This is the title of my thesis

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A thesis submitted for the Master's Degree in Business Management and Administration, Finance Specialization

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Abstract

This is an abstract

Aknowledgments

I would like to thank some of you ...

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Introduction

Over the past decades, humanity is progressively becoming aware of the finiteness of earth's resources and its impact on the current global warming. On the one hand, Houghton and Change (1996) anticipated in their first report an average global warming between +1° and +3.5° C until 2100 relative to the temperature of 1990. They also warned that an increase of temperatures superior to +2° C could have some harsh climatic repercussions. On the other hand the Kyoto Protocol had been written in 1997, enforced in 2005 and led to the first Global Agreement on global warming during the Paris Conference in 2015. Those different solutions implemented over the past decades did not have any significant impacts on the fight against global warming. Greenhouse Gas Emissions (GGE) have still increased considerably across years. Although the environmental consciousness-raising had already gained ground, according to Jean Jouzel (2017) human being have to act now if he wants to have a chance to reduce effects of climate change.

For the last several decades, companies have been more and more considered as entities responsible for stewardship of the natural environment (Majumdar and Marcus 2001; J. Przychodzen and Przychodzen 2015). Ecosystem degradation and resources depletion engender a threat to firm's longevity (Dowell, Hart, and Yeung 2000), and as a reaction, firms have to pro-actively adopt an environmental strategy (S. L. Hart 1995). In his speech at Lloyds of London 2015, Mark Carney, Governor of the Bank of England and Chair of the Financial Stability Board (FSB), identified climate change as one of the most material threats to financial stability (Elliott 2015). Companies facing higher risks associated to climate change are the ones subject to greater incentives to develop green strategies (Hoffman 2005). However, both economic benefits and strategic opportunities deriving from sustainable development are usually underestimated by managers and still too many companies do not feel concerned about global warming (Berchicci and King 2007; S. L. Hart 1995). Moreover, according to Scarpellini, Valero-Gil, and Portillo-Tarragona (2016), green projects are not common in companies of many countries because of significant barriers and a negligible culture of excluding sustainable development from an organization's strategy. If we consider that people's actions reflect a variable mix of altruistic motivation, material self-interest, and social or self-image concerns (Bénabou and Tirole 2006), demonstrating that green development is a significant interest for firms could be a serious step forward in the fight against global warming.

Prendre en compte les remarques de Prof. Béreau 050418, see pdf dans dropbox

To be continued...

1 Literature Review

1.1 Two perspectives on Corporate Environmental Performance

The paradigm of profit maximization of Friedman (1970) have been widely challenged these last decades. Whereas Friedman (1970) considers investment in pollution efficient technology as deviation from the wealth maximization goal, the literature is showing growing evidences that improving a company's environmental performance can lead to better economic or financial performance, and not necessarily to an increase in cost. Ambec and Lanoie (2008) have demonstrated that the expenses incurred to reduce pollution can be partly or completely offset by gains made elsewhere. Porter and van der Linde (1995) argued that rather than simply adding to cost, properly crafted environmental standards can trigger innovation offsets, allowing companies to improve their resource productivity. He even redefined the self concept of value creation in advocating that the solution lies in the principle of shared value which involves creating economic value in a way that also creates value for society by addressing its needs and challenges (Porter and Kramer 2011, Porter and Kramer (2018)). Freeman (1984) call to a radical rethinking of our model of the firm. According to him, companies have to consider their stakeholder, namely *"any group or individual who can affect or is affected by the achievement of an organisation's objectives"* (p.25) or else face negative confrontation from non-shareholder groups, which can lead to diminished shareholder value, through boycotts, lawsuits and protests etc. In other words, Freeman (1984) summarizes the idea that companies should consider corporate environmental performance as unavoidable cost of doing business.

1.2 Does it pay to be green?

While more and more companies are embracing this new paradigm and develop profitable business strategies that deliver tangible social benefits, others keep the old fashion way of Friedman (1970). This dichotomy have interested scholars and since they have sought to empirically answer the question, *"Does it pay to be green?"*. In a competitive business world, answering this question is crucial to provide a genuine economic justification to the new paradigm (Lu et al. 2014). Although results are mixed, the large quantity of studies on the nexus between Corporate Environmental Performance (i.e. CEP) and Corporate Financial Performance (i.e. CFP) in the last two decades allowed the appearance of recent meta-analyses[1] (Orlitzky and Benjamin 2001, Orlitzky, Schmidt, and Rynes (2003), Wu (2006), Albertini (2013), Dixon-Fowler et al. (2013), Endrikat, Guenther, and Hoppe (2014), Lu et al. (2014),

[1]The GICS classification is composed of eleven industry sectors, namely : Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Pharmaceuticals / Biotechnology, Telecommunication Services and Utilities.

Q. Wang, Dou, and Jia (2016), Busch and Friede (2018)) and all suggest that indeed it pays to be green. More precisely, a positive and bidirectional relationship does exist between CEP and CFP meaning that successful firms may have the resources necessary to improve their environmental performance, which in turn increases financial benefits that again can be invested back into further improvements of CEP (Endrikat, Guenther, and Hoppe 2014).

1.3 CEP and CFP as a broad meta-construct

CFP is a broad meta-constructs and the current literature have shown that each construct play a moderator role in the relationship between CEP and CFP (Orlitzky, Schmidt, and Rynes 2003, Lu et al. (2014), Busch and Friede (2018)).Scholars have mainly adopted three broad subdivisions of CFP: market-based (investor returns), accounting-based (accounting returns), and perceptual (survey) measures. Market-based measures (e.g. price-earning ratio, Tobin's Q, or share price appreciation) consider that returns should be measured from the perspective of the shareholders (Cochran and Wood 1984). Accounting-based measures require profitability and asset utilization indicators such as Return on Asset (i.e. ROA) or Return on Equity (i.e. ROE) (Cochran and Wood 1984, Wu (2006)). Finally perceptual measures of CFP is a more subjective approach based on the perception of survey respondents (Lu et al. 2014).

CEP is also a broad meta-constructs and no common definition exist in the literature (Albertini 2013, Endrikat, Guenther, and Hoppe (2014)). Scholars have used a wide variety of indicators as proxies for approaching the green performance of companies. Albertini (2013) use a three-group classification to summarize CEP measures : (i) Environmental Management Measures (i.e. EMV) which mostly refer to environmental strategy, integration of environmental issues into strategic planning processes, environmental practices, process-driven initiatives, product-driven management systems, ISO 14001 certification, environmental management system adoption, and participation in voluntary programs (Molina-Azorín et al. 2009, Schultze and Trommer (2012)). (ii) Environmental Performance Variables (i.e. EPV) which are mostly measures quantified in physical units (carbon dioxide emissions, physical waste, water consumption, toxic release) that can be positive (emission reduction) or negative (emission generated) (Albertini 2013). (iii) Environmental Disclosure Variables (i.e. EDV) such as information releases regarding toxic emission (Hamilton 1995), environmental awards (F. Chen, Ngniatedema, and Li 2018), environmental accidents and crises (Blacconiere and Patten 1994), and environmental investment announcements (Gilley et al. 2000). Endrikat, Guenther, and Hoppe (2014) split up CEP into two sub-dimensions, namely (i) process-based CEP which can be linked to the EMV approach of Albertini (2013) and (ii) outcome-based CEP which can be linked to the EPV dimension. According to Xie and Hayase (2007), process-based

CEP can be considered as a preliminary step of outcome-based CEP. Scholars demonstrated that the first approach have a positive impact on the second one which in turn has a positive impact on financial performance (Li, Ngniatedema, and Chen 2017, F. Chen, Ngniatedema, and Li (2018)).

Although recent recent meta-analyses (Orlitzky and Benjamin 2001, Orlitzky, Schmidt, and Rynes (2003), Wu (2006), Albertini (2013), Dixon-Fowler et al. (2013), Endrikat, Guenther, and Hoppe (2014), Lu et al. (2014), Q. Wang, Dou, and Jia (2016), Busch and Friede (2018)) have demonstrated the positive link between CEP and CFP, some scholars advanced that the multidimensionality of both CEP and CFP constructs are one reason why the conclusion of the relationship between CEP and CFP have been so mixed (Albertini 2013, Endrikat, Guenther, and Hoppe (2014), Miroshnychenko, Barontini, and Testa (2017)). For instance, Busch and Hoffmann (2011) found that process-based CEP (in terms of carbon management) negatively affects CFP, while outcome-based CEP (in terms of carbon emissions) has a positive influence on CFP. Cavaco and Crifo (2014) and Muhammad et al. (2015) have used both accounting-based indicators (i.e. ROA) and market-based indicators (i.e. Tobin's Q) as a proxy for CFP and got a positive relation between ROA and CEP while no relation between Tobin's Q and CEP. A general consensus have shown that accounting-based CFP are characterized by a stronger relation to CEP than market-based and perceptual indicators (Orlitzky, Schmidt, and Rynes 2003, Wu (2006), Albertini (2013), Lu et al. (2014), Busch and Friede (2018)).

