes a discussion of the problems of including silver in the analysis of the early modern trade exchange between Europe and China. The largest of those problems is the inability to construct a falsifiable theory on the role of silver in a time-space appropriation assessment. On the one hand, the general assumption is that net receipt of biophysical resources (in the form of embodied land and labour) in a trade relation is an indication of core status. If it can be shown that Spanish-American silver embodies less land and labour than Chinese tea, it should thus be an indicator of Spain being core and China periphery. But in this particular case, analysts claim that silver was an exception to the rule; silver was practically the only thing Europe could produce at an advantage. Thus, the result of the analysis could be interpreted both ways: as a confirmation of European dominance, or of silver exceptionalism in a world system dominated by China. This theoretical *cul-de-sac* discouraged me from finalizing the assessment of the quantities of land and labour embodied in silver, which is why such conclusions are not included in Paper 6. Before abandoning the enquiry, however, I had actually reached a tentative assessment of the embodied labour content of early modern silver, which I will present here.

During the time period that I was interested in, mainly the second half of the eighteenth century, Mexico was by far the largest silver producer in the world, yielding three times more silver than South America (Brown 2012:33). The most productive district was Guanajuato in central Mexico. Its richest mine was *La Valenciana*, which some years after opening in 1768 produced 60-70 percent of the district's total silver, and continued to do so for several decades. Its first owner, Antonio Obregón y Alcocer, was a pioneer who reduced labour costs by paying salaries entirely consisting of wages and not based on the traditional share (*partido*) of the ore, and who made heavy, industrial-like, investments in the mine in order to increase productivity (ibid.).

The Valenciana mine is also fairly well covered by scholars. Already in 1803, the famous explorer and researcher Alexander von Humboldt visited the Valenciana mine, and his *Political Essay on the Kingdom of New Spain* (Humboldt 1972) is a valuable source of data for historical studies on Mexican mining. For instance, some rough figures on the labour input into Valenciana and Guanajuato silver production can be drawn from it. At La Valenciana, “[t]he number of workmen are 1,800. Adding 1,300 individuals (men, women and children) who labour at the carriage of minerals to the places where they are tried, we shall find 3,100 individuals employed in the different operations of the mine” (ibid.:155). This should be around the year 1800, and a few years earlier, in 1793-95, there are “more than 2,000 workers at the mine” (Marichal 2007:112). This figure probably excludes the women and children

who also toiled there. Marichal estimates the total workforce of the La Valenciana silver mine in 1790 as “approximately 3,000 workers to produce more than 2 million pesos of silver per year” (Marichal 2006:29).

If we use that assessment, and assume that a year of labour consisted of an average of 300 work days (as my assumption is for Sweden in Paper 6), we can conclude that about 900,000 days of work (dw) were put into the Valenciana mine, and if the output was 2 million pesos, each peso required an input of 0.45 dw. The peso was defined as its weight in silver. After the devaluation of 1728, the Mexican peso was defined as 24.82 grams of silver. In 1777, it was devalued further to 24.44 grams (Salvucci 1994:132). Thus, around 1800, 2 million pesos were equal to 48.88 tonnes of silver. Measured by weight, the labour productivity at the Valenciana mine was about 54 g/dw. But rather than labour productivity what concerns us here is labour input into the production of a certain commodity. One kg of silver in late eighteenth-century Mexico, according to the above figures, required 18,412 days of work.

For Guanajuato as a whole, Humboldt (1972:155) estimates the total workforce in silver production as 5,000 and the output to 500,000 to 600,000 marcs, the mean value of which (550,000) is equivalent to about 123 tonnes of silver.²⁹ The labour productivity for Guanajuato, according to these figures, was 82.13 g/dw, and the labour input to produce one kg of silver was 12,176 – less than for La Valenciana, which is surprising and might be a consequence of less accurate, regional data.

The labour at the mine and refineries is not equal to the total labour embodied in silver. Its production was a complicated process which required sophisticated technology and large capital investments. I will not present a detailed description of the process here, but conclude that the most important material input in the process, besides huge amounts of silver ore, was mercury. According to Humboldt (1972:165), the Mexican refineries “generally employ six times of the quantity of mercury which the paste contains of silver”, thus for a kilogram of silver, about six kilograms of mercury were needed. The mercury used in New Spain in the second half of the eighteenth century came from the Almadén mines in southern Spain. These were known since Roman times and had for centuries belonged to the Fugger family. In the seventeenth century, the production was in decline, which restricted Mexican silver output. The major source of mercury in America, the Huancavelica mine in Peru, primarily supplied the Peruvian silver mines such as Potosí. In some periods, mercury was even imported from the mines in Idrija, now Slovenia, which belonged to the Austrian part of the Habsburg Empire. But in 1645, the Spanish Crown assumed direct control over Almadén (Bakewell 1971:ch.7) and around 1700, a new rich mercury vein was found there. During the eighteenth century, the

²⁹ According to Mary Maples Dunn’s Introduction to Humboldt (1972), one marc was “generally about 8 ounces” (ibid.:18), and since 1 ounce is 224 g, 550 000 marcs equals 123.2 tons.

Crown paid increased attention to the mines through recruitment of German technicians, more financial support and active recruitment of workers. The large increase of mercury output was a prerequisite for the booming silver production in Mexico in the second half of the eighteenth century, and also for the sharp increase of taxes collected for the Crown from New Spain (Marichal 2007).

