STOCKHOLM SCHOOL OF ECONOMICS

Master Thesis in Accounting and Financial Management

Does it Pay Off to be Environmentally Responsible?

A Study on European Firms

Jun Xu (40126) Maryna Boltenko (40122)

ABSTRACT

This paper investigates the link between environmental aspects of corporate social responsibility (CSR) and corporate financial performance for 160 European companies included in MSCI World from 2003 to 2006. By using the random effects regression model we study different dimensions of environmental risks and opportunities and their effects on corporate operating performance and market value. Environmental industry risk is found to be positively associated with operating performance and negatively associated with market value of the companies. The results also indicate a positive association between environmental and financial performance.

Keywords: environmental performance; environmental preparedness; operating performance; market value; European

Tutor: Professor Kenth Skogsvik

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Discussants: Marie Rasmussen

Andra Cristina Caragea

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Kenth Skogsvik

Professor, Stockholm School of Economics

Henrik Andersson

Assistant Professor, Stockholm School of Economics

Flemming Hedén

Senior Research Analyst and Product Manager, GES Investment Services®

Fredric Nyström

Key Account Manager, GES Investment Services®

Jing Lin

Alumna, Stockholm University

Per-Olov Edlund

Associate Professor, Stockholm School of Economics

Rita Moss

Business/Economics Librarian, University of North Carolina at Chapel Hill

Table of Contents

"To gain a good reputation, endeavor to be what you desire to appear"

Socrates

1. Introduction

1.1 Background

Nowadays business has a leading position in creating wealth, generating employment, utilizing natural resources, and attracting investment. Large multinational corporations play an important role in public policy, especially in countries with low standard of governance and in situations when governance mechanisms are inadequate. Economic power is shifting to corporations, implying their increasing role and responsibility for addressing social problems.

The idea that companies have a function other than merely the pursuit of profit, but also they need to consider the approach of making profits, is central for understanding the notion of corporate social responsibility (CSR). The perception of stakeholders and the role of values are important elements of CSR. Firstly, firms are seen as being responsible not only to the investors, i.e. shareholders and debt-holders, but rather to a variety of stakeholders and the society as a whole. Secondly, the concept of CSR is closely linked to business ethics, which considers how companies manage to integrate such values as honesty, integrity, respect, and fairness into their policies, practices and decision-making.

Different definitions of CSR stress the business-society interaction and share the idea that companies have a responsibility for the public good. The World Bank defines CSR as *"the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life, in ways that are both good for business and good for international development*"[1]. However, no single definition is sufficient to capture the range of issues, policies, processes, and initiatives covered by CSR.

There are many examples from the business life, suggesting the benefits of adoption of the CSR principles to corporate performance. For example, Philips Electronics' Marathon light bulbs - eco-friendly, energy-saving fluorescent bulbs - reached 12 per

[1] World Bank, www.worldbank.org/privatesector

cent yearly expansion in a normally stagnant market. When Ford enhanced energy efficiency at its North American production factories by 18 per cent and decreased water use by 5 billion gallons, it saved millions of dollars (Blowfield and Murray, 2008). Moreover, not paying enough attention to CSR could lead to a number of risks, such as threats to the company's reputation, acts exposing the company to costly lawsuits, harm to the company's ability to recruit or retain top quality co-workers, etc. All these issues affect financial performance and require significant attention to be given to CSR. Companies are not limited to focus on the abovementioned operational responsibilities, but could also consider the citizenship responsibilities, such as access to education, reducing inequality, ensuring environmental sustainability, etc. A firm cannot ignore the problems of the environment in which it operates.

Limited financial resources, however, imply that even the largest and the most profitable corporations need to choose what to prioritize. No doubt, that adopting CSR principles involves extra costs. Therefore, it is questioned by the cost-concerned school, if CSR benefits outweigh the associated costs, and thus if sustainability can be achieved without compromising economic growth (The Assabet Group, 2000). It is argued by CSR skeptics that environmental investment represents mainly increased costs, leading to decreased earnings that, in turn, result in lower market values (Walley and Whitehead, 1994). CSR initiatives require immediate financial expenses, but could potentially lead to financial benefits only in the distant future (e.g. Henderson, 2001).

One of the approaches to CSR policy could be an establishment of corporate responsibility as a core driver of business performance. In this way companies could align CSR with firms' strategic operations. Then CSR would emphasize long-term corporate performance and show how successful the business is in taking actions that, even though not necessarily in its immediate financial self-interest, would contribute to the long-term value creation. In this way CSR becomes a business driver that creates value within the company, and the company, in turn, creates value for the whole society.

Preston and O'Bannon (1997) separate the studies on the relationship between CSR and financial performance into three groups, showing:

1. How corporate responsibility relates to financial performance
2. How financial performance relates to corporate responsibility
3. That corporate responsibility and financial performance are synergetic.

Positive, neutral, or negative relationship can exist in all the three groups (Blowfield and Murray, 2008). For example, according to Milton Friedman, the Noble laureate in economics, there is a negative relationship between corporate responsibility and financial performance because CSR mistreats corporate assets (Friedman, 1962). Friedman stated that in a free society "*there is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud*" (Friedman, 1970). Cornell and Shapiro (1987) state that the relationship is positive because satisfying the desires of stakeholders improves financial performance. Waddock and Graves (1997) discuss how the strength of performance influences investments in CSR. It is argued that there is a synergetic relationship between CSR and financial performance: *"there may be a simultaneous and interactive impact, possibly forming a virtuous circle"*.

1.2 Purpose and structure

This study represents a modern-day search for a "buried treasure", with the aim to explore the existence of hidden links between CSR performance and business value creation. The purpose is to answer the question whether CSR generates business value: is it realistic to merge the established business objectives of higher profits and lower costs with a strong corporate dedication to environmental stewardship? Can corporate environmental management be aligned with the economic goals of a firm?

CSR is a broad phenomenon, but the aim of this paper is to empirically examine the impact of primarily environmental aspect of CSR on business value creation. Against the background of global warming posing threats to the existence of the earth and the modern society, environmental responsibility arises as an inevitable matter for corporations. Environmental policies and practices are a central and highly evident component of CSR, which facilitates the measurement of environmental dimension of CSR (Vogel, 2005). Furthermore, this study focuses on the companies, operating in the European Union, as it is easier for the independent institutions to measure environmental performance of companies in this region compared to the developing countries due to higher transparency and data availability (Vogel, 2005).

Environmental business policies are pursued for three main reasons: morality, compliance, and opportunity (Willard, 2002). The morality motivation is grounded on

the idea that companies owe to the society and the environment for the privilege to operate. The compliance argument is determined by the risk of current or expected environmental or social regulations. Compliance with environmental legislation saves money in fines, whereas the impact of proactive environmental initiatives is less obvious (Williard, 2002). Such initiatives are encouraged with an opportunity motivation, which is justified by companies seeing a possibility to raise profits. The focus of this paper is mainly on the opportunity motivation for CSR performance. The paper, thus, explores the market forces that either encourage or limit CSR practices.

The second section of this paper provides an overview of the theoretical studies in the field. The theoretical studies are founded on the frameworks that intend to clarify the character of the relationship between CSR performance from one side and financial performance from another side. The part that follows analyzes the empirical studies with the focus on the empirical research that gives evidence on the relationship by means of multivariate statistical analysis. After that, data selection and methodology of the thesis are described. The concluding part presents and discusses the main findings of the thesis. Suggestions for further research are given in the end of the thesis.

1.3 Contributions

Firstly, the problem of choosing an appropriate proxy for environmental aspects of CSR is addressed. Corporate environmental responsibility is a broad measure which can only be assessed with multidimensional indicators. Environmental performance is objectively quantified with environmental ratings produced by a specialized independent agency - GES Investment Services®. The rating is not only intended to reflect historical environmental performance, but also to identify future environmental risks and opportunities. Since the GES data has not received much attention in previous academic research, by using GES data new evidence is provided. Standard indicators are chosen to quantify corporate financial performance based on business norms and previous studies.

In terms of the statistical model, relevant methodologies are combined with a careful choice of variables based on the recent research in the field. To account for differences in industries among the companies, the industry-specific environmental risk is separated from the company-specific environmental opportunities, and their association to

financial performance of the companies is studied by associating them to both operating performance and the market value of the companies.

Based on the current knowledge, this study could be the first one for European companies, listed in MSCI World, regarding the relationship between CSR and companies' financial performance based on the GES ratings on environmental issues as a proxy for CSR. Showing how CSR influences business performance is meant to help managers understand why and which aspects of CSR, if any, they should consider. It is also intended to help companies clarify the importance of environmental performance to investors, and vice versa.

2. Theoretical framework

2.1 CSR, business and society

Corporate social responsibility (CSR) is currently a widely used concept in the field of business (Matten et. al., 2003). However, there is no strong consensus in the academic world on what this concept actually stands for (Egels, 2005). For example, McWilliams and Siegel (2001) define CSR as *"actions that appear to further some social good, beyond the interests of the firm and that which is required by law*". Other authors stress managerial motivations, instead of outcomes, as a key to understanding CSR (Baron, 2001; Swanson, 1995). The general notion refers CSR to the actions taken by companies to further some social good, beyond what is required of them by law (McWilliams and Siegel, 2001).

The assumption that environmental responsibility is an essential part of CSR seems to be less controversial than the abovementioned versatile character of CSR. Even though the concept originally referred to the social aspects of business responsibility, over time it has moved away from its initial narrow meaning. Nowadays, CSR is used in a wide range of contexts, which include both the social and environmental aspects (van Marrewijk, 2003).

It was in the 1950s, when the focus of social responsibility shifted to the behavior of companies rather than that of individuals. CSR theory is, therefore, based on different social and economic theories that explain the function of business in the society (Blowfield and Murray, 2008). Business organizations are inheriting the power from historically dominating religious institutions and governments, and become one of the most influential social entities: they control huge resources, operate over cross-national borders and affect each individual life (Phillips, 2002). Companies do not merely serve the private interests, but also get involved in the social affairs and employ corporate resources for wide public purposes.

There is an essential interconnection between corporations and the society as achievement of the companies and the communities are mutually reinforcing. When immense resources, knowledge, and human capital from corporations are used to address the problems, in which they have stake, it could result in a larger effect on social good than from philanthropic organizations and institutions (Halme and Laurila,

2008). From another side, business world needs a healthy society. Efficiency and innovation are fostered in the societies with good government, the rule of law and well-functioning property rights. Business also becomes more productive, when land, water, energy and other natural resources are utilized efficiently (Porter and Kramer, 2006).

The increasing interdependence between corporations and society has been enthusiastically embraced by academics, business leaders as well as economists, politicians, and others. The following quote illustrates the corporate role as a member of society that participates in social and political affairs in the broadest sense: "*Corporations are created by society and derive their legitimacy from the societies in which they operate. They need to be able to articulate their role, scope and purpose as well as understand their full social and environmental impacts and responsibilities"* (McIntosh et al. 2003, p.16). Matten et al. (2003) states that companies manage the citizenship rights of their employees and their families, which is particularly evident in societies with weak regulations, or when the welfare state is fragile. In such extreme cases, where there was earlier a governance vacuum, multinational corporations are expected to participate in governing by enforcing new rules and norms that ensure basic individual rights (Matten at al., 2003).

Many top executives believe that the perception of the role of business has changed, and companies are facing a range of new responsibilities: "*How you manage your relationship with society strengthens the company*," said Jeff Joerres, Chairman and CEO of Manpower. *"It's not the nice to do. It creates who you are"* (Blowfield and Googins, 2007). Companies are no longer viewed as passive bystanders in society, but rather they are expected to address openly the environmental and societal issues.

At the same time, an adequate theory of business responsibility should meet the condition of not only socially effective production and distribution, but also the necessities of economic growth and value creation. It implies that there is no escape from the powerful motive of private gain and profit which is often not totally consistent with social interest (Frederick, 2006). Even though many business leaders believe that companies have multiple responsibilities to diverse stakeholders and the society, it is also recognized that concerns for the environmental and social issues must not weaken their duty to shareholders.

Taking into account the insufficient business resources, the short-term financial perspective of investors determines the way the business is conducted. The new theories of CSR, therefore, do not reject the significance of the power of profits, and do not wish it away in a naive manner by imagining that businesspeople can or will disregard it as they make decisions. Instead they strive to find institutional means and a system to hedge this drive and to direct it in the valuable for the society channels (Frederick, 2006). The hope for such system was expressed by U.S. diplomat Adolf Berle speaking of the need to develop "*the conscience of the corporation*" (Berle, 1954) as well as by an economist John Kenneth Galbraith in his theory of countervailing power, stating that business can be both productive and socially responsible (Galbraith, 1952).

Business leaders also confirm this view, when they state that their intention to get involved in the societal issues is strengthened by the belief in good financial reasons for tackling social and environmental problems. As Jeffrey Immelt from GE states, *"I think you can run good business, but also solve big problems. Typically profits are created by businesses that are doing things that ultimately have real societal benefits".* Moreover, executives tend to state that they see no contradiction between awareness of societal issues and building long-term value (Blowfield and Googins, 2007).

In conclusion, even though there is a general recognition that financial results drive the capitalist process, the business world tends to acknowledge the common benefits and importance of corporate contribution to the society. CSR, therefore, seems to appear as an important issue for the prosperity of the society. From the corporate perspective, the context, representing the social conditions, in which each company operates, is also stated to have an impact on the corporate long-term competitive position. Even though context has attracted little attention compared to the importance of the value chain impacts, it has a significant strategic meaning for both companies and the community. Business leaders tend to express a rather confident opinion that CSR implementation results in long-term economic gains. However, it is still often questioned by the general public if statements like this can represent something more than pure executive rhetoric.

2.2 Managing and implementing CSR

CSR does not merely define the duties of the business to the environment and the society, but also describes how managers can handle these duties (Windsor, 2006). The way in which CSR is implemented will most probably influence its outcomes, including

the financial ones (Porter and Kramer, 2006). Implementation of CSR requires a change towards the CSR management mindset with the focus on the network of dynamic relations. The company could be considered as a part of a larger complex and changing system, rather than being a separate entity with stable and orderly system (Olsen, 2004). To put these broad principles into practice, it is important for companies to integrate CSR perspective into the core frameworks that guide the existing business strategies.

Strategies show how business builds and uses its competitive advantages to cope with the ongoing changes in environmental conditions on the way to goal achievement (Schaltegger, 2003). Strategy is about making choices, and the same applies to the success in the CSR strategy. Companies face hundreds of social issues that could be addressed, but only some of them would result in a competitive advantage and could make a real difference to the society. The decision if CSR activities present an opportunity to create a shared value for the business and the society could be a feasible criterion to guide CSR strategy.

Strategic CSR is defined as voluntary CSR actions that enhance a firm's competitiveness and reputation (Orlitzky et al., 2011). Economic theories of strategic CSR have evolved since the original "theory of the firm" perspective on CSR, outlined by McWilliams and Siegel (2001). It shows that CSR becomes an inseparable part of a larger complex and changing system that influences different levels and functions within the companies, such as marketing, quality control, financial management, and research and development (van Tudler, 2006).

The relationship of CSR action to the core business is often discussed in the literature (Porter and Kramer, 2006). Halme and Laurila (2008) argue about the methods and actions companies take to respond to environmental conditions and social demands. They suggest an action-oriented CSR typology that combines CSR policies into three types:

1) Philanthropy, emphasizing charity, sponsorship, donations etc.
2) CSR integration, emphasizing more responsible conduct of an existing business
3) CSR innovation, emphasizing developing new business models for solving social and environmental issues.

CSR is viewed nowadays as related to, but different from philanthropy and corporate giving that were for long the most common way for business to interfere with society

(Blowfield and Googins, 2007). The evolution of the CSR theory has led to the development of the concept of CSR integration that means combining the core business practices with CSR actions. CSR integration could address such issues as environmental soundness of products and production, ensuring high product quality and R&D investment - responsibility towards customers; taking diversity-oriented measures and paying fair wages to employees - responsibility to employees; implementing responsibility measures in the supply chain and supporting environmentally benign practices and policies - responsibility to local communities (Halme and Laurila, 2008).

There is also sufficient evidence showing how companies manage to turn societal challenges into business opportunities, either by developing new products or new ways of conducting business (Blowfield and Googins, 2007). It is in line with the third action type - CSR innovation, which represents the most recently developed concept. CSR innovation implies that companies take a proactive approach to CSR management by taking environmental or social problems as a source of business opportunities. Moreover, corporations could develop new products and services that provide a solution to the social and environmental problems (Halme and Laurila, 2008).

The main distinguishing feature of CSR philanthropy from CSR integration and innovation is that the latter should fulfill the strong win-win condition. Companies are not expected to protect the environment of pure willingness to help, but rather to benefit the environment, when it also makes business sense and would create revenue for the company (Halme and Laurila, 2008). However, it is important to understand that the proposed typology is merely a theoretical idealization, and the distinction between the three action types is rather vague in the business practice. Even though some CSR action type could be dominant in the company's business activity, most often different actions co-exist and create a CSR portfolio.

In conclusion, corporations are neither responsible for, nor capable of solving all the world's problems. Therefore, companies can identify a set of societal issues that they could address. If companies analyze CSR by using the same principles that guide their core businesses, it is argued that CSR could be more than a cost, constraint or a charitable deed, but also a source of opportunity, innovation, and competitive advantage (Porter and Kramer, 2008). Not all companies can build the whole value offer based on the environmental or social issues, but it is often believed that suggesting a new CSR dimension to the value proposition could enhance company's competitive position. At

the same time, integrating core business and CSR requires not only strong leadership and good intentions, but also much adjustment within an organization. Development and implementation of CSR strategy requires companies to spend extensive resources, including financial ones. The link between the financial resources spent on CSR strategy and the corresponding economic benefits, if any, is closer addressed in the next section.

2.3 CSR and financial performance

The academic and business world has been concerned with the role of business in the society for a long time, and the question of whether CSR has an effect on companies' financial performance and share price has been actively discussed. On a theoretical level, there are two opposing schools of thought within this area, namely: the cost-concerned school, arguing that environmental investments represent mainly increased costs to a company, and the value-creation school, arguing that environmental investment is a way to create competitive advantage and to improve financial returns to investors (The Assabet Group, 2000).

