# Towards Green Companies: A Panel Data Study of The Environmental and Financial Performance Nexus

Pierrick KINIF

Supervised by Sophie BÉREAU and Jean-Yves GNABO

University of Namur

Faculty of Economics, Social Sciences and Business Administration

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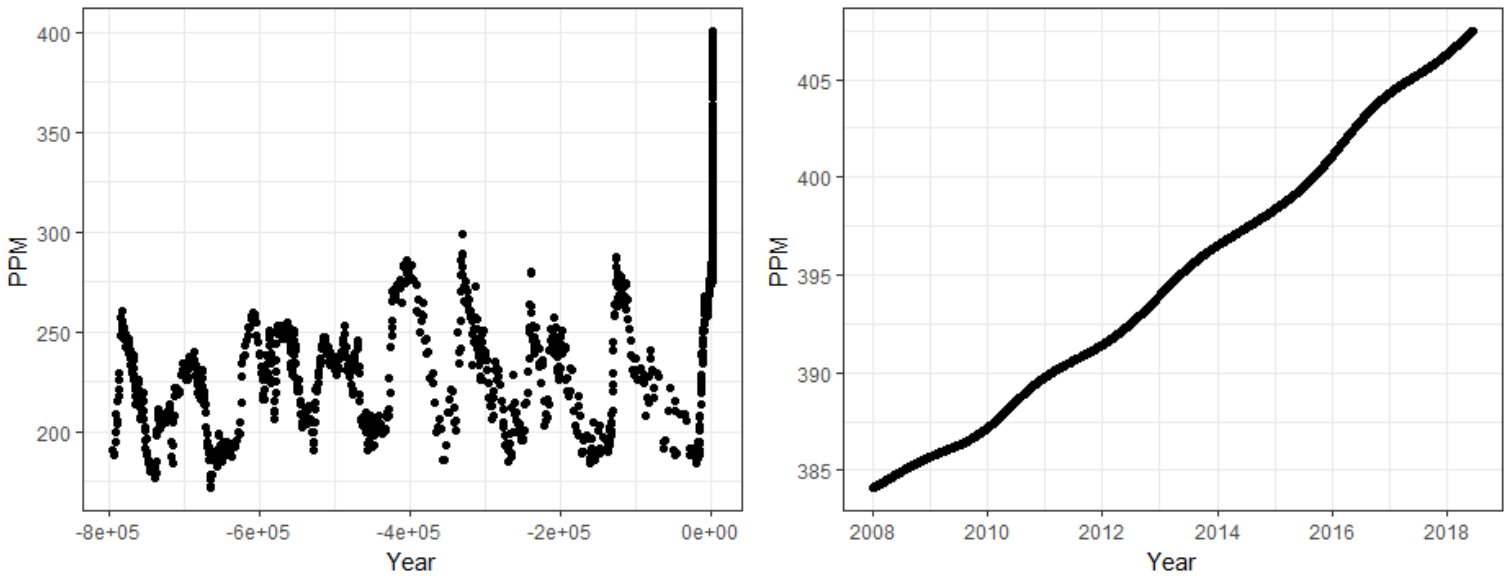
# Introduction