At Almadén and nearby Almadenejos, there were several mines and surface installations such as smelting furnaces, workshops, offices, warehouses, etc. The ore was excavated, then refined through smelting, and transported to Seville, then shipped across the sea. According to Dobada González (1994:218), it is difficult to determine the number of workers in the mines due to scarcity of data and difficulties in interpreting them, but some figures are provided. Between 1771 and 1776, “almost 1,000 workers were involved in mining and metallurgical tasks of medium or high skill” (ibid.), but this figure does not include “various tens” of artisans such as carpenters or blacksmiths nor “various hundreds of day workers” doing unqualified jobs such as drainage, ore extraction, smelting, warehousing, and so on (ibid.:229, n.5). In 1787, close to 1,400 inhabitants of Almadén and Almadenejos appeared in a census as workers of the mines, which, together with about 400 other employees, “constitute a stable segment of the work force that consisted of somewhat less than 2,000 members” (ibid.:218). But there was also a “fluctuating” component, consisting of “approximately 1,000 temporaries that gathered annually at the sites” (ibid.). At the end of the 1780s, there is an estimate by Director Hoppensack of “at least some 2,000 day labourers” (ibid.).

The work force at Almadén and Almadenejos, as far as we can judge, thus consisted of about 1,000 stable skilled workers and “hundreds” of day labourers – around 500 – in the early 1770s, but had increased to about 1,800 stable workers and 1,000-2,000 day labourers – around 1,500 – in the late 1780s. This was not a year-round workforce, however, since the mine closed in May-June and reopened in the fall (ibid.:217). Let us therefore assume that the labourers were working 225 days a year, as compared to 300 days in other businesses. The labour input in mercury production at Almadén was thus approximately 337,500 days in the first half of the 1770s, and 562,500 in the late 1780s.

Interestingly, the production of mercury does not follow the same upward curve as the size of the workforce. There was a rising trend in the late eighteenth century, but with high volatility. Thus, according to the sources, the output was roughly the same in the early 1770s as in the late 1880s, between 8 and 15 thousand Castilian quintals (1 quintal is a little more than 46 kg) as a moving average in the 1770s, and between 10 and 14 in the late 1880s; however, a sharp increase followed in the 1790s to levels well above 20 thousand quintals (ibid.:220). The increased workforce in the late 1780s *may* reflect the boom in the following years, in which output averaged about 18,000 quintals, while the lower estimates for the 1770s could be related to

the average output of about 12,000 quintals in the 1770s and 1780s. This is admittedly speculative, but would explain the differences in the size of the workforce, since there is nothing in the sources which suggests decreasing productivity. Estimates of the labour input into late eighteenth-century Almadén mercury production are provided in Table 4, approximating 1.5-1.6 kg of mercury per day of work.

Table 4. Assessment of Labour Productivity in Spanish Mercury Production

<i>Period</i>	<i>Work days</i>	<i>Production (kg)</i>	<i>Productivity (kg/dw)</i>	<i>Labour input (dw/kg)</i>
Ca. 1771-1776	337,500	550,000	1.63	0.675
Ca. 1785-1789	562,500	828,000	1.47	0.679

Source: Dobada González 1994.

As mentioned above, approximately six kg of mercury were needed to produce one kg of silver. To the days of labour mentioned above, about four days (4.05-4.08) should be added for mercury. In total, then, one kg of silver produced at La Valenciana required about 22-23 work days.

This does not include transportation work, however. Transports in the ancient biological regime were highly time consuming, but at least for ocean shipping not very labour intense. This is reflected in prices; even though the trip from Almadén to Guanajuato would take about five months,³⁰ the shipping costs to Mexico added about ten pesos to each quintal (Brown 2012:32) and the land transport to Guanajuato added somewhere between an extra two to two and a half peso per quintal (Humboldt 1972:170) and about eight pesos (Bakewell 1971:171).³¹ There is no fixed formula for translating price into labour time, but a rough figure could be deduced by comparing the transport cost with the total price of mercury. In a royal decree of 1777, the fixed price for a quintal of mercury in Mexico was set at 41 pesos, 2 reales (one real was an eighth of a peso) (Humboldt 1972:169). If shipping increased the price with 10 pesos, the price in Spain should have been 31 pesos, 2 reales, as compared to the end price in Guanajuato of about 43 pesos, 4 reales (if we

³⁰ The journey from Seville's seaport San Lucár (or nearby Cádiz) to Mexico's Caribbean port Veracruz usually took two months or more (the return trip took about four and a half month). The trip from Veracruz to Mexico City by mule took about one month, and since the distance remaining to Guanajuato is about the same, I estimate it to have taken another month. Finally, I add a month for the land transport from Almadén to San Lucár/Cádiz, about the same distance as between Veracruz and Mexico City, around 400 km (see Hoberman 1991:26).

³¹ Bakewell's data are for the 1630s, long before the late eighteenth century, but as far as I know, land transport was still conducted by similar mule trains as were employed in the seventeenth century, and the price difference is therefore unexplained.

follow Humboldt) or 49 pesos, 2 reales (if we follow Bakewell). Thus, transport added about 40-60 percent of the original cost. If the labour component of price was the same in transport as in mercury production – which of course is an uncertain assumption – we should add roughly two more days of work. To transport the silver back to Cádiz should, on the one hand, add much less labour, since silver weighed only a sixth of the mercury needed to produce it, but on the other hand, it was much more valuable and therefore needed armed surveillance. As a very rough figure, then, we can add two days of labour per kg, which would add up to about 27 days of work. This is still very preliminary, and to add some margins for the many omitted factors, let us say that the labour input into one kg of silver shipped to Cádiz in the late eighteenth century was no less than 30 workdays.