2.3.1 The cost-concerned school

The cost-concerned school is based on the neoclassical view of economics grounded on Adam Smith's (1776) theories about the "invisible hand" that ensures socially optimal behavior in the free marketplace. The liberal economic model of the firm states that companies contribute to the public good by following their narrow economic goals. This most influential view on economic system has been a main foundation for the interpretation of the relationship between CSR and financial performance. Based on this view of economy, the cost-concerned school, whose most influential representative is Milton Friedman, claims that there is a trade-off between CSR and financial performance.

This view is expressed in the article *"A Friedman doctrine – The Social Responsibility of Business is to Increase its Profits"*, which was published in the New York Magazine in 1970. Milton Friedman argued that voluntary CSR actions do not follow the market logic, and thus are not beneficial for the participants. Friedman's neoclassical argument is that firms have only one social responsibility, namely to increase its profits. When

improving their environmental/social performance, firms unnecessarily incur costs and, in turn, reduce their profitability.

In line with the Friedman's theory, Walley and Whitehead (1994) argue that it is costly and complicated to respond to environmental challenges. While environmental costs are rising for the vast majority of companies, there is little economic payback in sight. Mutually beneficial environmental opportunities are overshadowed by enormous environmental expenditures. When environmental challenges become more complex and costs increase, win-win solutions become scare. By focusing on such illusory solutions, companies are setting themselves for a fall with shareholders and the society at large. Both constituencies become cynical and disappointed when true costs of being green come to light (Walley and Whitehead, 1994). Therefore, such CSR-compliant solutions should not be the goal of the companies. For example, practices that abandon pollution have increasing marginal costs and decreasing marginal benefits, and thus the relationship between environmental performance and financial performance is argued to be negative (Wagner, 2001).

Another argument of Friedman (1970) is that companies should not engage in CSR practices because it is not in the interest of shareholders. From this shareholder-focused perspective, CSR is perceived as actions on the verge of fraud. Proponents of this shareholder-centric theory of the firm base their arguments on the classic work of Friedman (1970), and suggest that distraction of the managerial attention from the investors' interest leads to a breach of trust that negatively affects shareholder value. They consider shareholder wealth maximization to be the single social responsibility of the business (Jensen, 2002; Levitt, 1958).

Some authors stress the importance of transition cost and state that stakeholder management requires significant resources, such as time, financial and human resources to identify relevant stakeholder groups, to negotiate with them and to monitor their satisfaction (King, 2007). Even though such investments could increase trust in the long-term, they would not necessarily pay-off in the short-run (Hosmer, 1995).

2.3.2 The value-creation school

From another side, the value-creation school questions the prevailing view that there is an inherent trade-off of ecology versus economy. Such researchers see enormous economic value in balancing a multitude of stakeholder interests and demands.

The value-creation view is largely based on Freeman's *"Strategic Management: A Stakeholder Approach"* which is regarded to be a basis of good CSR management (Freeman, 1984). It states that companies are responsible to their multiple diverse stakeholders and other interest groups. The shareholder interests are definitely among these, but they are not primary or exclusive. Even though there is no agreement over the relative importance of the stakeholder groups, it is agreed that it is necessary to show respect and understanding of not merely economic factors, but also of the social issues. Moreover, success of organizations depends on these stakeholders. Freeman suggests that managing stakeholders by conducting corresponding strategic practices is vital for the survival and success of a company.

Supporter of the stakeholder theory in terms of directing stakeholder management at wealth creation state that business legitimacy requires constructive social performance, and that there is a positive long-term association between environmental/social and financial performance (e.g. Post et al., 2002; Phillips, 2003). The more recent interpretations of stakeholder theories, however, do not show a company as a set of separate, normally two-sided relationships with stakeholder groups, but rather as an organism that is rooted in a complex network of relationships (Blowfield and Murray, 2008).

Post et al. (2002) re-define corporations, based on the maxim: *"Corporations Are what they Do".* Companies are defined by a collaboration of multiple and diverse constituencies and interests. Even though the vital explanation for the survival of a company is its capability to generate capital, the authority of a present-day corporation as an institution within society – its "*license to operate*" – depends on its skill to meet the expectations of a numerous stakeholders. The wealth of companies can be created through managing such stakeholders' relationships. Efficient stakeholder management, defined as managing such relationships for mutual benefit, is stated to represent an essential condition for the long-term business success.

Phillips (2003) supports a long line of distinguished management thinkers who have made "stakeholders" the centerpiece of their management mindset. In the heart of Phillips's statement is the idea that business needs to be based on a notion of fairness. When business is not following the principles of fairness at core, stakeholders will exercise the political and social procedures to restrain business activity or to withdraw their resources from the company. In this way Phillips joins the stakeholder theory with

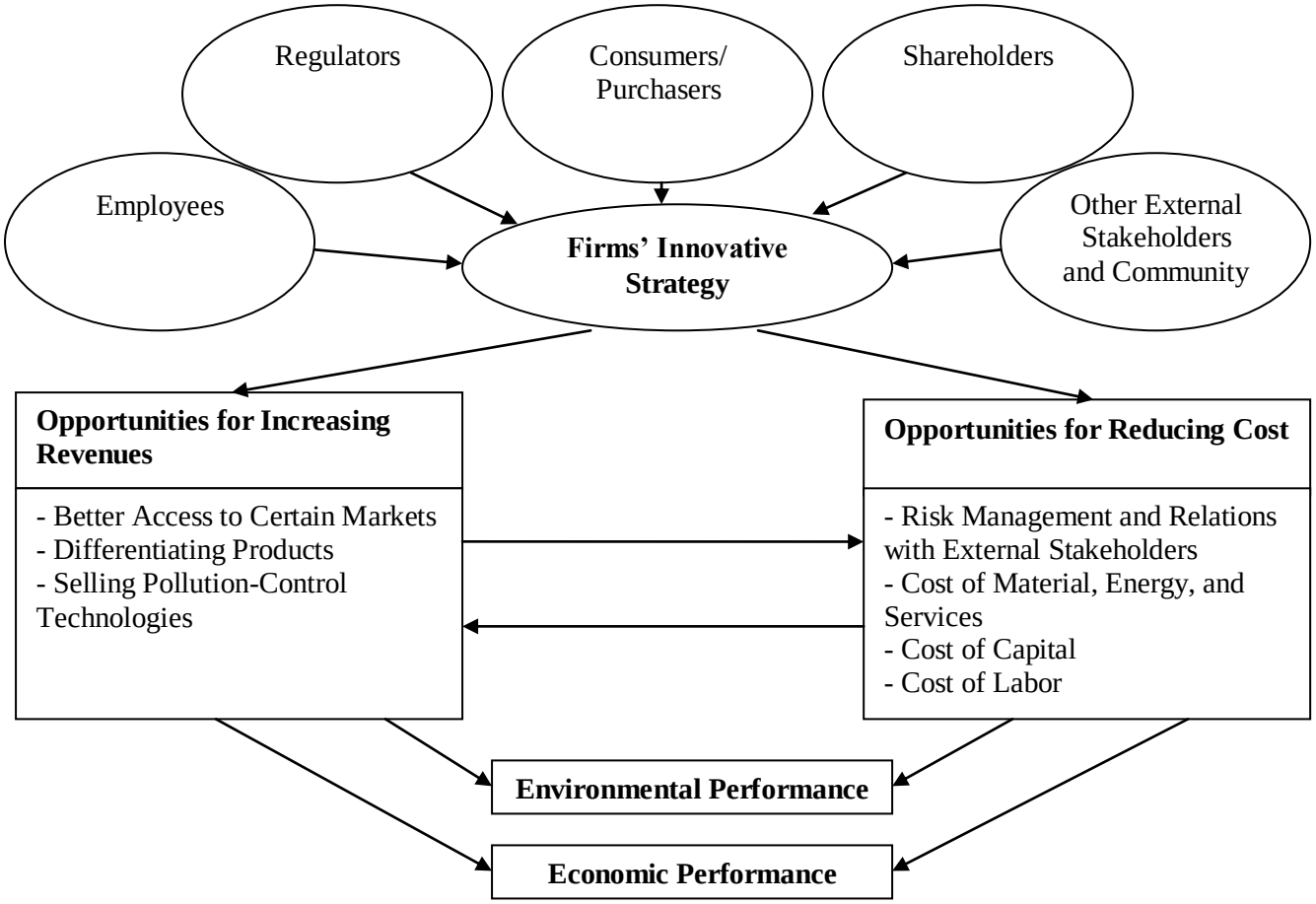
the moral and political theory of John Rawls "*A Theory of Justice"* (Rawls, 1971) into a sole theory of organizational ethics. He suggests that organizations are dependent on their stakeholders for their successes and failures.

The American economist Michael E. Porter introduced a new perspective to the debate, which is often referred to by the value-creation school. The Porter Hypothesis was proposed in 1991 (Porter, 1991), and subsequently elaborated in an influential paper by Porter and van der Linde (1995). Porter Hypothesis links together the environment, resource productivity, innovation, and competitiveness. It states that too much attention is centered on the static cost impacts of environmental actions, but the offsetting productivity benefits from environmental innovation are often ignored. However, the environmental improvement and competitiveness often come together. Environmental progress necessitates innovation to improve resource productivity – and that is exactly what the new challenges of global competition require. By applying such innovative actions a company could expect the related benefits to its reputation, cost-saving and risk reduction. As an example, when Scandinavian pulp-and-paper companies introduced totally chlorine-free paper, they could command considerable price premiums and serve a rapidly growing market of environmentally informed customers. It is, thus, argued that CSR should be recognized as economic and competitive opportunity, rather than as an annoying cost.

The Porter Hypothesis has been refined and reviewed by Ambec and Lanoie (2008). It is stated that the costs incurred to decrease environmental hurdle can be partially or entirely counterbalanced by the gains of executing a determined innovative strategy. For example, companies can use CSR as a part of a strategy to protect their reputations, minimize production costs and introduce environmentally-friendly products to the market. Moreover, it is possible to establish competitive advantages based on, for example, established environmental credibility, technical competence in green issues, etc. To be systematic, both sides of the balance sheet need to be considered: increasing revenues and reducing costs. First, better environmental performance leads to an increase in revenues through: 1) better access to certain markets; 2) differentiating products; 3) selling pollution-control technology. Second, better environmental performance can lead to cost reduction through: 1) risk management and relations with external stakeholders; 2) cost of material, energy, and services; 3) cost of capital; and 4) cost of labor. Figure 1 summarizes the mechanism.

Figure 1. Positive links between environmental and financial performance

Adapted from Ambec and Lanoie (2008)



All in all, there does not seem to be a universal agreement in the views on this controversial relationship between CSR and financial performance. There are theories supporting both negative (cost-concerned school) as well as positive (value-creation school) relationship. At the same time, a conclusive proof of such linkages remains elusive, and a vast body of literature is seeking empirical evidence to shed more light on the nature of this hypothesized relationship.

2.4 Hypothesis formulation

As it is shown in the previous section, there is no clear-cut agreement in theory on how CSR influences financial performance. Therefore, the main objective of this study is to evaluate what is the relationship between CSR, in particular the environmental dimension of CSR, and financial performance of the companies. To evaluate this relationship and the impact of environmental strategies on financial performance, a number of hypotheses are suggested in this section of the paper. The hypotheses are

suggested in this section to make clear structure of the paper, even though it is recognized that the line of reasoning below is mainly based on opinions, rather than theories.

First of all, following the argumentation of the value-creation school, presented in the previous section, it is suggested that environmental performance, which refers to an ability of a company to implement its environmental policy and to deal with environmental issues in daily operations, is positively related to the operating performance of the companies. It implies that the companies that pursue environmentally-friendly strategies benefit from the opportunities for increasing revenues and reducing costs. It leads to both better profitability and increased efficiency. Thus, the following hypothesis is suggested:

Hypothesis 1: There is a positive relationship between environmental performance and operating performance.

Furthermore, in line with the arguments of the value-creation school, better environmental performance is supposed to influence positively the market value of the company due to improved stakeholder management and the long-term CSR benefits. In this case, environmental strategies are perceived as a driver of future earnings, and hence higher market value is assigned to the companies that pursue forward-looking strategic environmental policies. Thus, the following hypothesis is suggested:

Hypothesis 2: There is a positive relationship between environmental performance and the market value of the companies.

Secondly, it is suggested that environmental preparedness, which refers to the level of how well a company integrates environmental awareness into its corporate policies and management control system, as such does not bring direct financial benefits to the profitability and efficiency of the companies, unless it is reflected in a better environmental performance. Even though companies incur costs when preparing themselves to facing environmental risks, it does not result in the short-term improvements to their financial performance. Thus, the following hypothesis is suggested:

Hypothesis 3: There is a negative relationship between environmental preparedness and operating performance.

From another side, environmental preparedness can lead to an improvement in reputation due to better stakeholder management. For example, one of the criteria to evaluate environmental preparedness is environmental reporting. Even though environmental reporting does not bring direct operational benefits to the profitability or efficiency of the companies, it is well-perceived by the stakeholders, and therefore leads to better reputation and hence higher value of intangible assets, such as, for example, companies' reputation. Thus, the following hypothesis is suggested:

Hypothesis 4: There is a positive relationship between environmental preparedness and the market value of the companies.

Thirdly, it is suggested that if a company belongs to an industry with high environmental risk, it necessitates this company to earn a higher rate of return to justify more risky operations compared to the companies operating in less risky industries. Better operating performance is, therefore, required to be able to function in an industry with higher environmental risks and constraints. Thus, the following hypothesis is suggested:

Hypothesis 5: There is a positive relationship between environmental industry risk and operating performance.

Moreover, it is suggested that higher environmental risk of the industry, which the company belongs to, is perceived negatively by the investors. Some environmentally-conscious investors might avoid buying stocks of the companies operating at the environmentally risky industries due to the social norms and constraints. Furthermore, companies operating at the high risk industries are required to comply with demanding environmental legislation that constantly implies additional costs. All these factors are supposed to have a negative impact on the market value of the companies. Thus, the following hypothesis is suggested:

Hypothesis 6: There is a negative relationship between environmental industry risk and market value of the companies.

Fourthly, in the high risk industries companies are assumed to face more environmental constraints at their daily operations. The companies need to deal with such issue by not only preparing themselves, but also by addressing pro-actively such environmental concerns when constructing environmental policies and strategies. The more frequently

the company deals with the environmental issues, the more likely it is that the financial performance, and in particular operating performance, of such companies is influenced by their environmental policies and strategies. Thus, the following hypothesis is suggested:

Hypothesis 7: There is a larger impact of environmental performance and preparedness on operating performance for high risk industries compared to low risk industries.

Moreover, the general public is more concerned with the environmental performance and policies for the industries with high environmental risk. Consequently, there is a larger impact of environmental strategies on companies' market value for the companies operating in high risk industries. Thus, the following hypothesis is suggested:

Hypothesis 8: There is a larger impact of environmental performance and preparedness on the market value of the companies for high risk industries compared to low risk industries.

All in all, the study of the abovementioned hypotheses allows evaluating different aspects of the relationship between environmental strategy and financial performance. It allows taking into account both the industry- and company-specific factors. Moreover, the impact on both operating performance and market valuation of the companies is considered. Thus, the intention is to provide a relatively complete picture on the relationship between environmental strategies and financial performance.

3. Previous empirical studies

3.1 CSR and financial performance

3.1.1 Measures of CSR performance

Companies are currently evaluated not only based on their financial returns to the shareholders, but also on the input they make to the society. Investors, employees, consumers, and other stakeholders start enquiring information about corporate environmental and social performance, which can be seen as an expression of an active civil society. Many firms, therefore, started to document CSR performance by introducing environmental and social reporting. The most recent trend is to integrate CSR reporting into the annual reports, which is meant to match long-term business strategy with the short-term business results (KPMG, 2010).

To critically evaluate such reporting and to measure CSR performance, special valuation techniques are required, which were developed by the rating institutions based on the concept of CSR. This has led to the development of numerous CSR ratings. These are the ratings that aggregate the non-financial social ecological and often ethical criteria. CSR ratings have a signaling function by enabling interested stakeholders to identify the change in the commitment of companies to CSR, which, in turn, can change the attitude and economic relation of stakeholders towards the companies (Schäfer et al., 2006).

CSR ratings have evolved into an established information services market with many different agents and technologies. However, unlike financial reporting, which is based on a uniform standard, such as the International Financial Reporting Systems (IFRS), there is no comparable standard for environmental and social reporting. Such reporting is, thus, voluntary and not standardized. Therefore, CSR ratings are characterized by high degree of heterogeneity and diversity due to the difference in the evaluation motives and diverse perceptions of CSR and ethics by the rating institutions (Sjöström, 2004).

The majority of the ratings base evaluation of companies on the international norms and conventions, such as fundamental environmental standards, UN Declaration on Human Rights, the ILO Core Labour Standards, the OECD Guidelines for Multinational Enterprises, OECD Guidelines on Corporate Governance, etc. However, the actual

weightings within the rating process of each criterion based on norms and standards are not disclosed to the external parties. The determination of threshold values remains also undisclosed. Another characteristic of the ratings is the focus on listed corporations – mainly the companies listed in the leading stock indices, as for example, MSCI World (Schäfer, 2006).

A large number of various variables, including different independent CSR ratings, have been used in the previous research on CSR and financial performance. In the earlier studies such measures of CSR as survey instruments (Aupperle, 1991), content analysis of documents (Wolfe, 1991), behavioral and perceptual measures (Wokutch and McKinney, 1991) were used. Pollution control investments are another commonly used one-dimensional measure (Shane and Spicer, 1983). However, such measures are unidimensional and may not properly reflect the overall level of a company's CSR performance. Such measures are also difficult to apply consistently across the range of industries and companies (Waddock and Graves, 1997).

The advantages of using independent ratings compared to the measures used in the earlier research are summarized in the paper by Waddock and Graves (1997). Each company is rated on multiple CSR attributes. A single group of researchers, working independently from the rated companies applies the same set of criteria to the related companies. The criteria are applied consistently across a wide range of companies, with data collected from a wide range of sources, both internal and external to the firm.