# Global Warming Is Not a Myth and Is Growing Fast

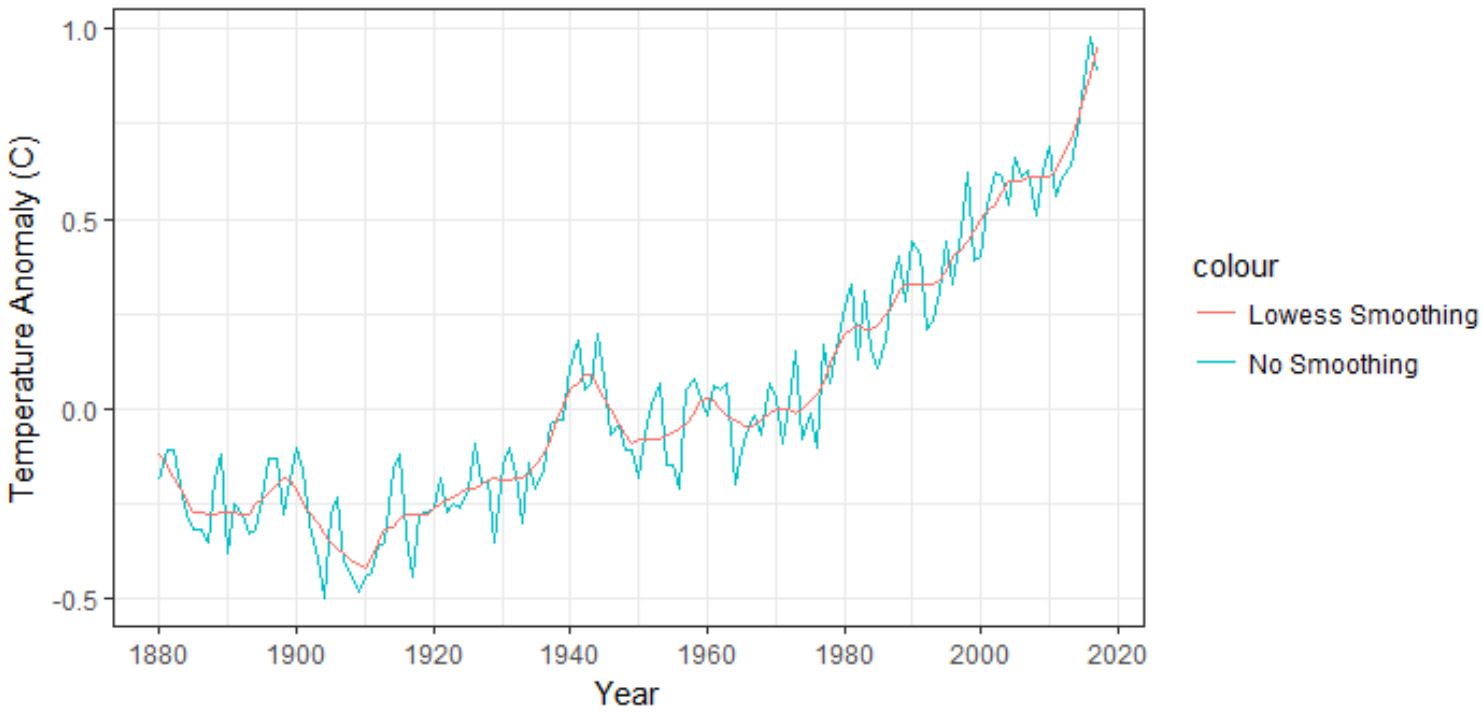
**Figure 1:** Global Atmospheric Concentrations of Carbon Dioxide Over Time




