# Results

The R script of this section is available in *"[Appendix B: Results - R script]"*.

## Descriptive Statistics

This section provides an overview of the database. Table 0.1 presents the main descriptive statistics of each variable. The sample size of ROA (i.e. N = 1176) is superior to the sample size of TobinsQ (i.e. N = 1038). Compared to ROA, calculating Tobin's Q requires a relatively high number of financial variables and is more susceptible to missing values [@Delmas2015]. This creates a disparity among the number of observations for each dependent variables. @Delmas2015 encountered the same issue and conducted an identical analysis to check whether this introduces a sample bias. I did the same and the *p-value* of the unpaired two-sample t-test equals 0.365 meaning that there is no significant difference between both samples.

Table 0.2 contains the matrix of correlation of the database. There are highly significant correlations between outcome-based CEP variables (i.e. carbon, water and waste productivity) and process-based CEP variables (i.e. sustainability pay link, sustainable themed commitment and audit score) suggesting that my model could suffer from a high degree of multicollinearity. Multicollinearity inflates the standard errors of the coefficients making some variables statistically insignificant when they should be significant [@Akinwande2015]. One common practice in the literature to detect multicollinearity is the computation of the Variance Inflation Factor (i.e. VIF) [@Salmeron2018]. VIF indicates how much the estimated variance of the $i_{th}$ regression coefficient is increased above what it would be if $R_i^2$ equaled zero [@Obrien2007]. Table 0.3 reports VIF of all variables. The maximum VIF is 2,477 meaning that there is no multicollinearity in the model [@Obrien2007].

## Outliers Treatment

@Lyu2015 defines outliers as observations in the dataset that appear to be unusual and discordant and which could lead to inconsistent results. @Osborne2004 have shown that even a small proportion of outliers can significantly affect simple analyses (i.e. t-tests, correlations and ANOVAs). Outliers are an issue only and only if they are influential, namely observations whose removal causes a different conclusion in the analysis [@Cousineau2010].

How to treat influential outliers is still a lively debate in the literature [@OrrJohn1991; @Cousineau2010]. @Tabachnick2007 argue that the imputation with the mean is the best method while @Cousineau2010 highlight that it tends to reduce the spread of the population, making the observed distribution more leptokurtic, and possibly increase the likelihood of a type-I error. @Dang2009 argue that a more elaborate technique involves replacing outliers with possible values (e.g. multiple imputation) while @Barnett1994 would prefer to remove or winsorize them. Alternatively, @Pollet2017 argue that inclusion or exclusion of outliers depend on the significativity of the results. According to them, if results are more significant without outliers, scholars should remove them.

Following the mindset of @Pollet2017, I removed outliers from the database. Influential outliers had been identified based on the Cook's distance [@Cook1977] which is a common statistical tool to assess the influence of outliers [@JPStevens1984; @Cousineau2010; @Zuurprotocoldataexploration2010]. Cook's Distance observes

the difference between the regression parameters of a given model, $\hat{\beta}$, and what they become if the $i_{th}$ data point is deleted, let's say $\hat{\beta}_i$. See *"[Appendix C: Outliers treatment]"* for further details on how I proceed.

## The Impact of Process-Based CEP on Outcome-Based CEP

Table 0.4 reports the main results of the analysis of the impact of process-based CEP (i.e. SPL, STC and A) on outcome-based CEP (i.e. CaP, WatP and WastP). Given the p-value of the F test, all models have FE making the *fixed effects estimation*, the most efficient estimator.

Except for Model (1) which indicates no significant relation between SPL and CaP, all models show evidence of a positive and highly statistically significant effect of process-based CEP on outcome-based CEP. Indeed, results demonstrate that companies, which link the remuneration of any member of a company's senior executive team with the achievement of environmental performance targets, have a better WatP (+0.022%) and WastP (+0.026%). The fact of having a sustainability committee on the board of directors level increases the CaP (+0.054%), WatP (+0.062%) and WastP (+0.042%). Finally, companies having their latest reported environmental metrics audited by a third party have a higher CaP (+0.062%), WatP (+0.07%) and WastP (+0.072%). Hence, hypothesis 1 is verified.

## The Impact of CEP on CFP

Table 0.5 reports the main results of the analysis of the impact of both process-based CEP (i.e. SPL, STC and A) and outcome-based CEP (i.e. CaP, WatP and WastP) on short-term CFP (ROA) and long-term CFP (i.e. TobinsQ). Based on the pvalue of BPLM and F tests, model (4) had been estimated with the *pooled OLS estimation* while model (5) had been estimated with the *fixed effects estimation*.

Model (4) shows evidence of a positive and statistically significant effect of SPL, A, and WaP on *long-term CEP*. Model (5) shows evidence of a positive and statistically significant effect of SPL, STC and CaP on *short-term CEP*.