In the study by Manescu and Starics (2007), CSR is represented by a set of ratings from the Sustainable Asset Management (SAM) Group, covering such dimensions as environmental, social and corporate governance. In another study by Belu and Manescu (2009) self-computed aggregate CSR scores are made, which are based on seven selected CSR dimensions, such as codes of conduct / bribery and corruption, corporate governance, eco-efficiency, human capital, risk management, and talent attraction.

Guenster et al. (2006) use the firm-level eco-efficiency ratings produced by Innovest Strategic Value Advisors in their examination of the relationship between corporate eco-efficiency and financial performance. Tsoutsoura (2004) use KLD rating data for the companies in the S&P 500. Hassel et al. (2005) use environmental rating for Swedish listed companies provided by CaringCompany Research AB. Those ratings are based on 23 criteria aggregated into five categories. Derwell and Vermijmeren (2007)

use four subsets of the CSR index, namely environmental performance, governance, product quality, and social performance (diversity, HR, community involvement and labor relations) to investigate the relationship of CSR to the implied cost of equity capital. Waddock and Graves (1997) construct an index of corporate social performance (CSP) based on the eight CSP attributes rated consistently across the entire Standard and Poors 500 by the firm Kinder, Lydenberg, Domini (KLD) to empirically investigate the linkage between financial and social performance.

3.1.2 Measures of financial performance

Although measuring financial performance is considered to be easier than measuring CSR, there is little agreement about which measurement to apply. Some researchers use market measures (Alexander and Buchholz, 1978; King and Lenox, 2001), others apply accounting measures (Waddock and Graves, 1997; Cochran and Wood, 1984) and some adopt both (McGuire et al, 1988). All the measures represent different approaches and have different implications (Hillman and Keim, 2001) and potential biases. Accounting measures capture barely historical aspects of firm performance. They are also a subject to bias from managerial manipulations and differences in accounting procedures. Market measures are forward-looking and focus on market performance. They are less susceptible to different accounting procedures and represent the investor's evaluation of the ability of a firm to generate future economic earnings (McGuire et al, 1988). However, the stock-market-based measures of performance also cause obstacles. Market measures may be assessing more than just the financial outcome of the organization (Shane and Spicer, 1983). The use of market measures suggests that an investor's valuation of firm's performance is a proper performance measure (McGuire et al, 1988).

According to Barber and Lyon (1996), ROA represents a broad measure of operating performance that addresses both profitability and efficiency. Wokutch and Mckinney (1991) used ROA to measure asset utilization. Given its static nature, the financial outcome of a firm can be objectively quantified by ROA. Tobin's Q measures the market valuation of a firm relative to the replacement costs of its assets. It reflects what cash flows the market thinks a firm will provide per dollar invested in assets (King and Lenox, 2001). Lindenberg and Ross (1981) suggest that the market values are subjective to the constraints of a technological, an economic, and a regulatory nature. If a firm

aims to maximize the market value, such constraints under which they operate are inevitable. Besides those fixed factors embedded in the firm, intangible factors, e.g. patent, reputation, special access to resources, etc. make the difference from the book value. Tobin's Q takes all the above-mentioned complexity into account, reflecting a firm's profitability and future performance from investors' point of view.

ROA is based on companies' contemporaneous income, whereas Tobin's Q is a forward-looking measure that reflects the intangible value that investors assign to a company. Therefore, ROA allows capturing the association between environmental and operating performance, whereas Tobin's Q allows capturing the value investors assign to environmental policies (Guenster et al., 2006).

In Kaplan and Zingales (1997), Tobin's Q is computed as the market value of assets divided by the book value of assets. The market value of assets is defined as the sum of the book value of assets and the market value of common stock outstanding minus the sum of the book value of common stock and the balance sheet deferred taxes. The above-mentioned approximation is used to ensure sufficient data availability. Moreover, it was found by Perfect and Wiles (1994) and by Chung and Pruitt (1994) that this type of proxy for Q is highly correlated with the more complex estimates.

In the study by Manescu and Starics (2007) and by Belu and Manescu (2009), firm profitability is measured by ROA to conduct an analysis of the impact of CSR practices on firm profitability. In the study by Waddock and Graves (1997) and Tsoutsoura (2004), firm profitability was measured using three accounting variables, such as ROA, ROE, and return on sales. It was found that ROA appeared to be more closely related to the KLD score than the other two measures of financial performance (Tsoutsoura, 2004). Moreover, it was found in the paper by Griffin and Mahon (1997) that ROA is one of the most common used measures of financial performance. Tobin's Q is used in the study by Dowell et al. (2000). In the study by Guenster et al. (2006), ROA represents operating performance and profitability, whereas Tobin's Q is used as a proxy for company's valuation, i.e. forward-looking measure reflecting the intangible value that investors assign to a company.

3.1.3 Control variables

To separate the impact of environmental variables on the financial performance, a set of control variables is often introduced in the previous research. Such variables allow

answering the question whether the observed relationship between CSR and financial performance is an outcome of some other underlying firm attribute, rather than environmental performance. A separate set of control variables is often applied for the relationship between CSR and operating performance as well as for the relationship between CSR and market value of the companies.

3.1.3.1. CSR – operating performance relationship

In the previous research such factors as company size, attitude towards risk and industry have been suggested as the factors that affect the relationship between CSR performance and operating performance (Ullman, 1985). There is evidence that smaller companies may not exhibit as much CSR behaviors as do the larger firms. When companies grow, they attract more attention from external parties and need to respond more openly to the stakeholders (Burke et al., 1986). Companies' size is usually measured by the total assets (Waddock and Graves, 1997; Guenster et al., 2006). The risk tolerance of management has an influence on their attitudes towards CSR activities. The level of debt held by the company is often used as a proxy for management's risk tolerance. As a proxy for the riskiness of a firm, the long-term debt to total assets ratio is often used (Waddock and Graves, 1997; Guenster et al., 2006). Finally, earlier studies show that there are distinct differences in CSR performance among different industries due to different industry characteristics. Therefore, it becomes important to control for industries effects to take such differences into account.

3.1.3.2 CSR – market value relationship

To investigate the relationship between the market value of the company and the CSR performance, the following control variables are introduced in the previous research: sales growth, company size, operating performance, company age and industry. Some studies found that the recent sales growth is positively related to the company's valuation (Hirsch, 1991; King and Lenox, 2001; Guenster et al., 2006). The logarithm of the book value of assets is used to account for differences in firm size (Gompers et al., 2003; Konar and Cohen, 2001; King and Lenox, 2001). To condition on differences in operating performance return on equity (ROE) is often used in the previous research (Capon et al., 1990). Some studies also account for companies' age by including age as a control variable (Guenster et al., 2006). Bruno and Claessens (2010) assume that larger and older companies tend to have higher Tobin's Q ratio. Industry-wide effects

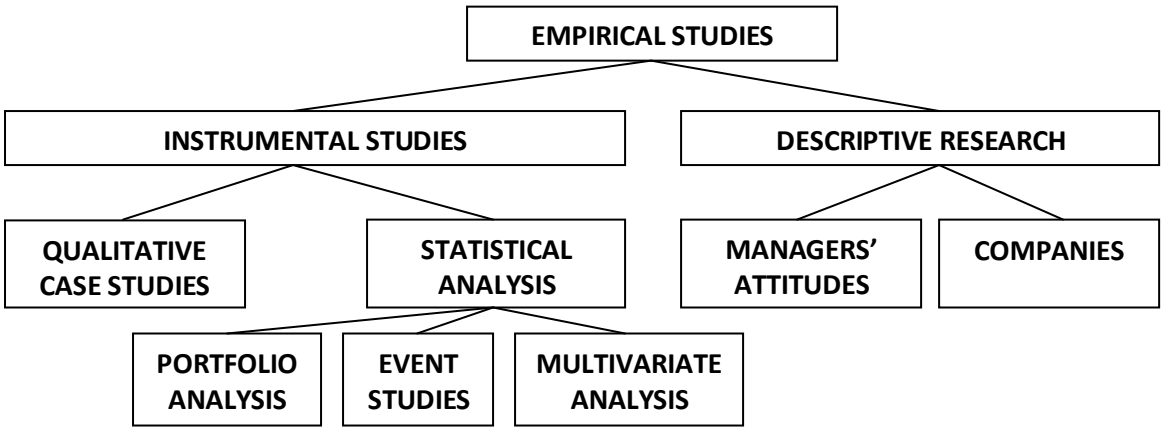
on the intangible asset value of the firm are controlled for by including industry dummies. Among other things industry dummies control for the difference in CSR performance between the heavy-polluting and environmentally-friendly industries (Konar and Cohen, 2001).

3.2 Relationship between CSR and financial performance

Empirical literature has used various methods, shown in Figure 2, to check the "pays to be green" assumption. Although numerous papers have examined the empirical relationship between CSR and corporate financial performance, the results have often been contradictory (Griffin and Mahon, 1997). Even though it was found that the majority of results point to a positive relationship between CSR and financial performance (Margolis, 2003), a number of authors claim that there is an inconclusive (Vogel, 2005) or negative relationship (Griffin and Mahon, 1997). This section focuses on the recent studies analyzing the relationship between CSR and financial performance by means of multivariate statistical analysis.

Figure 2. Empirical Studies Classification

Adapted from Salzmann et al., 2005



Some studies provide empirical evidence that higher environmental performance is associated with better financial performance. For example, in the study on economic value of corporate eco-efficiency, Guenster et al. (2006) examined the relationship between corporate eco-efficiency and financial performance over the period 1997 to 2004. Firstly, a positive and slightly asymmetric relation between eco-efficiency and operating performance was found: firms that are deemed eco-efficient have only a slightly superior ROA than the control group, whereas the least eco-efficient firms show

strong operational underperformance. The study rejects the notion expressed by CSR skeptics, that the benefits of adopting a strong environmental policy are unlikely to outweigh the costs.

Secondly, a positive and time-varying relation between eco-efficiency and firm valuation as measured by Tobin's Q was found: the shares of the most eco-efficient firms were initially undervalued, but later experienced an upward price correction. Time-varying valuation of environmental performance indicates that the market incorporates environmental information with a drift. The results of the regressions on Tobin's Q suggest that nowadays the market assigns more value-relevance to environmental information about the firms. Even though this study claims that the observed effects on Tobin's Q reflect a correction for undervaluation of eco-efficient companies, the question of whether such patterns would continue in the future remain unanswered (Guenster et al., 2006).

Other studies found negative or neutral relationship between CSR and financial performance. Hassel et al., 2005 in the study of value relevance of environmental performance for Swedish companies used the residual income valuation model, where market value of equity is expressed as a function of book value of equity, accounting earnings, and environmental performance. It was found that environmental ratings complement accounting information, which implies that environmental performance has value relevance in the stock market. There is a significantly negative relationship between the market value of listed Swedish companies and their environmental performance ratings as measured by an environmental performance index. The results apply across all industry groups, such as industry and services. It implies that environmental performance has negative influence on the market value of the firms, which is in line with the theories behind the cost-concerned school. However, the limitation of this study is relatively short time period from June 1998 until September 2000. Moreover, studying European data using different measures of environmental performance for cross-country comparisons and industry comparisons within the European Union is suggested as a topic for further research (Hassel et al., 2005).

In the study by Manescu et al. (2007) on the relevance of CSR criteria to explaining firm profitability, it was found that the majority of CSR scores did not contribute to explaining profitability. In particular, the scores related to environmental performance are not among the significant variables. The results suggest that company managers do

not face a trade-off between eco-efficiency and financial performance (Manescu et al., 2007).

The majority of the empirical literature does not clarify whether the association is generated by a company's choice to operate in environmentally cleaner industries or to operate cleaner facilities. Therefore, the above-mentioned research cannot answer whether it pays to be green or whether it pays to operate in green industries. The study by Semenova and Hassel (2008) considers the fact that industry determines environmental profiles of companies, and effects operating performance and market values. Higher level of industry risk leads to lower market values for the companies, even if such firms are more profitable than the low industry risk companies. It was found that the environmental industry risk and the company-specific environmental opportunities influence the operating performance and market value of the companies. In the polluting industries, environmental management is costly and reduces the operating performance. The data for this study include U.S. companies, and thus the results cannot be extended beyond this geographical region. The findings of the role of environmental constraints of the industry, and the reputational and operating benefits of the environmental management suggest the need for further research on the relationship between environmental and financial performance (Semenova and Hassel, 2008).

In conclusion, there is a growing amount of research articles that study an integration of CSR into business practices, and its effect on business profits. However, the results of such studies seem to be inconclusive (Arlow and Gannon, 1982; Frooman, 1997; Griffin and Mahon, 1997). There are major studies that show that good environmental/social performance is associated with good financial performance (Pava and Krausz, 1996). However, CSR skeptics do not seem to be persuaded by this evidence, since the results of the studies show large variation. Inconclusiveness of results can partially be explained by the use of sometimes poor CSR measures. The nature of environmental/social performance is very complex since it depends on many aspects that differ between countries, time periods, and industries. Another reason could be lack of control of CSR interaction with other company-specific and industry-specific variables, especially in the early studies. Moreover, the wide majority of studies focus on the U.S. companies from different industries, but the research area of such geographical regions as Europe is left behind. Thus, a verification of the causal relationship between environmental and financial performance remains vague. An

improvement in methodologies and CSR measurement over time allows applying more sophisticated techniques to facilitate more accurate measurement, and thus to improve validity of the study.

4. Methodology

4.1 Data

The data is collected based on GES environmental ratings for over 600 European companies in MSCI World Index. These companies are scattered among diverse industries for the time period between 2003 and 2006. This time horizon is chosen to eliminate the shock of financial crisis because it will have a large impact on both financial and environmental performance. The companies that have undergone mergers, acquisitions or discontinued operations have been omitted, narrowing down the data sample to 160 companies.

While sorting the data in STATA statistical software, each company has been labeled by a number from 1 to 160. The four years of data between 2003 and 2006 for each company are placed adjacently to one another, with the first year coming before the second in all cases. Accordingly, there are totally 640 observations in the data set given that each company is represented with four years of data. GES environmental ratings are provided by GES Investment Services®[2] and the data for other financial variables is exported from Thomson Reuters Datastream.

GES Investment Services® is an ESG (Environment, Social and Corporate Governance) service provider in Northern Europe. GES Risk Rating® is one of the sustainable investment products, which analyzes the risks in companies' reactions to environment, human rights and corporate governance. Both present performance and readiness for the future are taken into account to create full-scale CSR evaluation.

There are three dimensions in GES Risk Rating®: environmental, human rights and corporate governance. Each dimension is assessed based on international norms on ESG issues in line with the United Nations Principles for Responsible Investment (UN PRI). For environmental analysis, the criteria are drawn up to evaluate companies' preparedness and performance. Based on official company documents, dialogue with companies, media information and information from GES's partners, analysts give scores for each criterion and afterwards combine such scores to describe a general company's risk rating. In the meantime, the general risk of the industry, in which the company operates, is also provided.

[2] See Appendix 9.1 for more information

Companies receive a rating (from "Aa" -- "Cc") where the capital letters ("A"--"C") represents a general risk level of the company's industry and the lower case letters ("a"-"c") represents the risk level of the specific company, based on the evaluation of preparedness and performance. With the purpose of quantitative analysis, the seven non-numerical categories of GES Investment Services® ratings are converted in this study into numerical environmental scores, as shown below in Table 1.

Companies with the lowest industry risk receive a rating equal to zero. Companies with the highest industry risk ("C") receive a rating equal to six. Performance and preparedness conversions are based on a reversal scale. Companies with the highest environmental preparedness and performance (ranked with "a") receive a score equal to six. Companies with the lowest environmental preparedness and performance (ranked with "c") receive a score equal to zero.

Table 1: GES Investment Services® Risk and Opportunity Rating Scale

Risk			Opportunity		
General	Specific	Scale	Preparedness	Performance	Scale
A	a	0	a	a	6
A-	a-	1	a-	a-	5
B+	b+	2	b+	b+	4
B	b	3	b	b	3
B-	b-	4	b-	b-	2
C+	c+	5	c+	c+	1
C	c	6	c	c	0

Each observation is characterized by its ROA, ROE, sales growth, total assets, Tobin's Q, company age, long-term debt and year-end GES environmental ratings from 2003 to 2006. A dummy variable is also included to correct for the prevailing accounting system. To great extent, having multiple indicators on the same company allows controlling for certain unobserved characteristics of the companies. In the next section the variables are described in more detail.

4.1.1 Dependent variables

The measures of corporate financial performance are chosen to be the dependent variables. After reviewing previous studies in this area, ROA and Tobin's Q are adopted to characterize firm's financial performance.

ROA is used as an indicator for operating performance. ROA, defined as net income divided by total assets, measures the financial returns from the current assets employed by the company and is one of the most frequently used criterion for financial performance and profitability. The higher the company's ROA, the more effectively the company can convert invested asset into net income.

Tobin's Q is used as a proxy for the market value of the company. Tobin's Q is a market-derived measure that reflects expected future gains and captures the tangible and intangible values of a company. The Tobin's Q ratio is given by:

$$\text{Tobin's Q} = \frac{Total\ Market\ Value\ of\ Firm}{Total\ Asset\ Value}$$

, where the market value of firm is given by:

$$Tobin's\ Q = \frac{Market\ Value}{Total\ Assets} =$$

$$= \frac{(Total\ Assets + Market\ Value\ of\ Stock) - (Book\ Value\ of\ Common\ Stock + Deferred\ Taxes)}{Total\ Assets}$$

If Tobin's Q ratio is between 0 and 1, the cost to replace a firm's assets is greater than the value of its stock, implying that the stock is undervalued. Conversely, if Tobin's Q ratio is greater than 1, the firm's stock is more expensive than the replacement cost of its assets, implying that the stock is overvalued.

4.1.2 Independent variables

Ideally, the application of explanatory variables is intended to measure the actual environmental performance for each company. However, environmental performance involves generic complexity that is embedded within the company, so it is difficult to distinguish it from the overall operations of a company. Therefore, environmental ratings need to consider a wide variety of diverse criteria and aspects, which cannot be easily quantified. In particular, even though environmental ratings are based on many different criteria, the weights assigned to each criterion and the threshold values of each rating are rather subjective. Thus, the CSR performance measures are not as explicit as

financial ones, and there is no consensus on the best CSR measures to be adopted by academia or business so far.

