THE IMPACT OF ESG SCORES ON BOTH FIRM PROFITABILITY AND VALUE IN THE AUTOMOTIVE SECTOR (2002-2016)

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CESPIC WORKING PAPER
2019/01

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Abstract

This study analyses the impact of ESG scores on firms' profitability in the automotive sector between 2002 and 2016. In particular, we exploit a novel dataset of European and North American listed firms. Results show that the environmental component of the ESG scores is positively associated with firms' profitability. Among the components of overall ESG, the environmental score is the only that exhibits the most robust association. Eventually when considering firm value proxied by means of Tobin's Q, results show a negative association between the Tobin's Q and the environmental component of ESG. Further estimations have highlighted a more nuanced evidence in particular with regard to profitability namely: (i) there is a an inverse U-shaped relationship between the governance score of ESG and ROA of firms; (ii) when considering interactions, it comes out that as the firm size increases both environmental and social score are negatively associated with ROA; (iii) when considering non-linearities results show that when governance score is small ROA of firms slightly decreases but as the governance scores increases it eventually increases.

Keywords: ESG, Profitability, ROA, Firm Value, Tobin's Q.

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Introduction

The aim of this research work is to assess the impact of the ESG scores on performance indices of companies belonging to the Automobiles and Parts sector listed on European, American and Canadian regulated market between 2002 and 2016. The ESG scores are synthetic indicators which are based respectively on environmental, social and governance aspects and practices which influence and shape the behavior of firms. In fact, a large growing literature is nowadays investigating to what extent sustainable strategies affect both firm's performance and value. Needless to say, the challenge is to verify whether taking into account sustainability, environmental and social issues also payoffs in terms of performance and added value to the firm. Whether it is reasonable to say that such strategies of firms do contribute to the establishment of a more sustainable business context as envisioned in Waddock (2017), there are substantial doubts about the role of ESG in shaping both profitability and firm value [see among others Lee et al. (2018)]. In particular, the ESG scores combine elements which separately have already proven to affect firm performance and value of firms. In sum, albeit fragmented there is already a large literature on the topic. Friede et al. (2015) find more than 2,000 studies, that analyze the ESG and financial performance link.

As noted above, therefore, this study addresses the relationship between firm profitability and value and ESG in the automotive sector over the period between 2002 and 2016 for a panel of European and North-American companies. The focus on North American area can be explained in the light of availability and reliability of data. The choice of a very specific sector is also motivated by the search of reliable results. First and foremost, in such a way we rule out the risk of distortion in the results plausibly driven by heterogeneity between sectors. Secondly, when focusing on a specific sector it will be easier to target also a recurring doubt in the existing literature, namely the direction of causality between environmental and social behavior and firm performance. In fact, firms with better performance can be capable of investing more resources in environmental and social strategies, so generating a self-reinforcing positive association between ESG (or its component) and profitability [see on this point Waddock and Graves (1998)].

In brief, the main results we would claim are that the ESG score is positively associated with firms' profitability captured by means of Returns on Assets (ROA). In

brief, when the ESG score increases by 10% the profitability measure increases by 0.04. Yet, among the components of overall ESG, the environmental score is the one that exhibits an association in a linear model so suggesting that overall results are mainly driven by this. When the environmental score increases by 10% the profitability measure increases by 0.014. Eventually when considering firm value proxied by means of Tobin's Q, results also show a negative association between Tobin's Q and both the environmental component of ESG. In particular, a 10% increase in the one-year lagged environmental score translates into a current reduction in Tobin's Q of -0.01.

Eventually further estimations have highlighted a more nuanced evidence actually. First we have considered the interaction between the ESG scores and the firm size (captured by means of total assets). Findings show that as the firm size increases the relationship between both environmental and social components of ESG and firms profitability turns to be negative. Instead, no significant interaction emerges when considering the Tobin's Q as dependent variable. Yet, there is a an inverse U-shaped relationship between the governance score of ESG and ROA of firms. Eventually we have considered non-linearities. Results show that when governance score is small ROA of firms slightly decreases but as the governance scores increases it eventually increases. In other words there is an inverse U-shaped relationship between the governance score and the firm's profitability.

The remainder of the paper is organized as follows: in a first part a literature review is presented. In a second section the dataset and the empirical methodology are expounded. Eventually some alternative estimations and robustness checks are computed. A final section summarizes and concludes.

I. Literature and conceptual background

The literature on ESG metrics is relatively recent even if some components can be found in other strands of literature. Although corporate finance has historically researched about the determinants of stock returns and modeling future yields, recently the literature has been focusing on measuring the impact of non-financial information on listed companies' corporate financial performance. This field of study has become more relevant over time due to the increasing attention of investors. In

economic literature, the search for a relation between Environmental, Social and Governance scores (ESG) and corporate financial performance can be traced back to the beginning of the 1970s.