The available estimate for iron and tea that is closest in time to this late eighteenth-century silver assessment is 1772, when the labour input into 1,000 silver daler's worth of iron was estimated to be 881 dw, and for the same value of Bohea tea 774 dw. According to Kjellberg (1974:295), 1 silver peso was equal to 6 silver daler. As mentioned above, one peso was equal to 24.44 g of silver. Thus, the 30 dw required to produce 1 kg of silver should mean 122,2 dw to produce the silver equivalent of 1,000 silver daler. There are many uncertainties, omitted factors and potential sources of errors, so this result should be understood as tentative. Nevertheless, it indicates that trading silver for Swedish iron and Chinese tea resulted in a huge net flow of embodied labour time from Sweden and China to Spain. This conclusion – if confirmed in a more robust study – can either support the claim that there was a European dominance in the eighteenth-century world system, or it can support a Sinocentric or polycentric world view as the exception to the rule: silver as the "Trojan horse" that would, after centuries, put Europe in the centre of the world economy.

6. Summary of the Papers

In the following, the six papers in this thesis are summarized in some detail. The aims (A) and research questions (RQ) mentioned in section 1.4 are all addressed in the summaries, and the places where they are dealt with are indicated with numbers in italics within brackets. All this is also summarized in Table 5 below.

Paper 1. *Warlenius, Rikard, Gregory Pierce, and Vasna Ramasar (2015): "Reversing the Arrow of Arrears: The Concept of 'Ecological Debt' and its Value for Environmental Justice". Global Environmental Change 30:21-30.*

The aim of this article is to give a broad presentation of the concept of ecological debt, including climate debt, and especially to consider its potential benefit for arguments on environmental justice. The concept is first put into a historical context, where its capacity for mobilization is particularly stressed. In a historical narrative (*in response to A1 and RQ 1.1*) the birth of the notion is regarded as the conjunction of three important events: a rising environmental awareness culminating in the 1992 Rio summit; a reminder of past colonial oppression and exploitation prompted by the 500th anniversary of Columbus "discovery" of the Americas in the same year; and the increasing attention that was given to these issues following the Third World external debt crisis. The brilliance of the concept in this context was that it "effectively reversed the direction of the arrow of arrears" (Paper 1). The table set during the recent debt crisis was turned so that the South emerged as creditors and the North as debtors. After the Rio summit of 1992, the ecological debt concept continued to develop, mainly nurtured by environmental justice organizations in the global South. In the new millennium, the focus gradually shifted toward carbon or climate debt, a development that culminated during the strong climate mobilizations in 2009 and 2010.

The second part of the article goes deeper into the specifics of the concept (*RQ 1.2*). For the activists, it represented a "counter-hegemonic discourse calling for a fundamental reappraisal of North–South political and economic relations" (Rice 2009a). Eventually, more distinct definitions were produced within academia, and particular weight is given to a group of Belgian scholars headed by Eric Paredis. Their definition of ecological debt, including the two key ingredients "ecological damage" and "use at the expense of the equitable rights of others", is a crucial point

of departure for arguments in Papers 4 and 5 in this thesis. Their study has had a significant influence on this thesis overall.

The third section of Paper 1 presents three areas in which the concept could be utilized effectively (*RQ 1.3*): as a biophysical measure to quantify and thus highlight ecological inequalities in the world; as a legal instrument that might be used in court rooms to rectify some of these injustices; and as a distributional principle in international negotiations, mainly when the burdens of climate change are divided among the nations. The first and last fields are areas in which I have attempted to intervene, resulting in the third and fifth paper of this thesis. Finally, the fourth section discusses the use of ecological debt as a tool for achieving environmental justice (*RQ 1.4*). Among other aspects, an important distinction between monetization and commodification of the debt is highlighted.

Since this paper can be seen as a wide introduction to one of the key concepts of the thesis, it is logically placed first. It also introduces themes that recur in all the papers but especially in the normative perspectives dealt with in Paper 3 and problems related to quantification elaborated in Paper 5. It responds mainly to the first aim (*A1*) of the thesis – to explore the history of the concepts in focus – and to the second, i.e. to develop the concepts further (*A2*). Methodologically, it is influenced by the open, associative style common in the study of the history of ideas. Some primary sources – such as documents and protocols of movements – have been consulted, but the main sources are secondary literature.

Paper 2. Warlenius, Rikard: “*Decolonizing the Atmosphere: The Climate Justice Movement’s Arguments on Climate Debt.*” Submitted to a peer-reviewed journal.

Since the ambition is to develop proposals and policies on climate debt that are based on and of use for environmental justice organizations, I needed a way to operationalize their positions and transform their claims and observations into manageable data, distinct enough to allow for quantification, yet without betraying their original meaning. My solution was to conduct an argumentation analysis of nine central policy documents issued by the climate justice movement (CJM), in order to identify its basic claims, warrants and data on the issue of climate debt. Beside this important role in the overall jigsaw, the paper also had further aims. First, to add knowledge to the growing social science literature on the CJM. No previous article had focused on the CJM and climate debt, despite this being one of the core demands of the movement, and secondly, to better understand the shift of focus from ecological debt to climate debt. In 2009, James Rice conducted a similar study on key NGO documents focusing on *ecological* debt, in an article which is

also a key source for the previous, first paper in the thesis. By using a similar method, I was able to compare the results.

Congenial with the aims, the research is inductive and interpretative. It is not driven by a hypothesis, but as is stated in the paper, “the aims are explorative rather than derived from theory, and the method therefore mainly empirical and inductive”. The nine central CJM manifestos were carefully selected, and a modified version of Toulmin’s argumentation analysis was applied in order to identify their most important claims, data, and warrants (that is, principles or theories from which the claims are derived). As a part of the identification of the claims, a more distinct definition of climate debt is presented (*RQ 2.2*):

“A two-fold climate debt is owed by developed countries [and corporations] to developing countries [and future generations] for their appropriation of the planet’s capacity to absorb greenhouse gases above their fair share (an emission debt) and for their contribution to incremental costs caused by the adverse effects of climate change (an adaptation debt).”