Among such measures is the rating by GES Investment Services®, the one utilized in this paper. Based on GES Risk Rating®, its environmental dimensions are used as the independent variables that explain corporate financial performance. By converting the ratings into numeric values as suggested in Table 1, both general environmental industry risk and company-specific environmental prospects are considered in the model.

indrisk is the rating of the general industry risk, where the company operates. GES categorizes companies into industry groups based on Global Industry Classification Standard (GICS), and each industry is given a rating measuring its environmental risk.

prep is a firm's score of preparedness for environmental issues. It is decided based on an evaluation of a company's various schemes to deal with environmental issues. The criteria include: 1) organization and routines, 2) policy and program, 3) external verification, 4) environmental reporting, and 5) supplier evaluation.

perf is a firm's score of present status of dealing with environmental issues. The criteria for evaluation include: 1) greenhouse gases, 2) energy use, 3) use of water resources, 4) travel management, 5) remediation, 6) project development, 7) hazardous waste, 8) emissions to air, and eight more criteria.

It should be noted that the actual evaluation of the above-mentioned variables is difficult to quantify and even though many diverse criteria are used, such measures can still be considered rather vague.

4.1.3 Control variables

In the context of cross-company panel data, it is essential to notice that the measures of financial performance are sensitive to the set of variables that are held constant in regressions, when analyzing the effect of environmental indicators. To support the causal effect of environmental risk on financial performance, two sets of control variables are selected to match ROA and Tobin's Q respectively. The control variables for ROA and Tobin's Q are chosen separately in order to embody the characteristics of

static and market-derived nature. All values are converted to US dollars to be comparable.

The relation between ROA and environmental parameters is controlled for company size and leverage risk that have an important influence on corporate operating performance. Smaller companies are assumed to have fewer resources to invest in environmental policies and actions. Also, risk tolerance of companies' management defines the attitude towards CSR investments because CSR policy implies significant current costs with the potential benefits, if any, mainly in the long-run.

logta, defined as the natural logarithm of total book value of assets, is used as the indicator of company size. Generally speaking, smaller companies can provide fewer resources for environmentally responsible actions than larger companies. The logarithmic form is taken with the purpose to facilitate the comparisons across time and companies. It also pairs with Tobin's Q for corporate valuation.

ltd, defined as the long-term debt to total assets ratio, is chosen to represent risk tolerance, based on the previous research in the field. A higher percentage indicates a weaker capital structure. Typically, start-ups or firms that have recently undergone significant capital outlay would be expected to have a higher percentage than mature firms, and thus are less apt to act environmentally. Rarely, such firms have lower long-term debt percentage because the financial strains simply enable them to access the short-term debt. However, such an ambiguity in the application of long-term debt to total assets ratio does not exist in the case of this study because the sampled companies are all listed in MSCI with mature operation and stable financial performance, and thus *ltd* well measured the riskiness of a firm.

To explore the causal relationship between Tobin's Q and environmental risk, not only the above-mentioned company size, but also the following additional control variables that affect companies' market value are incorporated based on the previous studies in the field: sales growth and operating performance.

sales is sales growth during the last year. Sales growth has been found to be positively related to company value. In general terms, the larger the growth in sales over the last period, the higher is the company value.

roe is used to control for differences in financial performance of a company. Since ROE can be decomposed into three levels: operating profit margin, asset turnover and financial leverage, one can place great emphasis on the interests of shareholders by employing ROE to evaluate operating performance. In correspondence to the dynamic and more complex nature of Tobin's Q, ROE is preferred in this paper to control for company profitability due to its sophisticated composition.

4.1.4 Dummy variables

In additional to the quantitative variables, dummy variables are also introduced to measure the qualitative variables' effect on dependent variables. The difference in country accounting system and company age will lead to various characteristics of accounting measures and market values, respectively.

Bushman and Piotroski (2006) verify that under conservative accounting system managers provide a lower estimate of net assets, and thus ROA and other earnings-related measures are given by a lower bound valuation. Under fair value accounting system the reported measures are marked to market, and thus the book value could be different with market valuation of assets because of unrealized profit or loss recognition.

dum_accsys is the dummy variable controlling for different accounting systems in the country where a firm is registered. In the data sample, companies in United Kingdom, Ireland, the Netherlands and Denmark comply with fair value accounting system, while other countries conform to conservative accounting system (Alexander and Nobes, 2007). Thus, the dummy variable is given by 0 under conservative accounting system, representing 101 companies in the sample and otherwise by 1, representing 59 companies in the sample.

Likewise, company age exerts impact on a firm's market value because it is a measure of company's presence in the market. Larger and older companies are assumed to have higher Tobin's Q ratio. *dum_age* is the dummy variable controlling for difference in company age, namely, market presence. Company age is computed as the current year minus the year in which the company was initially listed in MSCI. The binary variable is defined by 1 for company age over 20 years and by 0 otherwise.

dum_indrisk is the dummy variable accounting for the differences in industry risk. It allows dividing the whole sample into three groups, based on the environmental industry risk that the company belongs to, namely the groups with the environmental risk ratings: 0 – 1, 2 - 4, and 5 – 6. This dummy, however, is only used for the regressions that do not include *indrisk* as an explanatory variable because an explanatory variable *indrisk* already accounts for the differences in environmental industry risk. For example, when the regressions on environmental preparedness and performance are run individually to explore how a focused dimension of environmental responsibility affects ROA or Tobin's Q, one includes *dum_indrisk* to take into account different industry risk levels among companies.

Meanwhile, time dummy is taken into account for all the regressions. Such dummy variable is commonly included to capture the time variance of Tobin's Q and ROA in panel data, namely the variation of data between the four years of the analysis.

4.2 Model estimation

In order to assess the causal relationship between corporate financial performance and CSR in environmental issues, the following multivariate models with three environmental variables are structured:

$$roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 C_{it} + \varepsilon_{it},$$

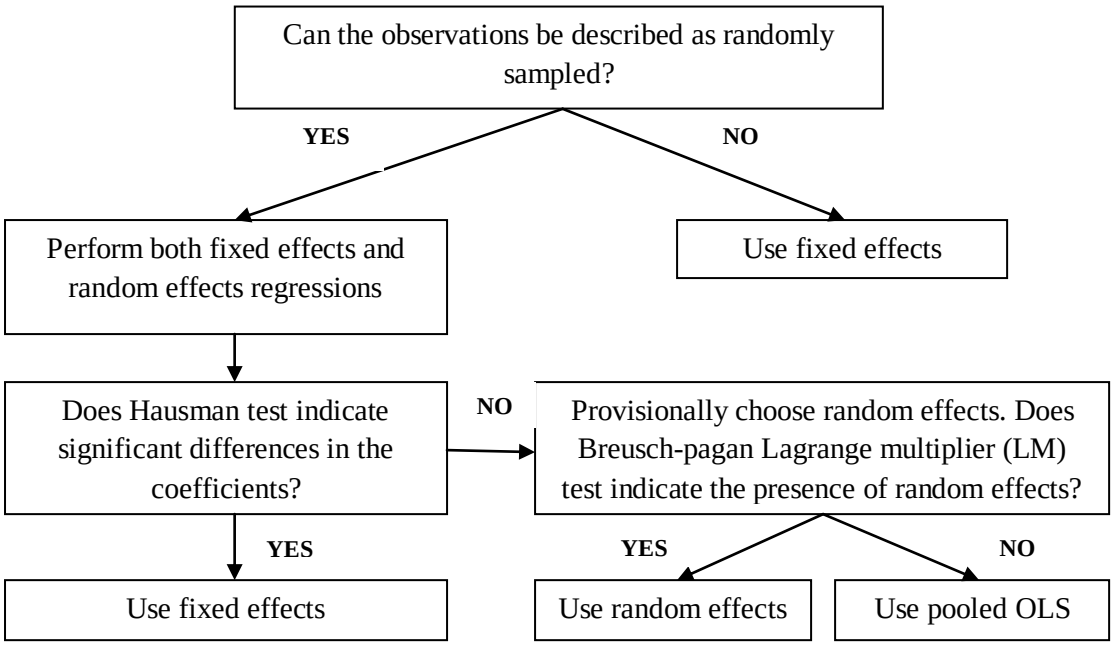
$$tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 C_{it} + \varepsilon_{it},$$

where C_{it} is a group of control variables corresponding to each respective dependent variable, ε_{it} is the error terms, i identifies the company (i= 1, 2, 3, …, 160 companies) and t denotes time periods for each company. The environmental and financial measures represent end of each year values.

While deciding about the estimation method for the model, the process shown in Figure 3 is used to approximate the best-fit type of model.

Figure 3. Choice of Regression Model for Panel Data

Adapted from Dougherty, 2002



According to Figure 3, the first step in choosing between random effects (RE) model and fixed effects (FE) model is based on whether the observations are randomly sampled. In this paper 160 companies are randomly selected from over 600 companies, with no preference on specific industry, country or any other property. So following the flowchart, the next step would be looking into both fixed effects and random effects models.

A classic FE model can be given by:

$$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it2} + \cdots + \beta_k X_{itk} + u_i + e_{it}$$

where

- $u_i (i = 1 \ldots n)$ is the unobserved and fixed effect for each entity
- Y_{it} is the dependent variable where i = entity and t = time
- X_{it} is the independent variable
- β_1, β_2 and β_k are the coefficients for the independent variables
- e_{it} is the error terms

FE model is particularly designed to explore the relationship between explanatory and dependent variables within an entity (country, person, company, etc.). It is appropriate to use FE model when one is interested in causal relationships changing only across time. The slope coefficient on *X* is the same from one entity to another. But the unobserved effects, u_i , varies from entity to entity based on each entity's own individual characteristics. Moreover, the unobserved effects may or may not influence the explanatory variables. By fixing the unobserved effects of a certain entity, the changes in dependent variable within that entity can be explained purely by the explanatory variables. Therefore, one can interpret it as following: for a given company, as *X* varies across time by one unit, *Y* increases or decreases by β units.

Moreover, the error terms in an ideal fixed effects model, e_{it}, are also assumed to be 1) uncorrelated with each explanatory variable across all time periods, 2) homoscedastic, and 3) serially uncorrelated across time.

A classic RE model can be given by:

$$Y_{it} = \beta_0 + \beta_1 X_{it1} + \cdots + \beta_k X_{itk} + u_i + e_{it}$$

where

- β_0 is the intercept
- u_i is the unobserved effect
- e_{it} is the error terms

The rationale behind RE model is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with each explanatory variable in all time periods. The intercept β_0 is given by the average of all entities' intercepts, so that one can assume that the unobserved effects u_i have zero mean. Since u_i is uncorrelated with independent variable in all time periods, one cannot use a transformation (e.g. first differencing) to eliminate the unobserved effects for Ordinary Least Squares (OLS) estimation. With Generalized Least Squares (GLS) estimation RE model resolves the autoregressive serial correlation among the composite error term as $\nu_{it} = u_i + e_{it}$. A balanced sample with large i and relatively small t is ideal to have good properties. Given that the unobserved effects are assumed to be uncorrelated with

the independent variables, RE model allows for independent variables that are constant over time, e.g. the rating of industry risk in this paper.

To decide between fixed or random effect one can run the Hausman test. The null hypothesis is that both random and fixed effects regressions can output identical coefficients, and the alternative is that fixed effects model works better than random effects model (Greene, 2008). If the p-values of the test statistics are larger than 5%, it implies that random effect model is in favor.

The fundamental reason why the coefficients in random and fixed effects model differ is that fixed effects model relax the assumption about correlation between explanatory variables and the unobserved effects. The greater the difference, the larger the test statistics is reported.

Fixed and random effects estimations are run separately for ROA and Tobin's Q on the environmental explanatory variables[3]. The Hausman test statistics for ROA is 5.92 with the p-value of 0.1158, and for Tobin's Q is 2.05 with p-value of 0.5620. Both test statistics are small enough and the p-values are over 5%, so that one cannot reject the null hypothesis in favor of random effects model. Consequently, random effects model is superior to fixed effects model, and hence is used in this paper.

Another option for panel data analysis is the OLS linear estimation. Estimators in fixed effects and random effects models are produced under more relaxed assumptions: FE model needs no assumption about the correlation between unobserved effect and the explanatory variables. Random effects model assumes that unobserved effects do not correlate with the explanatory variables because they are included in the error terms. Then GLS estimation in random effects model will absorb the resulting serial correlation over time. OLS estimation, however, requires stricter assumptions about the error terms, e.g. normally and identically distributed, independent and serially uncorrelated. If one disregards the fact that the composite error terms are often serially correlated, then OLS estimation can still be used, but becomes inefficient.

When the random effects estimation is assumed, the unobserved effects must be detected to avoid mismatching between the OLS estimation without the unobserved effects and the RE estimation. Breusch-pagan Lagrange multiplier (LM) test is

[3] See Appendix 9.2.1

developed to decide between random effects regression and a simple OLS regression. The null hypothesis is that the variance across entities is zero, namely, there is no significant difference across units (i.e. no panel effect). For the data used in this paper the test statistics for ROA is 381.17 with p-value of 0.0000 and for Tobin's Q is 798.46 with p-value of 0.0000, so that one can reject the null hypothesis, which implies that the random effects exist[4].

[4] See Appendix 9.2.2

5. Empirical results and discussion

5.1 Descriptive statistics

Descriptive statistics is used to help to look into the information that the data sample provides in more detail. By creating descriptive tables or plotting figures one can discover the facts or trends that may not be obvious otherwise.

Table 2 and 3 represent further breakdown of the observations by country and by industry. It can be seen that among the total of 14 European Union members involved, Britain, France and Germany, the main economic powers in the region, are home to 60% of the 160 companies in the sample. It should also be noted that the financial institutes make up almost a quarter of the sample, while energy companies constitute only 5%, which could lead to disproportionate problems.

Table 2: Country Classification

Country	Frequency
Belgium	3%
Germany	14%
Denmark	2%
Spain	4%
Finland	2%
France	20%
Britain	26%
Greece	2%
Ireland	3%
Italy	7%
Netherlands	6%
Norway	3%
Portugal	1%
Sweden	8%
Total	100%

Table 3: Industry Classification based on GICS

Industry	Frequency
Energy	5%
Materials	10%
Industrials	11%
Consumer Discretionary	17%
Consumer Staple	10%
Health Care	4%
Financials	24%
Information Technology	5%
Telecommunication & Services	7%
Utilities	8%
Total	100%

By illustrating the descriptive statistics of dependent variables and explanatory variables, one can summarize the main features of the sample, for example, the distribution, the central tendency, the dispersion and so on[5]. Table 4 below illustrates some basic descriptive statistics of the key variables in this paper. Because the sampled companies are mostly mature ones with large capitalization, the average of ROA is within expected high value. As expected for a market-derived measure, the variation of Tobin's Q is greater than that of ROA, since *tobinq*'s standard deviation is 1.015897 while roa's is 0.0652989. Based on the great difference between kurtosis and skewness, it is obvious that none of the variables is normally distributed.

Table 4: Descriptive Statistics of Key Variables

	Roa	*Tobinq*	*Indrisk*	*Prep*	*perf*
Mean	0.063392	1.640591	3.00625	4.067188	2.654688
Median	0.05155	1.31164	3	5	3
Std. deviation	0.0652989	1.015897	2.361001	1.923461	1.804483
Kurtosis	16.23832	14.95803	1.395048	2.707161	2.185348
Skewness	-0.132085	3.158399	0.0134	-0.86663	-0.08348
Min	-0.5482	0.637205	0	0	0
Max	0.315	8.253308	6	6	6

Figures 4 – 7 are the plots of dependent variables against time and company ID, implying that: 1) both *roa* and *tobinq* are randomly distributed across time and

[5] See Appendix 9.2.3

companies, without any clear patterns of distribution; 2) *tobinq* bears more outliers than *roa* against the respective mean values, so that the market valuation for each company differs more than the accounting value in the sample; 3) *roa* is dispersed relatively more than *tobinq* around corresponding mean values; 4) *roa* is more stable than *tobinq* over time as shown in Figure 4 and 6. To sum up, graphically and statically speaking, the dependent variables follow a random distribution.

As can be seen from the figures, there are few outlying data points given the large sample size. The impact of these outliers in this sample cannot be substantially exerted on the statistical inference of the population. Moreover, such observations can provide important information about the standard errors of dependent variables. Therefore, after controlling for the correctness of the numbers, it is decided not to drop such outlying observations.