**Source**: Data coming from US EPA (2016) and Pieter Tans et al. (2018)

# Global Warming Is Not a Myth and Is Growing Fast

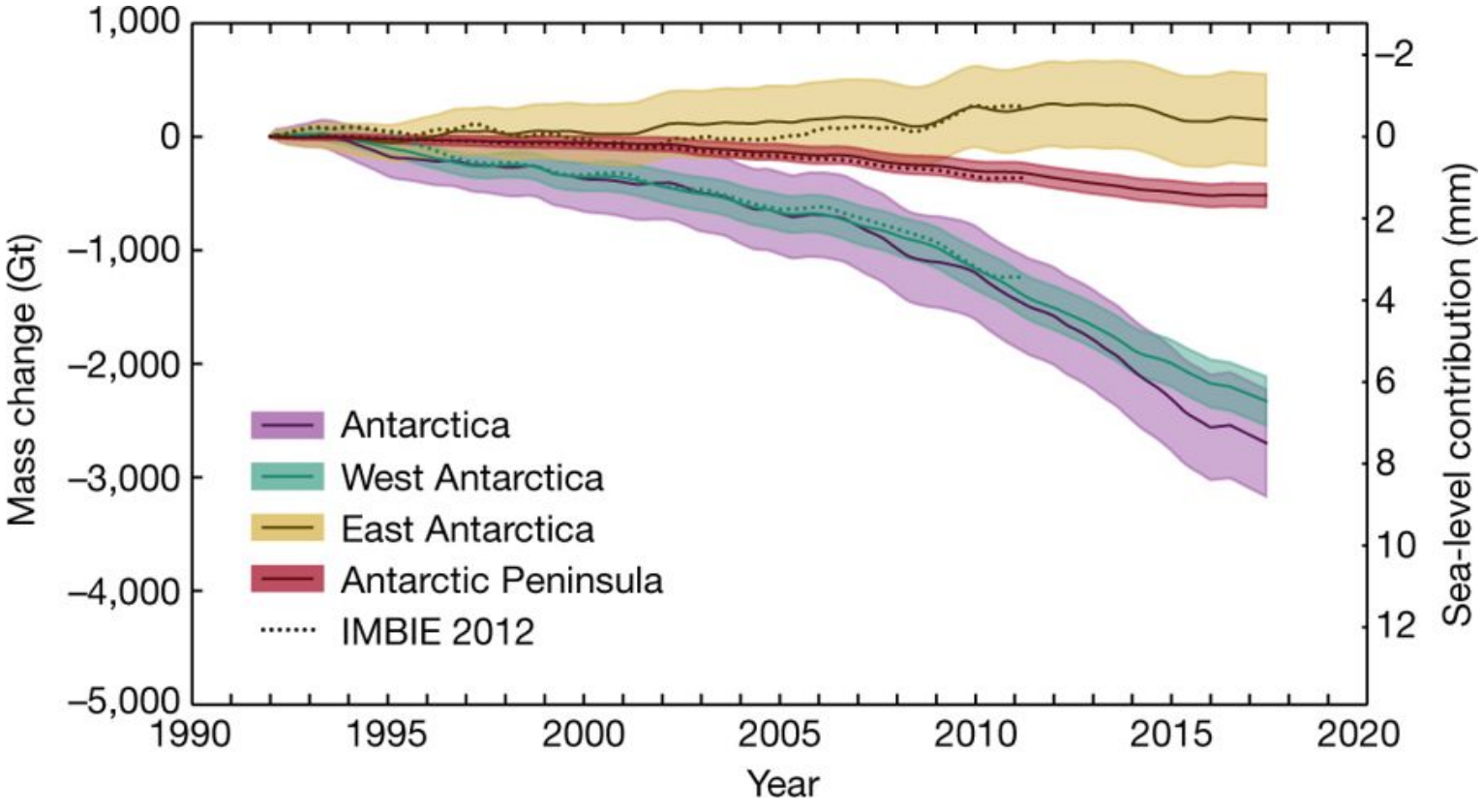
**Figure 2:** Global Mean Estimates Based On Land and Ocean Data




**Source**: Data coming from Gistemp Team (2018)

# Global Warming Is Not a Myth and Is Growing Fast

**Figure 3:** Cumulative Antarctic Ice Sheet Mass Change




**Source**: IMBIE team (2018)

# Global Warming Represents a Threat for Companies

- Resource depletion, effect on geography, increase of incertainty, increase of natural disasters,...
- "The ice sheets of Antarctica hold enough water to raise global sea level by 58 meters" (Fretwell et al., 2013)
- The Business and Sustainable Development Commission (2017) (p12) report states:

  *"... businesses need to pursue social and environmental sustainability as avidly as they pursue market share and shareholder value... If they don't, the costs and uncertainty of unsustainable development could swell until there is no viable world in which to do business."*

# Turn the Threat into an Opportunity

- Companies are important stakeholders of Global Warming.
- They are part of the **problem** but can be part of the **solution**
- The solution is **profitable**

**Contribution of this thesis**

This thesis **provides incentives** for companies to invest in environmental strategies and shows that **it does pay to be green**. Companies with better corporate environmental performance have better financal performance and the relation increases with a long-term perspective.