Considering the varying findings with regards to process-based CEP and outcome-based CEP and with a motivation to answer the call of Endrikat, Guenther, and Hoppe (2014), I hypothesize the following :

Hypothesis 1. Process-based CEP have a positive impact on Outcome-based CEP

Hypothesis 2. Outcome-based CEP have a positive impact on CFP

Hypothesis 3. Process-based CEP have a positive impact on CFP

1.4 When does it pay to be green?

Griffin and Mahon (1997) was the first to call for research that looks at the CEP-CFP relation over time. While scholars had been mainly answering the question *"Does it pay to be green?"* some have recently tried to move forward and gained interest in answering the call of Griffin and Mahon (1997) with the following question : *"When does it pay to be green?"* (Manrique and Martí-Ballester 2017).

Zhang and Chen (2017) have shown that CEP has a negative relationship with short-term financial performance and a positive relationship with long-term CFP. Delmas, Nairn-Birch,

and Lim (2015) observed that the more a firm decreases carbon emissions the more positive the investors perceptions of future market performance and the lower its short term financial performance. Song, Zhao, and Zeng (2017) have shown that corporate environmental management has a significant positive correlation with future financial performance, however it has no significant correlation with current financial performance. Manrique and Martí-Ballester (2017) demonstrated that in times of economic crisis firms which improve their corporate environmental performance improve their corporate financial performance, this effect being weaker for firms in developed countries, where only the short-term corporate financial performance improves, than for firms in emerging and developing countries, where the short- and long-term corporate financial performance improve. F. Chen, Ngniatedema, and Li (2018) have shown that a firms green performance not only impact an organization's financial performance in that particular year but also impact the year that follows.

Those empirical results provide evidences that no common consensus have be found yet to answer the question *"When does it pay to be green?"*. Busch and Friede (2018) demonstrated that at a meta-research level, the evidence of a time dependency on the CEP-CFP link is not significant and that the call of Griffin and Mahon (1997) remains to date unanswered.

To capture the time dimension in the CFP-CEP nexus, scholars consider accounting-based measures as a proxy for short term CFP and market-based measures as a proxy for long term CFP (Endrikat, Guenther, and Hoppe 2014, Delmas, Nairn-Birch, and Lim (2015), Zhang and Chen (2017), Manrique and Martí-Ballester (2017), Miroshnychenko, Barontini, and Testa (2017)). According to Endrikat, Guenther, and Hoppe (2014) :

> *"While accounting-based measures may capture immediate impacts, they may not appropriately account for intangible and long-term effects which are likely to be involved in the CEP-CFP link. Market-based measures, on the other hand, integrate estimations of a firm's future prospects and reflect the notion of external stakeholders (primarily investors) (Orlitzky, Schmidt, and Rynes 2003, Peloza (2009), Delmas and Nairn-Birch (2011)). Thus, market-based measures may better to capture the long-term value of certain environmental activities."*

Taking into account theoretical arguments and empirical findings and in order to move forward in answering the call of Griffin and Mahon (1997), I hypothesize the following :

Hypothesis 4. CEP have a stronger impact on short term CFP than on long term CFP

2 Research Framework

Based on the literature review I have developed four hypotheses. My research framework is summarized in the Figure 2.1. The latter, inspired by Li Suhong, Ngniatedema Thomas, and Chen Fang (2017) and F. Chen, Ngniatedema, and Li (2018), aims at answering three calls. Firstly Endrikat, Guenther, and Hoppe (2014) have highlight the need for a better understanding of the multidimensionality of both CEP and CFP constructs. To do that I will examine the combined effects of process-based and output-based CEP on both accounting-based and market-based measures of CFP. Secondly, to the best of my knowledge, Li Suhong, Ngniatedema Thomas, and Chen Fang (2017) and F. Chen, Ngniatedema, and Li (2018) were the first scholars to use the NewsWeek Green Ranking as a proxy for both process-based and output-based CEP and performed their analysis with a time frame of one year. Therefore apply a longitudinal study on this new database can help to provide a better understanding of the CEP-CFP nexus. Lastly, Busch and Friede (2018) claimed that to date and at a meta-research level, the call of Griffin and Mahon (1997) regarding the research that looks at the CEP-CFP relation over time remains unanswered and confused. Therefore capturing the short term vs long term CFP through the use of accounting-based and market-based measures could help to collect data for future meta-analysis.

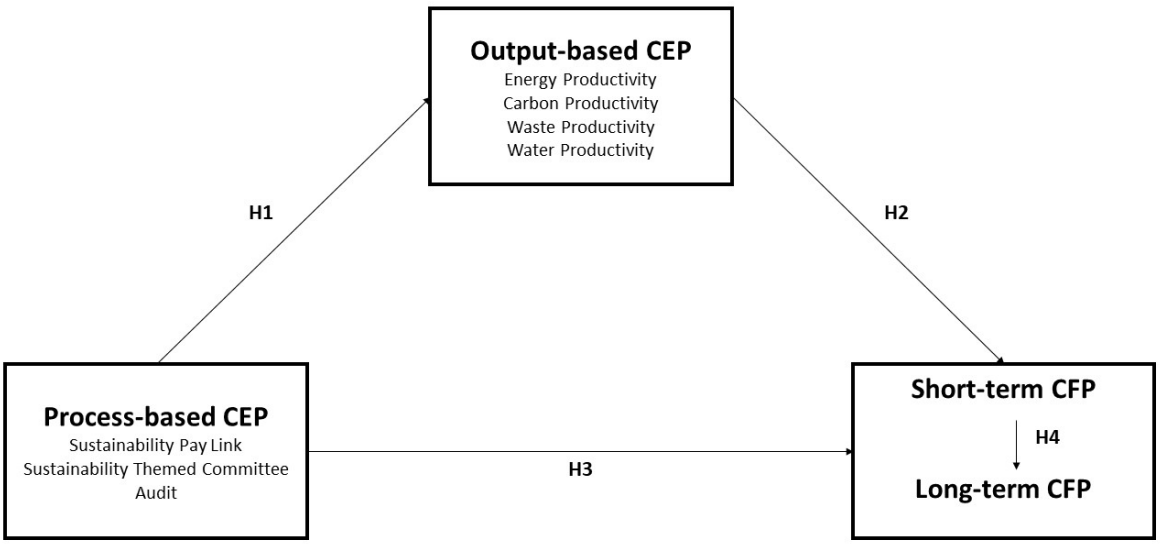


Figure 2.1: Research Framework

3 Data

3.1 Overview

The starting point of my data collection was the Newsweek Green Ranking which had assessed the world's largest publicly-traded companies in the US and in the world since 2009. This ranking had been developed through a collaboration between Newsweek, Corporate Knights Capital, HIP Investor Inc and leading sustainability minds from nongovernmental organizations and the academic and accounting communities. The ranking attribute an overall green score to companies. The score is based on a weighted average of key performance indicators (KPI's). This study uses these KPIs to measure both process-based and outcome-based of the 500 largest publicly-traded companies in the United States. Due to a methodology change[2] in the 2014 Newsweek Green Rankings, only the 2014, 2015 and 2016 ranking were considered. Among those three ranking and of the 500 US companies, 405 companies were listed for each years.

Even though green rankings were published in 2014, 2015 and 2016, each company is evaluated based on the 2012, 2013 and 2014 data. Therefore, measures for financial performance of companies will be based on the 2012, 2013 and 2014 fundamental data. Financial data have been mainly collected on Stockpup and in case of missing values I have completed with Morningstar and Ycharts. Of the 405 initial companies, a total of 8 companies were dropped because of missing data. The final sample includes 397 publicly-traded companies in the US covering the period from 2012 till 2014 inclusively.

Table 3.1 describes my variables and following sections deeply explained each variables.

