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# What Characteristics Do the Firms have That Go Beyond Compliance with Regulation in Environmental Protection? A Multiple Discriminant Analysis

Diego A. Vazquez-Brust<sup>1,2</sup> and José Antonio Plaza-Úbeda<sup>3,\*</sup> 

<sup>1</sup> Portsmouth University—Faculty of Business and Law, Richmond Building, Portland Street, Portsmouth P01 3DE, UK; diego.vazquez-brust@port.ac.uk

<sup>2</sup> Federal University of Santa Catarina (UFSC), Florianopolis 88040-900, Brazil

<sup>3</sup> Economics and Business Department, University of Almeria, Ctra. Sacramento s/n, 04120 La Cañada de San Urbano, Spain

\* Correspondence: japlaza@ual.es

**Abstract:** This paper is focused on analyzing the characteristics of firms that have environmental performance beyond the requirements of regulation in environmental protection. To identify such characteristics, we propose a value and context model building on environmental paradigms as conceptualized by Dryzek's environmental discourse theory. Using multiple discriminant analysis (MDA) to analyze data collected from a multi-respondent survey of Argentinean polluting firms, we identify distinctive characteristics of firms going beyond regulation and firms that do not comply with regulation. In particular, comparing with other five environmental discourses, endorsement of green growth is evaluated in its connection with compliance patterns. We find that supporting green growth discourse (also known as ecological modernization) is one of the characteristics of those firms that go beyond compliance in their environmental performance.

**Keywords:** greengrowth; degrowth; environmental protection; environmental behavior; discriminant analysis



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## 1. Introduction

What firms are more likely to go beyond compliance and what firms are likely to be offenders, those supporting degrowth, green growth, or sustainability? The central objective of this paper is to identify what characteristics of firms—including their endorsement of degrowth, green growth, and sustainability paradigms—can help classify firms into categories of compliance patterns. The degrowth paradigm—also known as survivalism—assumes that environmental protection and economic growth are incompatible and that reductions in growth are needed to ensure ecosystems survival [1,2]. The sustainability paradigm assumes that growth and environmental protection can be decoupled, and a balance achieved between planet and profit. The green growth paradigm—also known as ecological modernization or ecomodernism—proposes that environmental protection can be the driver of resource efficient growth [3]. Degrowth, sustainability, and green growth are three among an array of different environmental paradigms that can help classify the environmental compliance of a firm. A paradigm is a social construct that provides a fixed array of values, beliefs, habits, and attitudes that allow members of a group to interpret their social worlds [4]. When this construct is associated with a dominant group who uses it to legitimize prevailing institutions and justify political, social, or, as in this case, environmental action, it is referred to as a 'dominant' paradigm [5–8]. There is an increasing recognition amongst those interested in the study of corporate environmentalism that a firm's environmental behavior and performance will ultimately be determined by the dominant environmental paradigm adhered to by its managers and those with whom

they interact e.g., stakeholders [7,9,10]. When key stakeholders support environmental paradigms, external pressures to improve environmental performance can be expected. However, if such stakeholders' pressures occur in context where environmental paradigms have not been dominant, ingrained social norms, market structures, and workplace routines and capabilities may present obstacles for the translation of such pressures into performance [11,12].

Moreover, although external pressures can set motion to improve firms' environmental performance, for instance, forcing firms to implement environmental management practices (they cannot on their own lead to an environmental 'paradigm shift' in the firm [13]. In turn, only a corporate paradigm shift can lead to the endorsement of sustainable environmental practices if pressure were removed [14]. Since it is a common assumption that environmental change at the firm is induced by its top management [15–18], it must be the managers' values, beliefs, and attitudes that promote an environmental paradigm shift in any given firm [13]. Indeed, a strong stream of research identifies the existence of a firms' intrinsic 'predisposition' towards having or not having a pro-environmental behavior, which is embedded in managers' values and mindsets [19,20]. This predisposition will strongly influence their perceptions of signals announcing a pro-environmental change in the external or internal context and their reaction to those signals [14]. Managers endorsing pro-environmental paradigms will perceive and react to weak pro-environmental signals whereas others will not acknowledge or even dismiss relatively strong signals that large sections of society are endorsing a more pro-environmental agenda.