# Theoretical Framework

# Corporate Financial Performance (i.e. CFP)

**Focus on two of the three-group classification of Orlitzky et al. (2003):**

1. **Market-based measures** (e.g. price-earning ratio or Tobin's Q) consider that returns should be measured from the perspective of shareholders (Cochran and Wood, 1984). They are considered as proxies for **long-term CFP** (Endrikat et al., 2014).
2. **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). They are considered as proxies for **short-term CFP** (Endrikat et al., 2014).

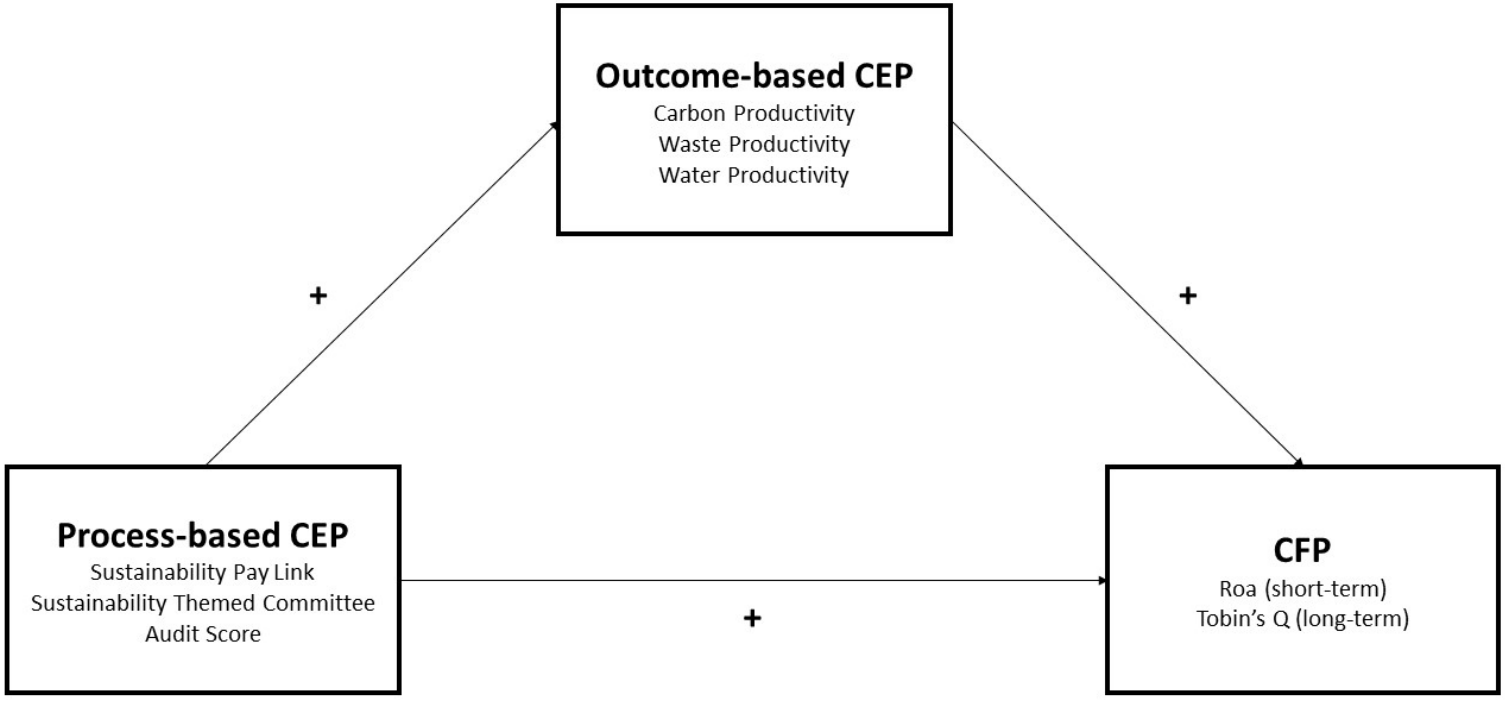
# Corporate Environmental Performance (i.e. CEP)