3.2 Dependent Variables

Regarding dependent variables, Endrikat, Guenther, and Hoppe (2014) claim that accounting-based measures (e.g. ROA, ROE, Return on Sales) capture immediate impacts and can be used as a proxy to measure short-term CFP while market-based measures (e.g. Tobin's Q, market capitalization, market to book value) integrate estimations of a firm's future prospects and can be better used as a proxy for long-term CFP. Among scholars that used both measures simultaneously, ROA and Tobin's Q are the ones that have been used the most frequently (Lioui and Sharma 2012, Cavaco and Crifo (2014), Muhammad et al. (2015), Delmas, Nairn-Birch, and Lim (2015), Semenova and Hassel (2016), Manrique and Martí-Ballester (2017)).

[2]The GICS classification is composed of eleven industry sectors, namely : Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Pharmaceuticals / Biotechnology, Telecommunication Services and Utilities.

Therefore I have decided to use ROA and Tobin's Q as a proxy for both short and long-term CFP.

ROA is a standard accounting measure of financial performance, which is calculated by dividing earnings before interest by total firm assets. Tobin's Q is defined as the ratio of the market value of a firm to the replacement cost of its assets (Chung and Pruitt 1994). Broadly speaking, firms displaying Tobin's Q greater than one are judged as using scarce resources effectively and those with Tobin's Q less than one as using resources poorly (Lewellen and Badrinath 1997). In other words investors prefers companies with Tobin's Q superior to one. Due to the complexity of calculating the replacement cost of a firm, the literature have seen several attempts to approximate Tobin's Q (Perfect and Wiles 1994). Tobin's Q value had been directly collected on Ycharts and this platform use the simple approximation of Chung and Pruitt (1994) which is summarized in Equation 1.

$$Tobin'sQ = \frac{MVE + PS + DEBT}{TA} \tag{1}$$

where MVE is the product of a firm's shares prices and the number of common stock shares outstanding, PS is the liquidating value of the firm's outstanding preferred stock, $DEBT$ is the value of the firm's short term liabilities net of its short-term assets, plus the book value of the firm's long-term debt and TA is the book value of the total assets of the firms.

Table 3.2 contains a sample of my database. Some missing values appears in the TobinsQ column. Compared to ROA, calculating Tobin's Q requires a relatively high number of financial variables and is more susceptible to missing values. This creates a disparity among the number of observations for each dependent variables. Delmas, Nairn-Birch, and Lim (2015) encountered the same issue and conducted an identical analysis to check whether this introduces sample bias. **Therefore I will do the same and depending on the robustness of results I will use one or two sample spaces in my study. I still need to figure out how to perform this test in R.**

3.3 Independent Variables

Concerning independent variables, both process-based and outcome-based CEP had been approached with the KPI's of the Newsweek Green Ranking. More precisely, I have used "Sustainability Pay Link", "Sustainability Themed Committee", and "Audit" as a proxy for process-based CEP and "Energy Productivity", "Carbon Productivity", "Water Productivity" and "Waste Productivity" as a proxy for outcome-based CEP.

A Sustainability Pay Link is a mechanism to link the remuneration of any member of a company's senior executive team with the achievement of environmental performance targets. A score of 100% accrues to the company when such a link exists and a score of 0% is attributed if there is no such link in place.

A Sustainability Themed Committee refers to the existence of a committee at the board of directors level whose mandate is related to the sustainability of the company, including but not limited to environmental matters. A score of 100% accrues to the company when such a link exists and a score of 0% is attributed if there is no such link in place.

An Audit refers to the case where a company provides evidence that the latest reported environmental metrics were audited by a third party. A score of 100% if such an audit has been performed, and a score of 0% is given when such audit was not performed.

Energy Productivity (i.e. EnP), Carbon Productivity (i.e. CaP), Water Productivity (i.e. WatP) and Waste Productivity (i.e. WastP) are calculated through equation 2, 3, 4 and 5.

$$EnP = \frac{Revenue}{TEC} \tag{2}$$

$$CaP = \frac{Revenue}{TGGE} \tag{3}$$

$$WatP = \frac{Revenue}{TW} \tag{4}$$

$$WastP = \frac{Revenue}{(TWG - TWRR)} \tag{5}$$

where $Revenue$ is the total revenue in US$, TEC is the total energy consumption, $TGGE$ is the total greenhouse gaz emissions in co_2, TW is the total water in m_3, TWG is the total waste generated in metric tons and $TWRR$ is the total waste recycled and reused in metric tons.

3.4 Control Variables

Several scholars (Telle 2006, McWilliams, Siegel, and Wright (2006), Surroca, Tribó, and Waddock (2010)) have argued that misspecified models may be the reason for the inconsistency of the empirical results in the CEP-CFP nexus. In order to improve the construct and to avoid the endogeneity issue due to omitted variables (Roberts and Whited 2013), Endrikat, Guenther, and Hoppe (2014) have highlighted potential determinants of the relationship between CEP and CFP : firm size, industry sector, financial risk, R&D activities, advertising intensity and capital structure (i.e leverage). In a meta-analysis study, Lu et al. (2014) argued that growth rate is equally important. Consequently this study use those seven variables control.

The common way to approach *firm size* is to use the natural logarithm of total assets (Delmas, Nairn-Birch, and Lim 2015, Miroshnychenko, Barontini, and Testa (2017)). To approach the company *industry sector* I use the Global Industry Classification Standard (GICS)[3]. A dummy for each industry sector had been included in the model. The Beta/Jensen's alpha (**to be defined**) is adopted as aproxy for *financial risk*. *Capital structure* is approximated with the ratio of long-term debt to common shareholders' equity (shareholders equity minus preferred equity). *R&D activities* had been measured as ... (**see Ycharts**). *Advertising intensity* had been... (**see when find a way to get those data**)

[3]The GICS classification is composed of eleven industry sectors, namely : Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Pharmaceuticals / Biotechnology, Telecommunication Services and Utilities.

Table 3.1: Variable Definition

	Variables	Description
1	Tobin's Q	The ratio of a firm's market value to the replacement cost of its assets
2	Return on Asset	Earnings before interest over total firm assets
3	Energy Productivity	Revenue ($US) / Total Energy Consumption
4	Carbon Productivity	Revenue ($US) / Total Greenhouse gas Emissions (CO2)
5	Water Productivity	Revenue ($US) / Total water (m3)
6	Waste Productivity	Revenue ($US) / [Total waste generated (metric tonnes)–waste recycled/reused (tones)]
7	Sustainability Pay Link	A mechanism to link the remuneration of any member of a company's senior executive team with the achievement of environmental performance targets. The existence of such a link is awarded a score of 100%. A score of 0% is attributed if there is no such mechanism in place
8	Sustainable Themed Commitment	Refers to the existence of a committee at the Board of Directors level whose mandate is related to the sustainability of the company, including but not limited to environmental matters. A score of 100% accrues to the company when such link exists and a score of 0% is attributed if there is no such link in place
9	Audit Score	Refers to the case where a company provides evidence that the latest reported environmental metrics were audited by a third party. Newsweek and their research partners award a score of 100% if such audit has been performed, and a score of 0% is given when such audit was not performed.
10	Capital Structure	The ratio of long-term debt to common shareholders' equity (shareholders equity minus preferred equity)
11	Growth	The ratio of earnings to revenue
12	Firm Size	Log of total assets
13	Industry	Global Industry Classification Standard (GICS) of the firm. The variable take a value from 1 to 10 where 1 = Consumer Discretionary, 2 = Consumer Staples, 3 = Energy, 4 = Financials, 5 = Health Care, 6 = Industrials, 7 = Information Technology, 8 = Materials, 9 = Pharmaceuticals / Biotechnology, 10 = Telecommunication Services and 11 = Utilities

Table 3.2: Sample selection of the data base

	Companies	YearFinancialIndicator	ROA	TobinsQ
1-2013	1	2013	0.07	1.07
1-2014	1	2014	0.05	1.03
1-2015	1	2015	0.05	1.54
2-2013	2	2013	0.08	0.36
2-2014	2	2014	0.06	
2-2015	2	2015	0.06	
3-2013	3	2013	0.18	1.42
3-2014	3	2014	0.19	1.53
3-2015	3	2015	0.19	1.63
4-2013	4	2013	0.06	2.18

4 Methodology

Here is my methodology...

4.1 Panel Data

4.1.1 Definition of panel data

Panel data, also called longitudinal data or cross-sectional time-series data include observations on N cross section units (i.e., firms) over T time-periods.