More precisely, regarding process-based CEP variables, results show that companies, which link the remuneration of any member of a company's senior executive team with the achievement of environmental performance targets, are characterized by both a higher Tobin's Q (+0.079) and ROA (+0.008). Then, the fact of having a sustainability committee on the board of directors level increases the ROA (+0.012). Finally, companies having their latest reported environmental metrics audited by a third party have a higher Tobin's Q (+ 0.158). Regarding outcome-based CEP variables, results demonstrate that a 1% increase of carbon productivity increases the ROA by 0.03 and a 1% increase of water productivity increases the Tobin's Q by 0.337. Hence, hypotheses 2, 3, 4 and 5 are verified.

Regarding control variables, firm size and industry sector negatively and significantly influence CFP in both models while growth has a positive impact, with an effect more pronounced in Model (4). These results support previous research [@EndrikatMakingsenseconflicting2014; @MiroshnychenkoGreenpracticesfinancial2017]. Against all odds, leverage does not have any significant impact.

Table 0.1: Descriptive Statistics

| Statistic | N | Mean | St. Dev. | Min | Max |
|-----------|-----|-------|----------|--------|--------|
| Roa | 1,176 | 0.06 | 0.07 | $-0.62$ | 0.42 |
| TobinsQ | 1,038 | 0.10 | 0.38 | $-1.30$ | 1.08 |
| Leverage | 1,130 | 1.51 | 8.02 | 0.00 | 157.90 |
| Growth | 1,174 | 0.12 | 0.24 | $-2.04$ | 5.96 |
| FirmSize | 1,172 | 10.35 | 0.60 | 8.45 | 12.51 |
| Industry | 1,177 | 4.59 | 2.65 | 1 | 11 |
| CaP | 1,177 | 0.12 | 0.18 | 0.00 | 0.97 |
| WaP | 1,177 | 0.09 | 0.18 | 0.00 | 0.99 |
| WastP | 1,177 | 0.07 | 0.17 | 0.00 | 0.97 |
| SPL | 1,177 | 0.49 | 0.50 | 0 | 1 |
| STC | 1,177 | 0.48 | 0.50 | 0 | 1 |
| A | 1,177 | 0.47 | 0.50 | 0 | 1 |

Table 0.2: Correlation Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Roa | | | | | | | | | | | |
| 2. TobinsQ | 0.40*** | | | | | | | | | | |
| 3. Leverage | -0.02 | 0.03 | | | | | | | | | |
| 4. Growth | 0.19*** | -0.02 | -0.07** | | | | | | | | |
| 5. FirmSize | -0.27*** | -0.66*** | -0.02 | 0.09*** | | | | | | | |
| 6. Industry | -0.10*** | -0.09*** | -0.05* | 0.00 | 0.06** | | | | | | |
| 7. CaP | 0.09*** | 0.02 | 0.03 | 0.00 | 0.07** | 0.04 | | | | | |
| 8. WaP | 0.08*** | 0.03 | 0.06** | -0.02 | 0.08*** | 0.02 | 0.67*** | | | | |
| 9. WastP | 0.07** | 0.01 | 0.08*** | -0.01 | 0.07** | 0.08*** | 0.56*** | 0.69*** | | | |
| 10. SPL | -0.05* | -0.11*** | -0.02 | -0.02 | 0.29*** | 0.09*** | 0.06** | 0.14*** | 0.15*** | | |
| 11. STC | 0.00 | -0.10*** | -0.01 | -0.04 | 0.29*** | 0.06** | 0.21*** | 0.26*** | 0.24*** | 0.48*** | |
| 12. A | -0.04 | -0.08** | 0.01 | 0.05* | 0.26*** | 0.04 | 0.21*** | 0.26*** | 0.28*** | 0.50*** | 0.46*** |

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

Table 0.3: Variance Inflation Factor

|  | Roa | Tobin's Q |
|---|---|---|
| SPL | 1.543 | 1.487 |
| STC | 1.507 | 1.475 |
| A | 1.527 | 1.514 |
| CaP | 1.862 | 1.846 |
| WaP | 2.477 | 2.425 |
| WastP | 1.966 | 2.008 |
| Leverage | 1.021 | 1.027 |
| Growth | 1.029 | 1.026 |
| FirmSize | 1.155 | 1.134 |
| Industry | 1.025 | 1.020 |

Table 0.4: The Impact of Process-Based on Outcome-Based CEP

|  | *Dependent variable:* | | |
|---|---|---|---|
|  | CaP | WaP | WastP |
|  | Model (1) | Model (2) | 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) |
| A | 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 |
| $R^2$ | 0.116 | 0.145 | 0.139 |
| 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

Table 0.5: The Impact of Process and Outcome-Based CEP on CFP (Lag = 1)

| | *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) |
| A | 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 |
| $R^2$ | 0.505 | 0.290 |
| 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