The claims identified (*RQ 2.1*) are, first, that this debt must be acknowledged, and second, that it should be compensated in full. The emission debt should be compensated primarily through a restoration of the atmospheric common by means of drastic emission reductions in debtor countries, but possibly also in the form of financial means and technology to compensate for increasing costs for mitigation in the creditor countries. The adaptation debt should primarily be paid in the form of finance and technology to compensate for costs for adaptation, but also by acknowledging human rights of people affected by climate change, such as migrants and indigenous peoples. Finally, the climate debt is claimed to be only a part of a wider ecological debt, and any effort to solve the climate crisis must be rooted in a broader effort to promote ecological and social justice between rich and poor people and countries.

The warrants or principles mobilized to back these claims include a vision of ecological integrity, historical responsibility (or “common but differentiated responsibility” [CBDR]), the climate system regarded as a common, a presumed right to sustainable development, and a (contested) right to emit a certain amount of greenhouse gases, up to what can be defined as fair and sustainable.

Finally, the four central EJO claims on ecological debt which Rice (2009a) has identified are compared to the CJM discourse on climate debt (*RQ 2.3*). Despite the consensual recognition of climate debt as an integral part of ecological debt, some differences were found. First, ecological debt is mainly analysed in terms of an unjust economic exploitation, while climate debt is rather seen as an expropriative violation of communal rights and territories. Second, the cancellation of the external debt is much less emphasized in the climate debt discourse than in the discourse on

ecological debt. Third, the climate debt claim mainly criticises past emission levels and the unwillingness to reduce the North's emissions as part of paying its climate debt, while the ecological debt claim is predicated on a critique of Northern production and consumption levels more generally. These differences are largely congenial with the conclusion that while an important political aim of the ecological debt discourse was to mobilize for external debt cancellation – and therefore framed in largely economic terms – the climate debt concept is mainly a tool for the advancement of climate action and climate justice, and is therefore framed differently (*RQ 2.4*). Like Paper 1, this article responds mainly to the thesis' first and second aims – to explore the history of the concepts in focus (*AI*) and to develop the concepts further (*A2*).

Paper 3. *Warlenius, Rikard: "Climate Debt Ethics: A Defense". Submitted to a peer-reviewed journal.*

Political theorists and philosophers have dealt with normative challenges related to climate change at least since the early 1990s, and many of the assumptions, claims and propositions made by the climate justice movement on climate change – identified in the previous, second paper of this thesis – have been discussed already. Some other issues raised in the CJM climate debt discourse have not been as thoroughly dealt with yet. In this paper, the assumptions and claims emanating from this discourse that are debatable from a normative perspective are addressed and defended. Critical views are presented and weighed against counter-arguments, which in most cases are derived from the existing discourse, but in some cases the result of external, critical reflection.

The groundwork for this paper was laid in my 2013 response to a critique of climate debt ethics by the French economist Olivier Godard. However, this paper is more concise, has a more well-defined benchmark – the analysis of the CJM claims in Paper 2 – and responds to a wider spectrum of criticism than only that presented by Godard. The research questions are whether the climate justice movement's claims regarding climate debt are ethically defensible, with what arguments and, in cases where its claims are hard to defend, what an improved climate debt ethics would look like. Also, a sketch of an allocation model based on climate justice and climate debt is presented.

Six normative problems related to climate debt as defined in Paper 2 are discussed. First, the premise that a debt can arise without a formal contractual agreement; second, that climate debt is based on responsibilities that are collective and inter-state; third, that such responsibilities are inter-generational; fourth, that the climate debt claims are backed by the Contributor Pays Principle; fifth, the assumption that

the climate system is a global common; and finally, the claim that there is a right to development, and possibly a right to emit.

According to the analysis, most of these issues are possible to defend with established normative arguments (*RQ 3.1*). However, one problem is identified with regards to the Contributor Pays Principle, i.e. that those countries which have contributed most to climate change (through massive emissions) should also contribute most to the mitigation costs. The common response to arguments that there cannot be any responsibility attached to emissions made by earlier generations, or when humanity was ignorant about the dangers of climate change, is that since the benefits from the emissions remain in terms of development and welfare, so should the responsibility. This principle is well established within ethics, law, and probably also common sense. But there is a particular case that is troubling, and that is in cases where the benefits of historical emissions have vanished. This is particularly relevant for some republics that formerly were part of the USSR, countries with immense climate debts but waning welfare systems. Assigning full responsibility to them could very well clash with other justice principles, such as not making already poor people worse off.

These former welfare states are exceptions to the general rule of high correlation between historical emissions and current economic level, yet they deserve to be carefully considered. In the final part of this paper, an allocation model based on the Contributor Pays Principle, but modified to consider the cases of stalled development, is sketched (*RQ 3.2*). The conclusion drawn is that by granting early action and prioritizing subsistence emissions over luxury emissions as well as basic needs over luxury consumption, historical accountability within an international burden sharing system would be the most promising model.

The three first papers could be regarded as Part 1 of the thesis – they all focus on ecological debt and/or climate debt. Although thematically focused, the papers pertain to three distinct academic disciplines: the first is broadly historical, the second applies a linguistic method from philosophy but in a context of social movement research, and the third can be categorized as normative political theory. They respond to the aims of exploring (*A1*) and developing (*A2*) the concepts of ecological debt and climate debt, and this paper is the main attempt to justify the normative foundation of these concepts (*A4*). In papers belonging to Part 2, the conceptual basis is broadened to discuss ecologically unequal change and how it can be linked to ecological debt, and also, the repertoire of methods is broadened to include quantitative analyses.

Paper 4. Warlenius, Rikard (2016): “*Linking Ecological Debt and Ecologically Unequal Exchange: Stocks, Flows, and Unequal Sink Appropriation.*” *Journal of Political Ecology* 23: 364-380.

