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Department of Economics

Disclosure of firms' environmental performance

– Does the SV approach reduce efficiency losses from asymmetric information?

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– Does the SV approach reduce efficiency losses from asymmetric information?

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ABSTRACT

Sustainability assessment of corporates has been recognized as an important and powerful tool to support a shift towards a sustainable development. In order to regulate activities with negative externalities and make socially responsible investment decisions, information and methods provided by third parties have become key instruments for investors and policy makers to mitigate market failures. However, assessment tools vary largely and despite being carefully developed, may not provide sustainable outcomes according to economic theories. Therefore, this present paper explores and critically examines the Sustainable Value (SV) approach developed by Figge and Hahn (2004) to measure corporate sustainable performance, focusing on the environmental indicator carbon dioxide emission. The objective is to evaluate if the SV approach can reduce efficiency losses from asymmetric information on environmental performance. More specifically, the Sustainable Value of CO_2 created by a sample of Swedish corporates in a range of sectors is calculated and analyzed with the ambitious purpose of seeking to determine if the method promotes sustainability according to environmental economics. This is done by calculating and comparing CO_2 performance according to the SV method and to social cost calculations for assessing marginal cost of externalities. The study shows, based on empirical and theoretical findings, that the SV approach should not be considered as a fully relevant method for assessing the corporates environmental sustainability performance as it could increase the efficiency losses of asymmetric information if used by socially responsible investors. This is pointed out by comparing rate of return for different information scenarios and shows that while sustainability assessment approaches are needed, the efficiency losses created from using one might actually increase unsustainable outcomes.

Keywords: Sustainability assessment, Sustainable Value, Social Cost of CO2, Socially Responsible Investment, Efficiency losses, Asymmetric information

ABBREVIATIONS

SV	Sustainable Value
SRI	Socially Responsible Investment
EE	Environmental Economic
TBL	Triple Bottom Line
EIA	Environmental Impact Assessment
SEA	Strategic Environmental Assessment
GRI	Global Reporting Initiative
SCC	Social Cost of Carbon
SC	Social Cost
ASR	Adjusted Size Ratio
RTR	Return to Cost Ratio
MEC	Marginal External Cost
GVA	Gross Value Added
MPC	Marginal Private Cost
MSC	Marginal Social Cost
LCA	Life Cycle Assessment

TABLE OF CONTENTS

1. Introduction 1

1.1 Background 1
1.2 Research area and objective 3
1.2.1 Objective 4
1.3 Delimitations 5
1.4 Outline of the thesis 6

2. Literature review 7

2.1 Conceptualizing sustainability assessment 8
2.2 Measuring corporate contribution to sustainability 9
2.3 Sustainable Value approach 10

3. Theoretical framework 12

3.1 Sustainable Value Approach 12
3.2 Environmental Economics 15
3.3 Sustainability 18
3.4 The socially responsible investor's (SRI) perspective 20

4. Data presentation 22

4.1 Companies 23
4.2 Benchmarks 25
4.3 Data for Social cost method 28

5. Results – data analysis and findings 31

5.1 Sustainable Value Method 31
5.2 EE Method- Social cost of carbon emission 35
5.3 Comparison 37
5.4 Socially Repsonsible investment 38

6. Discussion & Conclusion 40

7. Bibliography 44

8. Appendixes 47

Appendix 1.Previous SV studies 47
Appendix 2.Company data 48
Appendix 3. Tables for sector benchmark 54

LIST OF FIGURES

Figure 1 Areas of concern 4

Figure 2 Thesis outline 6

Figure 3 Value Spread (positive vs negative) 13

Figure 4 Illustration of negative external effects and firm's profit maximization 15

Figure 5 Three pillars of sustainability 18

Figure 6 Efficiency loss of uniformed/asymmetric information investments 20

Figure 7 Capital allocation based on information 21

LIST OF TABLES

Table 1 Companies chosen with Gross Value Added, CO_2 data and Total cost* 25

Table 2 Data for Swedish benchmark 26

Table 3 Data for sector benchmarks 26

Table 4 Social Cost of CO_2, 2010-2050 (US EPA, 2015) 29

Table 5 Data for social cost calculations 30

Table 6 Company ranking based on SV contribution (using Swedish benchmark) 31

Table 7 Company ranking based on RCR 31

Table 8 Sector ranking based on average RCR 31

Table 9 Benchmark comparison 33

Table 10 Social cost of CO_2 and ASR (two models estimate) 35

Table 11 SCC for each sector 36

Table 12 Ranking of sector per average CO_2 (ton) 36

Table 13 Comparison of SV (two different benchmarks) and Social cost (two different methods) 37

Table 14 Rate of return with no information, social cost or SV information 38

Table 15 Information scenarios with top five rates of return corporates 39

1. INTRODUCTION

1.1 BACKGROUND

To create a sustainable development is one of the most pressing issues of our time. While the new climate change agreement, recently adopted by 195 parties at the COP21, has made great progress in identifying crucial areas for a common climate action, the agreement is said to be “simply not enough” by critics. To ensure progress, all production and consumption processes must be sustainable.

It’s important to note that not only do we have the market failure of the production externalities; which is a result from corporations using environmental resources for free in their production process. There is also a failure of asymmetric information with respect to firms’ environmental performance (Mason, 2013). As it is difficult for consumers (or investors) to know the environmental impact of a firm, it creates difficulties in choosing products for consumers or objects for investors with environmental preferences. The firm is likely to know about its environmental impact and thus with imperfect information, a “green” firm produces less than when consumers or investors are perfectly informed while a “dirty” firm produces more than consumers demand. Appropriate environmental labelling can reduce these efficiency losses from asymmetric information.

During the past years, development shows that several environmental economist have been intrigued by the use of information as an alternative to the more traditional economic methods for regulating externalities (Mason, 2013). This strategy has been named the “third wave in pollution control”, after legal regulations and market-based instruments. The evidence shows that the regulatory approaches have been overly costly and sometimes even incapable of reaching the desired goals of pollution control (Tietenberg, 1998). The market-based approaches (including emission charges, tradable permits etc.) have more flexibility and improved cost-effectiveness to control pollution. However, the implementation of these does not fully solve the problem of regulating all the enormous amounts of harmful pollutions and substances emitted by corporates and households. Thus, the third wave of information based pollution control is highly important for the monitoring, implementation and enforcing of a more effective system (Tietenberg, 1998). Information has the potential to mitigate environmental damages, shifting production away from dirty to clean firms.

Consumers (and thus also investors) are evidently showing a higher willingness to pay for “protecting the environment”, along with firms who want to capitalize on this demand (Mason, 2013). However, with the problem of asymmetric information, sustainable decisions are difficult to make. This is where the role of information and labeling enters. Mitigating environmental/social damages by shifting the production towards firms with more efficient cleaner production requires disclosure and information. Assessing corporate sustainability has the purpose of providing decision makers with an evaluation of integrated nature-society system perspective of the global economy, which assist them in determining which actions should be taken in order to reach a sustainable society (Singh, Murty, Gupta, & Dikshit, 2012). The role of labeling and information provision by a third-party can act as a solution to the imperfect information (Mason, 2013).

One of such information tools has been presented by Figge and Hahn (2004). They developed a value-based methodology to assess the sustainability performance of companies, named Sustainable Value (SV) which has been recognized as a promising approach for measuring corporate contribution to sustainability (Kuosmanen & Kuosmanen, 2009).

The fundamental idea of the SV method arises from management activities. Rappaport (1986) introduced the shareholder value model, a concept that is based on net present value. Here, the economic value of a company is equal to the present value of all future cash flows. In value-based environmental management, this concept is developed further and examines how environmental management can have a positive impact on the value drivers, (such as sales growth and capital investments). The idea is that companies can seek value drivers (create shareholder value) in environmental or social areas, such as activities that reduces emission which can translate into reduction of environmental costs, marketing opportunities (green-products), increase in demand etc. Thus, by avoiding and being prepared for risks and taking advantages of future opportunities of a strong environmental management, corporates can optimize their current operations (Figge, 2005). The SV approach allows the assessment of corporate sustainable performance in a value-orientated way, compared to burden-oriented. The value-oriented concept is however not new, other prevailing approaches such as eco-efficiency has been proposed as a promising measure, showing the ratio of created value per unit of environmental impact (Van Passel, Nevens, Mathijs, & Van Huylenbroeck, 2007). However, three major shortcomings to measure the sustainability contributions of corporates with the eco-efficiency method have been identified by the authors of the SV approach.

Firstly, it’s a relative measure (expressing corporate contributions to sustainability as benefits per unit of environmental or social impact) which does not provide any information about effectiveness and thus the environmental and social performance of a corporate in absolute terms cannot be derived. Secondly, there might be a rebound effect. Improved eco-efficiency might be over-compensated by two effects; Eco-efficiency might lead to growth and thus increase the use of environmental resource (rebound effect). The improved eco-efficiency by one corporate could be offset by the less eco-efficient corporate usage. Thirdly, eco-efficiency does not cover all social and environmental impacts simultaneously.

Thus, Figge and Hahn (2004) wanted to go beyond eco-efficiency and solve the recognized shortcomings as they developed the SV approach. The main advantage and explanatory power of this method is that it measures sustainable performance in monetary terms, integrating different forms of economic, social and environmental capital that are relevant for a sustainable development. This advantage makes it a useful tool that translates sustainable performance into a language that is recognized by investors and managers thinking, connecting the financial result to corporate sustainable performance (Figge, Barkemeyer, Hahn, & Liesen, 2006).

Socially responsible (SR) investors and analysts can incorporate the SV methodology into their strategies to identify under-performers (corporates who lag behind in their sustainability performance), make impact investments (invest in corporates with the intention to generate economic, environmental and social returns) and negative screenings (avoid investing in “harmful” corporates). The SR investors are interested to place capital in businesses that combine social (sustainable) and financial returns. Thus, the

SV method can provide the tool to determine which sectors or companies that are vulnerable to risks and tighter regulations as well as which companies are better prepared and perform well (Figge et al., 2006). This is important as recent studies show that social responsible investing (SRI) is gaining bigger grounds and according to the US SIF foundation (the Forum for Sustainable and Responsible investment), the total US-domiciled assets under management using SRI strategies increased from $3.74 trillion in 2012 to $6.57 trillion in 2014, an expansion of 76 percent. This number represents that roughly one out of six dollars is under sustainable, responsible and impact investing management in the United States (US SIF, 2014).

Moreover, corporate managers can use the assessment of the SV approach, who aims to monitor and measure their sustainable performance, to communicate their development as well as to identify vulnerabilities of possible tighter regulations. Lastly, policy makers and regulators can find the approach useful in order to identify sectors and companies that should be targeted for implementation of environmental or social policies (Figge et al., 2006). In addition, the authors clarify that the SV does not indicate if a company is sustainable. Instead it shows how much a company has contributed to more sustainability from a given benchmark, and where the resource should be allocated for optimal use (maximum surplus for each resource unit).

However, what happens if the assessment and information is not priced appropriately? There has already been critique towards the SV approach, where especially Kuosmanen & Kuosmanen (2009) examines the method and specification errors, claiming that there are some unrealistic assumptions made by the authors of the approach. Other studies show that measurement errors, gaming behavior and misunderstandings create great challenges for full information, which could decrease the quality of information provided by a third-party to consumers. The quality disclosure and information provided should be critically examined as it may not allow for reduction in efficiency losses, but might actually harm the consumer (investor), and thus the overall sustainable development. Therefore, this thesis will aim at examining if the SV approach is an appropriate tool for reducing efficiency losses of asymmetric information.

1.2 RESEARCH AREA AND OBJECTIVE

Inspired by the discussion of assessing corporate sustainability performance, this thesis addresses the challenges and outcomes of the information that the SV approach supplies with respect to corporate environmental impact.

Two fundamental areas of research are identified. The first area concerns the notion of sustainability in the context of environmental damages, understanding the economic perspective of a sustainable development and how it can be realized by applying approaches to put a monetary value on external costs. The second area concerns the assessment of corporate sustainability, dealing with the economic welfare effect that information can have on consumers'/investors' decisions. As such, the purpose of this thesis is to contribute with knowledge on sustainability assessment methods, with specific focus on SV approach, as well as to add new logic to, this relatively new topic of making socially responsible investments.

1.2.1 OBJECTIVE

The overall objective of the thesis is to evaluate if the SV method can reduce efficiency losses from asymmetric information on environmental performance. This is done in a three step procedure as described below.

First, an illustrative case study is conducted. The study will assess the sustainable value of 19 companies in 5 sectors in Sweden based on the SV method developed by Figge and Hahn (2004). By accounting for the external cost of carbon dioxide emissions, the sustainable value measures the monetary value of the corporates' contribution to sustainability.

Second, an assessment of the social cost of carbon dioxide emission of the corporates is calculated, based on environmental economic (EE) reasoning of accounting for external damages.

Third, a comparison of the outcomes of the two different approaches of taking into account external costs caused by environmental and social damages is conducted. The outcomes are analyzed from the economic perspective on sustainability as well from a socially responsible investor's perspective.

Research questions to answer:

How can we assess a company´s impact on sustainability by its environmental impact, via the SV approach and economic methods?

How much sustainable value, measured with the Sustainable Value approach, is created by the selected 19 Swedish companies in the 5 sectors examined?

Does the SV method give promising results according to economic theories on sustainability?

What are the possible outcomes for the socially responsible investor, when decisions are based on the information provided by the SV approach?

Figure 1 Areas of concern

1.3 DELIMITATIONS

This thesis focuses on a rather complex topic (sustainability) which has many different aspects that could be analyzed from a variety of academic fields. Focusing on the external cost and damages of negative externalities, the thesis does not cover the possible positive externalities such as technological advances which would aid in the development towards more sustainability. Uncertainty and risk in firm performance are also excluded. The number of companies selected is also limited, due to limitations on social and environmental data from corporates. Also, the thesis is only providing results for the year 2012, not giving any information on the development of the corporates' performances.

As will be discussed further, the thesis is limited to be concentrated on the sustainability of corporates based on the environmental indicator, carbon dioxide emissions. The reasons for including only CO_2 emissions are several. Firstly, it is the primary greenhouse gas emitted from human activities in the earth's atmosphere and is identified as the major contributor of global climate change. Carbon dioxide exists naturally in the atmosphere and the emissions come from a variety of natural sources, however since the anthropogenic activities amplified (industrial revolution in 1750), the CO_2 emissions have increased vastly, affecting the ecosystems, biodiversity and livelihoods of people. Thus, identifying and internalizing the externality costs of CO_2 emissions is an established and fundamental economic problem, several regulatory initiatives have been taken to reduce carbon dioxide emissions (US EPA, 2014) and a variety of methods and models have been developed to quantify the social cost of carbon (SCC). Therefore, a meaningful comparison of the SV method of accounting for externalities can be compared to the economic assessment of social carbon cost. Thus, the choice of using CO_2 emissions is based on the ease of empirical calculations as well as political urgency.

A consideration has been made to the inclusion of social indicators such as corporate giving, local employment, and number of work accidents or fatalities. However, the inclusion of the social aspects is under the influence of more constraints due to the difficulty to find quantifiable and comparable data on the corporate, as well on the benchmark level. Many such indicators are difficult to measure, such as choice of work accidents which are measured as LTIFR (Lost time injury frequency rate), number of accidents etc.. Therefor the study will not include such indicators.