Figure 4: Plot of ROA against Company

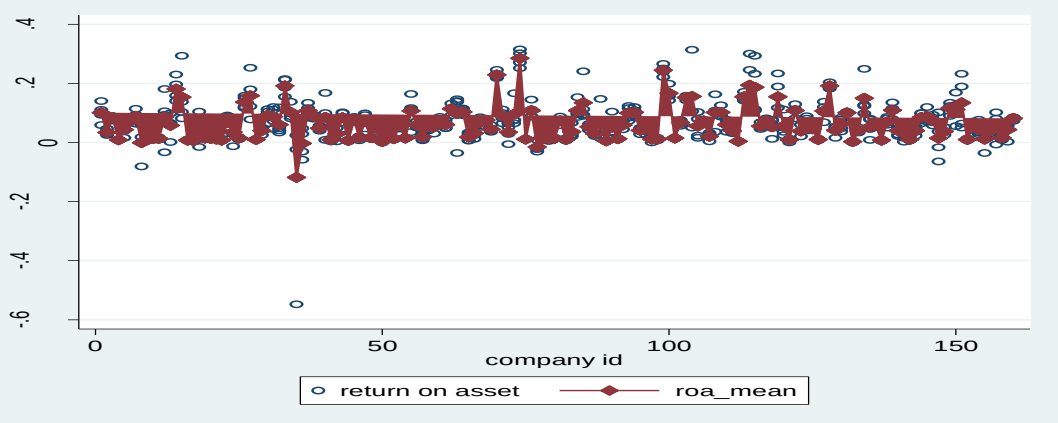


Figure 5: Plot of ROA against Time

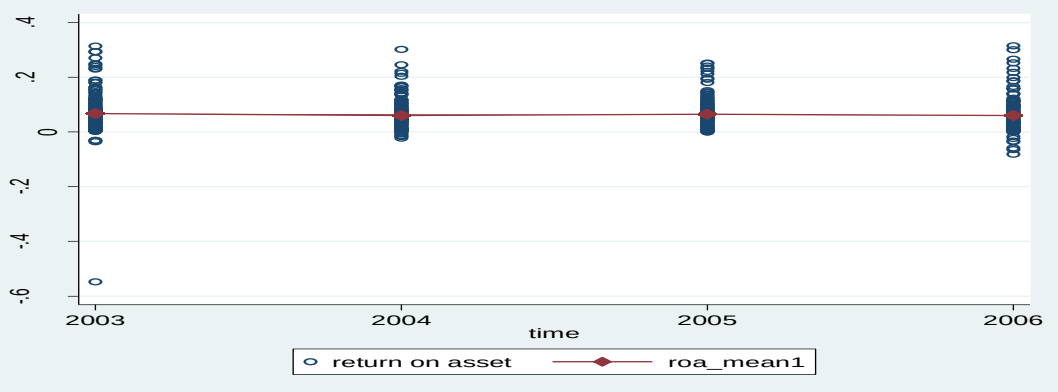


Figure 6: Plot of Tobin's Q against Company ID

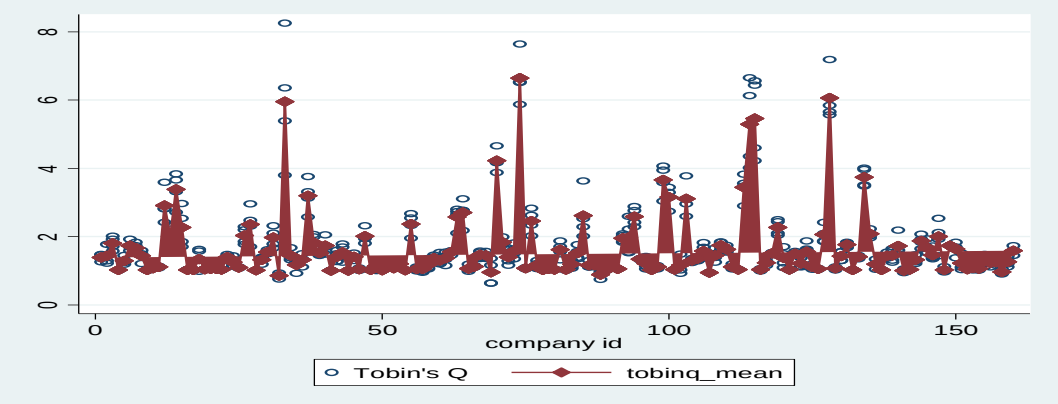
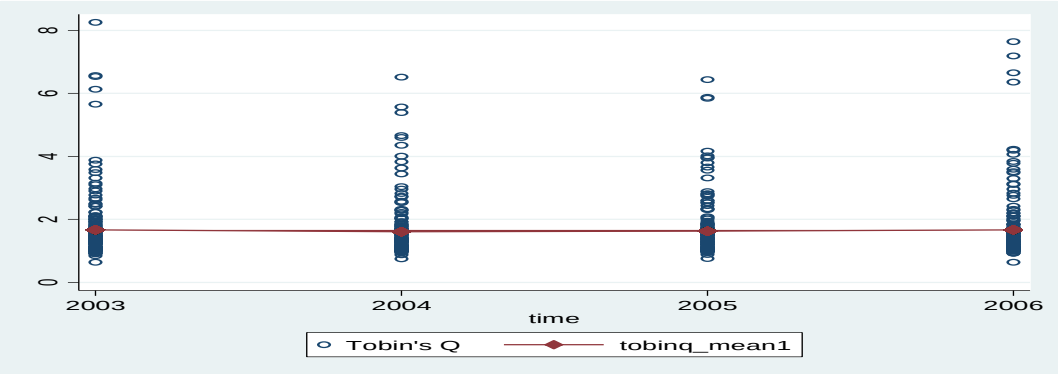


Figure 7: Plot of Tobin's Q against Time



As the range of environmental rating values is pre-determined between 0 to 6, one can look at the frequency distribution to justify the randomness. Table 5 summarizes the overall frequency distributions of the explanatory variables, suggesting no clear pattern of distribution for each explanatory variable.

Table 5: Frequency Distributions of Explanatory Variables

Variable	***indrisk***		***prep***		***Perf***	
Value	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0	148	23.13	71	11.09	149	23.28
1	94	14.69	6	0.94	12	1.88
2	58	9.06	42	6.56	69	10.78
3	42	6.56	98	15.31	242	37.81
4	62	9.69	88	13.75	56	8.75
5	78	12.19	143	22.34	73	11.41
6	158	24.69	192	30.00	39	6.09

23.13% of the observations receive the lowest rating of general industry risk, while 24.60% receive the highest. Recalling section 4.1.4, where the dummy variable of industry risk is defined, one can tell that the observations are largely scattered among low industry risk (*indrisk* < 2) and high industry risk (*indrisk* > 4) accounting for 37.82% and 24.69% respectively.

In terms of the environmental preparedness for the future, over 87% of the observations received a rating above "c+" (*prep* =1), among which 30% have the highest score, according to Table 5. For the environmental performance, the majority of the observations has reached or exceeded the medium level of attainment, but there are still 23.28% with the lowest rating.

Because a panel data set is characterized by both cross-sectional and time-series dimensions, each explanatory variable also changes over time. STATA gives the "within percentage" in the table of general frequency distribution[6], so that the stability of a certain variable can be told. The higher the "within percentage", the more stable this variable is. It follows that a time-invariant variable will have a tabulation with "within percentage" of 100.

None of the explanatory variables are time-invariant as shown in Table 6, implying that they fluctuate over time. *indrisk* is the most stable variable with total within percentage of 95.81. Conditional on a company having *indrisk* of 0 in one of the years, its industry risk ratings remain the same for the rest of the time period. It can be implied that the companies with the lowest industry risk have been able to operate with constant industry risk, while the risk level of other relatively risky businesses fluctuates over time. Obviously, *prep* is the most volatile variable with the lowest total "within percentage" equal to 43.72. Another phenomenon worth mentioning is that conditional on a company ever having *prep* or *perf* of 1, only 25% of its observations remain 1, while conditional on a company ever having the lowest rating in *prep* or *perf*, 52.21% and 51.03% of its observations respectively remain 0. It is quite paradoxical that companies with lower environmental preparedness and performance actually change more than companies with the lowest ratings.

[6] See Appendix 9.2.3, page 76

Table 6: Within Percentage in the General Frequency Distribution of Explanatory Variables

Ratings	*Indrisk*	*Prep*	*Perf*
0	100.00	52.21	51.03
1	97.92	25.00	25.00
2	96.67	38.89	35.20
3	87.50	45.37	53.07
4	91.18	32.35	29.17
5	97.50	36.86	38.83
6	94.05	60.00	44.32
Total	95.81	43.72	43.84

5.2 Partial correlations

To check for correlation among explanatory variables, Pearson test is performed to give out the correlation matrix as shown in Table 7. The null hypothesis of Pearson test is that there is no correlation between two variables. The null hypothesis can be rejected, if p-values of the correlation coefficient in parentheses in Table 7 are smaller than 5%, given that the confidence level is 95%.

Table 7: Pearson Correlation Coefficients

	Roa	*Tobinq*	*Indrisk*	*Prep*	*Perf*
roa	1.0000				
tobinq	0.7015 (0.0000)	1.0000			
indrisk	0.2268 (0.0000)	-0.0187 (0.6375)	1.0000		
prep	0.1340 (0.0007)	0.0252 (0.5247)	0.4386 (0.0000)	1.0000	
perf	0.0987 (0.0124)	-0.0061 (0.8782)	0.1178 (0.0028)	0.5951 (0.0000)	1.0000

Obviously, *roa* is correlated with all the explanatory variables, while *tobinq* is not correlated. *roa*'s correlation coefficients with i*ndrisk*, *prep* and *perf* are 0.2268, 0.134 and 0.0987 respectively, at the significance level of 5%.

Moreover, the three explanatory variables are correlated with each other, given the significant coefficients of 0.4386, 0.1178 and 0.5951 with all p-values smaller than 5%. Correlation among the explanatory variables implies that regressions should be run individually on each explanatory variable, instead of an additive form.

5.3 Multivariate regressions

In this section, random effects models with control and dummy variables are run for both dependent variables: ROA and Tobin's Q. Results and analysis are summarized in Tables 8, 9 and 10 followed by statistic inference.

5.3.1 Regressions on individual environmental dimension

As mentioned in Section 5.2, the three environmental variables on the right-hand side of the model are highly correlated with each other based on Pearson correlation test. One should avoid the redundancy among correlated independent variables with regard to what they explain, because the *Y* relationship with each of the independent variables overlaps to some degree with their relationships with other variables. Therefore, each individual explanatory environmental variable is regressed separately on ROA and Tobin's Q to investigate the specific effect of an environmental dimension on the financial performance.

The models are expressed as following, and the results[7] are summarized in Table 8:

$$roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum\_accsys_{it} + u_i + e_{it} \quad (1)$$

$$tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + \beta 6 dum\_ageit + ui + eit \quad (2)$$

$$roa_{it} = \beta_0 + \beta_1 prep_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum\_accsys_{it} + \beta_5 dum\_indrisk_{it} + u_i + e_{it} \quad (3)$$

$$tobinq_{it} = \beta_0 + \beta_1 prep_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + \beta 6 dum\_ageit + ui + eit \quad (4)$$

[7] See Appendix 9.2.4

$$roa_{it} = \beta_0 + \beta_1 perf_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum\_accsys_{it} + \beta_5 dum\_indrisk_{it} + u_i + e_{it} \quad (5)$$

$$tobinq_{it} = \beta_0 + \beta_1 perf_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + + \beta 6 dum\_ageit + ui + eit \quad (6)$$

Table 8: Results of Regressions on Environmental Variables Individually

	***roa* model (1)**	***tobinq* model (2)**	***roa* model (3)**	***tobinq* model (4)**	***roa* model (5)**	***tobinq* model (6)**
Intercept	.3599844 (0.000)	6.476731 (0.000)	.3766107 (0.000)	6.512589 (0.000)	.3883514 (0.000)	6.561465 (0.000)
Indrisk	.0034541 (0.015)	-.0592268 (0.035)	-	-	-	-
Prep	-	-	.0009235 (0.474)	.0014287 (0.941)	-	-
Perf	-	-	-	-	.0063121 (0.000)	.0309169 (0.032)
Ltd	-.0946422 (0.003)	-	-.0937767 (0.004)	-	-.0917894 (0.004)	-
Logta	-.0168834 (0.000)	-.2734693 (0.000)	-.0177614 (0.000)	-.2740613 (0.000)	-.019042 (0.000)	-.2799195 (0.000)
Sales	-	.0229156 (0.681)	-	.0200837 (0.732)	-	-.0212238 (0.722)
Roe	-	.0673971 (0.164)	-	.0702542 (0.148)	-	.065559 (0.170)
dum_indrisk	no	no	yes	yes	yes	yes
dum_accsys	yes	yes	yes	yes	yes	yes
dum_age	no	yes	no	yes	no	yes
Time dummies	yes	yes	yes	yes	yes	yes
Overall R^2	0.2532	0.3181	0.2478	0.3326	0.2629	0.3389
F-value	454.35 (0.0000)	1453.35 (0.0000)	440.60 (0.0000)	1490.10 (0.0000)	468.23 (0.0000)	1523.88 (0.0000)

In terms of general industry risk, regressions (1) and (2) estimate significant coefficients, β_1, and intercepts, β_0, at 5% significance level. Coinciding with the hypotheses in Section 2.4, industry risk is positively related to ROA (β_1=0.0034541, p-value=0.015), but negatively related to Tobin's Q (β_1=-0.0592268, p-value=0.035).

In the regressions on environmental preparedness and performance, the industry dummy is included to control for various industry risk levels among the companies. None of the corporate financial measures is related to preparedness based on the insignificant coefficients in model (3) and (4) at the 5% level, although the sign of coefficient in model (4) is consistent with the hypothesis.

The relationship between corporate financial measures and environmental performance is verified by model (5) and (6). Significant coefficients for both ROA and Tobin's Q were found: β_1=.0063121 with p-value=0.000 in model (5) and β_1=0.0309169 with p-value=0.032 in model (6). Both of them are positively related to the dependent variables as expected from the hypothesis.

The goodness-of-fit can be evaluated by the R^2 and *F* statistics. R^2 measures how successful the model fit is in explaining the variation of the data. R^2 can take any value between 0 and 1, with a value closer to 1 indicating that a greater proportion of variance is accounted for by the model. In the context of linear multivariate regression, the value of R^2 indicates the percentage of dependent variable that can be explained by the explanatory variables. However, for the panel data analysis, the overall R^2 of a model is mixed with an effect of cross-sectional and time-series estimations. The rule of thumb is that R^2 over 10% in panel data regression implies that the model is acceptable to fit the data set, even though the higher R^2 the better the model fit is. All the overall R^2 values in the results for this paper are above the 25% level, which is quite assuring.

F statistics is used to test whether the coefficients are jointly significant in the regressions. The null hypothesis is that coefficients of the regressors are all jointly zero. One can reject the null hypothesis if the p-value of the *F* statistics is smaller than the significance level. In this case, all the *F* statistics are significant with the p-values smaller than 5%, so that all the models are significant.

5.3.2 Regressions on environmental variables in additive form

To explore the bonding effect of environmental variables on corporate financial performance, this section shows an additive version of panel data regressions. Model (7) and (8) are the regression results with control and dummy variables, while model (9) and (10) are those without.

The models are defined as following, and the results[8] are summarized in Table 9:

$$roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 ltd_{it} + \beta_5 logta_{it} + \beta_6 dum\_accsys_{it} + u_i + e_{it} \quad (7)$$

$$tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 logta_{it} + \beta_5 sales_{it} + \beta_6 roe_{it} + \beta_7 dum\_accsys_{it} + \beta_8 dum\_age_{it} + u_i + e_{it} \quad (8)$$

$$roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + u_i + e_{it} \quad (9)$$

$$tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + u_i + e_{it} \quad (10)$$

Table 9: Results of Regression in Additive Form

	***roa* model (7)**	***tobinq* model (8)**	***roa* model (9)**	***tobinq* model (10)**
Intercept	.3761753 (0.000)	6.561595 (0.000)	.0428021 (0.000)	1.658982 (0.000)
Indrisk	.0035021 (0.031)	-.0600547 (0.022)	.0064712 (0.000)	-.0051839 (0.813)
Prep	-.0031938 (0.060)	-.0142211 (0.449)	-.0031899 (0.083)	-.0141398 (0.441)
Perf	.0074102 (0.000)	.0342455 (0.010)	.006829 (0.000)	.0307337 (0.019)
Ltd	-.0914388 (0.004)	-	-	-
Logta	-.0181976 (0.000)	-.2796805 (0.000)	-	-
Sales	-	-.0168978 (0.775)	-	-
Roe	-	.0624972 (0.192)	-	-
dum_indrisk	no	no	no	no
dum_accsys	yes	yes	no	no
dum_age	no	yes	no	no
Time dummies	yes	yes	yes	yes
Overall R^2	0.2711	0.3226	0.0523	0.0000
F value	489.86 (0.0000)	1507.58 (0.0000)	315.27 (0.0000)	598.30 (0.0000)

[8] See Appendix 9.2.4

In the regressions with control and dummy variables, satisfactory results for R^2 and *F* statistics in models (7) and (8) are found. The insignificant coefficients are the ones of environmental preparedness: for Tobin's Q $\beta_2 = -0.0142211$ with p-value=0.449 and for ROA $\beta_2 = -0.0031938$ with p-value=0.060. Regarding *indrisk*, both the positive coefficient for ROA and the negative coefficient for Tobin's Q are consistent with Hypotheses 5 and 6. Furthermore, despite the insignificant β for *prep*, coefficients of model (8) are all jointly significant with the *F* statistics, so that the model can still be regarded significant.

Conversely, the regressions without any control or dummy variable give out deteriorated results, especially for Tobin's Q. The R^2 of model (10) is 0 indicating that the model has no predictive power. Indirectly speaking, a simple regression of corporate financial measures on environmental variables cannot resolve the complex relation. Therefore, it shows that inclusion of more regressors is necessary to increase the explanatory power of the model.

5.3.3 Regressions of high and low industry risk sub-samples

In this section the whole data sample is divided into two sub-samples, based on different industry risk levels. Consistent with the definition of *dum_indrisk* in section 4.1.4, high industry risk is defined as *indrisk* >4, and low industry risk is defined as *indrisk* <2. The model specifications are the same as in section 5.3.1, but now they are used for two separate sub-samples. Comparison of two extremes, high risk and low risk sub-samples, by eliminating the middle industry risk companies allows distinguishing more clearly the effect of companies' industry risk on their financial performance.

There are 236 observations in the high industry risk sub-sample and 242 in the low industry risk sub-sample. Besides, high industry risk sub-sample includes 60 companies and low industry risk includes 61 companies. The fact that the number of observations differs from the amount of companies indicates that not all the companies in the sample remain in the same industry risk category over time. Overlapped observations and companies in the regressions show that the regressions are run based on an unbalanced panel.

In Table 10, all the regressions are significant with relatively high R^2 values and significant *F* statistics. The significant coefficients of explanatory variables exist in

model (17) and (18), modeling the effect of environmental performance on corporate financial performance in high risk industry, and indicating that better environmental performance leads to better corporate financial performance. The coefficient of Tobin's Q is substantially greater than that of ROA, implying that in the high risk industries the environmental performance, one of the essential dimensions of CSR, is more closely related to the market value of a firm than to the operational excellence. The R^2 in model (18), 0.4510 is almost double of that in model (17), 0.2448. It implies that in high industry risk companies a firm's environmental performance can crucially affect its market valuation.

Regarding other insignificant coefficients, in particular those of the environmental preparedness, no inclusive conclusion can be drawn given the *F* statistics, p-values of coefficients and R^2. Further investigation might be conducted with larger sample or more regressors.