In this paper, the focus is broadened to include a concept that in many ways is related to ecological debt, i.e. ecologically unequal exchange, although this proximity is rarely discussed. Here, these hidden connections are illuminated and conceptualised as the relation between stocks and flows, approximating the relation between interest rate and balance in accounting.

First, ecological debt as defined in Paper 1 is revisited, and it is concluded that the concept is used in mainly three ways: as underpayment debts, biophysical debts, and punitive debts. The first is measured in money, the second in physical units and the third escapes quantitative measurement, but might still be repaired monetarily more or less symbolically. Then, the focus shifts to the history of the concepts of unequal exchange and ecologically unequal exchange (RQ 4.1). The former has a long history, going back to classical political economy, Marxism and dependency theory. Its most elaborate form was given by the Greek economist Arghiri Emmanuel. Importantly, he distinguished between unequal exchange in the broad sense – as a result of different levels of productivity in different countries (or regions, or sectors within a country) – and unequal exchange in the narrow sense – a result not of differences in the organic composition of capital but of *wage differences* or *different rates of surplus value extraction* that are established and maintained due to different institutional settings and the immobility of labour between countries. In the 1980s the notion was picked up by Stephen Bunker, who laid the foundation for a marriage between the structuralist concept of unequal exchange and methodologies from ecological economics. From the 1990s and onward, the concept ecologically unequal exchange (coined by Hornborg 1998) has developed and matured theoretically and methodologically.

A particular difficulty for the ambition to link ED and EUE is presented by emissions of substances that have globally harmful consequences, most importantly carbon dioxide and other greenhouse gases. The carbon or climate debt is generally regarded as a part of the ecological debt, but there is no consensus on how carbon emissions should be included in a calculation of ecologically unequal exchange. I propose a new concept, *unequal sink appropriation* or the more specific *carbon sink appropriation*, as a way of bridging the gap (RQ 4.3). Thereafter, I try to establish the full connection between ED and EUE through a stock versus flow perspective (RQ 4.2). “*The net flows of natural resources, other products, wastes, and sink appropriations, we call ecologically unequal exchange. The cumulative stock resulting from these historical net flows, we call ecological debt.*”

The method and style of the article is primarily historical and analytical. It responds to several of the aims of this thesis. The parts discussing ecological debt and ecologically unequal exchange resemble the introduction to the concept of ecological debt in the first paper, including an outline of its inspiration from the history of ideas (A1). Some arguments unavoidably repeat similar points made in Paper 1, but the concepts are also developed further and new concepts coined (A2), while the primary aim of this paper is to link the concepts together (A3).

Paper 5. Warlenius, Rikard. “Climate Debt as Cumulative Carbon Sink Appropriation: Estimates for 154 countries, 1850-2011”. Submitted to a peer-reviewed journal.

My attempts to develop a pertinent model for quantifying climate debt go back to 2010, when I wrote a Master thesis in Human Ecology called *Sweden’s climate debt* (Warlenius 2010), which analysed several existing proposals, mostly by different NGOs, and proposed a synthesized formula. Within the EJOLT project, I modified this model and applied it to all countries. It formed the basis of the climate debt calculations presented in EJOLT’s online *Environmental Justice Atlas* in 2015. Yet, some further fine-tuning was made before the final version was submitted. It now draws substantially on other papers in the thesis. It relies on the historical background of the ecological debt concept presented in Paper 1; it is based on the CJM definitions of climate debt identified in Paper 2, and partly also on the normative analyses in Paper 3; and it develops further the conceptual distinctions and innovations made in Paper 4. It is not merely a quantification of climate debt, of which there are several, but of emissions debt, adaptation debt, and carbon sink appropriation.

Although it differs in form from the other papers in this thesis because of its quantitative modelling, being based on statistical data more than written sources, this profound dependence upon the earlier chapters makes it the climax of the first five papers. It is the final piece of the jigsaw. It is both an attempt to develop the concepts in focus throughout this thesis (in response to A2) and, primarily, to find methods to quantify them (A5).

As mentioned, the conceptualization of climate debt depends on the CJM claims identified in Paper 2. Thus, climate debt is seen as consisting of two parts: an emission debt and an adaptation debt. The formulas for calculating them are explained here (RQ 5.1). However, there are some minor deviations from the CJM definition. Most importantly, I have divided the emission debt into two parts: one part represents the historical debt consisting of emissions above a fair, per capita share of what the global sinks can absorb sustainably, the other part is an inter-generational debt, consisting of emissions beyond what is sustainable and which

therefore will damage future generations. This dual emission debt is inspired both by fellow academics (Paredis *et al.* 2008) and conceptualisations within CJM (mainly in Bolivia); it is not a consensual view, but neither does it contradict the consensus.

The emission debt (both the historical and inter-generational part) is calculated for all 154 countries. I use Paredis *et al.* (2008) as the point of departure, but deviate from their model in some ways. For instance, the scientific underpinning is updated and the methodology simplified to make it applicable to existing data.

The adaptation debt is also defined and formalized, but I do not regard it as meaningful to actually calculate it, because of major uncertainties in both current data and predictions of future development. The concept of GRR – *gross responsibility ratio* – is introduced to refer to how large a part of total responsibility for climate change is carried by a particular country (assuming it is a debtor; creditors have no GRR). So if the UN or some other body would decide that there is a global adaptation need of, say, US \$100 billion per year, the responsibility of a debtor country would be to contribute this sum times its GRR, minus its national adaptation costs. Furthermore, carbon sink appropriation, first discussed in Paper 4, is defined and formalized (RQ 5.2).