Considering the choice of the SV approach, it is motivated by the fact that it's a relatively new approach of assessing economic, environmental and social resources from a value-based perspective (monetary units), which is a new way of looking at corporate sustainability performance. As there is no consensus on how to assess corporate sustainability, it is interesting to see the relevance of methods like this from an economics perspective, as the SV approach has been applied in several projects and case studies (see examples in appendix).

The intention with the result of this study is not to guide investors in their decisions, but rather to provide a deeper understanding of the complexity of using third-party information for corporate sustainability performance.

1.4 OUTLINE OF THE THESIS

The thesis is divided into six major chapters. In this first chapter the background, problem and purpose of the paper has been presented along with limitations of the study and thesis framework. Next, the literature on the topic is reviewed, giving the reader a better understanding of sustainability assessment methods and previous studies conducted in the field.

Thereafter, a theoretical framework is presented based on four key topics (SV approach, Environmental Economics, Sustainability and SRI perspective) building the foundation for the empirical research. More precisely, the first section is devoted to the Sustainable Value approach to clarify the method and the calculations. The second section deals with the theories of environmental economics, mainly the reasoning of accounting for damages caused by externalities. The third section gives an understanding of the essential concept of sustainability and sustainable development in economics. Subsequently, the last section explains the problematics of asymmetric information in responsible investments and applies it to the assessment of corporate sustainability.

The fourth chapter focuses on the data presentation, presenting the scope of the study with limitations and data inclusions as well as definitions of benchmarks and list of corporates assessed. The chapter is focusing on presenting the data needed for the empirical research, specifically focusing on data for calculating SV and data presentation for the EE (Environmental Economic) method for calculating Social Cost of CO_2. Subsequently, the fifth chapter focuses on the findings and results, comparing the result from the SV calculations and the EE method for assessing marginal cost of externalities. Finally, the last chapter contains the discussion and conclusion. Here the main research questions are answered and discussed.

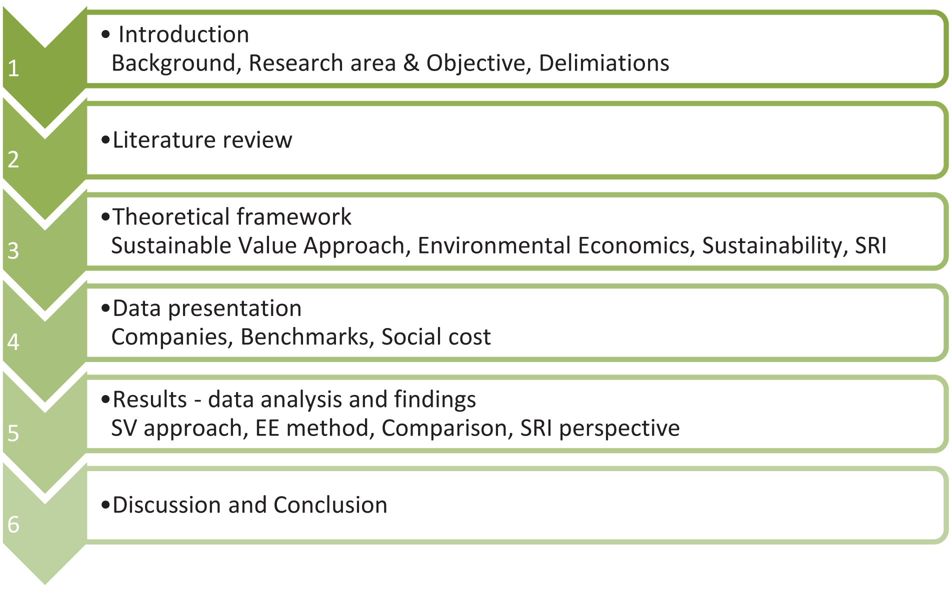


Figure 2 Thesis outline

2. LITERATURE REVIEW

The literature chapter begins with studies which have tried to evaluate disclosure and labeling to reduce the information asymmetry and continues with literature on conceptualizing sustainability assessment and corporate sustainability assessment. Thereafter the review focus on the literature related to the Sustainable Value approach, previous studies and critique.

As discussed in the introduction of the paper, reducing efficiency losses from asymmetric information with respect to firms' environmental performance is becoming of great significance. While the literature on sustainability assessment tools and disclosure of reporting is quite large, it was problematic to find a specific study with the same purpose as the current one. Thus the literature review will focus on related papers with similar focus.

Previous economic literature which has tried to review quality disclosure and the effect of third-party disclosure on consumer choice and seller behavior is a review by Dranove & Jin (2010). The authors define quality disclosure as an effort by a certification agency to systematically measure and report product quality, when other forms of quality assurance are inadequate. The paper has a focus on healthcare, education and finance sector to review empirical evidence on issues regarding quality disclosure. They reason that quality disclosure is a two-edged sword, which allows for greater match for consumers and sellers but at the same time can decrease the quality with sellers gaming behavior that harms the consumer. Measurement errors, inspector bias and consumer misunderstandings are clear problems, and thus it is difficult to say if information disclosure is actually helping consumers. The authors also discuss that the short run consequences are quite known, however, very little is known about the long run effects of quality disclosure. Low quality firms may be driven out by quality disclosure and invite high quality competitors or encourage improvements in quality, which would be important benefits in the long run.

Similar to the current thesis, Mason (2013) discuss the welfare effects of eco-labeling and the possible outcomes that a third-party information can provide. The paper discusses the fundamental appeal of eco-labeling as a policy instrument to mitigate environmental damages by shifting production from brown/dirty firms to green/clean firms. In an exemplifying model, Mason (2013) shows that there are likely substantial benefits related to the introduction of a certification scheme and that eco-labeling would serve as an attractive alternative to other forms of regulatory control. Thus, the cost of other environmental regulations (such as monitoring, enforcement or expected losses attributable to asymmetric information) should be compared to any reduction in net surplus (with respect to information effects) as a result from third party certification. The paper also reflects upon the possible complications related to eco-labeling and the challenges related to measuring carbon emissions which make the labeling likely to be noisy.

Nevertheless, in line with the development of sustainability as a concept, has the development of assessing sustainability emerged. Different framework and indicator systems to evaluate sustainability (both at firm and higher level) have made great progress (Van Passel et al., 2007). The number of methodologies, processes and tools of assessing sustainability is now in the hundreds (Poveda & Lipsett, 2011).

2.1 CONCEPTUALIZING SUSTAINABILITY ASSESSMENT

Since the study will focus on sustainability assessment, it's important to clarify what the term really tries to describe if it is to fulfil its potential of being a tool for promoting sustainability. Thus, the literature review will continue in the literatures that have tried to conceptualize sustainability assessment.

In a review conducted by Pope et al. (2004), they present an alternative notion of sustainability assessment, with the aim of seeking to determine whether or not an initiative is actually sustainable. The study compares Triple Bottom Line (TBL) approaches and principle based approaches to develop a sustainability criteria. Here, they go further into problematics that all sustainability assessment tools should not be assumed to be "good for the environment", or even encourage sustainable development. The authors highlight that sustainability as a concept is hard to define and can be seen as a concept like "love" or "freedom", which are fuzzy until applied in a specific context. Therefore, the applications of sustainability are often based on principles and concerns that have taken different emphases. Thus, the importance of understanding the conceptual origins of sustainability assessment is highly convenient and the difficulty of integrating all three pillars of sustainability, that maximizes "win-win-wins" and minimizes trade-offs.

The authors distinguish between two forms of impact assessment approaches; EIA (applied to projects) and SEA (applied to policies plans and programs). EIA (environmental impact assessment) SEA (strategic environmental assessment) approaches can be considered as examples of integrated impact assessment or sustainability assessment (considering economic, environmental and social impacts). A distinction was made between EIA-driven and Objective-led processes (SEA) in order to review their contribution to sustainability. The paper conclude that EIA-driven integrated assessment fails to address the concept of sustainability as a societal goal and focus more on minimizing negative impacts or reducing unsustainable practices. On the other hand, the objective-driven was concluded to be more compatible with sustainability. It assesses a sustainable contribution to aspirational objectives, in contrast to the EIA-driven, which aims to ensure that TBL "triple bottom line" impacts of a proposal are acceptable compared with baseline conditions. However, the study points out that most integrated assessment processes in practice, including objective-led processes, tend to limit themselves to measurement of positive or negative contribution of sustainability and this may not be sufficient to drive the goal of sustainability and not just the "direction to target".

Although the paper by Pope et al. (2004) is mostly a review of literature and previous assessment methodologies of sustainability, it is a useful reference for the forthcoming analysis as it summarizes the many issues related to sustainability assessment and the problematics of integrating economic, environmental and social values into assessment approaches.

Poveda & Lipsett (2011) reviews and discusses a range of fundamental tools of sustainability assessment, ranging from; approaches, models, strategies, methodologies, appraisals and credit weighting tool for sustainability and environmental rating systems. They conclude that finding the appropriate assessment instrument is a critical step in order to gain successful outcomes in improving sustainability. The paper presents a classification of assessment tools (generic, strategic and integrated) and also discusses the complexity of sustainability. Regarding assessment methods, they are acknowledged as being essential so that progress can be made. The evaluation and monitoring of progress has a definite role in accomplishing sustainable goals and to provide decision makers with the correct status.

2.2 MEASURING CORPORATE CONTRIBUTION TO SUSTAINABILITY

A number of studies have tried to develop a framework for sustainability criteria that focus on the assessment of companies. Krajnc and Glavic (2005) reviews some of the existing framework of corporate sustainability assessment and present a model for designing a composite sustainable development index that include company performance on all three sustainability dimensions (Environmental, Economic and Social). The main focus of the paper is on indicators and how to integrate them in order to determine sustainable development in a relevant manner for decision-making. The authors state that the introduction of frameworks such as GRI (global reporting initiative) and the development of environmental management standards (such as ISO), lay the ground for assessing sustainability performance using indicators (Krajnc & Glavič, 2005). Before the introduction of sustainability reports, most companies only considered the standard financial indicators to track their business effectiveness. Nowadays, integrating the elements of financial, environmental and social aspects in the company's annual report is the trend. These reports translate sustainability issues into more quantifiable measures to provide information on the company's overall contribution to sustainability.

Krajnc & Glavič (2005) remark that despite the large number of indicator frameworks, no attempt has been made to create an aggregate measure for easy comparison of sustainability performance on a company level (at the time). The paper presents a design of a composite sustainable development index (Icsd), which assesses company performance as a function of time, and also the effectiveness of the model in a case study. The model use indicators on all three pillars (normalized), to incorporate them into an integrated measure of performance. The authors chose 6 economic, 22 environmental and 10 social indicators, these are aggregated into sub-indices and aggregated into the Icsd. The result shows the development of the Icsd for the case company over a time interval and the different path of the sub-indices. However, the authors also recognize possible disadvantages of the model as the normalized data may mask absolute figures (that are highly relevant for some stakeholders) and the determined weights of the indicators may suffer from high degree of subjectivity. Despite the drawbacks, the authors also highlights that even though further development is needed, this method has great potential to become a useful tool of sustainability assessment (Krajnc & Glavič, 2005).

Other studies conducted in the field to express corporate contributions to sustainability include concept such as; eco-efficiency (eg. OECD, 1998; WBSD, 2000; Meul et al, 2005), external cost and benefits analysis (Pretty et al, 2000), Indicators based on cost-benefit analysis (Callens and Tyteca, 1999), the sustainability function (Van Calker et al, 2006)(Van Passel et al., 2007).

2.3 SUSTAINABLE VALUE APPROACH

The sustainable value method (SV) was developed by Figge & Hahn (2004, 2005) as part of the EU-funded ADVANCE project to measure the environmental performance of 65 European companies. Since then, the method has been applied in a variety of studies and research questions, both across different sectors (ADVANCE project) and within specific sectors ((Van Passel et al., 2007), (Kuosmanen & Kuosmanen, 2009)). A sample of studies reviewed (which have implemented the method) can be found in the appendix section of this thesis.

Compared to burden-oriented approaches, which focus on reducing negative impacts, the SV approach offers new viewpoints and advantages. First, it's a value-oriented approach. This means that it analyses how much value has been created with a set of environmental impacts as compared with the use of these resources by other companies (where resources should be optimally allocated). Second, the SV method is using a new perspective as it assesses the resource use from the standpoint of the investors (that allocates the resources across firms), rather than from the standpoint of the resource user (managerial level), or the loss of resource use (the environment) (Mondelaers, Van Huylenbroeck, & Lauwers, 2011). Furthermore, the approach is a monetary measure of sustainability. This is an important advantage as it allows for greater understanding and gives decision makers information in a format that readily enables comparison with other types of information (Van Passel et al., 2007).

Figge & Hahn (2004) laid the foundation for the SV approach, where the authors present the approach and the reasoning behind it rather than the implementation of the method. The concept of sustainability at the firm level is discussed along with an introduction of absolute and relative measures to corporate sustainability. The authors reason about the shortcomings and challenges of these measures and state that a *true sustainable measure must consider the efficiency and the effectiveness of all three dimensions of sustainability simultaneously*. The **if** and **where** questions must be answerable; *if* the measure contributes to sustainability and *where* resources have to be allocated to achieve the highest contribution to sustainability as possible. Thus, both external and opportunity cost must be considered. The Sustainable Value method is based on the paradigm of strong sustainability and thus the result is a constant overall level of eco- and social effectiveness, substitutability between different forms of capital does not matter.

However, despite the variety of studies conducted and the promising results that the SV methodology provides, the approach has become subject of some serious debate. In 2009, Kousmanen and Kousmanen (2009) (from now on KK) critically examined the approach developed by Figge and Hahn (from now on FH) (2004), causing the later to respond in an article in which they argue that the critique of KK has serious misspecification and disappointingly fails in its assessment. Nevertheless, it is still of interest to take a closer look into the research of the SV approach conducted by KK and the shortcomings identified. Conveniently, Ang & Van Passel (2010) put forward a clarifying and constructive comment to the debate.

The confusion, as the authors put forward as the basis for the debate, is the twofold interpretation of the SV presented in the original Figge and Hahn (2004) paper. On the one hand, the SV is based in the financial economic theories and reflects the overall resource efficiency (in monetary terms) of the company compared to a predefined benchmark. Thus the assessment and value are seen from an investor’s perspective. On the other hand, it is suggested that the sustainable value also reflects the financial compensation that more efficient resource users would pay to less efficient resource users if the latter would forego the excess resource use, a prescriptive measure. The SV equivalence is thus only correct if the benchmark production function increases linearly. The article by KK bouts the second assumption, due to the strong assumption of linear production function which imply a perfect substitutability of all resources (violating the assumption of strong sustainability). They demonstrate (conducting several Monte Carlo simulations and reinvestigating the result of the (Figge et al., 2006) study that the results are likely to become biased and inconsistent.

However, as argued by (Figge & Hahn, 2009) and the “clarifying debate article” (Ang & Van Passel, 2010), the statistical test of KK are not very relevant if one instead assumes an investor’s perspective, using a financial economic and not production efficiency analysis. Instead, as argued by Ang & Van Passel (2010), other tracks can be taken for the production efficiency theory to be appropriate, such as estimating the production function of the firms using sufficient amount of data or using marginal products to reflect the marginal willingness to pay for an extra unit of resource. The authors also advocate more comprehensive analysis in addition to the SV approach (such as cost-benefit analyses or ecological footprint) could prove valuable in analyzing the impact of different policy measures on the sustainable value creation of firms.