The studies focused on the effect that ESG scores have on the cost of capital (equity and debt) and therefore on the related risk, highlighting that companies that have good sustainability standards enjoy significantly lower cost of debt and cost of equity due to a reduction of the relative risk. In fact, good corporate governance structures (Bhojraj and Sengupta, 2003) and good disclosure policies (Schauten an van Dijk, 2011) reduce the borrowing cost. Moreover, good environmental management practices (Bauer and Hann, 2010) have significantly lower credit spreads while firms with better relations (Verwijmeren and Derwall, 2010) have better credit ratings. Researches have also shown that good corporate governance leads to lower cost of equity (Lima ad Sanvincente, 2013), environmental risk management practices, disclosure on environmental policies (El Ghoul, Guedhami, Kim and Park, 2014), good employee relations and product safety (El Ghoul, Guedhami, Kwok and Mishra, 2011) lower firm's cost of equity.

Further studies also aimed to investigate the effects of sustainability on company's operating performance. Some studies show a positive correlation between the environmental, social and governance topics and operational performance [Fulton at al. (2012); Margolis et al. (2007); van Beurden and Gossling, (2008); Salama (2005)]. While the above mentioned works have shown that sustainability reduces the cost of capital and improves operating performance, further studies have investigated whether this information increases the benefits for equity investors. Studies has showed that higher sustainability scores generally outperform less sustainability firms. On the governance dimension the majority of research suggest that superior governance quality leads to better financial performance (Bebchuk, Cohen and Ferrel, 2010; Gompers, Ishii and Metrick, 2003; Cremers and Ferrel; 2013). Finally, on social dimension, the literature shows a positive relationship between employee satisfaction and stock market performance (Edmans, Li and Zhang, 2014).

On the environmental dimension of sustainability, in fact, there is a copious literature on the relationship between firm performance and environmental issues [see among others Konar and Cohen (2001), Dowell et al. (2000), Hart and Ahujia (1996)]. IN some studies eco-efficiency and environmentally responsible behavior are

viewed as factors leading to superior stock market performance (Derwall, Guenster, Bauer and Koedijk, 2005; Karpoff, Lott and Werly, 2005) and also to superior profitability [see among others Porter and Kramer (2006), King and Lenox (2001); King and Lenox (2002) and Ghisetti (2018) for a comprehensive discussion]. Yet, Ghisetti and Rennings (2014) highlight that both the typology of Environmental Innovation and the driver of their adoption affect the sign of the relationship between competitiveness and environmental performance. In particular, innovations leading to a reduction in the use of energy or materials per unit of output positively affect firms' competitiveness.

When considering aggregate ESG scores a more recent literature is already providing researchers with a complex evidence. Fatemi et al. (2017) investigates the effect of environmental, social, and governance (ESG) activities and their disclosure on firm value finding a positive effect. Capelle-Blancard and Petit (2017) investigate the stock market reaction to news about ESG factors for one hundred listed companies over the period 2002-2010. The authors find that on average companies gain nothing from positive announcements on ESG factors, but they suffer a drop in market value after negative announcements.

II. The data and the empirical strategy

The ESG scores are taken from the dataset Thomson Reuters Datastream. The data provider captures and calculates over 400 company-level ESG measures, of which they select a subset of 178 most comparable and relevant fields to power the overall company assessment and scoring process. The underlying measures are based on considerations around comparability, data availability, and industry relevance. They are grouped into 10 categories, weighted proportionately to the count of measures within each category formulates the final ESG Score, which reflects the company's ESG performance, commitment and effectiveness based on publicly reported information. The categories that compose the Environmental score are: (1) *Resource use, that reflects a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management*; (2) *Emissions reduction, that measures a company's commitment and effectiveness towards reducing environmental*; (3) *Innovation, that reflects the capacity to reduce the environmental costs and burdens for its customers, thereby creating new*

market opportunities through new environmental technologies and processes or eco-designed products.

The Governance components do capture: *(a) Management, that measures a company's commitment and effectiveness towards following best practice corporate governance principles; (b) Shareholders, that measures a company's effectiveness towards equal treatment of shareholders and the use of anti-takeover devices; (c) CSR strategy category score, that reflects a company's practices to communicate that it integrates the economic (financial), social and environmental dimensions into its day-to-day decision-making processes.*

The categories composing the Social score are: (*i) Workforce score measures a company's effectiveness towards job satisfaction, healthy and safe workplace, maintaining diversity and equal opportunities; (ii) Human rights category score, that measures a company's effectiveness towards respecting the fundamental human rights; (iii) Community category measures the company's commitment towards being a good citizen, protecting public health and respecting business ethics; (iv) Product responsibility, that reflects a company's capacity to produce quality goods and services integrating the customer's health and safety, integrity and data privacy.*

The dataset collects forty-seven listed firms from Europe and North America. Twenty-eight out of thirty-seven are headquartered in USA. The total sample is composed by 11 firms that produce automobiles (22.92% of total sample) and 37 that produce components (77.08% of total sample). In 2017 the worldwide number of listed firms exhibiting ESG scores in the automotive sector was 131. Figure 1 shows the total market capitalization in the end of each year and the number of listed companies that compose the sample. The trend of market capitalization shows a moderate growth between 2002 and 2007. After the 2008 financial crisis, the capitalization recovered from its previous loss and showed a sustained growth, peaking in 2015 and flexing slightly thereafter.