The empirical analysis is only an example of what can be done with the data. The emissions debt of industrialized countries is dramatic: for example, over 1000 tCO₂ per person in the case of the U.S. Besides the traditional West, several countries in Eastern Europe have considerable emission debts. The U.S. has the largest debt in absolute terms, 344 GtCO₂, much larger than Russia (88 GtCO₂) or Germany (75 GtCO₂). Among the claimants, India is number one in absolute terms with an emission claim of 26 GtCO₂, followed by Bangladesh (6.5 GtCO₂), Pakistan (3.7), and Ethiopia (3.1). The largest per-capita claim is held by Indonesia (87 tCO₂).

The annual carbon sink appropriation is reported for the years 1960, 1970, 1980, 1990, 2000 and 2010. A clear and interesting pattern is revealed. Already in 1960, global emissions of CO₂ were more than three times above what is defined as sustainable. In terms of countries, however, still only a minority had unfair and unsustainable per capita emissions. By 1970, a majority of the countries had a positive CSA (and were thus cumulating an emission debt). Even through the oil crises of the 1970s, global emissions did not sink, except for a small reduction in 1974. During this decade, countries such as Algeria, Egypt, Ecuador and Nigeria became net-contributors to climate change. By 1980, 112 out of 177 states had a positive CSA. The reduction of China's giant carbon claim started before the 1960s, and its CSA exploded during the 1980s and even more in the 1990s and 2000s. India and Pakistan did not cross the threshold to a positive CSA until the 1980s. Simultaneously many industrialized countries, such as the USA, Russia and most

European countries, started to stabilize emissions and CSA, but on a high, positive level which rapidly increased their debts.

In the 1990s, a large-scale reduction of emissions and CSA resulted from the structural crisis following the collapse of the USSR, but China's economic growth more than compensated for the emissions reduction in the former USSR. From 1970 to 2010, the CSA of China increased from 105 to 7577 MtCO₂/year! The most dramatic increase took place in the first decade of the 2000s, during which China had lost all of its emission claim and become an emission debtor.

The development of emission debts is also predicted into the future, revealing an alarming trend with a sharply rising curve for the global, inter-generational emissions debt. It is the legacy of current generations to our descendants.

Paper 6. *Warlenius, Rikard (2016): "Core and Periphery in the Early Modern World System: A Time-Space Appropriation Assessment". In Jarrick, Arne, Janken Myrdal and Maria Wallenberg Bondesson (eds.): Methods in World History: A Critical Approach. Lund: Nordic Academic Press.*

While there are three papers in which ecological debt and climate debt are the main focus (1-3), and two papers in which these concepts are linked to EUE, first analytically (4), then formally (5), this final paper is the only one with a main focus on EUE. It is a study of a historical case of ecologically unequal exchange, i.e. the trade of Swedish iron and Chinese tea during the 18th century, applying both qualitative, historical methods and quantitative, biophysical ones. This mix of methods builds on Hornborg's (2006) concept of time-space appropriation.

The paper is the end result of research that started already during my Master studies in Economic history (Warlenius 2011). This version is published as a chapter in a peer-reviewed book on world historical methods, and it thus focuses on methods, whereas the theoretical and historical contextualization is now included in the Contextualization section of this introduction.

The case is selected in order to test, or at least shed some light on, one of the battlefields of global history: whether the early modern world economy was centred around Europe or China. The idea is to calculate the embodied labour hours and hectare yields in the respective commodities exchanged at a certain rate in order to assess which country received a net flow of embodied labour and land. The direction of the net flow indicates which country was able, through terms of trade or by other means, to make a net gain of biophysical resources from the exchange, and can be regarded as more central in the world system.

The rather meticulous empirical investigation, reported in an appendix, yields a result that points to a massive transfer of embodied labour and a moderate transfer of embodied land from Sweden to China (*RQ 6.1*), which is interpreted as a support for the so-called *Sinocentric* theory, i.e. that China was the centre of the early modern world system. This latter argument cannot be "proven" statistically, but depends on analytical persuasion (*RQ 6.2*).

The topic of this article – early modern trade and production, historical theories, etc. – places it somewhat outside the main flow of this thesis, but it nevertheless belongs to its wider theme. It shares with the other papers the foundational theoretical perspective that flows of energy and matter are important for understanding economic development. In order to apply this perspective to important problems or cases, historical or current, it is necessary to dig deep into the theoretical and methodological issues raised. This case study is an example of how such an application can be conducted and is thus relevant also for those readers who share the general theoretical perspective but are completely uninterested in early modern economic history.

There is another sense, as well, in which this final paper fits into the general context of the thesis. Like all the other papers, it is concerned with the global historical dimension of environmental inequality. The five first papers are founded on the assumption that the accumulation of ecological debt is a global historical process of ecologically unequal exchange and environmental load displacement. This paper shows that ecologically unequal exchange and environmental load displacement can be identified at a specific point in early modern world history. It contributes to the overall development of the concepts (A2) and explores valid methods of quantifying them (A5).

Table 5. Responses to Aims in the Papers

	<i>P1</i>	<i>P2</i>	<i>P3</i>	<i>P4</i>	<i>P5</i>	<i>P6</i>
<i>A1. History of concepts</i>	X	X				
<i>A2. Conceptual development</i>	X	X	X	X	X	X
<i>A3. Linking ED and EUE</i>				X		
<i>A4. Normative justification</i>			X			
<i>A5. Quantifications</i>					X	X

7. Concluding Remarks

This thesis, including the introductory chapter, has aimed to explore, develop, link together, normatively defend, and quantify the concepts of ecological debt, climate debt, and ecologically unequal exchange, in order to empower the environmental (and climate) justice movements that either already employ them or, in my view, should do so. The previous section sums up how these aims (and the research questions) are dealt with in the papers. To conclude, I think I have been rather successful in meeting the aims: I have tried to explain their origin and usefulness, I have established a formal link between them, defended them using the academic normative discourse on climate responsibility, and calculated the climate debt of 154 countries. In accordance with Table 5 above, all papers in different ways contribute to the further development of the concepts, and this aim should also be apparent in this introductory chapter.