3. THEORETICAL FRAMEWORK

Due to the previous confusion of the SV approach as reported in the literature review, the current thesis will ambitiously aim at clarifying the interpretation taken in this study. Four major sections are distinguished in the theoretical framework; SV approach, Environmental Economics, Sustainability and the SR investor perspective. The main focus is to answer the research question; "How can we assess a company´s impact on sustainability by its environmental impact, via the SV approach and economic methods?" It also explains essential concepts of sustainability, and the problematics of asymmetric information in responsible investments.

3.1 SUSTAINABLE VALUE APPROACH

There are six major steps in the calculation of the Sustainable value. The first step answers the question; *How efficiently does the company i (where i=1,…,m firms) in sector k (k=1,…o sectors) use its resources?* The calculation is done using the Gross Value Added, GVA_i or $EBITDA_i$ (Earnings before interest, taxes, depreciation and amortization =corporate return figure) divided by the amount of resource used in one year R_h (where $h=1,….,n$ resources). This results in a value of efficiency (E_{ikh}) for each resource, which is defined as

$$E_{ikh} = \frac{GVA_{ik}}{R_{ikh}} \qquad \textbf{(1)}$$

In SV, the efficiency for a firm is compared to that of a benchmark, which is chosen without restrictions. The calculations can be done for the benchmark (j) using the return figure GVA_j (such as GDP) answering the question; *How efficiently does the benchmark use the resource h?*

$$E_{jh} = \frac{GVA_j}{R_{jh}} \qquad \textbf{(2)}$$

The benchmark represents the chosen object which each company is compared with. Important here is that the benchmark is defined and covers the same resource as used on the corporate level, and that the return measurement on the benchmark level corresponds to the company data. The selection of benchmarks is a central step in the SV method as it defines the cost of all capital forms and determines the explanatory power of the sustainable value analysis. There are several possibilities when choosing benchmark, such as region, national economies or sectors (Van Passel et al., 2007).

Next, the efficiency of the company and the benchmark is compared to answer; *Does the company use its resources more efficiently than the benchmark?* This is calculated by the efficiency of the company deducted with the efficiency of the benchmark (e.g. the industry as a whole). The result shows how much more or less return (GVA) per unit of resource the corporate produces compared to the benchmark, also known as Value Spread (VS_{ih}), which is written as

$$E_{ih} - E_{jh} = VS_{ih} \qquad \textbf{(3)}$$

The VS_{ih} can also be viewed in a more graphical illustration, as can be seen below;

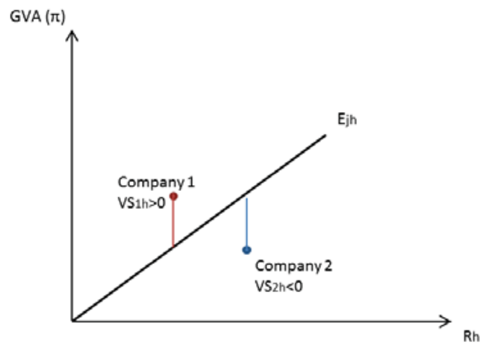


Figure 3 Value Spread (positive vs negative)

Company 1 creates a positive VS_{1h}, using its resources more efficiently than the benchmark and thus has created a greater GVA (return (π)) compared to the benchmark. Conversely, Company 2, which has a negative VS_{2h}, used its resources in a value-destroying way as it creates less return out of the resource used compared to the benchmark. The efficiency of the benchmark is, as already described previously in step 2, determined by the return of the benchmark in relation to the resource used in one year. Thus, the question can be answered with a simple "yes" or "no" (positive or negative) in addition to a reflection to the result of the monetary value of the VS per resource.

The fourth step is used to answer the question; *What is the value contribution of each resource?* The value contribution (VC_{ih}) of each resource considered at the benchmark level is calculated using the value spread (VS_{ih}), calculated in previous step, multiplied by the amount of each resource (R_{ih}) the company (i) has used. This gives an understanding of how much more the company used its resources in a value-creating way compared to the benchmark. This result can be either positive (value creating), showing how much excess return is generated with the amount of resource used (e.g. unit of CO_2 emitted) compared to a benchmark, or negative (value destroying), representing a loss in value due to less efficient use of the resource compared to an average of the industry (benchmark).

$$VC_{ih} = VS_i \times R_{ih} \qquad \textbf{(4)}$$

In the last step the Sustainable Value calculation is conducted in order to answer the question of; *How much Sustainable Value does the company create?* This considers all the resources that the company uses. To only sum all value contributions of each resource would result in double counting (as the return (GVA) is only produced once). Thus, the sum of the value contributions (VC) must be divided by the number of resources considered and thus the resources are weighted relative to their efficiency on the benchmark level. Sustainable Value is created if the return exceeds the cost.

$$SV_i = \frac{\sum VC_{ih}}{R_{in}} \qquad \textbf{(5)}$$

Thus, in a nutshell, the SV_{ih} can be expressed as follows:

$$SV_{ih} = R_{ih}\left(\frac{GVA_i}{R_{ih}} - \frac{GVA_j}{R_{jh}}\right)$$

Where the Sustainable Value (SV_{ih}) equals the amount of resources used by the company (R_{ih}) times (the Return figure of the company (GVA_i), divided by the R_{ih}, deducted by the return figure of the benchmark (GVA_j), divided by the amount of resources used by the benchmark (R_{jh}). The bracket value represents the earlier discussed value spread. By relating the firms efficiency to the efficiency of the benchmark (the market), the SV approach corrects for the external costs.

The equation gives an absolute SV in monetary terms of individual companies. However, the company size might affect the result when comparing companies, as bigger companies tend to generate larger quantities of resources and therefore create a greater (either positive or negative) Sustainable Value. Thus, to tackle the problem of company size in order to make meaningful comparisons Figge and Hahn (2006) have come up with a ratio which they name the Return to Cost Ratio (RCR). The measure is defined by them as a relative benefit-cost-ratio, taking the company return (GVA) in relation of to its so called opportunity cost, which is the return deducted by the created sustainable value (SV). This shows by which factor a company uses its resource more (or less) efficiently than the benchmark in relation to the size.

Hence, if the indicator RCR > 1 it reflects that a company used its resources more efficiently than the benchmark (and the opposite applies if RCR < 1). For example, a RCR of 1:2, shows that a company is only half as efficient in using its resources than the benchmark. The calculation is dependent on the result of the sustainable value (positive or negative).

$$Postive\ SV\text{: RCR} = \frac{GVA_i}{GVA_i - SV_i}$$

$$Negative\ SV\text{: RCR} = \frac{GVA_i - SV_i}{GVA_i} \qquad \textbf{(6)}$$

To clarify, if two companies of different size create the same positive SV, then company size (GVA) has to be taken into account in order to see which company uses its resources more efficiently. A larger company is likely to have a greater GVA and therefor a greater SV is required in order to achieve the same RCR (negative or positive) as a smaller company. For example, if both companies creates a SV of 5, and has a GVA of 10 and 6 respectively, then RCR would be greater for the smaller company. In the example, the smaller company uses its resources three times (6/2) more efficiently than the larger company.

$$Positive\ SV_{large\ company}\ (+5)\text{:}\ \frac{10}{10-5} = 2$$

$$Positive\ SV_{small\ company}\ (+5)\text{:}\ \frac{6}{6-5} = 6$$

3.2 ENVIRONMENTAL ECONOMICS

As the SV formula shows, the method corrects for external effects of a firm's operations by relating its efficiency to that of a benchmark. In economics, the correction is made with respect to the marginal external effect of production. Thus, this chapter of the theoretical framework will present the economics of accounting for damages caused by externalities.

The occurrence of market failure is mainly driven by the existence of public goods and externalities which cause the market to fail in its resource allocation. A public good is defined by being non-excludable and non-rivalrous, meaning that its availability is not reduced by the use of one individual (non-rivalrous) and that one individual cannot be excluded from using the good (non-excludable). Thus, public goods may become subject to overproduction as they are not owned by anyone and not priced by the market (also known as tragedy of the commons). If a public good is used excessively, it might result in negative externalities (e.g. air pollution) (Konjukturinstitutet, 2013).

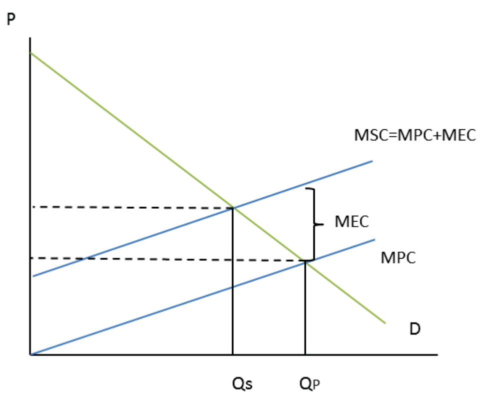
One of the earliest definitions of an externality, by Heller and Starett (1976) describes it as such;

"a situation in which the private economy lacks sufficient incentives to create a potential market in some good and the nonexistence of this market results in losses of Pareto efficiency."

Environmental impact provides an externality which can be defined as the cost (or benefit) that others (third party) than the producers and/or consumers get affected by. Externalities can be either positive or negative (beneficial or damaging). A positive externality is the positive effect an activity imposes on an unrelated third party. A negative externality is the opposite, i.e. when the welfare level of other people, who do not directly participate in the activity, is negatively affected (Rydén, Migula, & Andersson, 2003).

Since this paper concerns the harmful effects on the environment of carbon dioxide pollutions, the following discussion will focus on the negative externalities, or also called external costs. Important here is to note that private cost or benefits from an activity differ from social cost or benefits, which is illustrated in Figure 4.

Figure 4 Illustration of negative external effects and firm's profit maximization



The marginal social cost of production (MSC) is the cost when one more unit is added and all externalities included. The marginal private cost (MPC) is excluding externalities. The optimal level of production is when the demand (D) curve intersects with the marginal cost curves. Thus, the socially optimal level of production is Qs and the private optimal level of production is Qp. The market fails to stimulate the efficient use of environmental/social services as the production of the private firm is cheaper, due to the fact that the private cost of production does not include the monetary value or indirect cost of the externalities.

Thus, if the private costs (MPC) < social cost (MSC), the society is pricing the good to low and thus the outcome is an inefficient market, where there might be an overproduction of negative externalities (e.g. harmful pollutions) or underproduction of positive externalities (e.g. R&D activities). From a societal perspective, the social returns should be maximized and cost minimized to reach welfare (Helbling, 2012). Consequently, from the economics perspective, the uncompensated external effects that are generated from production and consumption behavior which result in inefficient allocation of resources, calls for correction and intervention to promote a more efficient use (Perman, 2003). In a perfectly functioning market economy, with no market failures, all costs/benefits are fully (and correctly) incorporated in the market prices (Perman, 2003, p. 542).

To stimulate sustainability principles, mainly environmental issues, different approaches have been taken by researchers and practitioners to assess and quantify social and environmental concerns (Poveda & Lipsett, 2011). To capture the damage caused by externalities and to solve inefficiency, internalizing these costs is an economic strategy to account for the total cost (including social, environmental, and economic factors). The costs are measured in monetary units and thus the cost of an environmental degradation (e.g. climate change) can be compensated by the benefits from manufactured capital (e.g. income) (Rennings & Wiggering, 1997).

Connecting this to the SV approach, the damage cost calculation of a corporate producing at Q_P from the societal perspective when MEC_i (Marginal External Cost) is constant can be seen as:

$$SC_{ih} = MEC_i * R_{,ih,P} \tag{7}$$

$R_{ih,P}$ is the firm's use of the resource at $Q_{P.}$ With the interpretation that the Social Cost (SC) is the marginal external cost times the number of resource used by the corporate. This corresponds to the Value Contribution calculation (step 4), where VC=VS*R. It is important to note here that the social cost can never be a positive value (unless one is considering positive externalities), in comparison to the VC value which can be either positive or negative, despite the fact that we are assessing negative externalities. This should be kept in mind for the discussion of welfare effects and socially responsible investment decisions.

The estimation of the marginal damage caused by an additional ton of carbon dioxide emissions can also be known as the social cost of carbon. The social cost of carbon (SCC) is a crucial instrument and defined by the Environmental Protection Agency (EPA) as an estimate of the economic damages associated with a small increase in carbon dioxide (CO_2) emissions, conventionally one metric ton, in a given year. The monetary figure also represents the value (or benefit) of the damages avoided for a reduction in emissions.

Thus, the calculation for the Social cost in this thesis is as follows;

$$SC_{ih} = SCC_h * R_{ih} \tag{8}$$

Where the marginal external damage (MEC) can be referred to as SCC, which is a monetary value per unit of carbon dioxide.

The SSC estimation can be based on integrated assessment models (US EPA, 2015), such as the DICE, FUND and Page models. The models are useful as they combine economic growth, climate processes and feedbacks between climate and the global economy into a framework. Also, the SCC estimates make it possible to incorporate the social benefits into cost-benefit analyses of regulatory action with marginal impact on cumulative global carbon emissions. Each model uses different approaches of translating warming (changes in atmospheric greenhouse concentration) into economic damages (Greenspan Bell & Callan, 2011). The economic damages or cost include (but is not limited to) changes in human health, property damages from increased flood risk, net agricultural productivity and the value of ecosystem services due to climate change (US EPA, 2015). Thus, the benefit of reducing emissions today comes from avoiding the cost in the future.

However, one must keep in mind that the SCC estimate is far from perfect. Some fundamental challenges have been recognized due to the many uncertainties when calculating the possible consequences.

Despite this, SCC is considered a useful measure to estimate the economic damages of marginal carbon dioxide emissions, as well as benefits of CO_2 reductions, and is used by nations for regulatory purposes or by companies for risk assessment and financial planning (Parry, 2007). The chosen measures of SCC for this thesis will be presented and discussed in the Data chapter. The result will be presented both in monetary values as well as with a ratio adjusting for corporate size. The adjusted size ratio (ASR) is calculated with the same condition as for the Return to cost ratio shown in eq. (6), with adjustment to the company size.

$$ASR_{ih} = \frac{GVA_i + SC_{ih}}{GVA_i} \tag{9}$$

Since $SC_{ih}<0$, we have that $ASR_{ih}<1$, which is in contrast to the corresponding measure RCR_{ih} suggested by the SV method which allows for $RCR_{ih}>1$.

3.3 SUSTAINABILITY

For the purpose of understanding and to clarify the concept of assessment for separating unsustainable outcomes from sustainable ones, this chapter focuses on defining and outlining the essential concept of sustainability in economics. Partly answering the question; Does the SV method give promising results according to economic theories on sustainability?

The concept of sustainability has been discussed within many different field and disciplines, and so many different suggestions have been advocated to define sustainability and sustainable development. The perhaps most common definition was provided by the Brundtland Commission in 1987: "*The development that meets the needs of the present without compromising the ability of future generation to meet their own needs"*. The report set out the economy-environment interdependence and argued that environmental limits to growth can be avoided by adopting and reducing, at the global level, the material content of economic activities and the use of resources as the value of output increases (Perman, 2003). Another well recognized view of sustainability is the relationship of the three pillars, Economic, Environmental and Social. This has been illustrated in a diagram indicating the balance of the three parts and as stated by FIgge and Hahn;

Figure 5 Three pillars of sustainability

"Only companies that contribute positively to all three pillars of sustainability at the same time contribute to sustainability."- Figge and Hahn (2006). This can be seen as the heart of sustainable development, where the whole is greater than the sum of its parts as the three dimensions are interrelated and therefore influence each other in several ways (Bardy, 2015).

While sustainability can be expressed in various disciplines, this chapter will focus on the economic perception of sustainability. Here, there are two key concepts of a sustainable state:

1. Utility/Consumption is non-declining through time.
2. Resources are managed so as to maintain production opportunities for the future.