4.1.2 Advantages of panel data :

As panel data analysis uses variation in both these dimensions, it is considered to be one of the most efficient analytical methods for data (Dimitrios Asteriou 2006). It usually contains more degrees of freedom, less collinearity among the variables, more efficiency and more sample variability than one-dimensional method (i.e.cross-sectional data and time series data) giving a more accurate inference of the parameters estimated in the model (Hsiao 2007, Hsiao (2014)).

4.1.3 Fixed or random effect model

Panel data may have individual (group) effect, time effect, or both, which are analyzed by fixed effect and/or random effect models. *A fixed effect model* examines if intercepts vary across group or time period, whereas a *random effect model* explores differences in error variance components across individual or time period. (Park 2011).

!! I need to test the fixed-random effect model of my database before moving forward !!

- Ng and Rezaee (2015) used the two-stage-least-square regressions to estimate its models.

** In case of presence of endogeneyity in an econometric model, OLS is not capable of delivering consistent parameter estimates (Wooldridge 2008).**

Citation from (Wooldridge 2008) :

> The general concept is that of the instrumental variables estimator; a popular form of that estimator, often employed in the context of endogeneity, is known as two-stage least squares (2SLS)

4.1.4 Endogeneity test

Problem of endogeneity in the CFP-CEP nexus :

Citation from (Endrikat, Guenther, and Hoppe 2014)

> Endogeneity occurs in cases where the independent variable in a regression model is correlated with the error term, or due to simultaneous causality between the dependent and the independent variable (Sánchez-Ballesta & García-Meca, 2007; van Essen et al., in press). As outlined earlier, the relationship between CEP and CFP may involve bidirectional causality. Therefore, the fact of controlling or not controlling for endogeneity can be conceived as a kind of methodological artifact, which may have a moderation effect on the study findings.

Even if panel data have a lot of advantages...

Two issues involved in utilizing panel data, namely heterogeneity bias and selectivity bias (Hsiao 2014).

Citation from Hsiao (2014):

> It is only by taking proper account of selectivity and heterogeneity biases in the panel data that one can have confidence in the results obtained.

Dang, Kim, and Shin (2015) examine which methods are appropriate for estimating dynamic panel data models in empirical corporate finance,especially in short panels of company data, in the likely presence of (1) unobserved heterogeneity and endogeneity, (2) residual serial correlation, or (3) fractional dependent variables. The bias-corrected fixed-effects estimators, based on an analytical, bootstrap, or indirect inference approach, are found to be the most appropriate and robust methods.

But Miroshnychenko, Barontini, and Testa (2017) used the OLS regressions in micro panel using the Huber-White sand which estimator, to account for the heteroscedasticity problem...
Which method should I use?

Hausmann test to test the random effects model for both dependent variables?

4.2 Econometric Model

The first hypothesis will be tested with T-tests on the impact of each green initiative on green performance.

Hypotheses two and three will be tested by regression analysis using the *plm* package. Econometric models are based on Delmas, Nairn-Birch, and Lim (2015) and Miroshnychenko, Barontini, and Testa (2017) and started from the general form:

$$Y_{t+1} = \beta_0 + \beta_1(X_{it}) + +\beta_2(C_{it}) + \varepsilon_{it} \tag{6}$$

where Y_{t+1} is the financial performance of firm i in year $t+1$, β is the vector of estimated regression coefficients for each of the explanatory variables X_{it}, C_{it} is a vector of control variables , ε_{it} is the error term.

More precisely I will regress six models :

Model 1 : Green Initiatives on Tobin's Q

$$TobinsQ_{it+1} = \beta_0 + \beta_1(SP_{it}) + \beta_2(ST_{it}) + \beta_3(AS_{it}) + \beta_4(C_{it}) + \varepsilon_{it} \tag{7}$$

Model 2 : Green Initiatives on ROA

$$ROA_{it+1} = \beta_0 + \beta_1(SP_{it}) + \beta_2(ST_{it}) + \beta_3(AS_{it}) + \beta_4(C_{it}) + \varepsilon_{it} \tag{8}$$

Model 3 : Green Performance on Tobin's Q

$$TobinsQ_{it+1} = \beta_0 + \beta_1(EP_{it}) + \beta_2(CP_{it}) + \beta_3(WatP_{it}) + \beta_4(WasP_{it}) + \beta_5(C_{it}) + \varepsilon_{it} \tag{9}$$

Model 4 : Green Performance on ROA

$$ROA_{it+1} = \beta_0 + \beta_1(EP_{it}) + \beta_2(CP_{it}) + \beta_3(WatP_{it}) + \beta_4(WasP_{it}) + \beta_5(C_{it}) + \varepsilon_{it} \tag{10}$$

Model 5 : Both Green Performance and Green Initiative on Tobin's Q

$$TobinsQ_{it+1} = \beta_0 + \beta_1(EP_{it}) + \beta_2(CP_{it}) + \beta_3(WatP_{it}) + \beta_4(WasP_{it}) + \beta_5(SP_{it}) + \beta_6(ST_{it}) + \beta_7(AS_{it}) + (C_{it}) + \varepsilon_{it} \tag{11}$$

Model 6 : Both Green Performance and Green Initiative on ROA

$$ROA_{it+1} = \beta_0 + \beta_1(EP_{it}) + \beta_2(CP_{it}) + \beta_3(WatP_{it}) + \beta_4(WasP_{it}) + \beta_5(SP_{it}) + \beta_6(ST_{it}) + \beta_7(AS_{it}) + (C_{it}) + \varepsilon_{it} \tag{12}$$

where :

- $TobinsQ_{it+1}$ = a proxy for a firm's financial performance
- ROA_{it+1} = a proxy for a firm's financial performance
- EP_{it} = a proxy for a firm's energy productivity
- CP_{it} = a proxy for a firm's carbon productivity
- $WatP_{it}$ = a proxy for a firm's water productivity
- $WasP_{it}$ = a proxy for a firm's waste productivity
- SP_{it} = a proxy for a firm's sustainability pay link
- ST_{it} = a proxy for a firm's sustainability themed commitment
- EP_{it} = a proxy for a firm's audit score
- C_{it} = a vector of control variables that include financial leverage, firm size, net margin and industry sector
- ε_{it} = the error term

Motivations to use one time lag - citation from (Albertini 2013):

> Hart and Ahuja (1996) argue that there is a time lag between the initiation of emission reduction efforts and the realization of bottom line benefits. First, pollution prevention requires up-front investment in training and equipment. Second, it takes time to gain reduction because internal reorganization and renegotiation of supply and waste disposal contracts may be required (Hart & Ahuja, 1996). Evidence also suggests that in the early stages of pollution prevention there is a great deal of "low-hanging fruit"—easy and inexpensive behavioural and material changes that result in large emission reductions relative to costs (Hart, 1994; Rooney, 1993). As the firm's environmental performance improves, further reductions in emissions become progressively more difficult, requiring more significant change in processes or even entirely new production technology (Russo & Fouts, 1997). Some studies have collected data on a longitudinal perspective (more than

1 year) in order to take into account the long-term payback of environmental management strategies, while others have collected data on a short period of time (1 year and less). Analysing the relationship between CEM and CFP during a short period of time implies that the researcher intends to prove that the environmental management influences regularly and at any time the financial profitability of the firm. Yet the natural and organizational environments are different because of the time markers of their respective materialities, such as short term for the financial profitability and very long term for the environmental issue (Bansal & Knox-Hayes, 2013). Thus, we can argue that the longitudinal characteristic of the studies might explain part of the variation in the results regarding the relationship between CEM and CFP. **NB: the hypothese had been verified : The relationship between CEM and CFP is significantly stronger for non-longitudinal studies (0.13) than for longitudinal studies (0.07)**

4.3 Panel Data Tests

This section will not be in the final document but in appendix. It is only to report the result of the bunch of tests I carried out in order to define which panel data methotolodies I will use for each one of my 6 models.

(**???**) and Torres-Reyna (2010) really helped me.

Here are the tests :

1. Test of poolability
2. Hausmann Test to determine the fixed or random effect
3. Test for time fixed effect
4. Test for cross-sectional dependence
5. Test for serial correlation
6. Test for stationarity
7. Test for heteroskedasticity

The table 4.1 summaries the result of each test for each model. You can find details below.