I begin this chapter with a section that aims to synthesise the concepts further. Since they are related and rest on similar ambitions, I propose that the application of one or more of them can be summarized as using the *ecological-economic asymmetries approach* (E-EAA). All applications of the approach either assume or are directly involved in the measuring of some kind of *biophysical accounting* (step 1), most rely on *heterodox economics* (step 2) and conceptualize *spatially distributed inequalities* (step 3), while also often (especially for ecological debt and climate debt) entailing a *historical perspective* (step 4). Finally, the research is often based on a normative standpoint although not always – actually, too seldom – on explicit *normative reasoning* (step 5). I have also summarized how the concepts are used, both in my papers and by others, with regard to scale, temporality, unit of analysis, quality, fields, and scope. Through this synthetic discussion, I hope to have contributed to a closer linking of these concepts into a coherent approach, a common framework, or discourse which is marked by strong similarities, while also identifying and discussing the contradictions and variations within it.

Since the papers themselves discuss, at least briefly, the theories applied, the section on theory in the introductory chapter is mainly focused on ontology and epistemology. Critical realism is introduced and regarded as a valuable foundation for the ecological-economic approach of this thesis. Without ontological realism, without a strong conviction that there is a world existing independently of human knowledge but that is highly sensitive to our actions, I would find it pointless to

spend years of supporting the struggles for stopping climate change and distributing the costs fairly. Yet without epistemological relativism, without acknowledging that our knowledge of the real is limited, fallible, and biased, it would be hard to explain the many failures of science that have contributed to the precarious situation we are now facing. That misconceptions such as racism, sexism and Eurocentrism have been – and partly remains – hegemonic in science belong to those failures, and it should be met by demands for stronger objectivity through a standpoint epistemology that critically analyses how power asymmetries can – but are not certain to – skew science. A call for stronger objectivity can be regarded as contradictory to the application of normative political theory in social science, but I would claim the opposite. Science is never value-free, and an open discussion of our normative points of departure makes science more transparent and less likely to uncritically reproduce received standpoints. I believe that critical realism and knowledge of normative theories serve as a good foundation for critical, heterodox science, both as assistance in exposing the taken-for-granted and for legitimizing critical perspectives.

Investigations of ecological-economic asymmetries are not tied to one particular theoretical tradition, although it is common to invoke what I, in the third section, refer to as neo-Marxist economics. It is not accidentally so; the modern debate on unequal exchange was largely a product of dependency theory and world system analysis, and an important reason for the good fit between E-EAA and neo-Marxist economics is the common view that inequalities under capitalism have a strong spatial or territorial dimension, according to which the world is divided into core, periphery and semi-periphery. The neo-Marxist tradition is also the wider context in which John Bellamy Foster developed the Marxian metabolic rift analysis, which is becoming more and more influential in E-EAA. Thus, the “marriage” between E-EAA and neo-Marxist economics, including increasingly metabolic rift analysis, is largely a happy one, and this should be apparent in the papers of this thesis.

Yet, during the research process I have also become troubled over some parts of this theoretical complex, such as a vague definition of imperialism, an overemphasis on economic growth, and concepts of space that are useful in the politicization of territorial conflicts but probably too inflexible to fully capture all the spatial dimensions of unequal exchange relations in a changing world economy. Therefore, David Harvey’s historical-geographical materialism is explored as a potential, theoretical alternative. It should be underlined that this exploration is indeed tentative and clearly goes outside the theoretical focus of the papers, which hardly refer to Harvey at all. It is rather a first attempt to search for new ways to address and frame these issues, in response to what I have sometimes experienced as troublesome in the research so far. Yet, judging from this preliminary examination, there is not doubt that Harvey’s theorizations of uneven development, accumulation by dispossession, and “capital’s ecosystem” has great potentials. His analyses of

spatial dimensions and capitalist development seem more dynamic and sophisticated, but lacks, in my opinion, a comprehensive theory on the *ecological* consequences of uneven development. A way forward could be to synthesize parts of ecologically unequal exchange theories and metabolic rift analysis with Harveyan understandings of uneven development.

This introductory chapter also contains a section on methods, or mixed methods to be specific. Also the methods applied are explained in the papers. A reading of the papers will reveal that many different methods, including both qualitative and quantitative, are applied. This is often the case in E-EAA research, since it simultaneously denotes a method for identifying and assessing unequal flows of energy and matter, *and* a theory aiming at explaining these phenomena. The aim here is thus to explain the “methodological chain” throughout the thesis – how the different methods applied in the different papers feed into each other in order to enhance knowledge on the subject – and also to legitimize this eclectic use of methods through references to the growing field of mixed methods research (MMR). I also try to discuss how critical realism can be used as a theoretical framework for MMR studies. This is also partly forward-looking: the combination of CR and MMR could be used more consistently in future explorations of ecological-economic asymmetries.

The section called Contextualizations is a collection of texts that are included to provide further substance and background to the papers. The environmental and climate justice movements are obviously crucial for the thesis in so many ways, yet largely absent in the papers. Here, a brief introductory background to them is provided. The discussions on the origin of capitalism and of Eurocentrism are mainly included as the context of the sixth paper, which is more of a solitary project compared to the other papers, which are more mutually integrated. I hope to have substantiated its relevance here. These discussions are, however, also relevant for the third section on Marxist approaches to E-EAA. The attempt at quantifying the role of silver in early modern ecologically unequal exchange is also a glimpse of where further research could lead.