Accordingly, a development is sustainable if the following holds:

$$U_t \leq U_t^{MAX}$$

Where the utility level at time t must be less or equal to the maximum utility which can be held constant forever from time t onwards, given production opportunities available at time t (Perman, 2003).

But the question is then, how can sustainability be realized? The problem can be answered by two distinct conditions; weak- or strong-sustainability. While the views differ over what is needed to be met for the realization of sustainability, they have the same outlook of the definition of sustainability, specifically constant utility (consumption). In short, the difference of weak/strong is about the substitutability when it comes to capital (Perman, 2003, p. 90). As the total stock of capital can be defined by natural and human-made capital, the question is whether or not there are substitution possibilities. Natural capital consist of the naturally provided stock (such as fertile land, crude oil, fish, earth's atmosphere), while human-made capital is the sum of physical (e.g. infrastructure), human (e.g. learned skills) and intellectual capital (knowledge part of society).

Weak sustainability can be linked to the neoclassical economic theories and is perhaps the most common view amongst economists (Perman, 2003, p. 91). The idea is that we can consume some of our natural capital, as long as the loss is offset by an increasing stock of human-made capital (Bardy, 2015). This means that there is an unconditional substitution between the various forms of capital and thus all capital are close substitutes.

If the production function of the economy is defined as;

$$Q = Q(L, K_N, K_H)$$

Where L represents labour, K_N natural capital and K_H human-made capital, weak sustainability advocates argue that the weighted sum of K_N and K_H must be non-declining (Perman, 2003). As long as this condition is met, the needs of future generations are met and thus, sustainability is achieved (Gowdy & Walton, 2008).

On the other hand, strong sustainability proponents argue that the level of $K_{N,}$ in the production function must be non-declining so that the resource structures remain unchanged. In other words, the strong sustainability criterion assumes that the substitutability of K_N and K_H is rather limited as the capital forms are complimentary (Perman, 2003). This implies that natural capital, such as the atmosphere, cannot be substituted by any form of human-made capital. Strong sustainability is often referred to as an ecological economics approach to environmental problems as it is more concerned with maintaining non-renewable/substitutable environmental features.

Figge and Hahn (2004) claim that the SV approach is based on the notion of strong sustainability, because all dimensions of sustainability are considered and that the constant environmental and social performance is ensured. More precisely, they say that on the macro level the sustainable value expresses the excess value created by a company while preserving a constant level of capital use. On the micro level, the method shows whether different forms of capital have been allocated to the most value-creating uses, where less efficient users of resources can reduce exactly the environmental/social impacts in question by being compensated by the efficient users. Resulting in a constant overall level of eco- and social effectiveness.

However, the idea provided by the SV authors regarding strong sustainability does not correspond to the existing criteria by economists. In the SV method, K_N can actually be declining and resource structures can change, which contradict the strong-sustainability condition. Thus, the results from the approach can't be promising according to strong sustainability criteria. The SV approach could on the other hand claim weak sustainability, as the approach considers the value created by corporates as being substitutable with other resources so that resource stocks can actually decline.

3.4 THE SOCIALLY RESPONSIBLE INVESTOR'S (SRI) PERSPECTIVE

This chapter introduces the socially responsible investor's perspective, where information related to the corporate sustainability performance such as the Sustainable Value approach can present risks for market failure.

As described in the introduction, socially responsible investors aim at placing capital in businesses that combine and maximize both the social (sustainable) return and financial return. In doing so, the investor needs information regarding the corporate sustainability performance. Information can, as already mentioned, act as a solution to market failure. This can be illustrated as seen in the Figure 6 below.

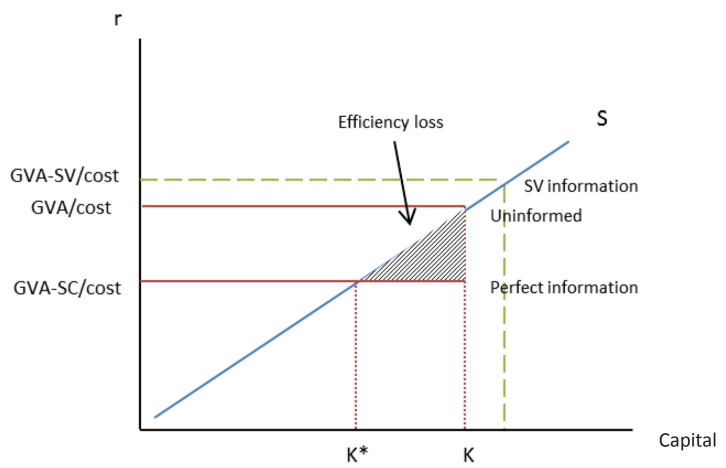


Figure 6 Efficiency loss of uniformed/asymmetric information investments

Here the axes; *r* is the rate of return, which is measured as net return (GVA) in relation to total cost, and *K* is capital. The figure relates to the market failure of asymmetric information. Assume that the SR investor base it investment decision in a market where there is no information on the corporate sustainability performance (cost of externalities), where the r=GVA/cost. This implies that the corporate itself has more information about its sustainability performance and thus in a market with perfect information the return is decided by (GVA-SC)/cost. Here, the SC represents the social cost of external effect that the SR investor is interested in.

These two scenarios represent the two demand curves in the figure. Thus, the uniformed demand curve GVA/cost shows how many units capital the investor would desire with no information, while the (GVA-SC)/cost demand curve indicate what the investor desires with full information. Thus, if the investor has full information (knowing the corporate social cost), their willingness to pay/invest in the corporate would be lower, (denoted K* in the figure). If not, there is an efficiency loss, which is shown by the triangular area in the figure. Accordingly, information regarding the effect of externalities and the social cost that the production of a corporate has on third-parties is highly desirable and would reduce the information asymmetry in the market and associated efficiency losses. Thus, one would assume that approaches, such as the SV approach, are promising when it comes to measuring corporate sustainability performance and therefore providing information that allows for less information asymmetry and greater sustainability. However, information is perhaps more complex than that. Illustrated in figure 3 is a third scenario, if the investor is provided with the SV information. As can be seen, if the SR investor bases it decision on a positive SV which may not correspond to the social cost of external effect (due to asymmetric information), there is a possibility that there is a greater efficiency loss than the case of no information. However, Figge and Hahn (2006) argue that SV labelling can reallocate capital from firms with low SV to firms with high SV and thereby contribute to sustainability. Whether this occurs is illustrated in Figure 7.

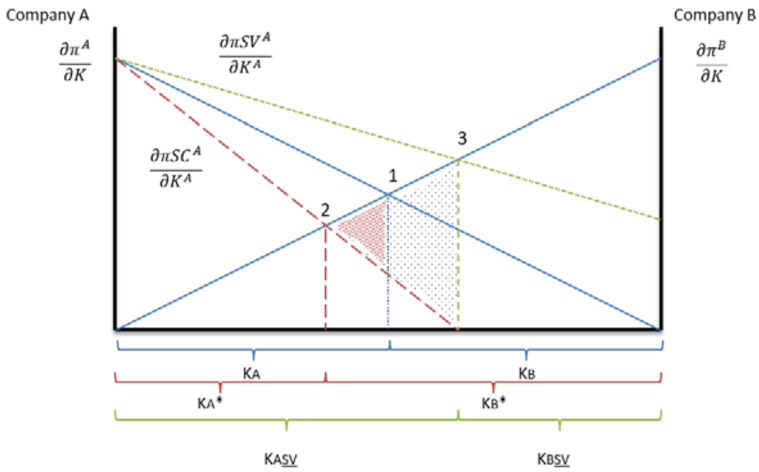


Figure 7 Capital allocation based on information

The two ways of assessing a corporates' externality value/cost, which has been introduced in the previous chapter (SV approach and Social cost of carbon dioxide), has the potential to guide SR investors in their decision on where their capital should be allocated[1]. The above figure 4 illustrates the scenario of an investor deciding on where to allocate capital (for greatest sustainable return for its shareholders) in a two company case setup based on three information-scenarios. In the first scenario the investor has no information regarding the corporate sustainable performance, resulting in a 50/50 spread of capital allocation between company A and company B (assuming the companies has equivalent financial return). In the second scenario, the investor is provided with the social cost information, where it's evident that company A has a greater social cost (emits CO_2) compared to company B. The information would cause the investor to allocate less capital to company A in order to generate greater social return. The triangular area indicates the efficiency loss, for society and the SR investor, if investing in case 1. In the third scenario the SR investor is provided with SV assessment information regarding the sustainability performance of Company A. Assuming that the SV information is positive (the corporate is outperforming it peers), the SR investor would allocate more capital to company A and thus also less to company B, with the perception that this is giving the highest sustainable return. However, assuming this would cause even greater efficiency losses for society and would present a great risk for market failure.

[1] While this thesis focus on the assessment of the natural resource carbon dioxide, the problem could be applied to all types of negative externalities assessed in corporate sustainability performance.

4. DATA PRESENTATION

In order to make the previously discussed theoretical methods empirical, the Data chapter will present the specific data needed and obtained. First, the scope of the study is presented with limitations and data inclusions. After that the company sample and data is described, including a list of companies assessed. The benchmarks are defined and data sources for the benchmarks discussed in the next section. The last section defines the data for the EE method, presenting the chosen estimated values and respective models, focusing on the social cost of carbon dioxide.

To meet the objective, sustainable value calculations will be conducted with the guidance of the ADVANCE study guidelines to Sustainable Value Calculations (Figge et al., 2006). The first step in calculating the Sustainable Value is to choice the scope of the analysis. The ADVANCE study proved to be giving meaningful results when it came to both intra-sector and inter-sector analysis, therefore this study will focus on both inter-sector and intra-sector analysis in the Swedish economy. The chosen sectors, corporates and benchmark data will be defined in the sections below. The estimations will be made using Microsoft Excel.

The scope of the analysis will also be defined by the inclusion of resources. In this context it is highly relevant to choose the resources (Economic, Environmental, and Social) that can be measurable and quantifiable in a meaningful way. The Sustainable Value is not restricted to an assessment of the use of environmental resources, however in this study the assessment will focus Carbon dioxide (CO_2) emissions. The CO_2 emissions are measured in metric tons. In line with the Statistic Sweden (SCB), emissions of CO_2 refer to the net contribution to the atmosphere, which means that emissions from biofuels (wood fuels, liquors and tall oil) are excluded.

The economic resources are the capital use of a company, this can be measured in terms of total assets of a company or fixed assets. In this study the sum of key figure EBITDA (Earnings before interest, taxes, depreciation and amortizing) and personnel expenses will be used as measurement for how much return the company creates with its economic resources (Gross Value Added). This is in line with the ADVANCE guidance guidelines (Figge et al., 2006).

Time horizon is another important factor to consider for the scope of the assessment. In this case the decision was made to make the study as "up to date" as possible using the year 2012. This will increase the possibility of the inclusion of environmental data (CO_2 reporting) in the coverage, due to the fact that such data availability has increased in later years and the calculations of such are more complete. Limiting to 2012 also increase the likelihood of finding sustainability reports. Unfortunately it was not possible to use data from a more recent year due to non-existing environmental data for the sector benchmark. Looking at data from only one year also has the advantage of minimizing the risk of corrections for adjustment in subsequent years due to restructuring of a company or adjustment in calculations made by the company.

In short, the scope of the data:

- The sustainable value of 19 companies in Sweden
- Review period: Year 2012
- Indicators: Environmental (CO_2-emissions), Economic (GDP, Gross Value Added)
- 5 sectors
- 6 benchmarks

The study relies on data and other information from publicly available corporate reports, online databases, and publications.

4.1 COMPANIES

There are three major criteria's that the companies selected must fulfill for the scope of this thesis. They must all be registered in Sweden, have a direct effect on the environment in addition to that the environmental and financial information must be publicly available in the recent desired year (2012). The economic and environmental indicators assessed include; the return figure of the company (Gross Value Added), Total cost and the CO_2-emissions within the production processes.

The sample consists of 19 firms in the Swedish economy in the year of 2012. The sample is chosen based on the 20 largest corporates by turnover in the Swedish economy, according to the database Retriever AB, according to the above criteria's. Despite intense data collection efforts, a number of companies had to be excluded from the list due to missing environmental data. One must remember that the reporting on environmental data is not standardized and the scope of the study is limited due to the quality and scope of the data on the resources. Seven of the corporates did not report their CO_2 emissions and thus had to be excluded from the study. However, to increase the scope of the study an inclusion of companies in specific sectors was selected. A total of 19 companies in six sectors could be included, matching the criteria's and the scope of the study.

The company data includes the economic and environmental indicators. Unlike traditional accounting data on financial information, the environmental data is more restricted and can vary in its scope and calculation, therefore a section below is devoted to the treatment of data for the environmental resource CO_2.

The data source on financial information is from Retriever AB accessed via Uppsala University and the university library. Retriever is a research tool and database for evaluating and measuring corporate and media information. As describe above, the sum of key figure EBITDA (Earnings before interest, taxes, depreciation and amortization) and personnel expenses will be used as measurement for how much return the company creates with its economic resources. The figure is an approximation of the Gross Value Added (GVA) used by the recommendation of Figge and Hahn (2006). EBITDA is an accounting figure and allows the comparison of performance of one corporate to another, showing a company's present operating profitability eliminating the effects of accounting and financing decisions.

$$Gross\ Value\ Added = EBITDA + personnel\ expences$$

The personnel expense figure is calculated using the total amount of employees times the personnel expenses per employee. All figures are reported in the Swedish currency figure SEK for the financial year 2012. The variable will be named Gross Value Added.

The total cost figure for 2012, which will be used for calculating the financial rate of return in the SR investor chapter, is also taken from the database Retriever AB. The figure comprise of all 10 cost items found under income statement (resultaträkning) for each corporate. However, not all 10 cost items were available for the corporate sample, the majority of the corporates had data for 6 items, while two corporates (E.ON and Gina Tricot) had data for 4 items. Overall the total cost figure is relatively low in relation to GVA, which should be kept in mind for the coming result.

One of the main sources of information for this study is the publicly available corporate reports. The environmental/social key figures are collected from the annual reports, publications and sustainability reports of the selected corporates. As discussed earlier, the companies included must report on their CO_2 emissions. This study will assess the direct (scope 1) and indirect (scope 2) CO_2 emissions. More specifically, the study considers the carbon dioxide emission that arise directly from sources owned or controlled by the company and emissions generated by purchased electricity consumed by the company. Using this indicator (CO_2 emissions) the environmentally damaging activities of the specific company can be assessed specifically linked to their processes. Adding scope 1 and 2 is recognized as a good starting point for company comparison.

One of the main concerns when collecting the data for the environmental figures (as well as in the case of social figures) has been the availability, disclosure and comparability of the data. While transparency of corporate sustainability performance has increased rapidly in the last years, disclosure and reporting is still not of standard principle. The CO_2 reporting has been driven by the GHG protocol (providing the scopes), however, as discovered in the data collection process, corporates still seem to put their own interpretations in context and do not report in a systematic manner. For example, data on CO_2 could be presented in a bar chart with inadequate exact figures, resulting in imperfect information.

In table 1 below, the sample of companies is presented along with sector specification, Gross Value Added, CO_2 in ton and Total cost figure for the year 2012.