Table 10: Regression Results of Sub-Samples

	Low Industry Risk *(indrisk < 2)*				**High Industry Risk *(indrisk > 4)***			
	roa* *model (11)	***tobinq* *model (12)***	***roa* *model (13)***	***tobinq* *model (14)***	***roa* *model (15)***	***tobinq* *model (16)***	***roa* *model (17)***	***tobinq* *model (18)***
Intercept	.3690734 (0.000)	7.826025 (0.000)	.3758263 (0.000)	7.855312 (0.000)	.2242177 (0.002)	3.106724 (0.000)	.247319 (0.001)	3.04433 (0.000)
Prep	.0009535 (0.475)	-.0107304 (0.763)	-	-	.002932 (0.086)	-.0063557 (0.624)	-	-
Perf	-	-	.0029922 (0.041)	.0101312 (0.758)	-	-	.0056357 (0.000)	.0299782 (0.002)
Ltd	-.0168413 (0.665)	-	-.0195718 (0.627)	-	-.1576564 (0.002)	-	-.1591237 (0.002)	-
Logta	-.017978 (0.000)	-.3366158 (0.000)	-.0185135 (0.000)	-.3407875 (0.000)	-.0083965 (0.065)	-.1085352 (0.003)	-.0098187 (0.038)	-.110991 (0.004)
Sales		.0179814 (0.763)	-	.0034329 (0.961)	-	.8300935 (0.000)	-	.7003834 (0.000)
Roe	-	.0142494 (0.929)	-	.0108701 (0.946)	-	.1612855 (0.040)	-	.1689827 (0.002)
dum_indrisk	no	no	no	no	no	no	no	no
dum_accsys	yes	yes	no	no	yes	yes	no	no
dum_age	no	yes	no	no	no	yes	no	no
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Overall R^2	0.4196	0.3704	0.4226	0.3730	0.2385	0.4436	0.2448	0.4510
***F* value**	44.00 (0.0000)	34.03 (0.0000)	49.52 (0.0000)	32.22 (0.0000)	31.03 (0.0000)	89.48 (0.0000)	35.50 (0.0000)	96.08 (0.0000)

5.4 Model diagnostics

Diagnosing the model requires statistical tests and theoretical justification based on the underlying assumption of the chosen model. An ideal random effects model exists under the following assumptions:

(1) for each i, the model is given by:

$$Y_{it} = \beta_0 + \beta_1 X_{it1} + \cdots + \beta_k X_{itk} + u_i + e_{it}$$

where β_j are the coefficients to estimate and u_i is the unobserved effect.

(2) the data is randomly sampled from the population

(3) no multicollinearity among the explanatory variables

(4) the variance of error terms is constant, i.e. homoscedasticity

(5) the error terms are serially uncorrelated

Assumptions (1) and (2) have been checked and satisfied in Section 4.2. Moreover, the following tests need to be run to test for assumption (3) – (5).

5.4.1 Test for multicollinearity

Multivariate regression assumes that one of the explanatory variables exerts impact on the dependent variable, while other explanatory variables are held constant, "ceteris paribus". The term multicollinearity implies that several variables are near perfect linear combinations of one another. The primary concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients can get wildly inflated.

Given the multivariate regressions, the assumption of ceteris paribus – other relevant factors being equal – has to be taken into account, so that over controlling can be avoided and the causal inference can be identified explicitly. To fit a better model, multicollinearity test is run for explanatory variables and for control variables to see whether perfect linear relationships exist among regressors[9].

[9] See Appendix 9.2.5

The linear regression must be run before testing for multicollinearity by executing the Variance Inflation Factor (VIF)[10]. The following regressions are run before obtaining the VIF value of each variable on the right-hand side of the equations in Table 11.

$$\text{roa} = \alpha + \beta_1 indrisk + \beta_2 prep + \beta_3 perf + \beta_4 ltd + \beta_5 logta + \mu$$

$$\text{tobinq} = \alpha + \beta_1 indrisk + \beta_2 prep + \beta_3 perf + \beta_4 logta + \beta_5 sales + \beta_6 roe + \mu$$

Table 11. VIF of Explanatory Variables and Control Variables

	Roa	***Tobinq***
Indrisk	1.45	1.43
Prep	1.97	1.99
Perf	1.66	1.72
Logta	1.19	1.17
Ltd	1.06	-
Sales	-	1.01
Roe	-	1.02

As a rule of thumb, a variable whose VIF values are greater than 10 may become a risk to the model. It means that the standard error of this variable would be at least $\sqrt{10}$ times as large as it would be if VIF was 1, so that the coefficient would have to be $\sqrt{10}$ as large to be statistically significant. Thus, a VIF greater than 10 indicates that the variable could be considered as a linear combination of other explanatory variables and the model can be modified.

None of the resulting VIF values of explanatory and control variables are greater than 10, implying that the multicollinearity can be neglected. Therefore, the assumption that no perfect linear relationships exist among the regressors holds here for further analysis.

5.4.2 Test for heteroskedasticity

For linear multivariate regressions the homoscedasticity assumption states that the variance of the error terms, conditional on the explanatory variables, is constant. In the context of

[10] *vif* (stands for Variance Inflation Factor) command is used in STATA to check for multicollinearity.

panel data, the intra-entity disturbance can create heteroskedasticity within the panel under OLS estimation. Generally, it is caused by measurement errors, omitted variables, subpopulation differences (in this case, three subsets of low-risk, medium-risk and high-risk industries) and other model misspecifications. Because heteroskedasticity leads to biased standard errors, not only the p-values of estimators will inflate, but other test statistics and the confidence intervals can also suffer. In this paper heteroskedasticity is tested with White's General Test for Heteroskedasticity[11].

White's General Test adds squares and cross products of all the explanatory variables to capture the non-linear form of heteroskedasticity, even when the error terms are not normally distributed. White's test involves regressing the squared error term from the OLS regression on the explanatory variables in the regression. The same linear regressions as in Section 5.4.1 must be run before testing heteroskedasticity. The decision rule is that the null hypothesis of homoscedasticity can be rejected, if the p-value is smaller than 0.05 given the 5% significance level. The test statistics are summarized in Table 12.

Table 12: Test Results for Heteroskedasticity

	test statistics	p-value
Roa	15.53	0.0773
Tobinq	24.19	0.0040

One cannot reject the null hypothesis of homoscedasticity in regressions on ROA, but can reject that for Tobin's Q. The error terms are homoscedastic for ROA, and therefore the assumption (4) in Section 5.4 of constant variance of error terms can be satisfied, given the dependent and explanatory variables.

The heteroskedasticity in regressions of Tobin's Q violates assumption (4), so that the correlation between market value and environmental measures needs further adjustment. Robust standard errors, allowing heteroskedastic error terms, are therefore used in the regressions to control for the heteroskedasticity.

[11] See Appendix 9.2.6

5.4.3 Test for serial correlation

Autocorrelation has to do with the structure of the error terms from the perspective of time series data. The error terms - the differences between the predicted and actual values in one time period - are likely to be correlated to those in the next time period. It could be caused by model misspecification and data manipulation. Similar to heteroskedasticity, autocorrelation leads to inefficient, but still unbiased OLS estimators, and also unreliable *F* statistics.

Lagram-Multiplier test is performed to test whether the error terms are serially correlated[12]. The Lagram-Multiplier test's null hypothesis is no serial correlation in the serial error terms from the regressions. The null hypothesis can be rejected, if the p-value of the test statistics is smaller than 5%. The results[13] are illustrated in Table 13 below:

Table 13: Test Results for Serial Correlation

	test statistics	p-value
Roa	4.323	0.0392
Tobinq	0.185	0.6675

For Tobin's Q, the null hypothesis cannot be rejected, i.e. the data does not have first-order autocorrelation. But the result is contrary for the regression on ROA, so that the assumption (5) is violated here. The error terms in regressions of ROA can be considered unstable over time in this case. Robust standard errors are also used in all the regressions of ROA as a remedy.

5.5 Analysis and discussion

This section analyzes the results of the regressions presented in the previous section, and suggests the implications for management. Summary of hypotheses verification is presented in Table 14.

[12] See Appendix 9.2.7
[13] "xtserial" command in STATA

Table 14: Verification of Hypotheses

Hypothesis	Result
Hypothesis 1: There is a positive relationship between environmental performance and operating performance.	Cannot be rejected
Hypothesis 2: There is a positive relationship between environmental performance and the market value of the companies.	Cannot be rejected
Hypothesis 3: There is a negative relationship between environmental preparedness and operating performance.	Inconclusive: The association is positive, and the result is not significant
Hypothesis 4: There is a positive relationship between environmental preparedness and the market value of the companies.	Inconclusive: The association is positive, but the result is not significant
Hypothesis 5: There is a positive relationship between environmental industry risk and operating performance.	Cannot be rejected
Hypothesis 6: There is a negative relationship between environmental industry risk and market value of the companies.	Cannot be rejected
Hypothesis 7: There is a larger impact of environmental performance and preparedness on operating performance for high risk industries compared to low risk industries.	Inconclusive: The association for performance is larger for high risk sub-sample than for the low-risk sub-sample, and the results are significant. However, the results for preparedness are not significant, even though the coefficient for the high risk sub-sample is larger compared to the low risk sub-sample.
Hypothesis 8: There is a larger impact of environmental performance and preparedness on the market value of the companies for high risk industries compared to low risk industries.	Inconclusive: no significant results

First of all, the results imply that association between environmental performance and both the operating financial performance, measured by ROA, as well as on the market value of the companies, measured by Tobin's Q, is positive and significant. Based on these results, implementation of pro-active environmental strategies has a positive implication for the financial performance of the companies. The results of the study, hence, suggest that following pro-active environmental strategies brings benefits not only to the society, but also to the shareholders and other stakeholders, which is in line with the arguments proposed by the value-creation school.

Moreover, the abovementioned results suggest that the market takes into account environmental performance, when estimating corporate values. In particular, it implies that the market considers green companies as being more competitive and assigns higher values to such environmentally-responsible companies. It could be due to an increase in environmental consciousness of the present-day society that leads to more attention being paid to the environmental issues, such as climate change, pollution etc. Taking into account that the benefits of environmental strategies become more apparent in the long-run, the association between environmental performance and financial indicators could be even larger, if to consider its long-term effects.

Secondly, this study did not find a significant association between environmental preparedness and financial performance, which indicates that environmental preparedness does not directly associated with business value creation. The results indicate that it is not worth putting the same emphasis on environmental preparedness as it is on performance. There is a need to incorporate environmental practices and actions into the business strategy to realize the implications on financial performance. Such results, however, could be due to the fact that environmental preparedness brings more benefits, which are visible in the longer term. Therefore, it could be more appropriate to run lagged effects models on preparedness to see more significant results. However, even with the lagged effect models the impact of CSR on financial performance could be underestimated, given the short time horizon of the study.

Thirdly, the higher the industry risk, the more attention needs to be paid on the companies' environmental performance because the association is greater on the financial performance.

This conclusion is supported by the evidence from the regressions run on the whole data sample as well as from the low risk and high-risk sub-samples.

However, it is important to remember that the above-mentioned results are based on the not fully specified analytical model. The model does not include all the possible factors that have an influence on the dependent variables. Therefore, there could be some other influential dimensions that bias the results. Moreover, this study is performed merely on a sample of companies from the European Union. It implies that the results cannot be generalized and extended to other companies, especially in other geographical regions. Furthermore, there is no guarantee that the above-mentioned results apply for the extended time period. Lastly, the uninvestigated causality of the relationship between CSR and financial performance remains problematic. The suggestion that there is a positive association between environmental and financial performance does not guarantee that the association cannot go the other way round.

6. Conclusion

As an essential aspect of CSR, corporate environmental responsibility embodies how involved a firm is as a social citizen in environmental initiatives. For example, environmental practices can include such aspects as pollution prevention and control, natural resource management, recycling, introduction and marketing of green products, waste management, etc. When it comes to the implementation of CSR, the traditional mindset based on command and control should change to one focusing on the network of dynamic relations. Thus, a CSR-oriented company is no longer structured with top-down hierarchy, and every CSR principle is integrated within the core business process as an indivisible component in the corporate development strategy.

Although more and more CSR innovations have emerged, the challenge of CSR implementation still lies in the tradeoff between benefits and costs. Managerial decisions are often perceived as black or white: either environmentally-responsible or profitable. Even large corporations come across dilemma of financial stress from various environmentally responsible projects, and the focus of adopting CSR principles shifts to striking the balance between the benefits of CSR and the costs of running those CSR compliance projects.

However, instead of absorbing the cost of CSR projects, companies should attempt to identify a set of societal issues that are in line with their own business strategies, and then consolidate the benefits of CSR principles with corporate profits and growth. The ultimate goal is to align strategic business operations with CSR principles. Previous theoretical and empirical studies have recognized the interconnection between financial benefits and CSR contribution.

This paper explores the association between corporate financial performance and environmental responsibility with an empirical analysis of 160 European companies during the period 2003 - 2006. The analysis of this study focuses on the European companies listed in MSCI World Index. ROA and Tobin's Q are chosen to measure the corporate financial performance, and the environmental ratings by GES Investment Services® are used to quantify the corporate environmental responsibility. The environmental

responsibility is composed of three dimensions: general industry risk, environmental preparedness and environmental performance.

Random effects regressions are run to estimate the impact of individual environmental dimensions on corporate operational performance and market value. The empirical results and analysis indicate that: 1) ROA is positively associated with general industry risk and environmental performance; 2) Tobin's Q is negatively associated with the general industry risk, and is positively associated with environmental performance; and 3) all the regressions are significant in terms of jointly generating non-zero coefficients of explanatory variables.

Among the high risk industries, environmental performance is a more influential dimension on corporate financial performance. Environmental performance affects Tobin's Q more compared to ROA, which is evident from a difference in the respective coefficients. Among the low risk industries, the importance of environmental performance remains, and ROA is linked more closely to it than the Tobin's Q.

In sum, the results of the study indicate that European companies can integrate CSR values, in particular the principles of environmental responsibility, into their business strategies to strike the balance between the outlay for various CSR projects and growth of the corporate value. The results are in line with the previous studies that show that the costs of implementing environmental strategy are compensated by its corresponding benefits.

7. Suggestions for further research

There are many ways to measure CSR, but almost every measure is criticized to be too subjective and unclear in definition due to the complex nature of CSR. Further studies could investigate the association between CSR and financial performance based on various measures of CSR to eliminate the subjectivity bias of CSR measures. It becomes also important to design measures of CSR that could in a better way reveal the relationship between CSR and financial performance.

As CSR ratings are mainly published for listed large multinational companies, one further area for research could be to examine the relationship between CSR and financial performance for not listed as well as small and medium size companies.

Moreover, another area for research could be investigation of the impact of CSR on financial performance for the emerging market countries as the present studies are mainly focused on the companies from the developed countries.

As in this study the timeframe is limited for the period before the financial crisis, it could be also interesting to see the research on CSR relationship with financial performance during or after the financial crisis.

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9. Appendix

9.1 GES Investment Services® presentation[14]

GES Investment Services® (GES) is northern Europe's leading analysis house and service provider for responsible investment adding proven value to €650 billion of investments worldwide. GES stands for Global Ethical Standard, which is also the name of the base analysis – GES Ethical Global Standard®. The basis of this service and the add-on services are global standards for environment, human rights, business ethics and corporate governance.

The company was founded in 1992 by Magnus Furugård and Susanne Nyman who are the sole owners of GES. This ownership structure and the strategic decision to work with investors only has been a prerequisite in order to guarantee our clients independent research. In total GES has 29 employees divided up between offices in Stockholm (Sweden), Copenhagen (Denmark) and Zielona Góra (Poland). Of these, 20 are researchers. Their background ranges from asset management, environmental consultancies, human rights and UN organizations, research institutes and multinational enterprises.

The GES Risk Rating® is an analysis of risks in the companies' methods of dealing with the environment, human rights and corporate governance. The analysis is based on international norms on Environmental, Social and Governance (ESG) issues. It evaluates both the companies' present status and readiness for the future. The analysis model is easy to implement, and gives an immediate overview over a company's sustainability status, which can reduce the investment risk.

The environmental analysis is based on:

- *international standards for environmental management*
- *industry-specific key indicators for environmental performance*

The human rights analysis is based on:

- *UN Universal Declaration of Human Rights*
- *UN Convention on the Rights of the Child*
- *ILO Core Labour Conventions*

The corporate governance analysis is based on the OECD Guidelines for Good Corporate

[14] The content in this section is extracted from http://www.ges-invest.com and GES Investment Services® company presentation

Governance.

The analysis of each specific company is based on official company documents, dialogue with companies, information from non-governmental organizations, the media and GES' partners.

The companies obtain a rating (from Aa to Cc) for each of the areas environment, human rights and corporate governance. The capital letters (A-C) indicate the general risk level in the company's industry. The lower case letters (a-c) indicate the risk level in the particular company, based on preparedness and performance. Altogether the rating shows the company's ability to deal with the general risks that concern the type of activity and to comply with international norms and procedures.

GES Risk Rating® evaluates both the companies' preparedness (through management sustems, etc.) as well as performance through a number of criteria and sub-criteria.

Environment

- **Preparedness:**
  - Organization and routines
  - Policy and Programs
  - External Verification
  - Environmental Reporting
  - Supplier Evaluation
- **Performance**
  - Greenhouse gases
  - Energy use
  - Use of water resources
  - Travel Management
  - Remediation
  - Project Development
  - Hazardous waste
  - Emissions to air
  - +8 more criteria

Social

- **Employees:**
  - Discrimination
  - Freedom of association
  - Health & Safety
  - Working hours & wages
  - +5 more criteria
- **Community:**
  - Use of security forces
  - Corruption
  - +2 more criteria
- **Suppliers:**
  - Code of Conduct
  - Management system and Program
  - Performance evaluation

Governance

- **Board Management & Control:**
- Audit/Compensation /Nomination Committees
- Board Composition and Independence
- Board room diversity
- **Shareholder Rights:**
- Equal voting rights
- Ownership transperancy
- **Transparancy & Incentive:**
- Audit firm costs
- CEO compensation
- Governance reporting

GES Risk Rating® can be used to identify companies that don't perform as well as they could and/or should, and conversely those that do perform well on ESG factors. GES Risk Rating® also provides the analytical basis to support financial decision-making such as the construction of portfolios or active engagement with underperformers.