I finally want to return to the aims of this thesis. Its first and overarching aim is “[t]o empower Environmental Justice Organizations (EJOs) by responding to their demand for scientific methods that can be used to enhance their struggles”. This is an expression of a wider research ambition that is only partly visible in the thesis. One aspect of this aim is to pose research questions and use concepts in ways that are relevant for the EJ and CJ movements, and this is, hopefully, a characterizing feature of the thesis. This aspect is also concretized in the following, numerated, aims, which are addressed in the papers and summarized above. But if this actually results in the empowering of the EJOs also depends on whether the results are disseminated and used. For the sake of clarity I want to state that the intention has

never been that the thesis itself should be disseminated to a wider audience. The style is thus not overly accessible (but hopefully not arcane, either). Instead, dissemination has been achieved through presentations at conferences and workshops, a report directed to the EJ community (Warlenius *et al.* 2015), op-ed articles, and the EJ Atlas web page. The dissemination – and whether EJO’s have actually been empowered – is not apparent in the thesis and the overall aim is thus not possible to evaluate through the normal academic process. This aim should be regarded as an ambition that has strongly influenced the design of this research.

The paragraph on my aims with the thesis ends with a sentence that, too, expresses a wider research ambition: “...and pursuing these aims while respecting the original intentions of the EJOs, without diminishing their original ecological and egalitarian radicalism, yet independently and with due regard to scientific rigour.” This ambition can at least potentially lead to a delicate balancing, but I do not think that it has forced me into any major difficulties. I am sympathetic to the EJO intentions, but when I have found weak spots or contradictions in their claims, this sympathy has not stopped me from deviating from their original claims. In section 2.3, I discussed how I consider my role as an independent researcher within an action-research project such as EJOLT in rather great detail. I just have one thing to add: that it was a fantastic, once-in-a-lifetime-experience to collaborate with these amazing intellectual activists and activist-intellectuals from around the globe.

Post-script: The Short Fall

A month after I finished the first version of this Introductory chapter, snow fell heavily over Stockholm. 40 cm of snow in early November is highly unusual and took the local government by surprise. The snow clearing, since long privatized and under-dimensioned at least for this amount of snow, was slow and inefficient. Efficient ploughing was obstructed, it was reported, by the still non-frozen ground and because most cars still had summer tyres and in significant numbers ended up in snowdrifts, blocking the tractors.

Yet the Great Debate About Snow Clearing Failures was postponed because the same night as the worst snowfall, between the 8th and the 9th November, the U.S. elected a new president, and attention shifted swiftly.

Four weeks after sunning and bathing in the archipelago, we took out the skies and sledges of the basement and prepared for a long, cold winter. The following weeks, even as I write this, we are stunned by the elected president Trump's appointments and political turns. Is he really going to put a white supremacist as his chief strategist, a climate denialist as head of EPA and the CEO of Exxon as Secretary of state? One day he tells *New York Times* he has an open mind about climate change, the next the he says NASA's climate change research is politicized and funding will be withdrawn.

And what about future U.S. participation in the climate negotiations? The major argument professed in the corridors of UNFCCC for watering down the climate agreements has for long been the Republican majority in the U.S. congress that would never accept any binding and ambitious emissions targets. So the Paris agreement from 2015 was designed to be sufficiently vague and voluntary to be ratified by the president alone. But when ready for signing, a new president is elected that threatens to tear the agreement into pieces.

Is the storyline familiar? It should be. In 1997 vice president Al Gore headed the U.S. delegation in Kyoto and persuaded – or rather threatened and fooled – the assembled governments into accepting the so-called flexible mechanisms in the protocol, otherwise the protocol would not be ratified by Washington. This is how we were given the trade mechanisms that complicated the climate negotiations for the decade to follow. But we didn't get a U.S. ratification. President Clinton signed

it on the last day of his office, but the newly elected George W. Bush tore it apart on one of his first days in office.

Trump might do the same thing with the Paris agreement. The irony is, however, that the agreement is so weak this time that in the end, he might find it not worth the effort.

History repeats itself, first as tragedy, second as farce.

Whether Trump ditches the Paris agreement or not, he will be a disaster for US climate policies. He is likely to withdraw any restrictions on the fossil fuel industry, freeing it from any restrictions on fracking, drilling, and pipeline constructions.

Yet we must remember that it was under president Obama's rule, that U.S. police is violently confronting indigenous activists at Standing Rock for resisting the Dakota Access Pipeline. The terrifying news that the Arctic is 20 degree Celsius above its normal temperature in late November is not the result of the presidential election, but the cumulative result of decades of procrastination, with the consent of governments of all colours.

Exactly how disastrous the election of Trump will turn out to be is still unknown. But with him as president, at least no one will expect climate justice to be delivered from above. At least we all know that if we want to save the climate for today's and future generations, it will be up to us.

Stockholm,

20th of December 2016

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The climate and ecological crises are crises of asymmetries. The distribution of natural resources, sink capacities and embodied labour is deeply asymmetric and inverted to the, equally asymmetric, distribution of resource depletion and human vulnerability. These inequalities shape and are shaped by spatial and social power asymmetries.

The central focus of this book are concepts that are applied to expose, analyse and resist global asymmetries. While ecological debt and climate debt originate from the environmental justice movement, the background of ecologically unequal exchange is neo-Marxist and ecological economics. The histories of these concepts are traced and they are developed theoretically.

Special concern is devoted to climate debt. The climate justice movement's claims on climate debt are identified, their normative assumptions discussed and climate debt is calculated for most countries of the world.

Rikard Warlenius is a researcher, journalist and political activist. This is his PhD thesis in Human Ecology.

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