Regarding the poolability test I have an issue with my code that I still need to solve. This is why it is written *NA* in the table 4.1.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poolability	NA	NA	NA	NA	NA	NA
Hausmann	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Time Fixed Effect	No	Yes	No	Yes	No	Yes
Cross Sectional Dependence	Yes	Yes	Yes	No	No	No
Serial Correlation	Yes	Yes	Yes	Yes	Yes	Yes
Stationarity	None	None	None	None	None	None
Heteroskedasticity	Yes	Yes	Yes	Yes	Yes	Yes

Table 4.1: Test Summary

4.3.1 Test of poolability

Citation from (Croissant and Millo 2008) :

> *Pooltest tests the hypothesis that the same coefficients apply to each individual. It is a standard F test, based on the comparison of a model obtained for the full sample and a model based on the estimation of an equation for each individual. The first argument of pooltest is a plm object. The second argument is a pvcm object obtained with model=within. If the first argument is a pooling model, the test applies to all the coefficients (including the intercepts), if it is a within model, different intercepts are assumed.*

To carry out the of poolabiloty I have used the *pooltest* function. The null hypothesis of poolability assumes homogeneous slope coefficients.

When running my code I got this error : Error in FUN(X[[i]], ...) : insufficient number of observations

I still need to understand the origin of this error.

4.3.2 Hausmann Test to determine the fixed or random effect

Citation from Torres-Reyna (2010) :

> *To decide between fixed or random effects you can run a Hausman test where the null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects (see Green, 2008, chapter 9). It basically tests whether the unique errors (ui) are correlated with the regressors, the null hypothesis is they are not.*

The Table 4.2 summarizes results of the Hausman Test of each model. I hae used the *phtest* function to carry out this test. We can observe that all p-values are < 0.05 meaning that HO is not verified and my models are caraterized by a fixed effect.

Table 4.2: Hausman Test PValue

Model	P-Value
Model 1	8.62305026166821e-13
Model 2	0.0018761755365543
Model 3	5.36822721245658e-10
Model 4	1.76415468654531e-05
Model 5	1.34377499755074e-09
Model 6	2.96095711373484e-06

4.3.3 Test for time fixed effect

The Table 4.3 summarizes results of the test for each model. I have used the *pFtest* function to carry out this test.

P-Value is > 0.05 for model 1, model 3 and model 5 meaning that null hypothesis is verified and that there is not a significant time-fixed effect. However for model 2,model 4 and model 6 P-Value is < 0.05 meaning that null hypothesis is rejected and that there is a significant time-fixed effect.

Does this mean that for model 2,4 and 6 I have to add the time fixed effect in my model?

Table 4.3: Fixed Time Effect Test PValue

	Model	P-Value
F	Model 1	0.283424115171307
F	Model 2	9.31479195147999e-08
F	Model 3	0.416375667184508
F	Model 4	1.63640851108242e-06
F	Model 5	0.546871154322935
F	Model 6	7.2837991600062e-07

4.3.4 Test for cross-sectional dependence

Citation from Torres-Reyna (2010) :

> *According to Baltagi, cross-sectional dependence is a problem in macro panels with long time series. This is not much of a problem in micro panels (few years and large number of cases). The null hypothesis in the B -P/LM and Pasaran CD tests of independence is that residuals across entities are not correlated. B- P/LM and Pasaran CD (cross-sectional dependence) tests are used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in tests results (also called contemporaneous correlation).*

I have used the *pcdtest* function to carry out this test. The Table 4.4 show results of the test for cross-sectional dependence. We can observe that I have cross-sectional dependence in my model 1,2 and 3. However for model 4, 5 and 6, the P-Value is superior to 0.05 meaning that HO is verified and these models do not have cross-sectional dependence.

Table 4.4: Cross-sectional dependence's test - PValue

Model	Method	P-Value
Model 1	cd	8.10990133473153e-06
Model 2	cd	1.02664326155649e-15
Model 3	cd	0.00417462008675452
Model 4	cd	0.0420804962987959
Model 5	cd	0.250217047599656
Model 6	cd	0.0686916595213743

Note :'cd' stands for Pesaran's CD Statistic

4.3.5 Test for serial correlation

I used the Wooldridge's test for serial correlation in FE panels with the *pwartest* function to test the serial correlation of my models. According to Croissant and Millo (2008) this test is applicable to any fixed effect panel model, and in particular to short panels with small T and large n, which is my case. The null hypothese is that there is no serial correlation in the model. According to the P_Value of my models, I can conclude that I have serial correlation in all models.

Table 4.5: Wooldridge's test - PValue

	Model	P-Value
F	Model 1	4.25807482070969e-06
F	Model 2	0.00761859852921567
F	Model 3	5.42203235617637e-06
F	Model 4	0.0222387844478429
F	Model 5	5.52226189597595e-06
F	Model 6	0.0321823239861632

4.3.6 Test for stationarity

The Dickey-Fuller test to check for stochastic trends with the *adf.test* function. The null hypothesis is that the series has a unit root (i.e. non-stationary). In my case HO is rejected for both databases meaning that they do not have stationarity.

Table 4.6: Dickey-Fuller test - PValue

Database	P_Value
Roa	0.01
TobinsQ	0.01

4.3.7 Test for heteroskedasticity

I have used the *Bptest* function to test the presence of heteroskedasticity of my model. The Table 4.7 summarizes the p-value of each model. I find strange that all p-value equals zero. By meaning a p-value cannot be null, right? **What do you think?**

Table 4.7: Heteroskedasticity Test - PValue

	Model	P_Value
BP	Model 1	0
BP	Model 2	0
BP	Model 3	0
BP	Model 4	0
BP	Model 5	0
BP	Model 6	0

Starting from the premise that I have heteroskedasiticy I will compute the **sandwich estimators** of my models. The Table 4.8 summarizes the sandwich estimators for each model. **What should I do with that?**

See Miroshnychenko, Barontini, and Testa (2017) and Stock and Watson (2008)

If hetersokedaticity is detected you can use the sandwich estimaror (Torres-Reyna 2010)

vcovHC is a function for estimating a robust covariance matrix of parameters for a fixed effects or random effects panel model according to the White method (White 1980, 1984; Arellano 1987). The –vcovHC– function estimates three heteroskedasticity-consistent covariance estimators:

- "white1" - for general heteroskedasticity but no serial correlation. Recommended for random effects.
- "white2" - is "white1" restricted to a common variance within groups. Recommended for random effects.
- "arellano" - both heteroskedasticity and serial correlation. Recommended for fixed effects.

The following options apply*:

- HC0 - heteroskedasticity consistent. The default.
- HC1,HC2, HC3 – Recommended for small samples. HC3 gives less weight to influential observations.
- HC4 - small samples with influential observations

- HAC - heteroskedasticity and autocorrelation consistent (type ?vcovHAC for more details)

4.4 Sensitivity Analysis

For the sensitivity analysis, let's make as (Miroshnychenko, Barontini, and Testa 2017), namely take ROE as an other accounting based indicators and I need to find an other market based indicator.

Table 4.8: Sandwich Estimators

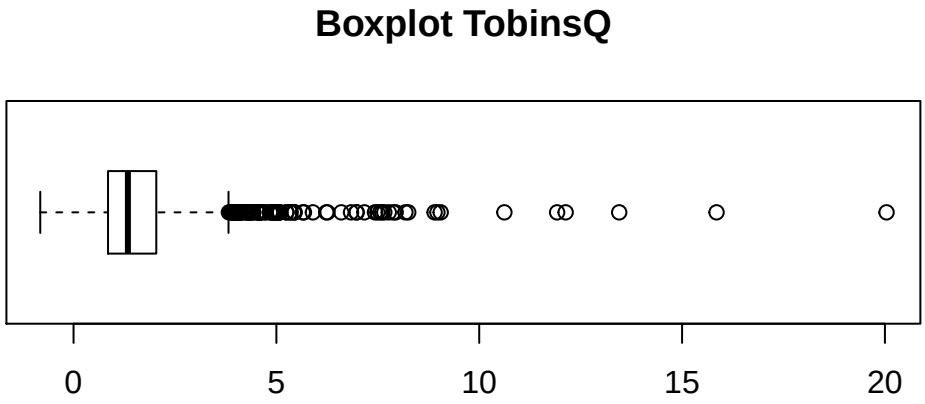
	Dependent variable:					
	(1)	(2)	(3)	(4)	(5)	(6)
SustainabilityPayLink	0.778*	−0.063			0.535	−0.048
	(0.461)	(0.055)			(0.581)	(0.057)
SustainableThemedCommitment	3.474	0.332**			2.885	0.384**
	(2.516)	(0.153)			(2.613)	(0.149)
AuditScore	0.454	0.006			0.084	0.022
	(0.931)	(0.081)			(0.911)	(0.087)
EnergyProductivity			0.076	0.019	0.093	0.018
			(0.150)	(0.017)	(0.150)	(0.016)
CarbonProductivity			−0.075	−0.038**	−0.049	−0.039**
			(0.172)	(0.019)	(0.179)	(0.019)
WaterProductivity			−0.093	0.036***	−0.094	0.037***
			(0.130)	(0.014)	(0.131)	(0.014)
WasteProductivity			−0.207*	0.0004	−0.183*	0.003
			(0.109)	(0.009)	(0.111)	(0.010)
Leverage	0.0001	−0.00002	0.0001	−0.00002	0.0001	−0.00002
	(0.0001)	(0.00003)	(0.0001)	(0.00003)	(0.0001)	(0.00003)
NetMargin	−0.006	0.053	−0.009	0.052	−0.007	0.052
	(0.039)	(0.065)	(0.040)	(0.064)	(0.040)	(0.064)
FirmSize	−0.321	−0.001	−0.317	0.00003	−0.323	−0.0002
	(0.432)	(0.020)	(0.429)	(0.021)	(0.432)	(0.021)