Table 1 Companies chosen with Gross Value Added, CO_2 data and Total cost*

Company name	Sector	Gross Value Added	CO2 (ton) 2012	Total cost
Aktiebolaget Electrolux	Manufacturing industry	7 418 057 101	690000	105 747 000
Aktiebolaget Volvo	Manufacturing industry	32 151 982 600	858800	286 573 000
ASSA ABLOY AB	Manufacturing industry	8 477 705 018	438900	39 948 000
Atlas Copco Aktiebolag	Manufacturing industry	21 910 124 964	332000	63 901 000
Axfood Aktiebolag	Commerce	1 832 896 994	30539	35 404 000
E.ON Sverige Aktiebolag	Public utility supplier	12 816 950 003	134300	8 892 000
Gina Tricot AB	Commerce	111 538 068	5824	1 323 100
H & M Hennes & Mauritz AB	Commerce	25 479 918 120	325 551	99 050 000
ICA Sverige AB	Commerce	3 082 610 586	134663	58 742 000
NCC AKTIEBOLAG	Construction	3 155 283 949	245000	55 049 000
Peab Sverige AB	Construction	65 731 257	148416	46 400 000
Sandvik Aktiebolag	Manufacturing industry	13 855 656 943	523000	87 104 000
SCANIA Aktiebolag	Manufacturing industry	12 743 039 983	266900	72 744 000
Skanska AB	Construction	5 563 116 059	430721	126 766 000
Svenska Cellulosa Aktiebolaget SCA	Manufacturing industry	11 575 811 013	3205000	78 276 000
Tele2 AB	Telecommunications	10 369 903 022	6910	216 539 000
Telefonaktiebolaget L M Ericsson	Manufacturing industry	19 010 099 540	909000	39 267 000
TeliaSonera Aktiebolag	Telecommunications	41 297 946 110	84395	87 191 000
Vattenfall AB	Public utility supplier	34 848 147 981	400000	160 492 000

*For more specific information on data used for each company the appendix will provide a full list of sector affiliation, corporate data, calculations and sources for data on CO_2 emission.

Sources: See appendix

4.2 BENCHMARKS

The benchmark selection is a crucial variable for the result, as it defines whether the value contribution of a firm is positive or negative. The companies CO_2 efficiency will be compared with that of the benchmark. In the ADVANCE guide (Figge et al., 2006), they are using EU15 economy as a benchmark, comparing the efficiency of the companies selected to the average efficiency of the EU15 countries (dividing the return of the benchmark by the amount of resource used). However, as also suggested by the authors, the SV analyses can be conducted with different benchmarks and as the benchmark efficiency defines the “hurdle” that companies must pass to create SV, it is important to determine it carefully.

For this thesis the sample include Swedish corporates from a variety of sectors. Therefore the sample of benchmark will include a variety of categories for creating greater explanatory power to the assessment of Sustainable Value. At the benchmark level, the economic variable (return figure) should correspond to the corporate level figure. On the corporate level the Gross Value Added figure is used and thus the economic benchmark figure should be defined accordingly. To make the comparison, Gross Domestic Product and GDP contribution on the sector level is used. The year considered is off course also corresponding to the company data, 2012.

List of benchmarks, marked in bold.

- **Swedish economy**
- Sector benchmarks
  - **Manufacturing industry**
  - **Commerce**
  - **Construction**
  - **Utilities**
  - **Telecommunication**

4.1.2.1 SWEDISH ECONOMY

Figge and Hahn (2006) suggest the use of the national economy figure as benchmark. Thus, the Swedish GDP and the national total emission release are used. The advantage here is also that a comparison can be made against all industries in the Swedish economy. The data collection will be conducted using national statistics from Statistics Sweden (SCB), a source that is considered highly reliable. In this scenario, corporates can create a positive Sustainable Value if they use their resources more efficiently than the national average benchmark.

Table 2 Data for Swedish benchmark

Benchmark	GDP	CO2 (ton)
Sweden	3 684 800 000 000	53 634 509

Data for the total CO_2 emissions to air is taken from SCB and calculated from the total amount of CO_2 from each sector for the year 2012 (53 634 508 metric tons). The biogenic CO_2 emissions are excluded. On the national level, GDP (Gross domestic product) is used as the economic variable of estimating the sum of the nation's economic activity and corresponds to the GVA of the corporate data as it measures output. The GDP data is collected from Statistics Sweden.

4.1.2.2 SECTOR BENCHMARKS

To create greater explanatory power to corporates within sectors and compare their performance to other peers, sector benchmarks are chosen to determine the SV. The benchmarks are defined according to sector affiliation. The sectors are separated according to Retrievers branch classification "bransch huvudgrupp" and translated into equivalent English classification in accordance with the Sweden statistics definitions (SNI2007). Thus, five sectors can be distinguished.

Table 3 Data for sector benchmarks

Sector benchmarks	GDP contribution	CO2 (ton)
Manufacturing industry	559 308 000 000	15 034 210
Commerce	352 366 000 000	1 414 734
Construction	180 787 000 000	2 304 025
Utilities	89 593 000 000	6 937 476
Telecom	40 506 000 000	19 301

The data on GDP from production for each sector (2012) is retrieved from the statistical database at SCB. The data on emissions to air (ton of carbon emissions for each sector, 2012) is retrieved from the Environmental accounts at SCB's webpage. The sector classifications are based on SNI 2007, the Swedish standard for industrial classification based on EU's recommended standard NACE Rev.2.

The second benchmark is the sector *Manufacturing industry,* corresponding to *Tillverkning & Industri* according to Retriever classification and C10-C33 *Tillverkingsindustrin* according to SCB. A number of sector specific industries are included here (Electrolux, SKF, Volvo, ASSA ABLOY, Atlas Copco, Sandvik, SCANIA, SCA, Ericsson), for a full classification see Appendix. Sweden has a large and internationally active manufacturing industry. The industry plays an important role with respect to progressive environmental actions. The need for environmental sustainability creates both restrictions as well as opportunities for the industry. Reducing the environmental impact from their processes with energy efficient actions, material reuse and by offering high-tech energy preserving technologies is both challenging and a necessity for the corporates (Mitsuishi, Ueda, & Kimura, 2008). The sector accounts for approximately 28% of Swedish carbon emissions in 2012. However, it's highly important to note that a small number of industries account for a majority of the sectors energy usage.

The third benchmark chosen is the specific sector *Commerce*. A comparison can be made to other businesses that produce the same type of service, namely wholesale and retail trade services (Axfood, H&M, ICA Sverige, Gina tricot). The data on emissions for the whole sector is retrieved from the statistical database SCB Statistics Sweden. I had contact with the person responsible for the statistical data update on "emission to air divided per sector SNI 2007 and year 2008-2012" to clarify the variable classifications. The benchmark variable "commerce" G45-47 will be used, according to the classification of SCB and SNI 2007. The data on the sectors economic contribution to GDP is also retrieved from SCB, based on the same sectors G45-47, which includes wholesale and retail business (excluding automobiles). On the corporate level (information from Retriever) two sectors "Partihandel" and "Detaljhandel" compose the sector *Commerce* based on two reasons. First, the similarity of retail and wholesale in production processes, second, to match the Sweden Statistics classification (SNI 2007).

The sector *Construction* corresponds to SCBs classification "F41-43 Byggverksamhet, and Bygg-, Design- & Inredningsverksamhet" according to Retriever. Three companies are included from the sector (NCC, Peab, Skanska). Public utility supply (Utilities) is the sector which comprise of corporates in electricity, gas, stem and air conditioning supply, corresponding to SCBs "*D53 El-,gas- och värmeverk"*. There are two corporates included in this sector (Vattenfall and E.ON). The last sector benchmark, Telecommunication, corresponds to SCBs classification "*J61 telekommunikation* and Data, IT & Telekommunikation" according to Retriever. There are two companies included in this sector in the thesis (TeliaSonera, Tele2).

4.3 DATA FOR SOCIAL COST METHOD

The data for the environmental economic (EE)-method is based on the estimation of the social cost of carbon emissions. There have been a wide range of estimates for calculating the social cost of carbon (or CO_2), depending on the different choices of model, impact measures, discount rate, valuation of non-economic impacts, treatment of equity etc. Over 100 estimates of the social cost are available, therefore span of the estimates is large, from US$-10 to US$ +350 per ton of carbon (Parry, 2007). Thus, it's evident that the data for calculating the social cost of carbon comes with many uncertainties and complications. Therefore this thesis will consider **two** different methods of assessing the value in monetary terms, demonstrating the uncertainty of such estimates but also giving more options of meaningful comparison.

The first estimate considered is used by the Environmental Protection Agency (EPA) and constructed by the interagency working group (IWG) on social cost of CO_2, US government (2010). One of the main reasons for choosing the SC-CO_2 estimate modeled by the interagency group for this thesis is due to the fact that they use an integrated assessment model based on the three well known models DICE, FUND and PAGE model (US EPA, 2015). Each model translates the emissions into changes in temperature and warming into economic damages, taking different approaches of doing so. In DICE for example, the temperature affects both consumption and investment. In FUND the damages also depend on the rate of temperature change in the previous period. While in the PAGE model, the consumption equivalent damages are calculated as a fraction of GDP (in each period), subject to the temperature in that period relative to the average temperature in each regions pre-industrial period. The SCC is calculated given an equal weight of the three models (Greenstone, Kopits, & Wolverton, 2011).

In July 2015, the SCC estimates where revised and updated accordingly. The updated version of the model gives a higher estimate compared to those reported by the government in 2010, much due to the improvements in damages modelling. As discussed in the theoretical chapter, the discount rate has a major impact on the outcome. Thus, the estimates for each year are dependent on the choice of discount rate (2.5, 3 and 5 percent), as can be seen in the table below (US EPA, 2015). These values are based on the mean SCC across the models, while the 95^{th} percentile at a 3 percent discount rate represent the higher than expected economic damage impacts from climate change of the SCC distribution (Greenstone et al., 2011).

Table 4 shows the four selected SCC estimates in from 2010 to 2050 in five year increments. The values for every decade (2010, 2020, 2030, 2040, and 2050) are calculated by combining all outputs (10,000 estimates per model run) from all scenarios and models for the given discount rate (Greenstone et al., 2011). The SCC value increase over time due to expected assumption that emissions in the future are expected to produce larger incremental damages. The three percent discount rate is the so called central value. The central value represents the average SCC of the models at the three percent discount rate and is the "most likely" value. According to the IWG the three percent is consistent with the estimates provided in economics literature as well as the guidance for consumption rate of interest.

Table 4 Social Cost of CO_2, 2010-2050 (US EPA, 2015)

Revised Social Cost of CO2, 2010 – 2050 (in 2007 dollars per metric ton of CO2)	5.0%	3.0%	2.5%	3.0%
Year	**Avg**	**Avg**	**Avg**	**95th**
2010	10	31	50	86
2015	11	36	56	105
2020	12	42	62	123
2025	14	46	68	138
2030	16	50	73	152
2035	18	55	78	168
2040	21	60	84	183
2045	23	64	89	197
2050	26	69	95	212

For this thesis, the central value is used and estimated in 2012 Swedish currency. Accordingly, calculating the dollar value of 3 percent discount rate in 2010 (US$31) in 2012 monetary value, the cumulative rate of inflation was 5.3% and the value $32.64 (using http://www.usinflationcalculator.com). This value had to be converted into the Swedish currency and thus calculated from the exchange rate (8.6831) from current date and time (2015-11-12 10:10:51) to receive a value of 283.42 SEK. This monetary value had to be converted into 2012 figures and thus the outcome is a value of 284.66 SEK based on the consumer price index ("Prisomräknaren," 2015). Thus, the social cost of CO_2 in Swedish currency of 2012 is 284.66 SEK, according to the SCC estimate of the interagency working group.

However, this study will also consider a second option for the social cost/economic damage of carbon dioxide emission, by reason of the many uncertainties involved. The second selected value is based on a recent study, conducted by two Stanford scientists (Moore and Diaz, 2015), denoting that the actual cost could be significantly higher compared to the estimations from the US government study, which justify for more stringent mitigation measures and the need increased efforts to curb greenhouse gas emission(Than, 2015).

The estimations are conducted using the integrated assessment model DICE (Dynamic Integrated Climate-Economy), with some modifications. The modifications include; allowing for climate change to affect the growth rate of the economy (through total factor productivity and capital depreciation), accounting for adaptation to climate change and distinguish between two regions of high- and low-income countries (Than, 2015). The estimation of the so called gro-DICE reveals that one additional ton of CO_2 emission in 2015 reduce the net social welfare by US$220 (Moore & Diaz, 2015). This shows that allowing for the inclusion of the modifications, can increase the SCC significantly and demonstrates that if climate change not only affect a country's economic output but also its growth, the social cost of carbon will be much higher than many precious studies expected(Than, 2015).

Therefore this study also includes this second option of SCC in the analysis. The so called gro-DICE value of $220 also had to be converted into 2012 Swedish monetary value. For that reason, 220 USD was converted into 2012 USD value, which resulted in $212.28 (cumulative rate of inflation -3.5%). Converting this dollar value into Swedish currency resulted in a value of 1843.54 SEK (based on exchange rate 2015-11-12). In addition, this value had to be converted into 2012 figures and therefore the outcome, based on the consumer price index, is a value of 1851.61 SEK in 2012.

Table 5 Data for social cost calculations

DATA	Source	Social cost of CO_2 (SEK)
Central value (3 %)	EPA and IWG	284.66 sek
gro-DICE model	Moore & Diaz	1851.61 sek

Accordingly, there are two values of expressing the cost of carbon emission for this study. The **Central value**; estimated from an integrated assessment model based on DICE, PAGE, FUND and the **gro-DICE value**; based on the DICE model with modification on the effect on growth rate of the economy, resulting in two highly diverse values of estimating the social cost of one ton of carbon dioxide emissions in 2012 Swedish monetary values. These values will lay the ground for calculating the Social cost of CO_2 for each company chosen in this study.

5. RESULTS – DATA ANALYSIS AND FINDINGS

In this chapter the results of the data analysis are presented. The findings include the result from the SV calculations and the EE method for assessing marginal cost of externalities and sustainability performance of corporates.

5.1 SUSTAINABLE VALUE METHOD

Based on the calculations of the SV method, the Sustainable Value is presented as well as the Return to Cost Ratio for each company assessed in every benchmark. The result gives insights to both intra-sector and inter-sector analysis. One of the main research questions in the thesis can be answered here; *How much sustainable value, measured with the Sustainable Value approach, is created by 19 Swedish companies in the 5 sectors?*

SWEDISH ECONOMY

When comparing the total sample of companies (19) to the benchmark Sweden it reveals some interesting results. The majority of companies have a negative value contribution (73 percent) based on the calculations of economic and environmental resource use. This means that these companies use their resources less efficient than the benchmark. A closer look also reveals that some sectors used their environmental resource in a value creating way compared to the Swedish benchmark. More specifically, the companies included in the Public utility suppliers (Vattenfall and E.ON) and Telecommunication sector (TeliaSonera and Tele2) both generate a positive value. H&M is the only company in the Commerce sector that used it environmental resource in a value creating way, compared to its peers. In other words, the four companies who achieved a positive Sustainable Value in 2012 would have created an additional amount of GDP, ranging between 35bn to 3bn SEK, compared to if the resources had been used by the Swedish economy on average.