Figure 1 - Total Capitalization (thousands of Euros) and number of firms

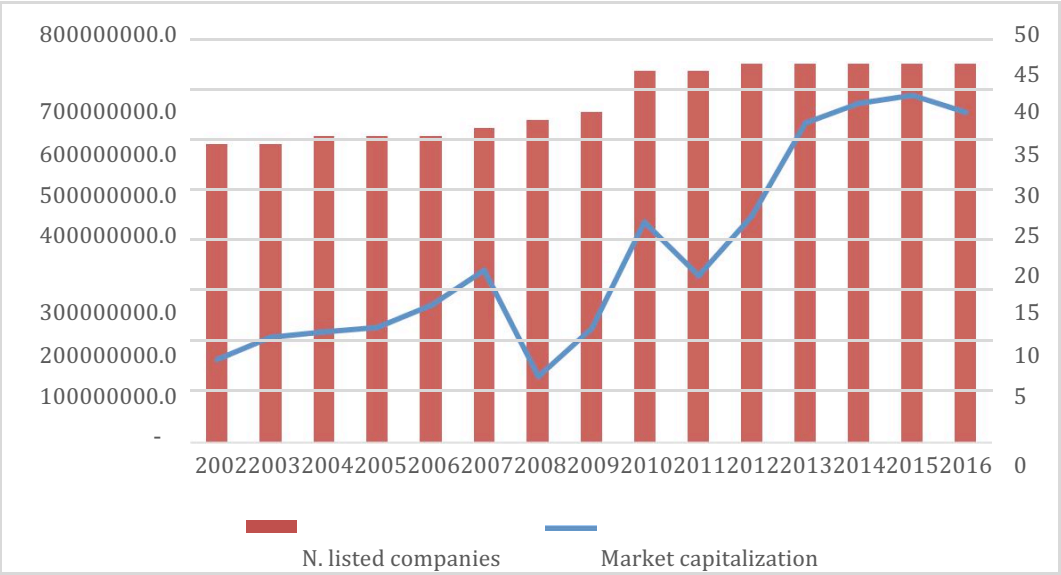

Table 1 - Number of firms

Country	N. AUTOMOBILES COMPANIES	N. AUTO COMPONENTS COMPANIES	TOTAL	%
CANADA	0	2	**2**	**4.17%**
FINLAND	0	1	**1**	**2.08%**
FRANCE	2	4	**6**	**12.50%**
GERMANY	4	4	**8**	**16.67%**
ITALY	1	1	**2**	**4.17%**
UNITED KINGDOM	0	1	**1**	**2.08%**
UNITED STATES	4	24	**28**	**58.33%**
TOTAL	**11**	**37**	**48**	**100.00%**

A set of control variables is employed and they are all drawn from Thomson Reuters Datastream too. Because of data availability, our data spans from 2002 to 2016. Table 2 reports the descriptive statistics of the variables used in the regression.

Table 2. Descriptive statistics

Variable	Min	Max	Mean	Std. deviation
ROA (EBITDA/Total Assets)	-0.5944	0.4892	0.1231	0.0858
Tobin's Q	0.5722	9.53	1.5357	0.8956
Environmental score	8.95	97.48	73.3188	27.2503
Governance score	2.79	96.61	60.6832	24.2865
Social score	5.65	98.75	65.3452	28.5531

ESG Score	11.57	92.86	51.7959	19.3476
Total Asset	9.1247	19.8069	15.4302	1.9583
Total Debt/Enterprise value	0	2.0946	0.4463	0.2619
Total Asset Turnover	0.1642	2.6449	1.1868	0.4295
Capex/Asset	0.0026	0.2871	0.0582	0.0351
R&D/Sales	0.0018	1.0232	0.0408	0.0662

a) ESG scores and ROA

In order to analyze the relationship between ESG scores and firm profitability we employ the following baseline OLS panel fixed effects model:

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The dependent variable is the Return on Asset (ROA), computed as the ratio between Earnings Before Interest, Tax and Depreciation (EBITDA) and total asset. In fact, according to the definition provided by Thompson Datastream the accounting indicator ROA is defined as the ratio between EBITDA and Total Asset and not as the ratio between EBIT and Total Asset. For this reason the above definition of ROA may be compared to a normalization of company's EBITDA on a measure of accounting size of the same company. In this regard EBITDA may be seen as the most similar accounting measure to the notion of unlevered cash flows. We also employ a parsimonious set of control variables established in the existing literature: a size variable, represented by the natural logarithm of total assets, a leverage variable, represented by the natural logarithm of the ratio between total debt and an accounting measure of enterprise value, an efficiency variable captured by means of the Total Asset Turnover, that is the ratio between net sales and revenues and total asset. Yet, we also include the one-year lagged profitability since these values are commonly highly correlated with past values. In the light of the results of the Hausman test, we employ a fixed effects model. Year dummies are also included. With the exception of the lagged dependent variable, all predictor variables are log-transformed by means of natural logarithm.