**Two-group classification of Endrikat et al. (2014):**

1. **Process-based CEP** which refers to "a strategic level and focuses on managerial principles and processes such as environmental objectives, environmental policies, or environmental management structures".
2. **Outcome-based CEP** which reflects "the observable and quantifiable results of these efforts (Delmas et al., 2011) and refers to measures such as the number of released pollutants or the ratio of recycled waste to total waste".

# Corporate Environmental And Financial Performance Nexus

**Figure 4:** Research Framework



# Hypotheses

- **Hypothesis 1.** Process-based CEP has a positive impact on Outcome-based CEP
- **Hypothesis 2.** Outcome-based CEP has a positive impact on short-term CFP
- **Hypothesis 3.** Outcome-based CEP has a positive impact on long-term CFP
- **Hypothesis 4.** Process-based CEP has a positive impact on short-term CFP
- **Hypothesis 5.** Process-based CEP has a positive impact on long-term CFP

# Methodology

# Econometric Model

## The link between Process-Based CEP and Outcome-Based CEP

$$Y_{it} = \alpha + \beta_1 SPL_{it} + \beta_2 STC_{it} + \beta_3 AS_{it} + Controls_{it} + d_t + u_{it} \quad (1)$$

where $Y_{it}$ is a proxy of outcome-based CEP measured as carbon productivity, water productivity and waste productivity, $SPL_{it}$ is a proxy for a firm's sustainability pay link, $STC_{it}$ is a proxy for a firm's sustainability themed commitment, $AS_{it}$ is a proxy for a firm's audit score, $Controls_{it}$ is a vector of control variables that includes firm size, industry sector, financial leverage and growth, $d_t$ represents the time effect and $u_{it}$ is the error term.

## The link between CEP and CFP

$$\begin{aligned} Y_{it+1} = \quad & \alpha + \beta_1 SPL_{it} + \beta_2 STC_{it} + \beta_3 AS_{it} + \beta_4 CaP_{it} \\ & + \beta_5 WatP_{it} + \beta_6 WastP_{it} + Controls_{it} + d_t + u_{it} \end{aligned} \quad (2)$$

where $Y_{it+1}$ is a proxy of CFP measured as ROA or Tobin's Q, $SPL_{it}$ is a proxy for a firm's sustainability pay link, $STC_{it}$ is a proxy for a firm's sustainability themed commitment, $AS_{it}$ is a proxy for a firm's audit score, $CP_{it}$ is a proxy for a firm's carbon productivity, $WatP_{it}$ is a proxy for a firm's water productivity, $WasP_{it}$ is a proxy for a firm's waste productivity, $Controls_{it}$ is a vector of control variables that includes firm size, industry sector, financial leverage and growth, $d_t$ represents the time effect and $u_{it}$ is the error term.

# Panel Data

**General form:**

$$Y_{it} = \alpha + \beta_k X_{itk} + u_{it} \tag{3}$$

- with $u_{it} = \mu_i + \epsilon_{it}$
- $\mu_i$ is the individual error component and is time-invariant. It can be considered as the unobserved effect model
- $\epsilon_{it}$, is the idiosyncratic error which is assumed well-behaved and independent of $X_{it}$ and $\mu_i$