9.2 STATA statistics output tables

9.2.1 Hausman Test

First of all, a fixed effects estimation of ROA is run and the coefficients are stored in STATA as "roafe". Secondly, a random effects estimation of ROA is run and the coefficients are stored in STATA as "roare". Finally the command of hausman test "hausman" is run to compare the results from two estimations. The same procedure applies to that for Tobin's Q.

```
. xtreg roa indrisk prep perf,fe

Fixed-effects (within) regression               Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0530                         Obs per group: min =         4
       between = 0.0003                                        avg =       4.0
       overall = 0.0048                                        max =         4

                                                F(3,477)           =      8.89
corr(u_i, Xb)  = -0.1260                        Prob > F           =    0.0000
```

roa	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
indrisk	.000634	.0070572	0.09	0.928	-.0132331	.0145011
prep	-.0037299	.0019454	-1.92	0.056	-.0075525	.0000927
perf	.0080474	.0015629	5.15	0.000	.0049764	.0111184
_cons	.0552947	.0219634	2.52	0.012	.0121378	.0984517
sigma_u	.05675581					
sigma_e	.03817905					
rho	.6884627	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(159, 477) =     8.09                 Prob > F = 0.0000

. est store roafe

. xtreg roa indrisk prep perf

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0511                         Obs per group: min =         4
       between = 0.0518                                        avg =       4.0
       overall = 0.0506                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(3)       =     33.47
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

roa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
indrisk	.0064294	.0018585	3.46	0.001	.0027868	.010072
prep	-.0030744	.001701	-1.81	0.071	-.0064083	.0002596
perf	.0068027	.0014545	4.68	0.000	.0039519	.0096534
_cons	.0385288	.0083756	4.60	0.000	.0221129	.0549447
sigma_u	.05085068					
sigma_e	.03817905					
rho	.63950425	(fraction of variance due to u_i)				

```
. est store roare
```

```
. hausman roafe roare
```

	Coefficients (b) roafe	(B) roare	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
indrisk	.000634	.0064294	-.0057954	.0068081
prep	-.0037299	-.0030744	-.0006555	.000944
perf	.0080474	.0068027	.0012448	.0005719

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 5.92
Prob>chi2 = 0.1158

```
. xtreg tobinq indrisk prep perf,fe

Fixed-effects (within) regression               Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0135                         Obs per group: min =         4
       between = 0.0038                                        avg =       4.0
       overall = 0.0007                                        max =         4

                                                F(3,477)           =      2.18
corr(u_i, Xb)  = -0.0731                        Prob > F           =    0.0899
```

tobinq	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
indrisk	.0049042	.0543648	0.09	0.928	-.10192	.1117283
prep	-.0131836	.0149863	-0.88	0.379	-.0426309	.0162637
perf	.0306772	.0120396	2.55	0.011	.0070201	.0543343
_cons	1.598045	.169193	9.45	0.000	1.265589	1.930501
sigma_u	.9882023					
sigma_e	.29410914					
rho	.91862972	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(159, 477) =    44.81                 Prob > F = 0.0000

. est store tobinqfe

. xtreg tobinq indrisk prep perf

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0134                         Obs per group: min =         4
       between = 0.0020                                        avg =       4.0
       overall = 0.0002                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(3)       =      5.79
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.1222
```

tobinq	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
indrisk	-.003604	.0287509	-0.13	0.900	-.0599548	.0527468
prep	-.0108648	.0145495	-0.75	0.455	-.0393813	.0176517
perf	.0284707	.0118488	2.40	0.016	.0052474	.051694
_cons	1.620023	.1234325	13.12	0.000	1.378099	1.861946
sigma_u	.97942518					
sigma_e	.29410914					
rho	.91728595	(fraction of variance due to u_i)				

```
. est store tobinqre
```

```
. hausman tobinqfe tobinqre
```

	Coefficients (b) tobinqfe	(B) tobinqre	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
indrisk	.0049042	-.003604	.0085082	.0461402
prep	-.0131836	-.0108648	-.0023187	.0035918
perf	.0306772	.0284707	.0022065	.0021345

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 2.05
Prob>chi2 = 0.5620

9.2.2 Breusch-pagan Lagrange Multiplier (LM) Test

To detect the presence of random effects, a random effects regression needs to be run before the test command "xttest0". "quietly" in the random effects regression means that the regression results are not displayed.

```
. quietly xtreg roa indrisk prep perf

. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        roa[company,t] = Xb + u[company] + e[company,t]

        Estimated results:
                 |       Var     sd = sqrt(Var)
        ---------+------------------------------
             roa |    .004264       .0652989
               e |    .0014576      .0381791
               u |    .0025858      .0508507

        Test:   Var(u) = 0
                            chi2(1) =   381.17
                        Prob > chi2 =   0.0000

. quietly xtreg tobinq indrisk prep perf

. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        tobinq[company,t] = Xb + u[company] + e[company,t]

        Estimated results:
                 |       Var     sd = sqrt(Var)
        ---------+------------------------------
          tobinq |   1.032046       1.015897
               e |    .0865002      .2941091
               u |    .9592737      .9794252

        Test:   Var(u) = 0
                            chi2(1) =   798.46
                        Prob > chi2 =   0.0000
```

9.2.3 Descriptive Statistics

"xtsum" describes the data in the following format. "between" means the variable varies between companies, "within" means that variable varies within companies over the four time periods "N" is the total number of observations, "n" is the number of companies with observations and "T" is the average number of time periods for each company.

```
. xtsum roa tobinq indrisk prep perf
```

Variable		Mean	Std. Dev.	Min	Max	Observations	
roa	overall	.063392	.0652989	-.5482	.315	N =	640
	between		.0559437	-.118175	.284975	n =	160
	within		.0338962	-.366633	.256567	T =	4
tobinq	overall	1.640591	1.015897	.6372054	8.253308	N =	640
	between		.9854698	.852321	6.644354	n =	160
	within		.2558414	-.5136404	3.943931	T =	4
indrisk	overall	3.003125	2.361001	0	6	N =	640
	between		2.356743	0	6	n =	160
	within		.2148625	1.003125	5.003125	T =	4
prep	overall	4.067188	1.923461	0	6	N =	640
	between		1.743524	0	6	n =	160
	within		.821036	.3171875	6.317188	T =	4
perf	overall	2.654688	1.804483	0	6	N =	640
	between		1.491557	0	5.75	n =	160
	within		1.020717	-.8453125	5.654687	T =	4

"sum" gives out the variable's frequency, skewness, kurtosis and other details.

```
. sum roa tobinq indrisk prep perf,detail
```

return on asset

	Percentiles	Smallest		
1%	-.0328	-.5482		
5%	.00385	-.081		
10%	.00795	-.064	Obs	640
25%	.0153	-.0583	Sum of Wgt.	640
50%	.05155		Mean	.063392
		Largest	Std. Dev.	.0652989
75%	.091	.3006		
90%	.14065	.3022	Variance	.004264
95%	.1885	.3146	Skewness	-.1320845
99%	.2707	.315	Kurtosis	16.23832

Tobin's Q

	Percentiles	Smallest		
1%	.8837321	.6372054		
5%	1.006785	.6375365		
10%	1.019925	.7469656	Obs	640
25%	1.055723	.7547731	Sum of Wgt.	640
50%	1.31164		Mean	1.640591
		Largest	Std. Dev.	1.015897
75%	1.713791	6.655188		
90%	2.692678	7.189846	Variance	1.032046
95%	3.715579	7.647025	Skewness	3.158399
99%	6.518831	8.253308	Kurtosis	14.95803

General Environmental Risk

	Percentiles	Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	640
25%	1	0	Sum of Wgt.	640
50%	3		Mean	3.003125
		Largest	Std. Dev.	2.361001
75%	5	6		
90%	6	6	Variance	5.574325
95%	6	6	Skewness	.0134003
99%	6	6	Kurtosis	1.395048

Subscore Environment - Preparedness

	Percentiles	Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	640
25%	3	0	Sum of Wgt.	640
50%	5		Mean	4.067188
		Largest	Std. Dev.	1.923461
75%	6	6		
90%	6	6	Variance	3.699704
95%	6	6	Skewness	-.8666265
99%	6	6	Kurtosis	2.707161

Subscore Environment - Performance

	Percentiles	Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	640
25%	1	0	Sum of Wgt.	640
50%	3		Mean	2.654688
		Largest	Std. Dev.	1.804483
75%	4	6		
90%	5	6	Variance	3.25616
95%	6	6	Skewness	-.0834803
99%	6	6	Kurtosis	2.185348

"xttab" performs one-way tabulations and decomposes counts into between and within components in panel data. The overall part of the table summarizes results in terms of company-years. We have 148 company-years of data in which indrisk=0 in 23.13% of our data. Between part repeats the breakdown, but this time in terms of companies, 37 of our companies' indrisk=0. The reason why the total of "between" is not 160 is that some companies' rating change. So, there are companies that sometimes have rating of 0 and at other times have different ratings.

```
. xttab indrisk
```

	Overall		Between		Within
indrisk	Freq.	Percent	Freq.	Percent	Percent
0	148	23.13	37	23.13	100.00
1	94	14.69	24	15.00	97.92
2	58	9.06	15	9.38	96.67
3	42	6.56	12	7.50	87.50
4	62	9.69	17	10.63	91.18
5	78	12.19	20	12.50	97.50
6	158	24.69	42	26.25	94.05
Total	640	100.00	167	104.38	95.81
			(n = 160)		

```
. xttab prep
```

	Overall		Between		Within
prep	Freq.	Percent	Freq.	Percent	Percent
0	71	11.09	34	21.25	52.21
1	6	0.94	6	3.75	25.00
2	42	6.56	27	16.88	38.89
3	98	15.31	54	33.75	45.37
4	88	13.75	68	42.50	32.35
5	143	22.34	97	60.62	36.86
6	192	30.00	80	50.00	60.00
Total	640	100.00	366	228.75	43.72
			(n = 160)		

```
. xttab perf
```

	Overall		Between		Within
perf	Freq.	Percent	Freq.	Percent	Percent
0	149	23.28	73	45.63	51.03
1	12	1.88	12	7.50	25.00
2	69	10.78	49	30.63	35.20
3	242	37.81	114	71.25	53.07
4	56	8.75	48	30.00	29.17
5	73	11.41	47	29.38	38.83
6	39	6.09	22	13.75	44.32
Total	640	100.00	365	228.13	43.84
			(n = 160)		

9.2.4 Regression Results

All the regressions are run with robust standard errors to control for heteroscedascity and autocorrelation.

(1) $roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum\_accsys_{it} + u_i + e_{it}$

```
. xi: xtreg roa indrisk ltd logta dum_accsys i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0289                         Obs per group: min =         4
       between = 0.3360                                        avg =       4.0
       overall = 0.2532                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(8)       =    454.35
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |   .0034541   .0014248     2.42   0.015     .0006615    .0062467
         ltd |  -.0946422   .0319668    -2.96   0.003    -.1572959   -.0319884
       logta |  -.0168834   .0026775    -6.31   0.000    -.0221311   -.0116356
  dum_accsys |   .0184363   .0084406     2.18   0.029      .001893    .0349795
_Itime_2004 |  -.0050505   .0050528    -1.00   0.318    -.0149538    .0048528
_Itime_2005 |   .0000564   .0048952     0.01   0.991    -.0095381    .0096509
_Itime_2006 |  -.0011946   .0052989    -0.23   0.822    -.0115803    .0091911
       _cons |   .3599844   .0551389     6.53   0.000     .2519141    .4680548
-------------+----------------------------------------------------------------
     sigma_u |  .04185486
     sigma_e |  .03876284
         rho |  .53829778   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(2) $tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + \beta 6 dum\_ageit + ui + eit$

```
. xi: xtreg tobinq indrisk  sales roe logta dum_age dum_accsys i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0053                         Obs per group: min =         4
       between = 0.3413                                        avg =       4.0
       overall = 0.3181                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(10)      =   1453.35
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |  -.0592268   .0280159    -2.11   0.035    -.114137   -.0043166
       sales |   .0229156   .0558124     0.41   0.681    -.0864746    .1323058
         roe |   .0673971   .0484614     1.39   0.164    -.0275855    .1623798
       logta |  -.2734693   .0561065    -4.87   0.000    -.3834359   -.1635026
     dum_age |   -.043241   .1527684    -0.28   0.777    -.3426616    .2561795
  dum_accsys |   .3016205    .141157     2.14   0.033     .0249579    .5782832
_Itime_2004 |  -.0250826    .031505    -0.80   0.426    -.0868313     .036666
_Itime_2005 |  -.0011555   .0334864    -0.03   0.972    -.0667876    .0644766
_Itime_2006 |   .0937706   .0442158     2.12   0.034     .0071093     .180432
       _cons |   6.476731   1.079802     6.00   0.000     4.360359    8.593104
-------------+----------------------------------------------------------------
     sigma_u |  .76233194
     sigma_e |  .29545045
         rho |   .8694111   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(3) $roa_{it} = \beta_0 + \beta_1 prep_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum_{accsys_{it}} + \beta_5 dum_{indrisk_{it}} + u_i + e_{it}$

```
. xi: xtreg roa  prep ltd logta dum_accsys dum_indrisk i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0282                         Obs per group: min =         4
       between = 0.3289                                        avg =       4.0
       overall = 0.2478                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =    440.60
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        prep |   .0009235   .0012894     0.72   0.474    -.0016036    .0034507
         ltd |  -.0937767   .0327121    -2.87   0.004    -.1578913   -.0296621
       logta |  -.0177614   .0025598    -6.94   0.000    -.0227785   -.0127444
  dum_accsys |   .0173456   .0084975     2.04   0.041     .0006908    .0340005
 dum_indrisk |   .0054265   .0040609     1.34   0.181    -.0025327    .0133856
 _Itime_2004 |  -.0048189    .005031    -0.96   0.338    -.0146796    .0050417
 _Itime_2005 |   .0003419   .0048344     0.07   0.944    -.0091332    .0098171
 _Itime_2006 |  -.0008088   .0053043    -0.15   0.879     -.011205    .0095874
       _cons |   .3766107   .0518557     7.26   0.000     .2749753    .4782461
-------------+----------------------------------------------------------------
     sigma_u |  .04213478
     sigma_e |  .03879315
         rho |  .54122103   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(4) $tobinq_{it} = \beta_0 + \beta_1 prep_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + +\beta 6 dum\_ageit + ui + eit$

```
. xi: xtreg tobinq prep  sales roe logta dum_age dum_accsys dum_indrisk i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0049                         Obs per group: min =         4
       between = 0.3569                                        avg =       4.0
       overall = 0.3326                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(11)      =   1490.10
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        prep |   .0014287   .0193571     0.07   0.941    -.0365105     .039368
       sales |   .0200837   .0587317     0.34   0.732    -.0950284    .1351958
         roe |   .0702542   .0485387     1.45   0.148      -.02488    .1653883
       logta |  -.2740613   .0533189    -5.14   0.000    -.3785645   -.1695582
     dum_age |  -.0463859   .1512924    -0.31   0.759    -.3429135    .2501417
  dum_accsys |   .2764915   .1429441     1.93   0.053    -.0036738    .5566568
 dum_indrisk |  -.2011904   .0754436    -2.67   0.008    -.3490572   -.0533236
 _Itime_2004 |  -.0249027   .0330667    -0.75   0.451    -.0897122    .0399068
 _Itime_2005 |  -.0013678   .0352818    -0.04   0.969    -.0705189    .0677832
 _Itime_2006 |   .094644    .04405     2.15   0.032     .0083076    .1809805
       _cons |   6.512589   1.051563     6.19   0.000     4.451564    8.573614
-------------+----------------------------------------------------------------
     sigma_u |  .75175241
     sigma_e |  .29574146
         rho |  .86597652   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(5) $roa_{it} = \beta_0 + \beta_1 perf_{it} + \beta_2 ltd_{it} + \beta_3 logta_{it} + \beta_4 dum\_accsys_{it} + \beta_5 dum\_indrisk_{it} + u_i + e_{it}$

```
. xi: xtreg roa  perf ltd logta dum_accsys dum_indrisk i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0740                         Obs per group: min =         4
       between = 0.3330                                        avg =       4.0
       overall = 0.2629                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =    468.23
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                              (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0063121    .001057     5.97   0.000     .0042404    .0083838
         ltd |  -.0917894   .0320376    -2.87   0.004    -.1545819   -.028997
       logta |   -.019042   .0027072    -7.03   0.000    -.0243479   -.013736
  dum_accsys |   .0148977   .0087007     1.71   0.087    -.0021554   .0319508
 dum_indrisk |   .0035847   .0039252     0.91   0.361    -.0041085    .011278
  _Itime_2004|  -.0051884   .0050161    -1.03   0.301    -.0150198   .0046429
  _Itime_2005|  -.0000496   .0047924    -0.01   0.992    -.0094425   .0093434
  _Itime_2006|   .0000981   .0052422     0.02   0.985    -.0101764   .0103725
       _cons |   .3883514   .0537167     7.23   0.000     .2830686   .4936343
-------------+----------------------------------------------------------------
     sigma_u |  .04220691
     sigma_e |  .03788621
         rho |  .55378948   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(6) $tobinq_{it} = \beta_0 + \beta_1 perf_{it} + \beta_2 sales_{it} + \beta_3 logta_{it} + \beta_4 roe_{it} + \beta_5 dum\_accsys_{it} + + \beta_6 dum\_age_{it} + u_i + e_{it}$

```
. xi: xtreg tobinq perf  sales roe logta dum_age dum_accsys dum_indrisk i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0138                         Obs per group: min =         4
       between = 0.3629                                        avg =       4.0
       overall = 0.3389                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(11)      =   1523.88
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                              (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0309169   .0143866     2.15   0.032     .0027197    .0591142
       sales |  -.0212238   .0595473    -0.36   0.722    -.1379344    .0954868
         roe |    .065559   .0478134     1.37   0.170    -.0281535    .1592715
       logta |  -.2799195    .053562    -5.23   0.000    -.3848991   -.1749399
     dum_age |  -.0485469   .1530214    -0.32   0.751    -.3484634    .2513696
  dum_accsys |   .2637635    .139255     1.89   0.058    -.0091714    .5366983
 dum_indrisk |  -.2150117   .0776521    -2.77   0.006    -.3672071   -.0628163
  _Itime_2004|  -.0266315   .0311988    -0.85   0.393    -.0877801    .0345171
  _Itime_2005|  -.0016633   .0332649    -0.05   0.960    -.0668612    .0635347
  _Itime_2006|   .0998828   .0443439     2.25   0.024     .0129703    .1867953
       _cons |   6.561465   1.033431     6.35   0.000     4.535979    8.586952
-------------+----------------------------------------------------------------
     sigma_u |  .75090273
     sigma_e |  .29387614
         rho |  .86717812   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(7) $roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 ltd_{it} + \beta_5 logta_{it} + \beta_6 dum\_accsys_{it} + u_i + e_{it}$