Table 3 reports the results. For sake of readability coefficients of control variables are not displayed. The overall ESG score does exhibits a positive association with ROA. In particular, when including the one-year lagged value of ROA, the association between ESG and current ROA gets more robust so reaching a 5% threshold of statistical significance. Control variables do exhibit the expected signs so not suggesting concerns about the general fitness of the model. In order to compute the quantitative effect we can say that for a 10% increase in ESG score, the difference in the expected mean ROA value is: 0.41**ln*(1.1)= 0.04. In brief, when the ESG score increases by 10% the profitability measure increases by 0.04. Since values of ROA in our samples are bounded between -.59 and .49 (please see table 2 above), this result is by no means trivial. In particular, this result appears to be mainly driven by environmental component of ESG. In fact, only the latter appears to be significantly associated with profitability. When the environmental score increases by 10% the profitability measure increases by 0.014.

Table 3 - Return on Asset and ESG scores
(dependent variable ROA defined as EBITDA/Total asset; fixed effects model)

	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
Log of environmental score	**.018***	**.015****						
	(.0101)	**(.007)**						
Log of governance score			.001	.004				
			(.0111)	(.010)				
Log of social score					.010	.012		
					(.011)	(.010)		
Log of ESG score							**.037***	**.041****
							(.022)	**(.019)**
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES
Lagged dependent variable	NO	YES***	NO	YES***	NO	YES***	NO	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-.552	-.226	-.497	-.179	-.530	-.2112	-.5921	-.274
	(.514)	(.437)	(.520)	(.452)	(.513)	(.432)	(.519)	(.429)
Observations	387	365	387	365	387	365	380	360
Number of firms	47	47	47	47	47	47	47	47
R-squared:								
Within	0.359	0.4331	0.3541	0.4297	0.3565	0.4326	0.3688	0.4465

Between	0.0207	0.2216	0.0197	0.2154	0.0191	0.2125	0.0144	0.2031
Overall	0.0461	0.2424	0.0449	0.237	0.043	0.2323	0.0374	0.2324

Robust errors in brackets; errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

Therefore, it is reasonable to investigate further on the environmental components. Eventually we have run the baseline regression by including simultaneously the three distinct factors of the environmental score. Results are shown in table 4 below. The capacity of a firm to reduce the use of resources finding more eco-efficient solutions appears to be negatively associated with the profitability measure. The plausible interpretation is that costs associated with such processes may have a negative impact on profitability. However the impact seems to be negligible. The negative quantitative impact on ROA of a 10% increase in the resource use score is -0.001. Instead, the emission reduction score is positively associated with firms' profitability and a 0.01 increase in ROA measure would be associated with a 10% increase in the emissions score.

Table 4 – Environmental components of ESG and Profitability
(dependent variable ROA defined as EBITDA/Total asset; fixed effects model)

Log of Resource Use Score	**-.008****	-.004
	(.005)	(.003)
Log of Emissions Score	**.012***	.005
	(.007)	(.006)
Log of Enviromental innovation score	.012	.008
	(.008)	(.007)
Control Variables	YES	YES
Lagged dependent variable	NO	YES
Year dummies	YES	YES
Constant	-.495	-.194
	(.487)	(.438)
Observations	371	351
Number of firms	43	43
R-squared:		
Within	0.3736	0.4373
Between	0.0065	0.1725
Overall	0.0373	0.2242

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

Eventually we have estimated the interaction of ESG variables and the firm size. Once added an interaction term between the firm size (captured by means of the log of total assets) and the different ESG metrics, the results deliver a more nuanced evidence. First, the social score of the ESG gains statistical significance and it is positively associated with firms' profitability. In particular, in model 4.6 including the lagged measure of ROA, there would be a .02 increase in the profitability measure associated with a 10% increase in the social score. The interaction terms between firm size and both environmental score and social score are negative so suggesting that as the firm size increase the different ESG scores are negatively associated with profitability. The plausible interpretation in broader terms is that as the firm size grows the range of costs associated with the commitment to environmental and social issues prove to become detrimental for firms' profitability. In simpler words, it is likely that adaptation costs are increasing in the size of firms.