Table 6 Company ranking based on SV contribution (using Swedish benchmark)

Company name	Value contribution
TeliaSonera Aktiebolag	35 499 837 731
Tele2 AB	9 895 171 949
Vattenfall AB	7 367 333 344
E.ON Sverige Aktiebolag	3 590 266 489
H & M Hennes & Mauritz AB	3 113 901 405
Axfood Aktiebolag	- 265 194 502
Gina Tricot AB	- 288 582 593
Atlas Copco Aktiebolag	- 898 951 185
SCANIA Aktiebolag	-5 593 533 584
ICA Sverige AB	-6 169 011 768
Peab Sverige AB	-10 130 750 206
NCC AKTIEBOLAG	-13 676 715 017
ASSA ABLOY AB	-21 675 618 843
Sandvik Aktiebolag	-22 075 508 196
Skanska AB	-24 028 293 845
Aktiebolaget Volvo	-26 849 326 427
Aktiebolaget Electrolux	-39 986 348 149
Telefonaktiebolaget L M Ericsson	-43 440 051 723
Svenska Cellulosa Aktiebolaget SCA	-208 614 216 270

Table 7 Company ranking based on RCR

Rank	Company name	RCR
1	Tele2 AB	22
2	TeliaSonera Aktiebolag	7,1
3	E.ON Sverige Aktiebolag	1,4
4	Vattenfall AB	1,3
5	H & M Hennes & Mauritz AB	1,1
6	Axfood Aktiebolag	1,1
7	Atlas Copco Aktiebolag	1,0
8	SCANIA Aktiebolag	1,4
9	Aktiebolaget Volvo	1,8
10	Sandvik Aktiebolag	2,6
11	ICA Sverige AB	3,0
12	Telefonaktiebolaget L M Ericsson	3,3
13	ASSA ABLOY AB	3,6
14	Gina Tricot AB	3,6
15	Skanska AB	5,3
16	NCC AKTIEBOLAG	5,3
17	Aktiebolaget Electrolux	6,4
18	Svenska Cellulosa Aktiebolaget SCA	19
19	Peab Sverige AB	155

Table 8 Sector ranking based on average RCR

Telecom	10,9
Utilities	4,3
Commerce	3,7
Manufacturing industry	4,9
Construction	55,3

The data result also indicates that there are wide varieties in the performance of individual companies. The least efficient company (SCA) creates significantly less return with its resources compared to the benchmark and all the other companies assessed. The inefficient performance of SCA probably lies in the fact that the company emits (and account for) a considerable amount of CO_2 compared to its peers. The company is part of a high emitting industry (pulp and paper), which by its natural manufacturing process of paper emits large amount of CO_2, the sector is said to be the 4^{th} largest emitter of greenhouse gases among U.S manufacturing industries ("Environmental Professionals Network," 2014). Not surprisingly, there are also other manufacturing corporates at the bottom of the table 6, however varying in the scope of negative value creation. Atlas Copco is the company in the sector with the least negative value (-898million), followed by SCANIA with almost 6 times more negative value.

The majority of the corporates at the top of the table generate less CO_2 emission than the ones in the bottom, however there is no strong correlation between the Sustainable value and tons of CO_2 emission release.

When accounting for company size according to eq. (6) in Section 3, the result provides a slightly different outcome (seen in Table 7). The ranking of the corporates get affected by correcting for company size with RCR. The table below reveals that in 2012, the position of the best performing Telecommunication sector and Utilities suppliers is changed (switches spot), and that the best performing company (Tele2 AB) is about 22 times more efficient than the benchmark in Sweden. The worst/least efficient company (Peab) shows a negative RCR of 155, way behind its peers in the Construction sector(Skanska and NCC), of 5,3 times less efficient use than the Swedish economy on average.

The sector comparison (see Table. 8), calculated by the average return to cost ratios of the respective companies, show that the Telecom and Utilities sector is in the top while the Construction, Manufacturing industry and Commerce sector can be found in the bottom. However, the interpretation of the result should be treated with caution as there can be vide differences within one sector. Not surprisingly the telecommunication sector is in the top, using its resources almost 11 times more value creating than the Swedish economy on average, the sector is not a raw material resource user and does not require CO_2 for production processes.

SECTOR BENCHMARKS

Table 9 Benchmark comparison

	Sustainable Value	
Company name	Benchm. Sweden	Benchm. Sectors
TeliaSonera Aktiebolag	35 499 837 731	-135 817 429 778
Tele2 AB	9 895 171 949	-4 131 752 851
Vattenfall AB	7 367 333 344	29 682 407 588
E.ON Sverige Aktiebolag	3 590 266 489	11 082 552 666
H & M Hennes & Mauritz AB	3 113 901 405	-55 604 655 847
Axfood Aktiebolag	- 265 194 502	-5 773 412 937
Gina Tricot AB	- 288 582 593	-1 339 038 213
Atlas Copco Aktiebolag	- 898 951 185	9 558 943 492
SCANIA Aktiebolag	-5 593 533 584	2 813 731 745
ICA Sverige AB	-6 169 011 768	-30 457 731 739
Peab Sverige AB	-10 130 750 206	-11 579 838 297
NCC AKTIEBOLAG	-13 676 715 017	-16 068 819 522
ASSA ABLOY AB	-21 675 618 843	-7 850 408 079
Sandvik Aktiebolag	-22 075 508 196	-5 601 174 111
Skanska AB	-24 028 293 845	-28 233 720 966
Aktiebolaget Volvo	-26 849 326 427	202 601 129
Aktiebolaget Electrolux	-39 986 348 149	-18 251 567 043
Telefonaktiebolaget L M Ericsson	-43 440 051 723	-14 806 840 093
Svenska Cellulosa Aktiebolaget SCA	-208 614 216 270	-107 657 733 018

When calculating the SV of the corporates in each sector using the different sector benchmarks, it is interesting to see how the result changes. The majority of companies get the same sign (neg or pos), however there are companies that get quite a dramatic change depending on which benchmark chosen. For example, Atlas Copco and Scania, who got negative results when accounting with the Swedish benchmark, ends up getting large positive results when comparing to their sector peers. The opposite also occurs, with H&M, TeliaSonera, Tele2 having a positive SV compared to Swedish benchmark but a largely negative SV compared to its sector peers.

The result and possible reason for outcome for each sector benchmark is also discussed below. For sector tables with RCR result please see appendix.

MANUFACTURING INDUSTRY

There are eight companies assessed within the manufacturing industry sector for 2012. As can be observed in Table 9 above, the result show both positive as well as negative Sustainable Values and RCRs. This might be a result of the differences in sector specific belonging of the companies and their activities. The best performing company, Atlas Copco, contributes strongly to value creation in the Swedish economy (9.56 bn SEK), followed by SCANIA and Volvo. The outcome also shows that the company in the bottom is constant (SCA) in relation to the manufacturing industry, however with a less inefficient result (-107 bn) compared to the Sweden benchmark assessment (-208 bn). As discussed above, there are some particularities within the specific sector (pulp and paper) which SCA belongs to and thus the result should be analyzed and assessed under consideration. When accounting for company size with RCR, the ranking of the companies is only slightly changed, with ASSA and Ericsson switching place. The outlier continues to be SCA (over 10 times less efficient than the manufacturing industry average). Atlas Copco, Scania and Volvo use their environmental resources (CO_2 emissions) more (or equally) efficiently than the manufacturing industry. Atlas Copco creates environmental profit by using its resources 1.8 times more efficient than the other companies in the sector and thus contributed more to sustainability.

COMMERCE

When assessing the commerce sector in relation to the commerce benchmark, all four companies assessed are using their resources less efficiently than the benchmark. The table in appendix ranks the companies based on their RCR result and reflects the same ranking order as for the Swedish benchmark result. Within the specific sector *Clothing retail*, H&M used its resources three times less efficiently than the commerce sector on average. On the other hand Gina tricot, also clothing retailer, which despite a significantly less CO_2 intensive usage (5824 ton compared to H&M of 325.551 ton), is well below the commerce benchmark and can be found in the bottom of the table.

CONSTRUCTION

The construction sector turned out at the bottom of the sector comparison of the Swedish economy. Considering the intra-sector performance of the companies in the construction sector (NCC, Peab, Skanska) calculated with the benchmark Construction, all companies generate a negative result. The GVA (economic return) of Peab is considerably lower compared to its peers (65 713 257 SEK) and thus the RCR is strongly negative (creating 177 times less value than the construction sector on average), the company seem particularly CO_2 intensive compared to its capital use.

UTILITIES

Despite being a large contributor to overall greenhouse gas emissions, the Utilities sector and the two companies assessed (Vattenfall and E.ON) appear to use their resource in a value-creating way. In comparison to the benchmark of the Utilities sector, the two corporates use their resources about 7 times more efficiently. The intra-sector analysis reveals that despite the relatively higher Sustainable Value creation by Vattenfall, E.ON is ranked higher based on RCR.

TELECOMMUNICATION

There are two companies assessed in the Telecommunication sector (Tele2 and TeliaSonera). Both appear to create the highest Sustainable Value in the Swedish economy, however when analyzing them on the individual sector benchmark level, they use their resources in a value-destroying way. The result shows that TeliaSonera is lacking in its environmental performance and should improve and reduce its CO_2 usage considerably. With respect to the benchmark *Telecommunication*, the company gets a SV of negative -135 bn SEK and uses its resource about 4 times less efficiently than the Telecommunication sector average. In contrast, Tele2, which still is an underperformer compared to the benchmark, would have generated less negative value than TeliaSonera. However Tele2 also reveals a poor performance and is 1.4 less efficient than the benchmark.

5.2 EE METHOD- SOCIAL COST OF CARBON EMISSION

Based on the calculations of estimating the SCC for one ton of carbon emission in the two integrated assessment models chosen, the Central value and the gro-DICE value gives the result of the 19 companies assessed. The result gives an insight into the social cost of CO_2 for each company assessed, based on their reported CO_2 emissions.

Table 10 Social cost of CO_2 and ASR (two models estimate)

Company name	Central value	gro-DICE	ASR cv	ASR dice
Gina Tricot AB	1 657 860	10 783 777	0,985	0,903
Tele2 AB	1 967 001	12 794 625	1,000	0,999
Axfood Aktiebolag	8 693 232	56 546 318	0,995	0,969
TeliaSonera Aktiebolag	24 023 881	156 266 626	0,999	0,996
E.ON Sverige Aktiebolag	38 229 838	248 671 223	0,997	0,981
ICA Sverige AB	38 333 170	249 343 357	0,988	0,919
Peab Sverige AB	42 248 099	274 808 550	0,357	-3,181
NCC AKTIEBOLAG	69 741 700	453 644 450	0,978	0,856
SCANIA Aktiebolag	75 975 754	494 194 709	0,994	0,961
H & M Hennes & Mauritz AB	92 671 348	602 793 487	0,996	0,976
Atlas Copco Aktiebolag	94 507 120	614 734 520	0,996	0,972
Vattenfall AB	113 864 000	740 644 000	0,997	0,979
Skanska AB	122 609 040	797 527 311	0,978	0,857
ASSA ABLOY AB	124 937 274	812 671 629	0,985	0,904
Sandvik Aktiebolag	148 877 180	968 392 030	0,989	0,930
Aktiebolaget Electrolux	196 415 400	1 277 610 900	0,974	0,828
Aktiebolaget Volvo	244 466 008	1 590 162 668	0,992	0,951
Telefonaktiebolaget L M Ericsson	258 755 940	1 683 113 490	0,986	0,911
Svenska Cellulosa Aktiebolaget SCA	912 335 300	5 934 410 050	0,921	0,487

On the one hand, the result is not unexpected from the aspect that the corporates are ranked according to their amount of CO_2 emissions; with the largest CO_2 emitter (SCA) falling into the bottom of the table and the corporate with least CO_2 emission (Gina tricot) located at the top. On the other hand, the table also indicate the sector affiliation of each corporate, which give meaningful insight in terms of which sectors have the highest/lowest social cost of CO_2. As can be seen with the naked eye, based on the color affiliation, the manufacturing industry sector noticeably stands for the highest economic damage for its carbon emission.

More concrete, the calculations for the aggregate CO_2 in the manufacturing industry sums up to 7.2 bn tons of emitted CO_2, which is almost nine times as much as the second "worst" sector emitter, Construction (824 137 tons). In the table below, the aggregate result for the entire sectors are comprised, including the two SCC estimates. This result in a ranking with manufacturing industry in the top as worst performer, while the telecommunication sector end up in the bottom with values of almost 80 times less economic damage on the societal welfare compared to Manufacturing industry corporates.

Table 11 SCC for each sector

Sector	CO2 (ton)	Central value	gro-DICE
Manufacturing industry	7 223 600	2 056 269 976	13 375 289 996
Construction	824 137	234 598 838	1 525 980 311
Commerce	496 577	141 355 609	919 466 939
Utilities	534 300	152 093 838	989 315 223
Telecom	91 305	25 990 881	169 061 251

However, one should keep in mind that comparing sectors here might not give us meaningful result as the number of corporates included in each sector affiliation differs, and thus the outcome is rather insignificant.

Therefore, the average CO_2 emission for each sector is calculated, with the total CO_2 divided by the number of corporates included in each sector. The result show a slightly different outcome compared to the above ranking, as the Utilities and Commerce sector switch position. However, the manufacturing industry is still in the top. Table 12 also includes the average of the two SCC estimates, a result which indicate that the average manufacturing firm has a social cost of about 257 bn SEK based on the Central Value and about 1672 bn SEK based on gro-DICE.

Table 12 Ranking of sector per average CO_2 (ton)

Sector	Average CO2 (ton)	$\bar{x}$ Central value	$\bar{x}$ gro-DICE
Manufacturing industry	902 950	257 033 747	1 671 911 250
Construction	274 712	78 199 613	508 660 104
Utilities	267 150	76 046 919	494 657 612
Commerce	124 144	35 338 902	229 866 735
Telecom	45 653	12 995 441	84 530 626

Comparing the estimates of the Central value and the gro-DICE value, the results demonstrate the discussed deviate outcome of estimations with many uncertainties. In other words, the result shows the discussed concerns with the estimations of the social cost of carbon pollution as the integrated assessment models use their own assumptions and best available science to come up with the monetary value. With the gro-DICE model giving a value over six times higher than the estimated Central value (1851.61/284.66=6.501). Thus, assuming the one or the other estimate is incorrect, the social cost of carbon for the corporates (or sectors) will differ quite profoundly.

Considering the Adjusted size ratio (ASR), which can be seen in table 10, we see that $ASR_{ih}<1$, since $SC_{ih}<0$. This indicates that no company used it resources in a value creating manner as a result of their CO_2 emissions.

5.3 COMPARISON

This section compares the two different approached taken to assess corporate environmental impact and is an important step in the objective of evaluating whether the SV method can reduce efficiency losses from asymmetric information on environmental performance, as well as to analyze and answer the question; *Does the SV method give promising results according to economic theories on sustainability?*

Comparing the two result of company ranking based on the SV approach or the Social cost method, the outcome is two profoundly different table rankings. While four companies (Tele 2, Scania, Ericsson, SCA) ends up in the exact same position based on both approaches (SV using Swedish benchmark), the other fifteen companies are situated in different spots, indicting the vast difference in result depending on method choice. Some similarities can still be perceived, the majority of the manufacturing industry corporates are in the bottom of the tables, while the commerce and telecom sector corporates perform better. Interesting here is also to note that while the SV approach (using benchmark Sweden) indicate a positive sustainable value creation among five corporates, the SC methods indicate negative monetary values varying between -1 657 860 to -248 671 223 of those corporates. The result is expected as the SC method focus on the cost (burdens) that the corporate processes are to be responsible for, and the SV approach relates the corporate performance to the price (value) created in relation to the Swedish benchmark. However, this result relates to the main objective and thesis questions as it proves the huge difference in outcome of the methods. This give reason to believe that the SV method does not give promising result according to economic theories, as it can underestimate (or overstate) the corporates' environmental impact when compared to the social cost methods.