Management theory has largely researched both drivers to adopt environmental practices [11,21], obstacles blocking those practices [22–24], and beliefs and values towards the environment [16,25–27], but seldom ([28–31] being cases in point) have environmental paradigms, drivers, and barriers been conceptualized and tested empirically as a whole. Moreover, these studies considering jointly internal and external context factors and managers' environmental paradigms, have focused in one particular type of environmental paradigm (e.g., environmental conservatism by [31] rather than jointly analyzing different paradigms). Previous studies also focused on explaining variance in environmental performance, while less attention has been devoted to classifying firms according to distinct compliance patterns. Classifications matter not only for academic purposes but also for policy purposes: in developing countries, knowing the profile of firms likely to be offenders and the profile of firms likely going beyond compliance would help to allocate scarce enforcement resources where they are most needed.

To address these gaps, our paper proposes a value and context model building on environmental paradigms as conceptualized by Dryzek's environmental discourses theory [28–30]. Using multiple discriminant analysis (MDA) to analyze data, about 6 discourses and several other value and context factors collected from a multi-respondent survey of Argentinean polluting firms, we identify distinctive characteristics of firms going beyond regulation and offenders, note that different configurations of characteristics explain beyond compliance and offenders and find that endorsement of green growth (also known as ecological modernization) is a characteristic of firms that go beyond compliance in their environmental performance.

## 2. Theoretical Framework

Ref. [32]: 1999 define environmental management as a 'measure of all efforts to minimize the negative environmental impact of the firm's products throughout their life cycle' and environmental performance, as a measure of 'how successful a firm is in reducing and minimizing its impact on the environment, often relative to some industry average, such as for instance, compliance with relevant environmental regulation'. Environmental management involves all firm activities that enable it to detect and react to green pressures. This includes the administrative support, coordination, and management effort that go into the identification and implementation of practices to improve environmental performance as well as the communication of such efforts to stakeholders. Environmental management

activities are increasingly standardized (e.g., ISO 14001, EMAS) with empirical research suggesting that externally certified standards are linked to improvements in resource efficiency further motivating environmental improvements [26,33].

Therefore, we can expect that firms with stronger environmental management would be more likely to have beyond compliance performance and those with weaker environmental management are more likely to fail to respond to regulatory requirements.

Following Ref. [31], we contend that environmental management is necessary but not sufficient to improve the environmental performance of a firm, as this will need coalescing human commitment to the environment (values) and the presence of economic, political, and technological drivers (context). Accordingly, we propose that environmental performance improvements result from implementation of environmental management systems in alignment with an internal and external context favoring environmental protection and managers endorsing pro-environmental paradigms.