If $\rho(X_{itk}, \mu_i) \neq 0$ then $\mu_i$ is considered as the *Fixed Effect* (i.e. FE) and equation 3 becomes:

$$Y_{it} = (\alpha + \mu i) + \beta_k X_{itk} + \epsilon_{it} \tag{4}$$

else, $\mu_i$ is considered as the *Fixed Effect* (i.e. FE) and equation 3 becomes:

$$Y_{it} = \alpha + \beta_k X_{itk} + (\epsilon_{it} + \mu i) \tag{5}$$

- FE and RE models imply that OLS estimators of $\beta_k$ are inconsistent

# Panel Data

## Testing for RE

- Breusch-Pagan Lagrange Multiplier (i.e. BPLM) test (Breusch and Pagan, 1980)
- Examines if time and/or individual specific variance components equal zero (Park, 2011).
- If H0 is verified, there is no RE in the panel data.

## Testing for FE

- The presence of FE is tested by an F test (i.e. the function `pFtest` in `R`).
- It tests the individual and/or time effects based on the comparison of the within and the pooling model (Croissant and Millo, 2008).
- If H0 is verified, there is no FE in the panel data.

# Panel Data

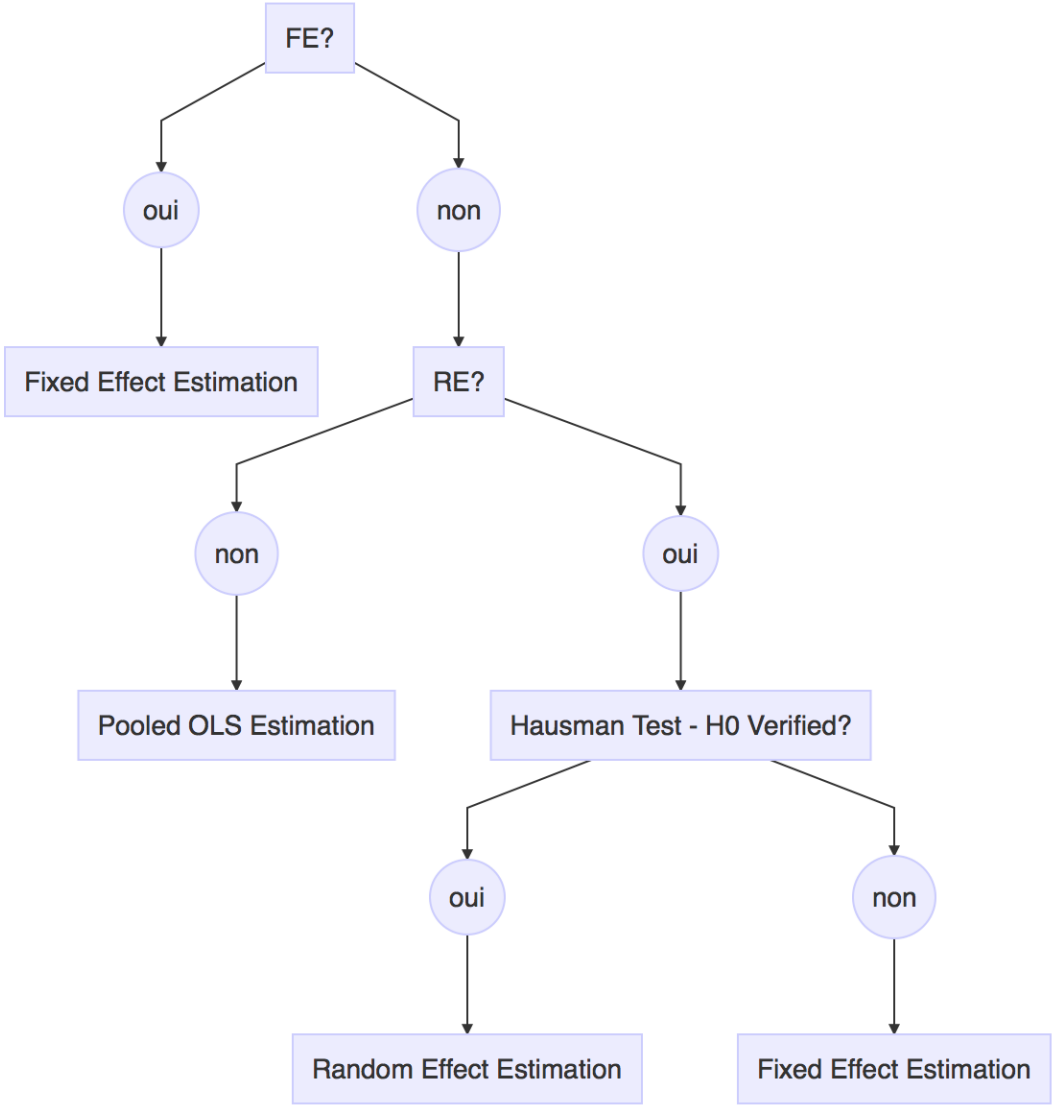



**Figure 5:** Process to Determine the Estimation Method

# Endogeneity Concern

## Omission variable bias

Inclusion of a vector of control variables $Controls_{it}$ that explains the relation between CEP and CFP

## Simultaneity bias

There is a bidirectional causality between CEP and CFP (Endrikat et al., 2014) that could cause simultaneous causality. I used a lagged instrument $Y_{it+1}$ to increase the confidence of the direction of the relationship (Miroshnychenko et al., 2017)