Table 5 – Interactions between ESG scores and Firm Size
(dependent variable ROA as EBITDA/Total asset; fixed effects model)

	4.1	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**
Log of environmental score	**.397****	**.270***						
	(.209)	**(.165)**						
Log of governance score			-.017	.012				
			(.092)	(.076)				
Log of social score					**.276****	**.220****		
					(.125)	**(.111)**		
Log of ESG score							**.257***	.200
							(.155)	(.153)
Log of Firm Size (total asset)	**.139****	.088	.036	.021	**.097****	.066	**.089***	.054
	(.070)	(.056)	(.027)	(.024)	**(.047)**	(.043)	**(.051)**	(.049)
Log of firm size * Log of environmental score	**-.025****	-.017						
	(.014)	(.011)						
Log of firm size * Log of governance score			.001	-.001				
			(.006)	(.005)				
Log of firm size * Log of Social score					**-.017****	**-.014****		
					(.008)	**(.007)**		
Log of firm size * Log of ESG score							-.014	-.010
							(.009)	(.010)
Other Control Variables	YES	YES	YES	YES	YES	YES	YES	YES

Lagged dependent variable	NO	YES***	NO	YES***	NO	YES***	NO	YES***
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-2.067**	-1.266	-.432	-.210	**-1.391****	-.916	-1.378	-.867
	(1.059)	(.855)	(.443)	(.395)	**(.729)**	(.670)	(.817)	(.768)
Observations	387	365	387	365	387	365	380	360
Number of firms	47	47	47	47	47	47	47	47
R-squared:								
Within	0.3754	0.4412	0.3543	0.4297	0.3765	0.4426	0.3759	0.4505
Between	0.0435	0.2387	0.0178	0.2199	0.0756	0.2946	0.0279	0.2349
Overall	0.1011	0.2824	0.0428	0.2399	0.1302	0.3097	0.0632	0.2673

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

b) Tobin's Q and ESG scores

Eventually we also estimate an OLS regression using Tobin's Q as the dependent variable and ESG score as main explanatory variables. Tobin's Q is commonly used as proxy for firm value or for firm's perspectives of profitability as it is intended to capture the value of long-term investments including intangibles. In brief, it is often used as proxy of firm's value. Fernando et al. (2017) for example finds that the Tobin's Q appears to be negatively correlated with environmental performance of firms. We employ the following definition:

? = −− ℎ

Then, we employ a slightly different model from the previous one. Firstly, in line with the existing literature, all predictor variables are one-year lagged. This determines a reduction in number of observations. In fact, profitability has an impact on firm value and so we include also here the one-year lagged ROA in the regression model as predictor variable. The control variables we employ are: the ratio between R&D and sales, the ratio between the total debt and a measure of enterprise value and the ratio between capex and assets. All explanatory variables are log-transformed by means of natural logarithm. In notations the empirical model to estimate determinant of Tobin's Q is:

$$\ln(\quad ^{?} \qquad)\,'(= R + \ -\ '(8- + \ '(8- + + '($$

where '(8- denotes alternatively the overall ESG score and its determinants, '(8-is the set of control variables and τ a year dummy. Errors are clustered on firm. Also in this case we show results of a fixed effects model. The regressions estimates show that only the environmental components of ESG exhibit a significant statistical association with the Tobin's Q. Such relationship is negative. The impact is not negligible. In particular, a 10% increase in the one-year lagged environmental score translates into a current reduction in Tobin's Q of -0.01. The plausible interpretation of this negative relationship is that environmental commitment increases the replacement costs of the firm so finally decreasing the Tobin's Q. In this respect size of firms presumably matter.

Table 6 - Tobin's Q and ESG scores

(dependent variable Tobin's Q; fixed effects model)

	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8
Log of environmental score (t-1)	**-.094****	**-.097****						
	(.045)	(.042)						
Log of governance score (t-1)			.028	.034				
			(.045)	(.046)				
Log of social score (t-1)					.002	.001		
					(.054)	(.053)		
Log of ESG Score							-.007	-.019
							(.087)	(.0913)
Control Variables (t-1)	YES	YES	YES	YES	YES	YES	YES	YES
Years dummies	YES	YES	YES	YES	YES	YES	YES	YES
Profitability (t-1)	NO	YES***	NO	YES***	NO	YES***	NO	YES***
Constant	3.713***	3.703***	3.506***	3.500***	3.411***	3.399***	3.373***	3.392***
	(.596)	(.683)	(.533)	(.6159	(.742)	(.861)	(.638)	(.741)
Observations	290	287	290	287	290	287	283	280
Number of firms	35	35	35	35	35	35	35	35
R-squared:								
Within	0.4666	0.478	0.4588	0.4709	0.4563	0.4672	0.4511	0.4616
Between	0.4513	0.4439	0.4407	0.4306	0.4445	0.4343	0.4614	0.4525
Overall	0.476	0.4624	0.4576	0.442	0.4614	0.4462	0.4805	0.4673

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

Eventually also for the Tobin's Q we have estimated the different components of the environmental score. However, no significant results take shape (see table 7). Yet, we have introduced in the baseline regression an interaction of ESG variables and the firm size (see Table 8). Also in this case we do not find significant results for the ESG factors. Interestingly, the insight envisioned in table 6 above seems to be confirmed because also in table 8 the size of firms (captured by the log of total asset) is negatively associated with Tobin's Q.