```
. xi: xtreg roa indrisk prep perf ltd logta dum_accsys i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0799                         Obs per group: min =         4
       between = 0.3418                                        avg =       4.0
       overall = 0.2711                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(10)      =    489.86
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |   .0035021   .0016218     2.16   0.031     .0003234    .0066807
        prep |  -.0031938   .0016988    -1.88   0.060    -.0065234    .0001358
        perf |   .0074102   .0013293     5.57   0.000     .0048048    .0100156
         ltd |  -.0914388   .0316012    -2.89   0.004    -.1533761   -.0295015
       logta |  -.0181976   .0028497    -6.39   0.000    -.0237828   -.0126123
  dum_accsys |   .0173726   .0080584     2.16   0.031     .0015783    .0331668
 _Itime_2004 |  -.0058125   .0048883    -1.19   0.234    -.0153934    .0037684
 _Itime_2005 |  -.0008194   .0046085    -0.18   0.859    -.0098519    .0082131
 _Itime_2006 |  -.0003634   .0051232    -0.07   0.943    -.0104048    .0096779
       _cons |   .3761753   .0569437     6.61   0.000     .2645677     .487783
-------------+----------------------------------------------------------------
     sigma_u |  .04207386
     sigma_e |   .0378099
         rho |  .55322546   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(8) $tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + \beta_4 logta_{it} + \beta_5 sales_{it} + \beta_6 roe_{it} + \beta_7 dum\_accsys_{it} + \beta_8 dum\_age_{it} + u_i + e_{it}$

```
. xi: xtreg tobinq indrisk prep perf sales roe logta dum_age dum_accsys i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0160                         Obs per group: min =         4
       between = 0.3452                                        avg =       4.0
       overall = 0.3226                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(12)      =   1507.58
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |  -.0600547   .0262137    -2.29   0.022    -.1114326   -.0086768
        prep |  -.0142211   .0187745    -0.76   0.449    -.0510184    .0225763
        perf |   .0342455   .0133443     2.57   0.010     .0080912    .0603999
       sales |  -.0168978   .0591924    -0.29   0.775    -.1329128    .0991171
         roe |   .0624972   .0479137     1.30   0.192    -.031412     .1564063
       logta |  -.2796805   .0553553    -5.05   0.000    -.388175    -.1711861
     dum_age |  -.0450419   .1542707    -0.29   0.770    -.3474069    .257323
  dum_accsys |   .2978471   .1455214     2.05   0.041     .0126303    .5830638
 _Itime_2004 |  -.0289019   .0325691    -0.89   0.375    -.0927361    .0349324
 _Itime_2005 |  -.0040588   .0348944    -0.12   0.907    -.0724505    .0643329
 _Itime_2006 |   .0983407   .0446542     2.20   0.028     .0108201    .1858612
       _cons |   6.561595   1.087985     6.03   0.000     4.429184    8.694006
-------------+----------------------------------------------------------------
     sigma_u |  .75799586
     sigma_e |  .29379967
         rho |  .86938813   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(9) $roa_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + u_i + e_{it}$

```
. xi: xtreg roa indrisk prep perf i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0578                         Obs per group: min =         4
       between = 0.0516                                        avg =       4.0
       overall = 0.0523                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    315.27
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |   .0064712   .0015489     4.18   0.000     .0034353    .009507
        prep |  -.0031899   .0018418    -1.73   0.083    -.0067997     .00042
        perf |    .006829   .0013243     5.16   0.000     .0042334    .0094247
 _Itime_2004 |  -.0068808   .0048092    -1.43   0.153    -.0163067    .0025452
 _Itime_2005 |  -.0028294    .004759    -0.59   0.552     -.012157    .0064981
 _Itime_2006 |  -.0062859   .0050351    -1.25   0.212    -.0161544    .0035826
       _cons |   .0428021   .0074747     5.73   0.000      .028152    .0574523
-------------+----------------------------------------------------------------
     sigma_u |  .05085392
     sigma_e |  .03816181
         rho |  .63974184   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(10) $tobinq_{it} = \beta_0 + \beta_1 indrisk_{it} + \beta_2 prep_{it} + \beta_3 perf_{it} + u_i + e_{it}$

```
. xi: xtreg tobinq indrisk prep perf i.time,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       640
Group variable: company                         Number of groups   =       160

R-sq:  within  = 0.0254                         Obs per group: min =         4
       between = 0.0021                                        avg =       4.0
       overall = 0.0000                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    598.30
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     indrisk |  -.0051839   .0218721    -0.24   0.813    -.0480523    .0376845
        prep |  -.0141398   .0183713    -0.77   0.441    -.0501469    .0218673
        perf |   .0307337   .0131306     2.34   0.019     .0049983    .0564691
 _Itime_2004 |  -.0628503   .0329369    -1.91   0.056    -.1274054    .0017048
 _Itime_2005 |  -.0453837   .0354134    -1.28   0.200    -.1147927    .0240252
 _Itime_2006 |   .0006249    .038624     0.02   0.987    -.0750767    .0763264
       _cons |   1.658982   .1727971     9.60   0.000     1.320306    1.997658
-------------+----------------------------------------------------------------
     sigma_u |  .97948974
     sigma_e |  .29324792
         rho |  .91773982   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(11) ROA on preparedness for low industry risk

```
. xi: xtreg roa prep ltd logta dum_accsys i.time if indrisk<2,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       242
Group variable: company                         Number of groups   =        61

R-sq:  within  = 0.0064                         Obs per group: min =         3
       between = 0.4680                                        avg =       4.0
       overall = 0.4196                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =     44.00
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        prep |   .0009535   .0013351     0.71   0.475    -.0016632    .0035702
         ltd |  -.0168413   .0388359    -0.43   0.665    -.0929583    .0592756
       logta |   -.017978   .0045258    -3.97   0.000    -.0268484   -.0091077
  dum_accsys |    .007302   .0120815     0.60   0.546    -.0163774    .0309813
 _Itime_2004 |  -.0049483   .0044732    -1.11   0.269    -.0137155    .0038189
 _Itime_2005 |   .0027009   .0040366     0.67   0.503    -.0052107    .0106125
 _Itime_2006 |   .0018488   .0059504     0.31   0.756    -.0098137    .0135113
       _cons |   .3690734   .0883299     4.18   0.000     .1959499    .5421969
-------------+----------------------------------------------------------------
     sigma_u |  .04701502
     sigma_e |  .02417751
         rho |  .79085523   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(12) Tobin's Q on preparedness for low industry risk

```
. xi: xtreg tobinq prep sales roe logta dum_age dum_accsys i.time if indrisk<2,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       242
Group variable: company                         Number of groups   =        61

R-sq:  within  = 0.0227                         Obs per group: min =         3
       between = 0.3946                                        avg =       4.0
       overall = 0.3704                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =     34.03
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0001

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        prep |  -.0107304   .0355436    -0.30   0.763    -.0803946    .0589337
       sales |   .0179814    .063588     0.28   0.777    -.1066489    .1426117
         roe |   .0142494   .1597761     0.09   0.929     -.298906    .3274048
       logta |  -.3366158   .0847189    -3.97   0.000    -.5026619   -.1705697
     dum_age |  -.1468602   .3081627    -0.48   0.634     -.750848    .4571276
  dum_accsys |   .1490661   .2807932     0.53   0.596    -.4012785    .6994108
 _Itime_2004 |   -.117024   .0599583    -1.95   0.051    -.2345401    .0004922
 _Itime_2005 |  -.0410246   .0789773    -0.52   0.603    -.1958171     .113768
 _Itime_2006 |   .1001676   .0987606     1.01   0.310    -.0933997    .2937349
       _cons |   7.826025   1.641819     4.77   0.000     4.60812    11.04393
-------------+----------------------------------------------------------------
     sigma_u |  1.0032172
     sigma_e |  .38393095
         rho |  .87225094   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(13) ROA on performance for low industry risk

```
. xi: xtreg roa perf ltd logta dum_accsys i.time if indrisk<2,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       242
Group variable: company                         Number of groups   =        61

R-sq:  within  = 0.0208                         Obs per group: min =         3
       between = 0.4694                                        avg =       4.0
       overall = 0.4226                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =     49.52
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0029922   .001636     1.83   0.041    -.0002143    .0061987
         ltd |  -.0195718   .0403318   -0.49   0.627    -.0986207     .059477
       logta |  -.0185135   .004751    -3.90   0.000    -.0278252   -.0092017
  dum_accsys |   .0067505   .0116767    0.58   0.563    -.0161354    .0296363
_Itime_2004 |  -.0055734   .0045762   -1.22   0.223    -.0145425    .0033957
_Itime_2005 |   .0017583   .0040421    0.44   0.664    -.0061641    .0096807
_Itime_2006 |   .0020818   .0059279    0.35   0.725    -.0095366    .0137002
      _cons |   .3758263   .0911974    4.12   0.000     .1970827     .55457
-------------+----------------------------------------------------------------
    sigma_u |  .0470298
    sigma_e |  .02395186
        rho |  .79404314   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(14) Tobin's Q on performance for low industry risk

```
. xi: xtreg tobinq perf sales roe logta dum_age dum_accsys i.time if indrisk<2,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       242
Group variable: company                         Number of groups   =        61

R-sq:  within  = 0.0216                         Obs per group: min =         3
       between = 0.3976                                        avg =       4.0
       overall = 0.3730                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =     32.22
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0002

                                    (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0101312   .0328841    0.31   0.758    -.0543206    .0745829
       sales |   .0034329   .0696541    0.05   0.961    -.1330867    .1399525
         roe |   .0108701   .1613457    0.07   0.946    -.3053617     .327102
       logta |  -.3407875   .0860032   -3.96   0.000    -.5093506   -.1722244
    dum_age  |  -.1457867   .3134826   -0.47   0.642    -.7602013    .4686279
  dum_accsys |   .1336674   .2709563    0.49   0.622    -.3973972    .6647319
_Itime_2004 |  -.1188341   .0584716   -2.03   0.042    -.2334365   -.0042318
_Itime_2005 |  -.0408603   .0730727   -0.56   0.576    -.1840802    .1023596
_Itime_2006 |   .1021906   .1001395    1.02   0.307    -.0940792    .2984604
      _cons |   7.855312   1.631532    4.81   0.000     4.657568    11.05306
-------------+----------------------------------------------------------------
    sigma_u |  1.0012847
    sigma_e |   .3843084
        rho |  .87160082   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(15) ROA on preparedness for high industry risk

```
. xi: xtreg roa prep ltd logta dum_accsys i.time if indrisk>4,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       236
Group variable: company                         Number of groups   =        60

R-sq:  within  = 0.0983                         Obs per group: min =         2
       between = 0.3055                                        avg =       3.9
       overall = 0.2385                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =     31.03
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0001

                                    (Std. Err. adjusted for clustering on company)
```

roa	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
prep	.002932	.0017089	1.72	0.086	-.0004173	.0062813
ltd	-.1576564	.0506996	-3.11	0.002	-.2570258	-.0582871
logta	-.0083965	.004548	-1.85	0.065	-.0173104	.0005174
dum_accsys	.0311366	.0114299	2.72	0.006	.0087344	.0535388
_Itime_2004	-.0072195	.0053057	-1.36	0.174	-.0176184	.0031794
_Itime_2005	-.0048753	.0051574	-0.95	0.345	-.0149836	.005233
_Itime_2006	-.0063222	.0051228	-1.23	0.217	-.0163627	.0037182
_cons	.2242177	.0879039	2.55	0.011	.0519293	.3965062
sigma_u	.02718438					
sigma_e	.0277404					
rho	.48987771	(fraction of variance due to u_i)				

(16) Tobin's Q on preparedness for high industry risk

```
. xi: xtreg tobinq prep sales roe logta dum_age dum_accsys i.time if indrisk>4,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       236
Group variable: company                         Number of groups   =        60

R-sq:  within  = 0.1908                         Obs per group: min =         2
       between = 0.5045                                        avg =       3.9
       overall = 0.4436                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =     89.48
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on company)
```

tobinq	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
prep	-.0063557	.01296	-0.49	0.624	-.0317568	.0190454
sales	.8300935	.1328756	6.25	0.000	.5696621	1.090525
roe	.1612855	.0786046	2.05	0.040	.0072233	.3153478
logta	-.1085352	.0369387	-2.94	0.003	-.1809336	-.0361367
dum_age	.0718321	.1014165	0.71	0.479	-.1269406	.2706049
dum_accsys	.3299271	.1069048	3.09	0.002	.1203976	.5394566
_Itime_2004	.0071162	.0326111	0.22	0.827	-.0568004	.0710329
_Itime_2005	.0224518	.0305529	0.73	0.462	-.0374309	.0823344
_Itime_2006	.0305405	.0330872	0.92	0.356	-.0343092	.0953903
_cons	3.106724	.6643551	4.68	0.000	1.804612	4.408836
sigma_u	.25707823					
sigma_e	.16380398					
rho	.71124121	(fraction of variance due to u_i)				

(17) ROA on performance for high industry risk

```
. xi: xtreg roa perf ltd logta dum_accsys i.time if indrisk>4,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       236
Group variable: company                         Number of groups   =        60

R-sq:  within  = 0.1722                         Obs per group: min =         2
       between = 0.2805                                        avg =       3.9
       overall = 0.2448                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(7)       =     35.50
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                              (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
         roa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0056357   .0012701     4.44   0.000     .0031464    .008125
         ltd |  -.1591237   .0515789    -3.09   0.002    -.2602165   -.0580309
       logta |  -.0098187   .0047333    -2.07   0.038    -.0190958   -.0005417
  dum_accsys |   .0324355   .0112057     2.89   0.004     .0104728    .0543983
_Itime_2004 |  -.0082208   .0050468    -1.63   0.103    -.0181123    .0016708
_Itime_2005 |  -.0056281   .0047872    -1.18   0.240    -.0150108    .0037547
_Itime_2006 |  -.0055839    .004861    -1.15   0.251    -.0151113    .0039435
      _cons |   .247319    .0902518     2.74   0.006     .0704288    .4242092
-------------+----------------------------------------------------------------
     sigma_u |  .0282133
     sigma_e |  .02663008
         rho |  .52884408   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

(18) Tobin's Q on performance for high industry risk

```
. xi: xtreg tobinq perf sales roe logta dum_age dum_accsys i.time if indrisk>4,vce(robust)
i.time            _Itime_2003-2006    (naturally coded; _Itime_2003 omitted)

Random-effects GLS regression                   Number of obs      =       236
Group variable: company                         Number of groups   =        60

R-sq:  within  = 0.2301                         Obs per group: min =         2
       between = 0.5087                                        avg =       3.9
       overall = 0.4510                                        max =         4

Random effects u_i ~ Gaussian                   Wald chi2(9)       =     96.08
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                              (Std. Err. adjusted for clustering on company)
------------------------------------------------------------------------------
             |               Robust
      tobinq |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        perf |   .0299782    .009839     3.05   0.002     .0106941    .0492622
       sales |   .7003834   .1343501     5.21   0.000      .437062    .9637048
         roe |   .1689827   .0716034     2.36   0.018     .0286427    .3093228
       logta |   -.110991   .0387969    -2.86   0.004    -.1870316   -.0349504
     dum_age |   .0646004   .1015941     0.64   0.525    -.1345204    .2637212
  dum_accsys |   .3277773   .1064798     3.08   0.002     .1190808    .5364739
_Itime_2004 |   .0063892    .030427     0.21   0.834    -.0532466    .0660249
_Itime_2005 |   .0244915   .0275026     0.89   0.373    -.0294125    .0783956
_Itime_2006 |   .0359542   .0323334     1.11   0.266     -.027418    .0993265
      _cons |    3.04433    .691999     4.40   0.000     1.688037    4.400624
-------------+----------------------------------------------------------------
     sigma_u |  .26481691
     sigma_e |  .15896223
         rho |  .73511753   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

9.2.5 Test for Multicollinearity

A linear OLS regression needs to be run before the test command "vif".

```
. quietly reg  roa indrisk prep perf logta ltd

. vif
```

Variable	VIF	1/VIF
prep	1.97	0.507143
perf	1.66	0.603915
indrisk	1.45	0.690122
logta	1.19	0.842001
ltd	1.06	0.943931
Mean VIF	1.46	

```
. quietly reg  tobinq indrisk prep perf sales roe logta

. vif
```

Variable	VIF	1/VIF
prep	1.99	0.503467
perf	1.67	0.600417
indrisk	1.43	0.697708
logta	1.17	0.852960
roe	1.02	0.977298
sales	1.01	0.986998
Mean VIF	1.38	

9.2.6 Test for Heteroskedasticity

```
. quietly reg roa indrisk prep perf

. imtest,white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(9)      =     15.53
         Prob > chi2  =    0.0773

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	15.54	9	0.0773
Skewness	2.46	3	0.4828
Kurtosis	1.51	1	0.2190
Total	19.50	13	0.1083

```
. quietly reg tobinq indrisk prep perf

. imtest,white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(9)      =     24.19
         Prob > chi2  =    0.0040

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	24.19	9	0.0040
Skewness	34.47	3	0.0000
Kurtosis	11.10	1	0.0009
Total	69.76	13	0.0000

9.2.7 Test for Serial Correlation

```
. xtserial roa indrisk prep perf

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     159) =      4.323
           Prob > F =      0.0392

. xtserial tobinq indrisk prep perf

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     159) =      0.185
           Prob > F =      0.6675
```