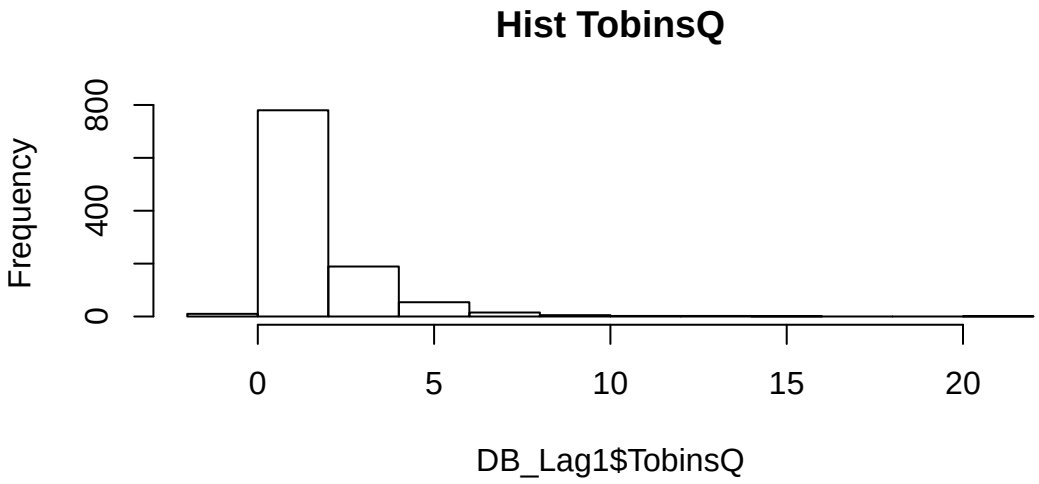
Note: *p<0.1; **p<0.05; ***p<0.01

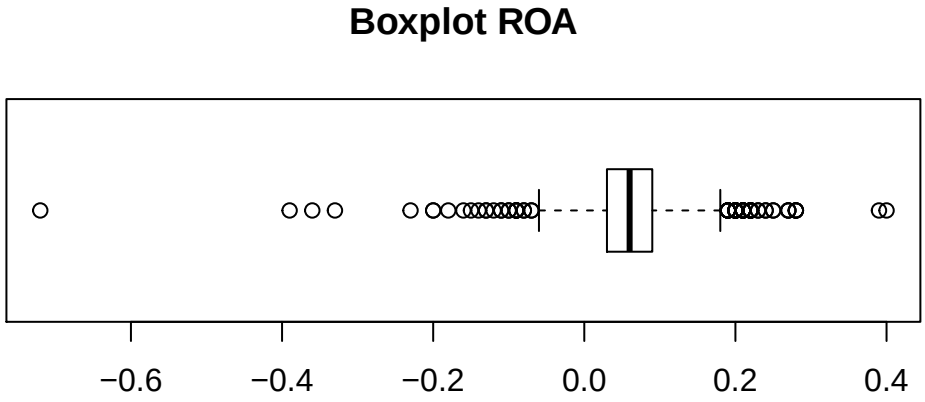
5 Results

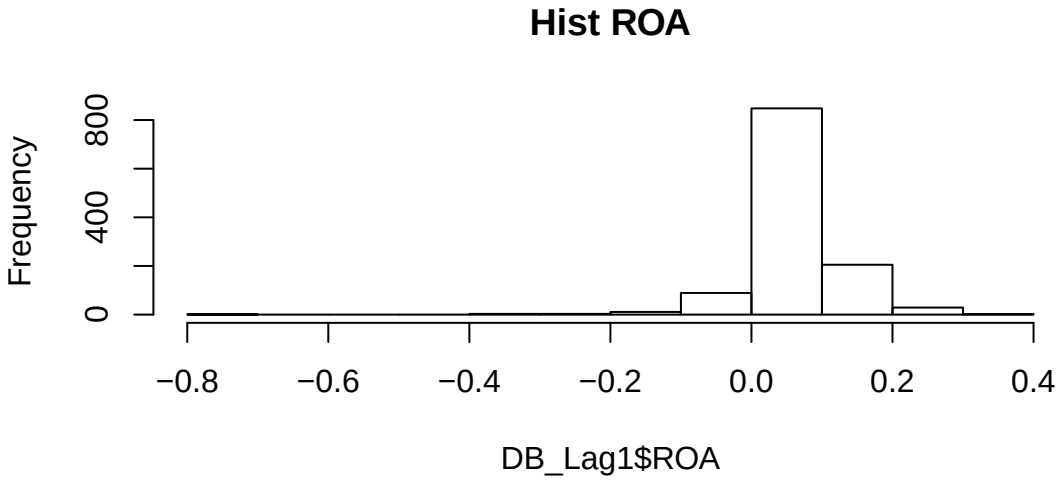
5.1 Descriptive Statistics

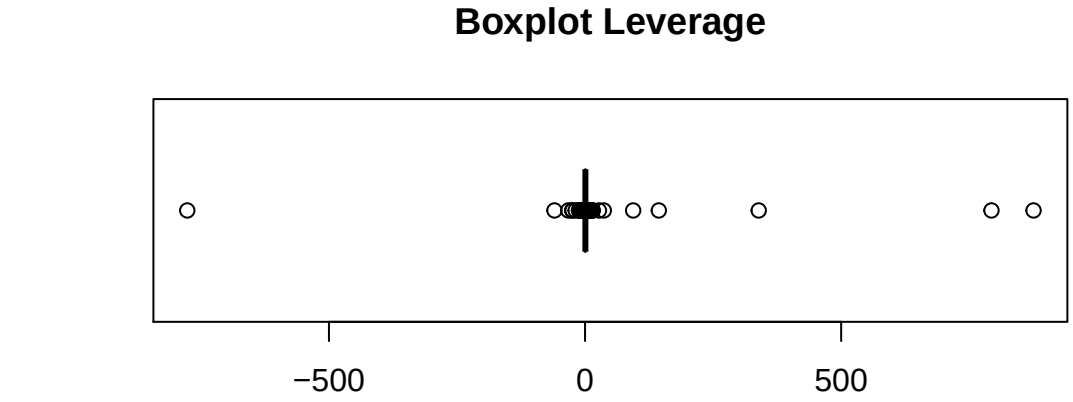
5.2 Some boxplots and histogram

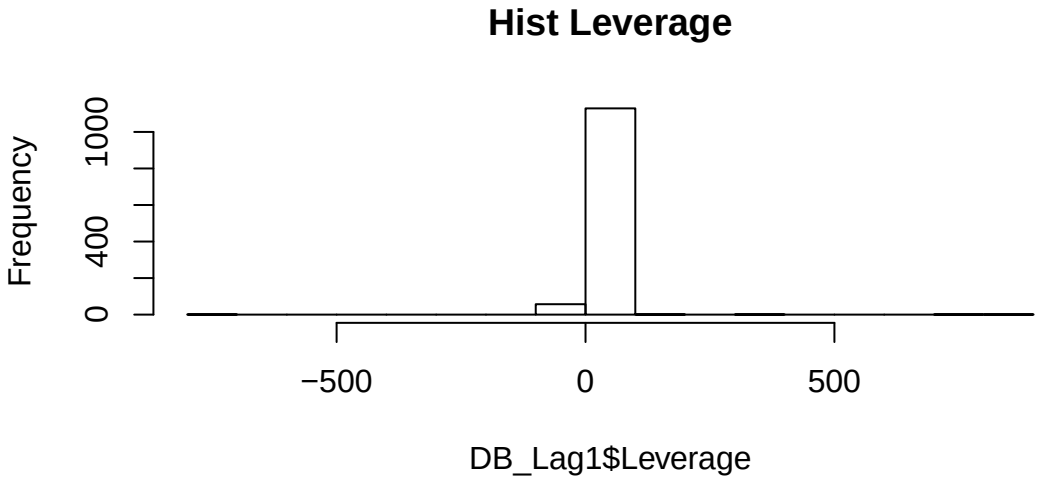


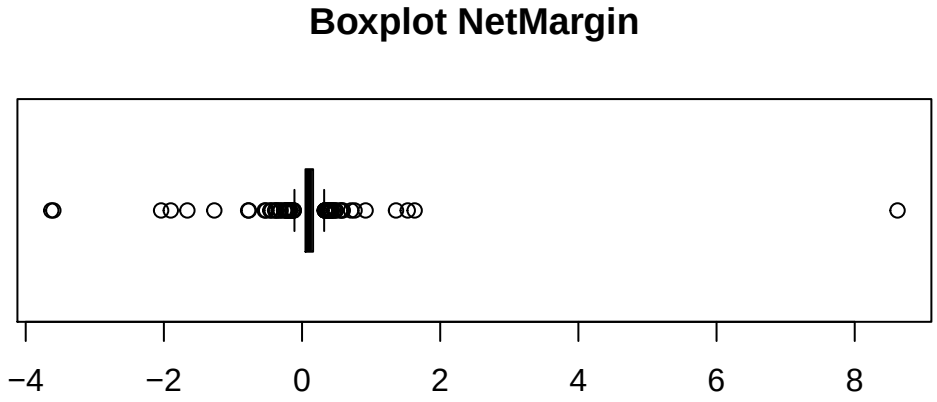


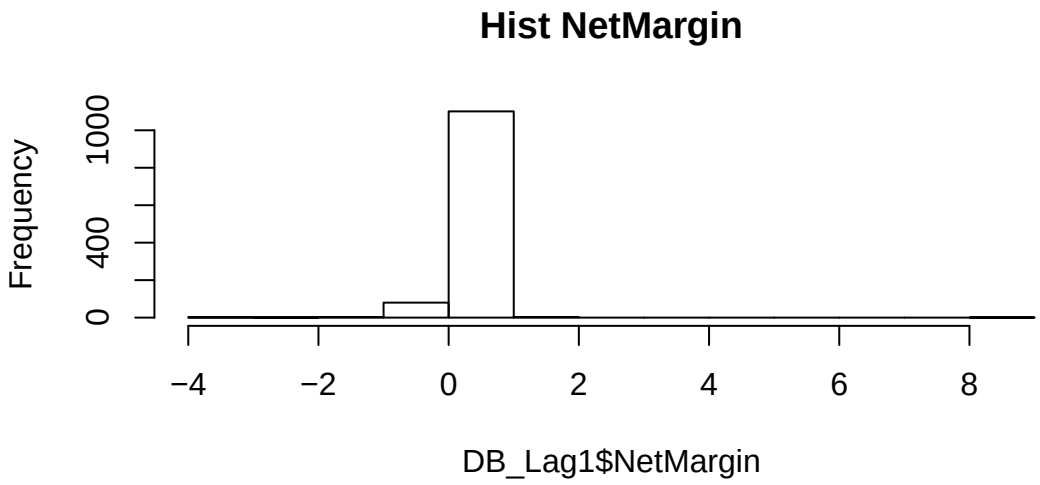

Boxplot ROA
−0.6
−0.4
−0.2
0.0
0.2
0.4

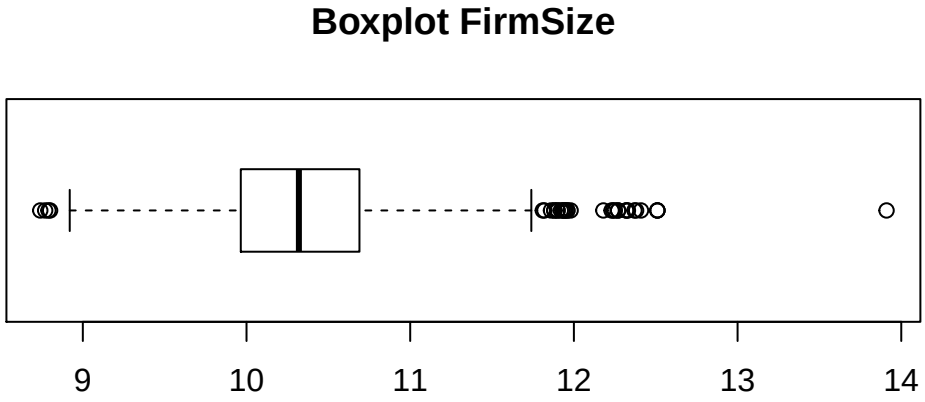

Hist ROA
Frequency
0
400
800
−0.8
−0.6
−0.4
−0.2
0.0
0.2
0.4
DB_Lag1$ROA

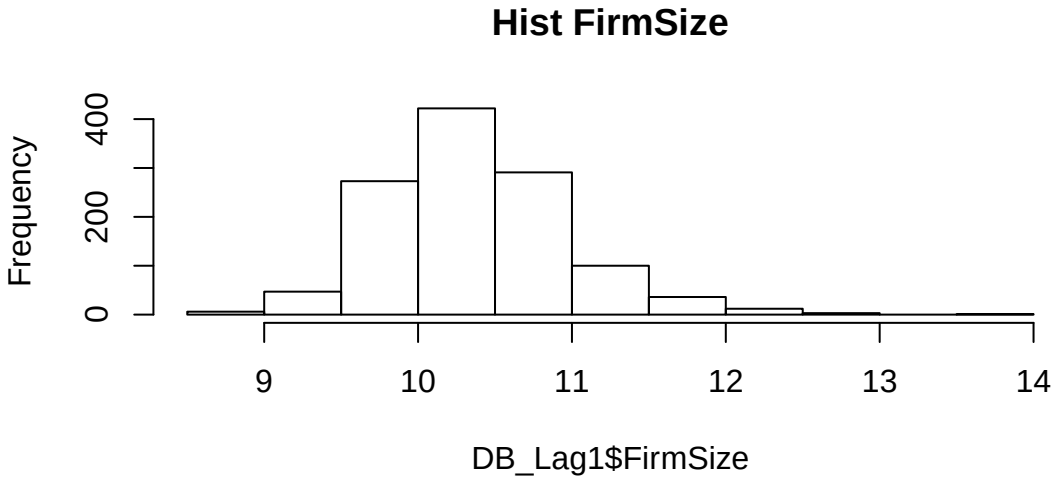

Boxplot Leverage
−500
0
500


Hist Leverage
Frequency
0
400
1000
−500
0
500
DB_Lag1$Leverage


Boxplot NetMargin
−4
−2
0
2
4
6
8


Hist NetMargin
Frequency
0
400
1000
−4
−2
0
2
4
6
8
DB_Lag1$NetMargin

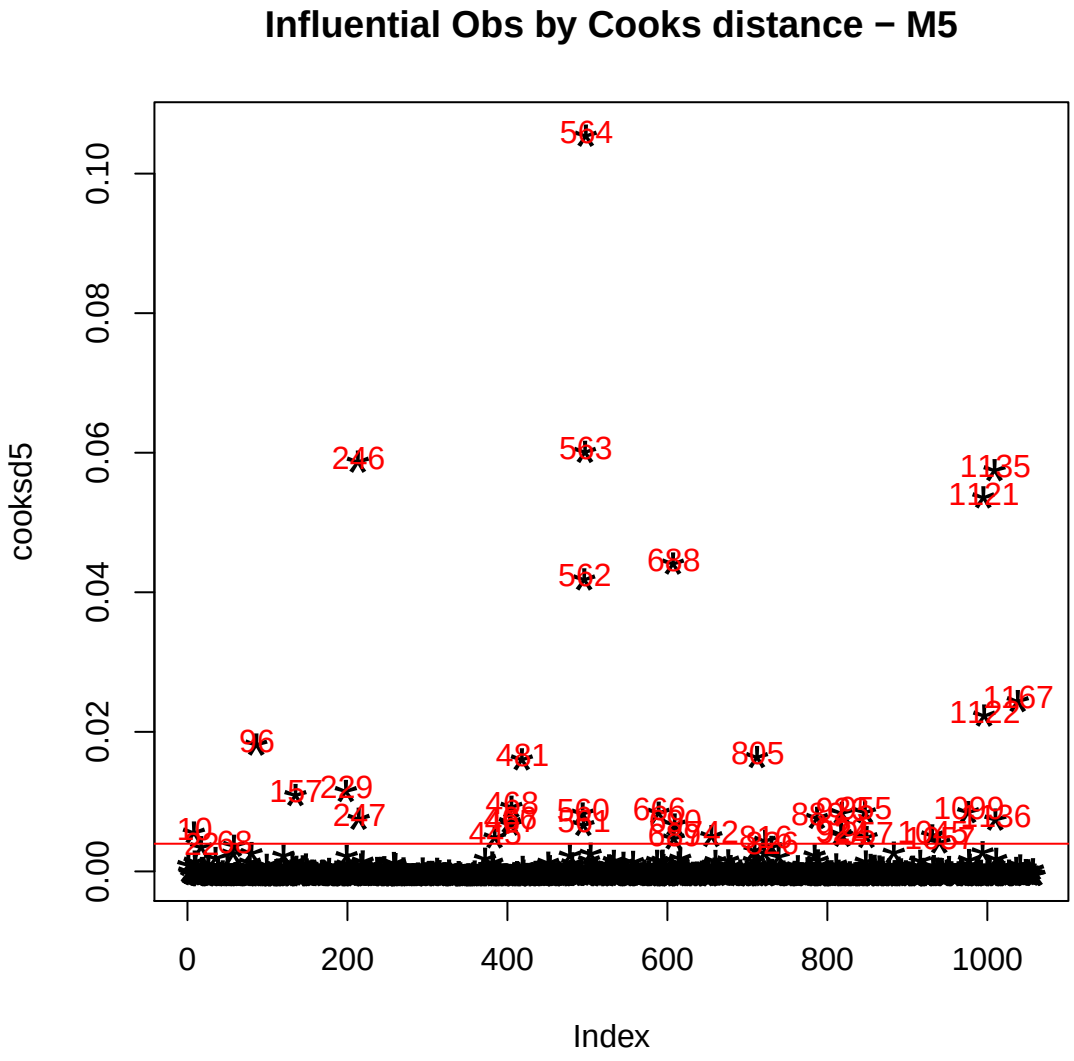

Boxplot FirmSize
9
10
11
12
13
14

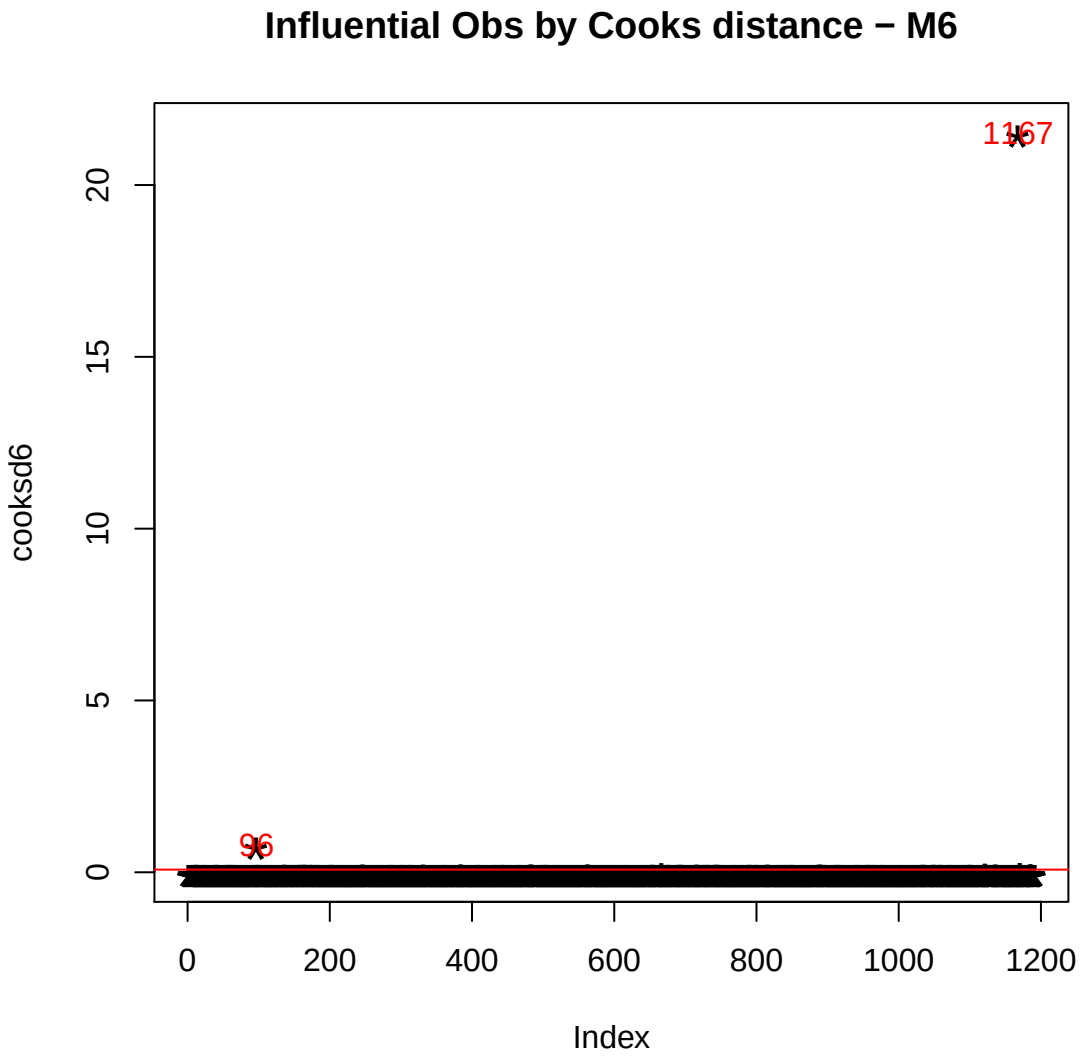

Hist FirmSize
Frequency
0
200
400
9
10
11
12
13
14
DB_Lag1$FirmSize

5.3 Cooks Distance