## Presence of FE in the model

Under FE, endogeneity is a concern. The Fixed Effect Estimation (i.e. equation 6) solves this as $(\mu_i - \frac{1}{T}\sum_{t=1}^{T}\mu_i) = 0$ (Roberts and Whited, 2013).

$$(Y_{it} - \frac{1}{T}\sum_{t=1}^{T}Y_{it}) = \beta_k(X_{itk} - \frac{1}{T}\sum_{t=1}^{T}X_{itk}) + (\epsilon_{it} - \frac{1}{T}\sum_{t=1}^{T}\epsilon_{it}) \quad (6)$$

# Results

# Process-Based CEP Positively Influences Outcome-Based CEP

**Table 1:** The Impact of Process-Based on Outcome-Based CEP

| | *Dependent variable:* | | |
|---|---|---|---|
| | CaP<br>Model (1) | WaP<br>Model (2) | WastP<br>Model (3) |
| SPL | 0.010 (0.011) | 0.022* (0.012) | 0.025** (0.011) |
| STC | 0.058*** (0.010) | 0.067*** (0.011) | 0.046*** (0.011) |
| AS | 0.057*** (0.010) | 0.068*** (0.011) | 0.071*** (0.011) |
| FirmSize | −0.005 (0.008) | −0.008 (0.008) | −0.010 (0.008) |
| Leverage | 0.0003 (0.001) | 0.001* (0.001) | 0.001** (0.001) |
| Growth | 0.028 (0.028) | 0.001 (0.030) | 0.003 (0.028) |
| Industry | 0.002 (0.002) | −0.00001 (0.002) | 0.004** (0.002) |
| BPLM test (pvalue) | 0*** | 0*** | 0*** |
| F test (pvalue) | 0*** | 0*** | 0*** |
| Observations | 1,123 | 1,123 | 1,123 |
| Adjusted $R^2$ | 0.109 | 0.138 | 0.132 |
| F Statistic (df = 7; 1113) | 20.888*** | 26.892*** | 25.632*** |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