Table 13 Comparison of SV (two different benchmarks) and Social cost (two different methods)

	Sustainable value			Social cost of CO2	
Company	**Benchm. Sweden**	**Benchm. Sectors**	**Company**	**Central value**	**gro-DICE**
TeliaSonera Aktiebolag	35 499 837 731	-135 817 429 778	TeliaSonera Aktiebolag	24 023 881	156 266 626
Tele2 AB	9 895 171 949	-4 131 752 851	Tele2 AB	1 967 001	12 794 625
Vattenfall AB	7 367 333 344	29 682 407 588	Vattenfall AB	113 864 000	740 644 000
E.ON Sverige Aktiebolag	3 590 266 489	11 082 552 666	E.ON Sverige Aktiebolag	38 229 838	248 671 223
H & M Hennes & Mauritz AB	3 113 901 405	-55 604 655 847	H & M Hennes & Mauritz AB	92 671 348	602 793 487
Axfood Aktiebolag	- 265 194 502	-5 773 412 937	Axfood Aktiebolag	8 693 232	56 546 318
Gina Tricot AB	- 288 582 593	-1 339 038 213	Gina Tricot AB	1 657 860	10 783 777
Atlas Copco Aktiebolag	- 898 951 185	9 558 943 492	Atlas Copco Aktiebolag	94 507 120	614 734 520
SCANIA Aktiebolag	-5 593 533 584	2 813 731 745	SCANIA Aktiebolag	75 975 754	494 194 709
ICA Sverige AB	-6 169 011 768	-30 457 731 739	ICA Sverige AB	38 333 170	249 343 357
Peab Sverige AB	-10 130 750 206	-11 579 838 297	Peab Sverige AB	42 248 099	274 808 550
NCC AKTIEBOLAG	-13 676 715 017	-16 068 819 522	NCC AKTIEBOLAG	69 741 700	453 644 450
ASSA ABLOY AB	-21 675 618 843	-7 850 408 079	ASSA ABLOY AB	124 937 274	812 671 629
Sandvik Aktiebolag	-22 075 508 196	-5 601 174 111	Sandvik Aktiebolag	148 877 180	968 392 030
Skanska AB	-24 028 293 845	-28 233 720 966	Skanska AB	122 609 040	797 527 311
Aktiebolaget Volvo	-26 849 326 427	202 601 129	Aktiebolaget Volvo	244 466 008	1 590 162 668
Aktiebolaget Electrolux	-39 986 348 149	-18 251 567 043	Aktiebolaget Electrolux	196 415 400	1 277 610 900
Telefonaktiebolaget L M Ericsson	-43 440 051 723	-14 806 840 093	Telefonaktiebolaget L M Eri	258 755 940	1 683 113 490
Svenska Cellulosa Aktiebolaget SCA	-208 614 216 270	-107 657 733 018	Svenska Cellulosa Aktiebola	912 335 300	5 934 410 050

5.4 SOCIALLY REPSONSIBLE INVESTMENT

While the above comparison give meaningful insight to the different ranking and environmental performance of the corporates evaluated, the thesis also aims at exploring the possible outcomes for the socially responsible investor, answering the question; *What are the possible outcomes for the socially responsible investor, when decisions are based on the information provided by the SV approach?*

Thus, in order to make meaningful comparison of the information provided by the different methods, a calculation of the rate of returns was conducted. The rate of return was estimated by taking GVA minus the SV or Social cost, divided by the Total cost of the firm, reflecting the profit in relation to the cost on a yearly basis. The rate of return for the different information scenarios is presented in the table below (with SV being the Swedish benchmark).

Table 14 Rate of return with no information, social cost or SV information

		Social cost		
Company	**No information**	**Central value**	**gro-DICE**	**SV**
Aktiebolaget Electrolux	0,070	0,068	0,058	-0,308
Aktiebolaget Volvo	0,112	0,111	0,107	0,019
ASSA ABLOY AB	0,212	0,209	0,192	-0,330
Atlas Copco Aktiebolag	0,343	0,341	0,333	0,329
Axfood Aktiebolag	0,052	0,052	0,050	0,044
E.ON Sverige Aktiebolag	1,441	1,437	1,413	1,845
Gina Tricot AB	0,084	0,083	0,076	-0,134
H & M Hennes & Mauritz AB	0,257	0,256	0,251	0,289
ICA Sverige AB	0,052	0,052	0,048	-0,053
NCC AKTIEBOLAG	0,057	0,056	0,049	-0,191
Peab Sverige AB	0,001	0,001	-0,005	-0,217
Sandvik Aktiebolag	0,159	0,157	0,148	-0,094
SCANIA Aktiebolag	0,175	0,174	0,168	0,098
Skanska AB	0,044	0,043	0,038	-0,146
Svenska Cellulosa Aktiebolaget SCA	0,148	0,136	0,072	-2,517
Tele2 AB	0,048	0,048	0,048	0,094
Telefonaktiebolaget L M Ericsson	0,484	0,478	0,441	-0,622
TeliaSonera Aktiebolag	0,474	0,473	0,472	0,881
Vattenfall AB	0,217	0,216	0,213	0,263

Before analyzing the result it's important to again mention the Total cost figure which comprise of figures from the data source Retriever, where the majority of the corporates had data for 6 figures (out of 10), while two corporates (E.ON and Gina Tricot) only had data for 4 figures. This evidently affects the result of the rate of return calculated and as can be seen in the table, E.ON especially has an extraordinarily high rate. Overall, the high rates can be explained by the small Total cost figures, which are probably not giving us full information when it comes to variable and fixed cost of the corporates. However, despite this limitation, the results give some meaningful outcomes.

As discussed in the theoretical chapter, a responsible investor is interested in information regarding both economic and environmental performance of the corporates. Thus for the analysis one must consider the different information scenarios in order to evaluate if there are efficiency losses to be made with different information. To exemplify, the top five corporates with respect to rate of return has been chosen in each information scenario, one can imagine that an investor invest a total of five million (one million in each corporate).

Table 15 Information scenarios with top five rates of return corporates

	Information scenario					
Company	**No information**	**Central value**	**gro-DICE**	**Company**	**SV**	**gro-DICE**
E.ON Sverige Aktiebolag	1,441	1,437	1,413	E.ON Sverige Aktiebolag	1,845	1,413
Telefonaktiebolaget L M Ericsson	0,484	0,478	0,441	TeliaSonera Aktiebolag	0,881	0,472
TeliaSonera Aktiebolag	0,474	0,473	0,472	Atlas Copco Aktiebolag	0,329	0,333
Atlas Copco Aktiebolag	0,343	0,341	0,333	H & M Hennes & Mauritz AB	0,289	0,251
H & M Hennes & Mauritz AB	0,257	0,256	0,251	Vattenfall AB	0,263	0,213
Sum	2,999	2,986	2,911	Sum	3,606	2,682

In the first scenario there is no information regarding the environmental performance (with respect to CO_2 emissions), the top five corporates have a shared return of 2,999 (E.ON, Ericsson, TeliaSonera, Atlas Copco, H&M). In the second scenario, the investor gets information regarding the social cost of the corporates' emissions and if using the central value method, the rate of return for the sum of the top five corporates would add up to 2,986 (same corporates), which is a decrease by 0,014. This can also be interpreted as an efficiency loss if the investor would have based its decision on no information (the same applies when using the gro-dice method, which results in an even greater efficiency loss of 0,089). The last scenario allocates the capital according to the SV approach, which does not favor the same five corporates. The investor will get a total SV calculated return of 3,606, investing in corporates, such as Vattenfall, which is not considered as a top five performer in the social cost methods. These firms give a net return of 2,682 when using the social cost calculated with the Gro-dice method. This results in an even greater efficiency loss of 0,229 (2,911-2,682), answering the thesis question compiled in the opening of this section.

6. DISCUSSION & CONCLUSION

This study was set out to explore the concept of sustainability assessment by considering the Sustainable Value approach proposed by Figge and Hahn (2004) for measuring corporate sustainable performance. More specifically, the thesis assesses the environmental performance of Swedish companies by accounting for their environmental indicator carbon dioxide emissions in 2012, using social cost calculations and the SV method. The motivation of the thesis objective is that inefficient use of environmental resources by corporates has the potential to create macroeconomic damages, and thus information concerning microeconomic performance can reduce the efficiency losses created by imperfect information.

The SV approach takes a rather original view on corporate sustainability performance. The approach measures value-creations in monetary terms, whereas the mainstream research focuses on burden-oriented measures to internalize externalities. While some SV practitioners have said it to be a very promising approach of assessing corporate sustainability performance, other stress the importance of measuring choices and quality disclosure for such methods the results of which might not necessarily lead to efficiency advances. Figge & Hahn (2008) argue for the use of Sustainable value approach in socially responsible and sustainable investment analysis. The authors claim that the unique features of the approach make it particularly suitable for assessment of corporate sustainable performance. Therefore, the aim was also to contribute with knowledge to SRI research from the economic perspective of considering efficiency losses from asymmetric information of using the approach. The potential of this work is to contribute with knowledge on the effects for investors (and overall sustainability) when using this type of third-party information.

The empirical findings are several, when considering the Swedish benchmark using the SV method. There are wide varieties in the performance of companies and five of them even get a positive sustainable value. However, the majority of companies assessed have a negative value contribution and unsurprisingly, the construction and manufacturing industry are the least value creating sectors based on average RCR. The result also show that the outcome changes depend on which benchmark is used. When considering sector specific benchmarks, some companies get large positive result while having negative result when using the Swedish economy benchmark. That being said, the benchmark selection becomes a crucial variable for the outcome and thus can create significant result errors for the user. To compare the SV approach result to environmental economic reasoning of accounting for damages, the social cost for one ton of carbon emission of two integrated assessment models was calculated. The sector ranking is similar to the SV approach; still, the social cost results show that all corporates have negative monetary values and $ASR_{ih}<1$, indicating that none of the corporates assessed actually have a positive sustainability value as a result of their CO_2 emissions. Important here is also to note that the two methods of social cost calculations (Central value, gro-DICE) gives highly deviating outcomes as there are many uncertainties when estimating the monetary cost of environmental damages from CO_2 emissions.

However, the company ranking with respect to cost of CO_2 emission differs between the social cost and the SV approaches, which is of main interest. It proves that it really does matter which type of assessment method we use for corporate sustainability performance as the SV approach can underestimate (or overestimate) the corporates environmental impact when compared to the social cost methods. This would contradict the reasoning by Figge and Hahn (2008) concerning the suitability for sustainable investment analysis, a flaw further verified in the calculations of the rate of return for the different information scenarios.

Following the logic of financial economic reasoning, an investor would invest in the corporates with greatest rate of return. For a socially responsible investor this would imply investing in a company with both strong economic and environmental performance in order to generate the greatest sustainable returns. For the SV approach to be promising, this would mean that it gives information which generates less efficiency losses than the information from social cost methods. However, the empirical result indicates that there are clear efficiency losses to be made if the investor bases it decisions on the SV approach information instead of no information at all. Thus, the research suggests that the SV approach does not reduce efficiency losses from asymmetric information on environmental performance and that it could affect the SR investor's outcome negatively. At the same time, the assumptions of a sustainable development made by Figge and Hahn (2004) have been critically examined in this study. The criterion for strong sustainability by economist is based on the idea that the level of natural capital must be non-declining, so supply of resources remains unchanged over time. Conversely, the SV approach (which is claimed to be based on strong sustainability), actually allows for declines in natural capital and thus the result cannot be promising according the economic theories on sustainability. While sustainability as a concept may be hard to define, as suggested by Pope, Annandale, & Morrison-Saunders (2004), having a clear understanding of the theoretical ideas behind it is fundamental. One might wonder if the SV methodology really had it clear from the start, as there has been critique towards the misspecification and assumptions made.

The findings of this study could influence further understanding of information provision by third-parties, especially in the field of socially responsible investments where information plays the role of identifying inefficient from efficient sustainable outcomes. Eco-labeling and third-party information has been suggested by economists to be a tool for reducing efficiency losses from asymmetric information, however as also suggested by Dranove & Jin (2010), the disclosure of corporate performance really is a two-edged sword as it allows for greater match for investors/consumers and sellers, but also increase the risk of information quality which may harm the welfare. The appeal of shifting production from dirty to clean firms discussed by Mason (2013), can be lost due to imperfect information of the SV approach. However, Mason (2013) also reflected upon the possible complications of labeling and especially the measurements of carbon emission, is highly challenging for the identification of green/clean firms. The complications may perhaps be the most important finding of the thesis, the information provided by the SV approach comes with many complications as it is limited and may suffer from high degree of subjectivity or perhaps even wrong information. The identified issues of empirical and theoretical findings show that the SV approach is not contributing to a sustainable transparency but could actually increase the efficiency losses if used by a SR investor. These findings show that by investing in a dirty firm, under the belief that it's actually green, create welfare losses and could increase unsustainable outcomes. How this finding may affect practice is difficult to say, however, it underlines the importance of a critical eye from SR investors when using third-party information.

At this point, it should also be highlighted that while this study is the first to assess the SV approach by considering economic reasoning of accounting for externalities through constructing an empirical research, the study is still restricted and face rather complex limitations. First of all there are data issues to consider, while the data for the environmental indicator CO_2 emissions is based on publicly available data and information from corporate sustainability reports and annual reports, the consistency and data quality from the corporates is a material issue. This limitation restricted the scope of the study, comparability as well as the information quality, reducing the statistical significance of the result. While the financial data is likely to be of sufficient quality, the environmental and social data can be subject to quality inconsistence much due to its relatively new introduction in the corporate reporting. At the same time, the environmental and social quantifiable measures might also be subject to the problem of greenwashing. The issue of greenwashing is about corporates presenting a misleading environmentally friendly image, to meet the consumer demand for sustainable services and goods. This is identified as a great challenge for consumers/investors (just think about the Volkswagen emissions scandal in 2015) and highlights the importance of third-party sustainability analysts to question the data provided by the corporates, to assure full information. As competition tightens, to become attractive from a sustainable perspective, corporates may well be reporting on the matters that "profits" them and outsource parts of their operations to third party companies to make it appear like they are lowering their environmental impact.

Regarding the social cost methods of accounting for carbon dioxide impact there are, as discussed in the study, many choices to be made for the impact measures and selections of model inclusions and thus the result comes with many uncertainties and reservations. However, by considering two different methods the wide range of impact measure was demonstrated and still proved to give meaningful result when comparing with the SV approach. Also, while it's difficult to say for example how the impact (and thus the value) would change with an increase in global temperatures, it would still imply the same ranking of corporates and thus the analysis with respect to SV would not change. The economic figure *Total cost* is another limitation discussed in the study, as it did not provide sufficient information for all the corporates and might not give perfect information, which points out the difficulty of finding full information when it comes to corporate data.

Another aspect of the restriction in this study is that it is limited to only one environmental indicator and thus the result should not be used as an indication for the corporates overall sustainability performance. However, the carbon dioxide emission indicator is still considered crucial in the context of a sustainable development and this study suggest corporates to achieve a net zero carbon footprint to be perceived as a more sustainable company. This means using renewable energy and avoiding carbon emission so that only unavoidable emissions are offset. Highlighting another limitation, the study is focused on minimizing the negative impact and reducing unsustainable practice and does not take into consideration that CSR performance is not only based on negative externalities but may well include positive ones. For example including Research & Development activities or compensating emissions by tree plantation or other projects, are also important indicators for corporate sustainability performance. Another important feature to consider is that the research does not reflect the full life cycle assessment (LCA) of the production, which if included, would increase the true environmental impacts of the corporates products. Today, several industries and companies have adopted LCA to improve their sustainability performance, label products and to develop business strategy. However, there are limitations with the assessment and due to lack of consistency and accuracy of data, inaccuracy is also a concern here.