### *2.1. Context Drives and Obstacles for Environmental Performance*

Managers will be the recipients of pressures from various stakeholder groups, internal or external to the firm to behave for or against the environment including employees, suppliers/buyers, shareholders, local community, NGOs, regulators etc. [11]. These pressures can take the form of criticisms, threats of loss of legitimacy, and other sanctions such as customer boycotts or loss of market value [26]. Following the seminal work of [34] in the study of managerial perceptions of stakeholder importance and environmental commitment, we analyze context factors from the point of view of manager's perceptions and interpretations. Several studies have focused on internal and external reasons for firms to improve their environmental performance [13,35]. National and international environmental standard requirements, supply chain requirements, availability of technology, environmental capabilities and community complaints are just some examples of environmental drives [11,36]. Similarly, several factors have been found as inhibiting plants to improve their environmental performance or hindering compliance with environmental regulation [37,38] divided his analyses into internal constituencies—corresponding to internal limitations that firms have to overcome in order to improve their environmental performance- and external constituencies. The latter are factors from the external environment that firms cannot control or modify directly and may constitute barriers that prevent firms from coping with environmental requirements. Ref. [39] performed a comparative study of Chilean, Colombian and Mexican SME's environmental needs. They found common obstacles such as imperfect capital markets (for instance a price structure that does not reflect environmental costs), difficulties to access information or problems to understand environmental regulation [40]. The equilibrium emissions intensity abatement model integrates variables related to context drivers and obstacles [41,42]. This model assumes that the price of pollution resulting from pressures such as fines, boycotts and stock market effects is the Expected Marginal Penalty, which the firm would have to pay at each level of emissions intensity. The function increases with the level of pollution so the more the expected marginal penalty, the more incentive will have the firm to comply. A marginal cost function represents the firms' cost of pollution abatement, marginal costs are increased by investment needed to overcome obstacles this function also increases with pollution and reduced by factors such as quality of technology increasing resource efficiency, organizational capabilities and availability of subsidies and financial incentives, the more it increases the less incentive will have to comply. The cost minimizing emission intensity is determined by the intersection of both functions [35,43,44].

Accordingly, we can expect that firms with beyond compliance will be associated with positive drivers, incentives stimulating development of capabilities and availability of good quality environmental technologies, while offenders will be more likely to be in a context with higher obstacles, and less access to quality technologies and economic and human resources.

## 2.2. Pro-Environmental Paradigms

Paradigms are never actually observed and can only be inferred indirectly by observing discourses and practices used by the firms. Environmental discourse theories propose that a discourse is a paradigm that is embedded in language, “it enables those who subscribe to a paradigm to interpret bits of information and put them together into coherent stories or accounts (storylines)” [45].

It is generally argued that the ‘stronger’ the paradigm, the more consistent are the practices (i.e., the observable actions taken by firms) with the discourses [46]. Whilst a number of studies have looked at environmental practices and attitudes in an attempt to gain insight into the values and attributes of relevant decision-makers (e.g., [16,47]), few explicitly look at environmental discourses to identify pro-environmental paradigms [31]. Two core references are Martin Hajer [48] and John Dryzek [29,45]. Hajer applies discourse analysis techniques to uncover the social paradigms embedded in the debate over acid rain in the UK and the Netherlands. Dryzek builds on this work by refining and extending the theoretical framework to include a wider spectrum of political views.

Dryzek identified four main environmental discourses challenged by a counter discourse or discourse denying that the environment should be a matter of importance for economic policy and corporate performance (termed Promethean or industrialist discourse). The 4 main environmental discourses are: Survivalist (also called degrowth discourse) which focuses on reducing economic growth as the only way to preserve nature’s carrying capacity and prevent environmental disaster. Environmental Problem Solving (EPS) that focuses on “fixes” of negative short-term impacts of growth in the environment through regulation and treatment of polluting effluents. Sustainability, advocating a balance between economic growth, environmental, and social protection which is based on decouple growth from environmental deterioration and green radicalism, which goes beyond degrowth by advocating that radical, disruptive changes in socio-economic structures and social values are needed to make sure that environmental concerns should take priority over anything else. Green growth—also called ecological modernization—is a sub-discourse of sustainability that sees investment in environmental protection as a driver of productivity, resource efficiency, and economic growth.

Within each discourse there are two main dimensions, one related to the individual (nature orientation) and a dimension related to the firm (firm orientation). This division responds to the ‘role allocation theory of discourses’ [49,50] which contends that people ‘activate’ different values according to the role they play (i.e., citizens or managers). Nature orientation is meant to capture managers’ environmental attitudes when they act as citizens, whereas firm orientation measures the discourse that is activated when assuming their role as managers.