# Both Process and Outcome-Based CEP Have a Positive Impact on CFP

**Table 2:** The Impact of Process and Outcome-Based CEP on CFP

| | *Dependent variable:* | |
|---|---|---|
| | TobinsQ | ROA |
| | Model (4) | Model (5) |
| SPL | 0.079* (0.044) | 0.008** (0.004) |
| STC | 0.063 (0.044) | 0.012*** (0.004) |
| AS | 0.158*** (0.044) | −0.004 (0.004) |
| CaP | −0.012 (0.135) | 0.030** (0.012) |
| WaP | 0.337** (0.155) | 0.006 (0.012) |
| WastP | −0.199 (0.156) | 0.010 (0.012) |
| FirmSize | −0.443*** (0.015) | −0.020*** (0.001) |
| Leverage | 0.003 (0.003) | −0.00000 (0.0003) |
| Growth | 0.465*** (0.152) | 0.138*** (0.012) |
| Industry | −0.026*** (0.007) | −0.002*** (0.001) |
| Constant | 10.701*** (0.345) | |
| BPLM test (pvalue) | 0.508 | 0.024** |
| F test (pvalue) | 0.323 | 0.012** |
| Observations | 954 | 1,093 |
| Adjusted $R^2$ | 0.500 | 0.282 |
| F Statistic | 96.388*** (df = 10; 943) | 44.007*** (df = 10; 1080) |
| *Note:* | | *p<0.1; **p<0.05; ***p<0.01 |

# Sensitivity Analyses

# Lagged Instrument of 2 Years

**Table 3:** The Impact of Process and Outcome-Based CEP on CFP

| | *Dependent variable:* | |
|---|---|---|
| | TobinsQ<br>Model (4) | ROA<br>Model (5) |
| SPL | 0.102** (0.044) | 0.008** (0.004) |
| STC | 0.062 (0.043) | 0.011*** (0.004) |
| AS | 0.153*** (0.044) | −0.002 (0.004) |
| CaP | 0.112 (0.133) | 0.039*** (0.012) |
| WaP | 0.194 (0.155) | −0.001 (0.013) |
| WastP | 0.032 (0.153) | 0.011 (0.013) |
| FirmSize | −0.427*** (0.015) | −0.019*** (0.001) |
| Leverage | 0.003 (0.003) | 0.0001 (0.0002) |
| Growth | 0.420*** (0.152) | 0.115*** (0.012) |
| Industry | −0.022*** (0.007) | −0.002*** (0.001) |
| Constant | 10.295*** (0.343) | 0.503*** (0.028) |
| BPLM test (pvalue) | 0.56 | 0.33 |
| F test (pvalue) | 0.363 | 0.598 |
| Observations | 946 | 1,078 |
| Adjusted $R^2$ | 0.483 | 0.247 |
| F Statistic | 89.135*** (df = 10; 935) | 36.368*** (df = 10; 1067) |
| *Note:* | | *p<0.1; **p<0.05; ***p<0.01 |

# Green Score as an Alternative

**Table 4:** Green Score - an Alternative Variable for CEP

| | *Dependent variable:* | |
|---|---|---|
| | TobinsQ | ROA |
| | Model (4) | Model (5) |
| GS | $0.669^{***}$ (0.093) | $0.051^{***}$ (0.008) |
| FirmSize | $-0.413^{***}$ (0.014) | $-0.018^{***}$ (0.001) |
| Leverage | 0.003 (0.004) | −0.0003 (0.001) |
| Growth | $0.528^{***}$ (0.162) | $0.134^{***}$ (0.013) |
| Industry | $-0.030^{***}$ (0.007) | $-0.002^{***}$ (0.001) |
| Constant | $9.916^{***}$ (0.336) | |
| BPLM test (pvalue) | 0.475 | 0*** |
| F test (pvalue) | 0.536 | 0.002*** |
| Observations | 956 | 1,094 |
| Adjusted $R^2$ | 0.479 | 0.263 |
| F Statistic | $176.286^{***}$ (df = 5; 950) | $79.571^{***}$ (df = 5; 1086) |
| *Note:* | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

# Summary

# Main Findings and Contributions

1. Process-based CEP positively influences outcome-based CEP
2. Both process and outcome-based CEP have a positive impact on CFP. This relationship is always positive, no matter the time horizon, and is stronger with a long-term perspective than a short-term perspective.
3. Answerr the call of Endrikat et al. (2014) who highlighted the need for a better understanding of the multidimensionality of both CEP and CFP constructs

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