Table 7 - Environmental components of ESG and Tobin's Q
(dependent variable Tobin's Q; fixed effects model)

	6.1	6.2
Log of Resource Use Score (t-1)	-.002	.006
	(.022)	(.024)
Log of Emissions score (t-1)	-.003	-.011
	(.025)	(.027)
Log of Environmental Innovation score (t-1)	.023	.018
	(.030)	(.031)
Control Variables (t-1)	YES	YES
Year dummies	YES	YES
Profitability (t-1)	NO	YES
Constant	3.332***	3.309***
	(.554)	(.627)
Observations	279	276
Number of companies	34	34
R-squared:		
Within	0.4573	0.4675
Between	0.4585	0.4454
Overall	0.4755	0.4597

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

Table 8 - Interactions between ESG scores and Firm Size
(dependent variable Tobin's Q; fixed effects model)

	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
Log of environmental score (t-1)	-.467	-.940						
	(.563)	(.652)						

Log of governance score (t-1)			.105	.174				
			(.316)	(.324)				
Log of social score (t-1)					-.245	-.486		
					(.435)	(.570)		
Log of ESG Score (t-1)							-.397	-.566
							(.582)	(.595)
Log of Firm Size (total asset) (t-1)	**-.260***	**-.397****	**-.164*****	**-.162*****	**-.225****	**-.289****	**-.250***	**-.291****
	(.144)	**(.183)**	**(.066)**	**(.067)**	**(.109)**	**(.150)**	**(.149)**	**(.158)**
Log of firm size * Log of environmental score (t-1)	.0242	.055						
	(.0363)	(.042)						
Log of firm size * Log of governance score (t-1)			-.005	-.009				
			(.0194)	(.020)				
Log of firm size * Log of Social score (t-1)					.016	.031		
					(.026)	(.035)		
Log of firm size * Log of ESG score (t-1)							.024	.033
							(.037)	(.038)
Control Variables (t-1)	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Profitability (t-1)	NO	YES***	NO	YES***	NO	YES***	NO	YES***
Constant	5.317***	7.253***	3.261***	3.056***	4.303***	5.152**	4.823**	5.419**
	(2.205)	(2.786)	(1.147)	(1.147)	(1.734)	(2.336)	(2.315)	(2.44)
Observations	290	287	290	287	290	287	283	280
Number of companies	35	35	35	35	35	35	35	35
R-squared:								
Within	0.4676	0.4827	0.4591	0.4719	0.458	0.473	0.453	0.4653
Between	0.4405	0.4201	0.4368	0.424	0.4476	0.4391	0.4576	0.4473
Overall	0.4713	0.4524	0.454	0.4358	0.4676	0.4589	0.4817	0.4695

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively

III. Non-linearities

Eventually we employ a simple robustness test seeking for a non-linear relationship between the ESG scores and the dependent variables. Results are puzzled and suggest the existence of non-linearities in the relationship we are investigating. Then, we add

to the regressions the quadratic term of the ESG score and its components. Results are puzzled and deliver a more nuanced evidence. Table 9 reports the results. Differently from regressions shown above, the governance score appears to be more relevant in determining profitability of firms. In particular, there is an inverse U-shaped relationship between the governance score and current ROA. That is, the coefficient of the quadratic term is positive. In fact, this suggests that when the governance score is small profitability of firms decreases. Eventually as the governance scores increases profitability of firms increases, namely the relationship appears to become positive even if the coefficient is rather small (Bellavite Pellegrini, Romelli and Sironi 2011, Bellavite Pellegrini, Sergi and Sironi 2017).

Table 9 – Return on Asset and ESG scores – non-linearities
(dependent variable ROA defined as EBITDA/Total asset; fixed effects model)

	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8
Log of environmental score	-.008	-.039						
	(.067)	(.064)						
Log of environmental score squared	.005	.007						
	(.010)	(.009)						
Log of governance score			**-.144****	**-.122****				
			(.066)	**(.56)**				
Log of governance score squared			**.021*****	**.018*****				
			(.009)	**(.008)**				
Log of social score					-.068	-.038		
					(.060)	(.049)		
Log of social score squared					.011	.007		
					(.009)	(.007)		
Log of ESG score							.160	.170
							(.165)	(.154)
Log of ESG score squared							-.016	-.0174
							(.0221)	(.021)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES
Lagged dependent variable	NO	YES***	NO	YES***	NO	YES***	NO	YES***
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-.506	-.133	-.394	-.128	-.410	-.142	-.806	-.513
	(.540)	(.457)	(.409)	(.362)	(.533)	(.426)	(.571)	(.504)
Observations	387	365	387	365	387	365	380	360
Number of firms	47	47	47	47	47	47	47	47
R-squared:								

Within	0.3592	0.4339	0.3727	0.4443	0.3598	0.434	0.3706	0.4487
Between	0.021	0.2196	0.0094	0.1533	0.0115	0.1936	0.0184	0.2251
Overall	0.0462	0.24	0.0271	0.1779	0.0335	0.2169	0.044	0.2527

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively.