Refs. [51,52] found evidence that managers holding strong pro-environmental values will exhibit environmental commitment when they act as citizens—for instance, committing to recycling or minimizing waste at home. However, these individuals will sometimes endorse lesser pro-environmental commitment for their firms when assuming their role as managers. Likewise, differences in levels of pro-environmental commitment as citizen and as manager, are related to perceived differences in “locus of control” when acting as citizens or managers.

From the above, we can expect that endorsement of ecological modernization (green growth), survivalism (degrowth), and green radical discourse at the individual and firm level will be more likely in beyond compliance firms; while offenders are more likely to be associated with Promethean discourse.

Another value-related variable that is relevant to the environmental performance of firms is the ethical orientation of its managers [53]. Ref. [53] found that managers with non-utilitarian ethics—doing something because it is the right thing to do; and managers with normative ethics—doing something because it is legally required, were likely to be found in firms with good environmental performance.

Finally, an individual's 'locus of control' [54] is an attitudinal factor that is consistently correlated to environmental behavior [26,55–57]. The locus of control determines what individuals see as being within or beyond their control depending on context specific constraints. [58] for instance emphasize the difference in behavior between individuals who exhibit an internal locus of control—they think that their own behavior 'makes' a difference—versus that of individuals with an external locus of control who see changes as somewhat random and/or provoked by more influential people.

Therefore, beyond compliance firms are likely to have managers with stronger internal locus of control, while offenders are likely to have managers with stronger external locus of control.

To complete this framework, it is necessary to assess the effect of potentially related demographic variables. Individual demographics such as age, gender, and socio-economics status are increasingly relevant to policymakers who are keen to identify potential supporters of pro-environmental causes or offenders of environmental legislation [51]. The age hypothesis suggests that younger people are more concerned about the environment than older people since they are less integrated in the existing social order [59]. The social class hypothesis [60] refers to a hierarchy of needs where more education and income stimulate environmental concern. The gender and fathering hypotheses suggest that gender influences the extent of environmental awareness and concerns, because women tend to be more nurturing. Similarly, parenthood increases environmental concerns as parents reflect on the world their children will inherit [51]. Finally, an ethical orientation that focuses on the welfare of other has also been associated with strong environmental performance. [7]

### 3. Methods

#### 3.1. Sample and Data Collection

To obtain data for our constructs, a survey was implemented in Argentina. Argentina is a developing country with strong environmental regulation but a patchy environment which results in an important number of offenders [61,62]. There is also an environmentally aware population [63] and flourishing eco-entrepreneurship with pro-active practices [64,65]. Early research [56,66] identified several of the pro-environmental discourses analyzed in the paper. All this makes the country a good case to explore our research objectives.

The purpose of the survey was twofold: Firstly, the aim was to gather more information on environmental paradigms and environmental performance. The second objective was to identify the characteristics of the 'context' (as well as the importance given by firms to these characteristics) in which the firm and its managers operate and how these impact upon the mindset–performance relationship.

The survey took place in the province of Buenos Aires. The sample included a total of 536 firms i.e., 13% of the population of polluting industries in Buenos Aires selected from a sample frame of 4000 firms belonging to high 'priority' sectors. The frame was composed of firms who were operating in sectors which used processes that involve, or potentially involve, the discharge of polluting substances and wastes in water, air, or soil, uses a lot of energy or water, and/or were dependent on non-renewable resources. These firms all had more than 5 employees and were classified into small, medium, and large generators of potential pollutants.

The sample was selected using a stratified design technique with industry, size, and geographical location as selection parameters. All firms were first stratified under the SIC Revision 3 classification although some categories had to be aggregated due to the small number of entries. This aggregation followed the criteria used by Ref. [67]. A second stratification was performed using plant size as measured by number of employees (small, medium, large) as in [41]. Within these strata, firms were ranked by their level of environmental impact as measured by the NCA or 'Level of Environmental Complexity'.