Despite these limitations, there are still conclusions to be drawn. While this study focus on the corporate environmental impact of 19 large companies in the Swedish economy, the result could be seen as a suggestion on how to apply the SV approach to other sectors, corporates or economies. Application of the economic perspective on sustainable development and demonstration of how it can be realized by putting a monetary value on the corporates external costs, one of the fundamental areas of research for this study is identified. In particular, by considering two different ways of accounting for the external cost of carbon dioxide emissions the study shows the practical difficulties of integrating environmental considerations. In addition, the research evaluates whether the SV approach can reduce efficiency losses from asymmetric information on environmental performance. It is then dealing with the economic welfare effect information can have on consumers'/investors' decisions. Here it was pointed out that, by comparing the different approaches of taking into account external cost caused by environmental damages, the SV approach should not be considered as a fully relevant method for assessing the corporates environmental sustainability performance as it might increase the efficiency loss when comparing rate of return. Due to the increase in interest towards socially responsible investment management, the need for assessment methods on corporate sustainability is gaining importance and while the SV approach is considered to be a promising attempt in doing so, there are several shortcomings identified.

Finally, while some major problems have been identified with the SV approach, it is likely not to be limited to this specific method. The assessment of sustainability is multifaceted and the approach taken by Figge & Hahn (2004) should still be considered as a strong attempt towards greater transparency and quality disclosure. The difficulty of integrating sustainability indicators for investment decisions should not be underestimated and while the SV method did not provide fully satisfying result, the same critical thinking should be applied to any other measurement for corporate sustainability performance. To continue the research and add new logic to SRI thinking, research should focus on careful examination of methods practiced today and consider the possible welfare outcomes when decisions are based on imperfect information.

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8. APPENDIXES

APPENDIX 1.PREVIOUS SV STUDIES

Selections of studies that have implemented the method include:

Barkemeyer, R.; Figge, F.; Hahn, T.; Liesen, A.; & Müller, F. (2011). Sustainable ValueCO2 Creation by Pulp & Paper Companies. Sustainable Value Research: Leeds, Marseille and Berlin.

The study assesses the carbon performance of 25 companies in the global pulp and paper sector using the SVCO2 approach, with funding from The Swedish Foundation for Strategic Environmental Research (MISTRA). The result show considerable differences in the sustainability performance of the companies assessed and illustrates the value that has been destroyed by the most carbon inefficient pulp and paper companies (compared to their peers).

Müller, F.; Barkemeyer, R.; Figge, F.; Hahn, T.; Liesen, A. & McAnulla, F. (2012). Sustainable Value Creation by Nordic Companies. Sustainable Value Research: Leeds, Marseille and Berlin.

This paper is perhaps the one that is closest in the empirical assessment to the current thesis. The authors assess the sustainability performance of 89 companies across a variety of sectors in the Nordic countries during the time period 2006-2010. For this study, the authors focus on the use of economic capital and on the climate change impact of activities within the production process of the respective companies (carbon performance). Also, the use of these resources is assessed against the prospective economic development and political carbon emissions reduction targets for the year 2020.

Van Passel, S., Nevens, F., Mathijs, E., & Van Huylenbroeck, G. (2007). Measuring farm sustainability and explaining differences in sustainable efficiency. Ecological economics, 62(1), 149-161.

This study uses the SV approach to measure farm sustainability and sustainable efficiency of 41 dairy farms during the observed period (1995-2001). The robustness of the result is tested using different benchmarks and possible causes of observed differences are analyzed using an empirical model. The result demonstrate, according to the authors, that the SV approach is promising and provides good guidance for decision making of the sustainable development of agriculture. A challenging topic discussed in the paper is the consideration of positive externalities and the performance up or down the value chain.

Lundgren, R.,Öhman, M. (2010). Sustainable Value Creation –A case study with three major Swedish airlines. Umeå School of Business.

The paper use a case study approach to measure the sustainable value created by three selected Swedish airlines, focusing on the environmental performance in 2006. The analysis is conducted from airlines management perspective and the authors conclude that the method is highly usable as a complement to other financial methods and gives the manager anther perspective of what value is. It can aid various internal processes and the analysis of what advantages a “green” decision could have produced.

APPENDIX 2.COMPANY DATA

Financial data accessed from the database Retriever via Uppsala University. For specific information on the environmental data (CO_2 emission), please find the text below each company.

Aktiebolaget Electrolux	Data/Info
Sector	Manufacturing industry
Sector specific	Power appliance
Number of employees	59 478
Personnel expenses/employee	286,78
EBITDA (tkr)	7 401 000
CO_2 emission (tons)*	690000

*Data found on http://annualreports.electrolux.com/2014/en/sustainability/gri-amp-ungc/gri-index/environment/emissions-effluents-and-waste/. Based on chart EN 18: Total greenhouse gas emissions, including fugitive emissions.

Aktiebolaget Volvo	Data/Info
Sector	Manufacturing industry
Sector specific	Automobile
Number of employees	102 082
Personnel expenses/employee	519,02
EBITDA (tkr)	32 099 000
CO_2 emission (tons)*	858800

* Data found on two links, Total scope 1 and 2 carbon dioxide (234800 + 624000): Environmental data & Volvo GroupLogisticsServiceshttp://www3.volvo.com/investors/finrep/sr13/en/earningtrust/managingourvaluecha/production/environmentalmanage/environmental-manag.html, http://www3.volvo.com/investors/finrep/sr13/en/earningtrust/managingourvaluecha/production/transportandlogisti/transport-and-logis.html

ASSA ABLOY AB	Data/Info
Sector	Manufacturing industry
Sector specific	Security & door opening solutions
Number of employees	42 762
Personnel expenses/employee	297,11
EBITDA (tkr)	8 465 000
CO_2 emission (tons)*	438900

* Data found in Sustainability report (2012)https://www.assaabloy.com/Global/Sustainability/Sustainability-Report/2012/ASSA%20ABLOY%20Sustainability%20Report%202012.pdf page.19 Emission related to energy consumption + related to substances in industrial processes.

Atlas Copco Aktiebolag	Data/Info
Sector	Manufacturing industry
Sector specific	Manufacturer (industrial tools etc)
Number of employees	39 113
Personnel expenses/employee	463,4
EBITDA (tkr)	21 892 000
CO_2 emission (tons)*	332000

*Data found in Annual report (2013) page. 6 scope 1+2 + transport (3) = 105000+227000
http://www.atlascopco.com/Images/Atlas%20Copco%20Annual%20report%202013_tcm17-3551938.pdf

Axfood Aktiebolag	Data/Info
Sector	Commerce
Sector specific	Food retail & wholesale business
Number of employees	7 254
Personnel expenses/employee	537,22
EBITDA (tkr)	1 829 000
CO_2 emission (tons)*	30539

*Data from the Sustainability report (2014) page.11 calculated comprising: electricity consumption, business travel + transport data from 2013 (18726+10207+868+738) (
http://www.axfood.se/Global/H%C3%A5llbarhet/AXF_HAR_14_eng_webb.pdf

E.ON Sverige Aktiebolag	Data/Info
Sector	Public utility supplier
Sector specific	Electricity
Number of employees	3 755
Personnel expenses/employee	785,62
EBITDA (tkr)	12 814 000
CO_2 emission (tons)*	134300

*Data from Sustainability report (2013) page.52 scope 1+ 2 carbon emissions (129900+4400).
http://www.eon.com/content/dam/eon-com/Nachhaltigkeit/CSBericht_2013/Downloads/E.ON_Sustainability_Report_2013.pdf

H & M Hennes & Mauritz AB	Data/Info
Sector	Commerce
Sector specific	Clothing retail
Number of employees	72 276
Personnel expenses/employee	289,42
EBITDA (tkr)	25 459 000
CO_2 emission (tons)*	325551

*Data from Sustainability report (2013) http://sustainability.hm.com/en/sustainability/downloads-resources/reports/sustainability-reports.html#cm-menu . Page.55 Emissions in tonnes (scope 1+2) including renewables.

ICA Sverige AB	Data/Info
Sector	Commerce
Sector specific	Food retail and wholesale
Number of employees	4 872
Personnel expenses/employee	556,36
EBITDA (tkr)	3 079 900
CO_2 emission (tons)*	140450

*Data found In the Annual report (2014) http://www.icagruppen.se/arkiv/pressmeddelandearkiv/2015/ica-gruppen-publicerar-arsredovisning-for-2014/ Calculated from page 121 Scope 1 (köldmedia och egenägda transporter) Scope 2 (Energi, inhyrda transporter) (91+48816+961+84795).

Gina Tricot AB	Data/Info
Sector	Commerce
Sector specific	Clothing retail
Number of employees	
Personnel expenses/employee	1 080
EBITDA (tkr)	111 093
CO_2 emission (tons)*	5824

*Data from Sustainability report (2013) www.ginatricot.com/.../hallbarhetsredovisning_297x420_2013_webb.pdf . Page.20 calculations for direct (1) and indirect (2) carbon emissions.

NCC AKTIEBOLAG	Data/Info
Sector	Construction
Sector specific	Construction of buildings
Number of employees	18 175
Personnel expenses/employee	620,85
EBITDA (tkr)	3 144 000
CO_2 emission (tons)*	245000

*Data from Annual report (2014) http://viewer.zmags.com/publication/b8c7dc2a#/b8c7dc2a/14 page.15 based on chart for year 2012, Including scope 1 and scope 2 carbon emissions.

Peab Sverige AB	Data/Info
Sector	Construction
Sector specific	Construction & civil engineering
Number of employees	7 083
Personnel expenses/employee	527,92
EBITDA (tkr)	61 992
CO_2 emission (tons)*	148416

*Data from Sustainability report (2012) http://www.peab.se/hallbarhet/rapporter-policys/ page.22 Carbon emissions in Sweden and Norway. Including scope 1 +2 (excluding 3).

Sandvik Aktiebolag	Data/Info
Sector	Manufacturing industry
Sector specific	Metal & materials industry
Number of employees	49 385
Personnel expenses/employee	499,28
EBITDA (tkr)	13 831 000
CO_2 emission (tons)*	523000

*Data from Sustainability report (2012), Environment diagrams and tables http://www.sandvik.com/en/about-us/sustainable-business/reports/sustainability-report-2012/environment/. Scope 1 + Scope 2 excluding emissions from the transport of raw materials and finished products as well as travel.

SCANIA Aktiebolag	Data/Info
Sector	Manufacturing industry
Sector specific	Automotive industry manufacturer
Number of employees	33 835
Personnel expenses/employee	503,62
EBITDA (tkr)	12 726 000
CO_2 emission (tons)*	266900

*Data from Annual report (2012) http://www.scania.com/investor-relations/financial-reports/2012/scania-annual-report-2012.aspx. Page.3 emissions of CO2 in kton from production and transport of goods (75,3 +191,6)

Skanska AB	Data/Info
Sector	Construction
Sector specific	Construction and development
Number of employees	56 618
Personnel expenses/employee	478,93
EBITDA (tkr)	5 536 000
CO_2 emission (tons)*	430721

*Data from Annual report (2012) http://group.skanska.com/sv/investerare/rapporter-publikationer/arsredovisningar/ Page.77 Including scope 1 (371158) + scope 2 (59563) ton.

Svenska Cellulosa Aktiebolaget SCA	Data/Info
Sector	Manufacturing industry
Sector specific	Hygiene and forest products
Number of employees	33 775
Personnel expenses/employee	438,52
EBITDA (tkr)	11 561 000
CO_2 emission (ton)*	3205000

*Data from Sustainability report (2013) http://www.sca.com/sv/press/publikationer/hallbarhetsredovisning/ Page.62 Including CO2 (kton) fossil and bought electricity (1589+1622) excluding biogenetic.

Telefonaktiebolaget L M Ericsson	Data/Info
Sector	Manufacturing industry
Sector specific	Communication technology
Number of employees	112 758
Personnel expenses/employee	568,47
EBITDA (tkr)	18 946 000
CO_2 emission (ton)*	909000

*Data from Corporate Responsibility report (2014) http://www.ericsson.com/thecompany/sustainability-corporateresponsibility. Page.35 Using Co2e in ktonnes Including Direct and indirect emissions from business travel, product transportation and commuting (355+554).

TeliaSonera Aktiebolag	Data/Info
Sector	Telecommunications
Sector specific	Data, IT and Telecommunications
Number of employees	26 793
Personnel expenses/employee	483,19
EBITDA (tkr)	41 285 000
CO_2 emission (ton)*	84395

*Data from Sustainability report (2013) https://www.teliasonera.com/Documents/Reports/2013/TeliaSonera_SR2013.pdf. Page. 36 table EN16: Total direct and indirect greenhouse gas emissions by weight including all Nordic countries.

Vattenfall AB	Data/Info
Sector	Public utility supplier
Sector specific	Electricity production
Number of employees	33 059
Personnel expenses/employee	760,7
EBITDA (tkr)	34 823 000
CO_2 emission (ton)*	400000

*Data from Sustainability performance report (2012) http://corporate.vattenfall.se/om-oss/finansiell-information/finansiella-rapporter/arkiv-finansiella-rapporter-2009-2013/. Page. 12 Chart.Total CO2 per country (electricity and hear) 0,4 Mtonnes. Emissions from the use of electricity (scope2 according to the Greenhouse Gas Protocol) are included in direct emission data, since most electricity used is from Vattenfall's own generation.

Tele2 AB	Data/Info
Sector	Telecommunications
Sector specific	Data, IT and Telecommunications
Number of employees	8 379
Personnel expenses/employee	465,81
EBITDA (tkr)	10 366 000
CO_2 emission (tons)*	6910

* Data found in the annual report (2012) http://www.tele2.com/Documents/documents/TL2_AR12_ENG.PDF page 35.Tabel EN16 Direct and indirect GHG-emissions, tons CO2-eq.

APPENDIX 3. TABLES FOR SECTOR BENCHMARK

Tables with Sustainable Value and RCR result for each sector with chosen corporates using the specific sector benchmarks.

Company name	Sustainable Value	RCR
Atlas Copco Aktiebolag	9 558 943 492	1,8
SCANIA Aktiebolag	2 813 731 745	1,3
Aktiebolaget Volvo	202 601 129	1,0
Sandvik Aktiebolag	-5 601 174 111	1,4
ASSA ABLOY AB	-7 850 408 079	1,9
Telefonaktiebolaget L M Ericsson	-14 806 840 093	1,8
Aktiebolaget Electrolux	-18 251 567 043	3,5
Svenska Cellulosa Aktiebolaget SCA	-107 657 733 018	10,3

Company name	Sustainable Value	RCR
H & M Hennes & Mauritz AB	-55604655847	3
Axfood Aktiebolag	-5773412937	4
ICA Sverige AB	-30457731739	11
Gina Tricot AB	-1339038213	13

Company name	Sustainable Value	RCR
NCC AKTIEBOLAG	-16 068 819 522	6
Peab Sverige AB	-11 579 838 297	177
Skanska AB	-28 233 720 966	6

Company name	Sustainable Value	RCR
E.ON Sverige Aktiebolag	11 082 552 666	7,4
Vattenfall AB	29 682 407 588	6,7

Company name	Sustainable Value	RCR
Tele2 AB	-4 131 752 851	1,4
TeliaSonera Aktiebolag	-135 817 429 778	4,3