This section will not be in the final document. Here I measure the cook's distance of my model 5 and 6. Cook's distance is a measure computed with respect to a given regression model and therefore is impacted only by the X variables included in the model. Cook's distance computes the influence exerted by each data point (row) on the predicted outcome. I summarise on a graph (i.e. one for each model), those observations that have a cook's distance greater than 4 times the mean and which may be classified as influential. I want to detect which observations is an outlier. See below both graphics.

Should I redo this process for each Model?





Here the function outlierTest from *car* package gives the most extreme observation based on the given model. **Should I remove those observations from my database?**

```
##        rstudent unadjusted p-value Bonferonni p
## 1167 -16.538226         2.0854e-55   2.4837e-52
## 96    -9.115733         3.2778e-19   3.9039e-16
## 384   -7.452510         1.7677e-13   2.1053e-10
## 483    5.266361         1.6530e-07   1.9688e-04
## 1121  -5.254983         1.7561e-07   2.0915e-04
## 1170  -5.226888         2.0378e-07   2.4270e-04
## 482    5.109215         3.7710e-07   4.4913e-04
```

```
## 562   -4.415030         1.1027e-05   1.3133e-02
## 1122  -4.412766         1.1141e-05   1.3269e-02
```

```
##       rstudent unadjusted p-value Bonferonni p
## 564  12.099145         1.2389e-31   1.3120e-28
## 563   8.665168         1.6889e-17   1.7885e-14
## 562   6.693406         3.5491e-11   3.7585e-08
## 1122  6.246067         6.1126e-10   6.4732e-07
## 1135  6.159497         1.0393e-09   1.1006e-06
## 1121  6.006707         2.6097e-09   2.7637e-06
## 923   5.428052         7.0805e-08   7.4983e-05
## 688   5.001849         6.6562e-07   7.0489e-04
## 924   4.372898         1.3486e-05   1.4282e-02
```

6 Discussion

Let's speak...

Conclusion

This is my conclusion...

Appendix

Appendix A : This is an appendix a

Appendix B : This is an appendix b

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