The overall ESG turns to be statistically insignificant. Eventually, also the relationship between Tobin's Q appears to be characterized by non-linearities as shown in table 10. First, it seems there is an inverse U-shaped relationship between environmental scores and Tobin's Q. That is, the coefficient of the quadratic term is positive. In fact, this would mean that when the ESG score is small the Tobin's Q decreases. Eventually as the environmental score increases the Tobin's Q increases. This results appears to be robust. The plausible interpretation of such result is that a minor commitment to environmental issues turns to be detrimental for firm value because of the costs associated but the firm value becomes higher because of the efficiency gains due to advancements in technology and efficiency.

Table 10 - Tobin's Q and ESG scores - non linearities
(dependent variable Tobin's Q; fixed effects model)

	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8
Log of environmental score (t-1)	**-.943***	**-1.048****						
	(.520)	**(.523)**						
Log of environmental score (t-1) squared	.111	**.125***						
	(.070)	**(.070)**						
Log of governance score (t-1)			.021	.0770				
			(.224)	(.232)				
Log of governance score squared			.001	-.006				
			(.031)	(.032)				
Log of social score (t-1)					-.495	-.420		
					(.835)	(.841)		
Log of social score squared					.067	.0569		
					(.109)	(.110)		
Log of ESG Score							.165	.132
							(.612)	(.607)
Log of ESG score squared							-.022	-.020

							(.083)	(.082)
Control Variables (t-1)	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Profitability (t-1)	NO	YES***	NO	YES***	NO	YES*	NO	YES***
Constant	5.378***	5.542***	3.507***	3.494	4.425**	4.260	3.052	3.109
	(.958)	(1.064)	(.548)	(.629)	(2.118)	(2.314)	(1.225)	(1.382)
Observations	290	287	290	287	290	287	283	280
Number of firms	35	35	35	35	35	35	35	35
R-squared:								
Within	0.4727	0.4856	0.4588	0.471	0.5633	0.4721	0.4512	0.4617
Between	0.399	0.3887	0.4414	0.4268	0.47	0.4595	0.4661	0.4562
Overall	0.4416	0.4259	0.4581	0.4394	0.4818	0.4662	0.4828	0.469

Standard errors in brackets; standard errors are clustered on firm; ***, ** and * denotes significance at the 1%, 5% and 10% level respectively;

IV. Summary and conclusion

This work focused on the impact of ESG scores on profitability of a panel of North-American and European listed firms in the automotive sector over the period between 2002-2016. In sum our main findings highlight that:

(i) the aggregate ESG score is positively associated with ROA (computed as the ration between EBITDA and Total assets) of firms. When the ESG score increases by 10% the profitability measure increases by 0.04. Please note that values ROA in our sample are bounded between -.59 and .49. In brief the result is by no means trivial.

(ii) Among the components of the aggregate ESG, the environmental score is the one that exhibits an association in a linear model so suggesting that overall results are mainly driven by this. When the environmental score increases by 10% the profitability measure increases by 0.014.

(iii) there is a negative association between the Tobin's Q and the environmental component of ESG. In particular, a 10% increase in the one-year lagged environmental score translates into a current reduction in Tobin's Q of -0.01.

These main findings are to be complemented with some additional results which emerged when studying interactions between different variables and non-linearities. In particular we found that:

(iv) there is an inverse U-shaped relationship between the governance score and ROA, namely when the governance score is small ROA of firms decreases. As the governance scores increases ROA increases.

(v) the size of firms matters because when controlling for the interaction term between the different ESG components and the size of firms it emerges that: (v.i) the interaction between the environmental score and the size of firm is negatively associated with ROA; (v.ii) the interaction between the social score and the size of firm is negatively associated with ROA. In simpler words, in both cases it is likely that adaptation costs are increasing in the size of firms.

In brief, there is a nuanced evidence on the impact of ESG scores on profitability of firms. In particular, from the methodological point of view, it ought to be noted that any proper analysis on this topic cannot rely on aggregate ESG scores only. Albeit informative, the ESG aggregate measure needs to be split into its components in order to derive more properly usable insights for managers and investors. Needless to say, the main limitation of this work descends from the lack of data. Development of ESG scores are a very recent advancement and therefore data availability is small. In particular, since the time-series is not long enough to evaluate properly the temporal effect of ESG aggregate score and its components is not analyzed in depth. In other words, we still have a little understanding of time horizon over which a better performance in ESG scores translates into an improved profitability. Further research would extend the dataset including Asian and African automotive companies and would also consider second-level subcomponents, namely the sub-components of environmental, social and governance scores respectively.

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Appendix

Table A.1 – Definition of variables

Variable	Definition	Source
ROA $_{it}$	It is the ratio between Earnings Before Interest Taxes and Depreciation (EBITDA) and Total Asset.	Thomson Reuters Datastream
Tobin Q	It is the natural logarithm of the ratio between the market value of equity plus the book value of asset minus the book value of equity and the deferred taxes all on book value of asset	Thomson Reuters Datastream
Environmental$_{it}$	The environmental pillar measures a company's impact on living and non-living natural systems, including the air, land and water, as well as complete ecosystems. It reflects how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities in order to generate long term shareholder value.	Thomson Reuters Datastream
Social$_{it}$	The social pillar measures a company's capacity to generate trust and loyalty with its workforce, customers and society, through its use of best management practices. It is a reflection of the company's reputation and the health of its license to operate, which are key factors in determining its ability to generate long term shareholder value.	Thomson Reuters Datastream
Governance$_{it}$	The corporate governance pillar measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long-term shareholders. It reflects a company's capacity, through its use of	Thomson Reuters Datastream

	best management practices, to direct and control its rights and responsibilities through the creation of incentives, as well as checks and balances in order to generate long term shareholder value.	
ESG Score$_{it}$	ESG Score is an overall company score based on the self-reported information in the environmental, social and corporate governance pillars.	Thomson Reuters Datastream
Total Asset$_{it}$	It is the natural logarithm of total asset	Thomson Reuters Datastream
Total debt/Enterprise Value	It is the ratio between total debt to a measure of enterprise value. [The Enterprise value is defined as (i) common equity + (ii) Preferred stock + (iii) Minority Interest + (iv) Long Term Debt + (v) Short term debt and current portion of long term debt].	Thomson Reuters Datastream
Total asset turnover $_{it}$	It is the ratio between net sales and revenue and total asset	Thomson Reuters Datastream
Capex/Asset $_{it}$	It is the ratio between Capex and total asset	Thomson Reuters Datastream

Table A.2 – Companies included in the sample

COMPANY NAME	HEADQUARTER	STOCK MARKET	N. YEARS OBS
AMERICAN AXLE & MANUFACTURING	USA	USA -NYSE	15
APTIV	IRELAND	USA -NYSE	5
AUTOLIV	SWEDEN	USA -NYSE and SWEDEN	15
BMW	GERMANY	GERMANY	15
BORGWARNER	USA	USA -NYSE	15

CONTINENTAL	GERMANY	GERMANY	15
COOPER TIRE & RUBBER COMPANY	USA	USA -NYSE	15
COOPER-STANDARD AUTOMOTIVE	USA	USA -NYSE	7
DAIMLER	GERMANY	GERMANY	15
DANA	USA	USA -NYSE	9
DORMAN PRODUCTS	USA	USA -NASDAQ	15
ELRINGKLINGER	GERMANY	GERMANY	15
FAURECIA	FRANCE	FRANCE	15
FIAT CHRYSLER AUTOMOBILES	UK-NETHERLANDS	USA -NYSE, UK & ITALY	15
FORD MOTOR COMPANY	USA	USA -NYSE	15
GENERAL MOTORS COMPANY	USA	USA -NYSE	7
GENTEX CORPORATION	USA	USA -NYSE	15
GENTHERM INCORPORATED	USA	USA -NYSE	15
GENUINE PARTS COMPANY	USA	USA -NYSE	15
GKN	UK	UK	15
GOODYEAR TIRE & RUBBER COMPANY	USA	USA -NYSE	15
GROUPE RENAULT	FRANCE	FRANCE	15
HARLEY-DAVIDSON	USA	USA -NYSE	15
LEAR CORPORATION	USA	USA -NYSE	8
LEONI	GERMANY	GERMANY	15
LINAMAR CORPORATION	CANADA	CANADA	15
LKQ CORPORATION	USA	USA -NASDAQ	13
MAGNA INTERNATIONAL	CANADA	USA -NYSE and CANADA	15
MARTINREA INTERNATIONAL	CANADA	CANADA	15
MICHELIN	FRANCE	FRANCE	15
MODINE MANUFACTURING	USA	USA -NYSE	15
MOTORCAR PARTS OF AMERICA	USA	USA -NASDAQ	15
NOKIAN TYRES	FINLAND	FINLAND	15
PEUGEOT	FRANCE	FRANCE	15
PIRELLI & C.	ITALY	ITALY	13
PLASTIC OMNIUM	FRANCE	FRANCE	15
PORSCHE	GERMANY	GERMANY	15
SCHAEFFLER TECHNOLOGIES	GERMANY	GERMANY	2
STANDARD MOTOR PRODUCTS	USA	USA -NYSE	15
STONERIDGE	USA	USA -NYSE	15
TENNECO	USA	USA -NYSE	15
TESLA	USA	USA -NASDAQ	7
TITAN TIRE CORPORATION	USA	USA -NASDAQ	15
TOWER INTERNATIONAL	USA	USA -NYSE	7
VALEO	FRANCE	FRANCE	15
VISTEON CORPORATION	USA	USA -NYSE	7
VOLKSWAGEN	GERMANY	GERMANY	15
WABCO HOLDINGS	USA	USA -NYSE	10