The Ministry of Public Works and the InterAmerican Development Bank (IDB) in Argentina supported the delivery, administration, and collection of the survey. The survey

is composed of two structured questionnaires (Questionnaire I “Environmental Practices”, Questionnaire II “Managers’ opinions” and a financial annex). It contained a total of 98 formal questions. Many of these questions were formulated using a Likert scale which implied that the actual number of questions was well over 300, although only a subset of 150 questions is used in this paper. The first questionnaire was completed by the manager in charge of environmental affairs or a substitute colleague, whilst the second was completed by a more senior manager empowered to take strategic decisions on environmental issues at the company level. In some cases (e.g., in smaller firms), the two questionnaires were completed by the same person. The first questionnaire took an average of 60 min to complete whilst the second took no more than 20 min. The final response rate was 76%. A total of 700 questionnaires were delivered and 536 were returned although 32 of these required additional chasing up due to item non-response.

### 3.2. Measures

#### 3.2.1. Dependent Variables

The compliance indicator was developed using information from a question asking for the firm’s level of compliance with regulation. Following pilot tests of the questionnaire, the question regarding compliance was phrased as follows: To what extent has your firm implemented compliance to environmental regulations? The scale was calibrated including three levels of non-compliance and two of compliance. The idea was that managers would feel less uncomfortable having an option such as ‘we do not comply but we are working to do it in the next two years’ in the number 3 of the scale. These answers were collected in the variable compliance, which was measured in a scale from 1 to 3, where 1 was no compliance, 2 was compliance, and 3 was beyond full compliance. It is interesting to note that 40% of the firms declare they do not comply with regulation, while 34% declare themselves to doing more than all required in terms compliance. The 40% of blatant offenders is even higher than the estimations of the Environmental Agency of Buenos Aires province regarding levels of evasion and secrecy (30%) and seems to indicate that the levels of bias are not important.

The data contained in the variable compliance was further recoded to create two binary variables. The variable COMP\_D collected beyond compliance (code = 2) versus compliance and non-compliance (Code = 1). Partial compliance aggregated the data corresponding to partial and non-compliance in the variable COMPLIANCE. In turn, the variable COMP\_D2 collected compliance and beyond compliance (Code 2) versus total no compliance (code 1). COMP\_D differentiates those beyond compliance from the rest of firms, whereas COMP\_D2 separates offenders with total non-compliance.

#### 3.2.2. Independent Variables

Table 1 resumes all independent variables used in our analysis. Appendix A1 includes components of each variable (with description, mean values, and std. deviation) and Appendix B2 describes factorial analysis of variables with dimensions (including component loads).

EMI was developed using information from answers to 11 questions based on previous constructs by Ref. [68]. To construct the EMI, we had to determine an appropriate distribution of weights. We resorted to using factor analysis, (applying principal component analysis as an optimization criteria) to derive an appropriate distribution of weights for the indicators composing the EMI as suggested by [51,69] and others. Applying PCA with a varimax rotation and restricting the output to a single component meant that 6 indicators were given weights fluctuating around 0 and had to be dropped (See Table A10). The 5 extracted components account for 67.86% of the variance in the indicators considered. The Bartlett’s sphericity test and the Kaiser–Meyer–Olkin measure (at 0.789) were well over the relevant benchmarks validating our construct [70]. High (low) EMI scores indicate that the firm has developed (failed to develop) internal administrative systems and policies to encourage and support improvements in environmental performance.

Table 1. Independent variables.

Type	Concept Measured	Variable Name	Description
Base	Environmental Management	EMI	Environmental Management Index
Value	Environmental Discourses	PROEMS EPSEMS SUSTEMS ECOEMS SURVEMS GREENEMS	Promethean Discourse Index Environmental Problem Solving Discourse Index Sustainable Discourse Index Green Growth Discourse Index Survivalist Discourse (Degrowth) Index Green (Radical) Discourse index
Value	Ethics	F1-ETHS	Non-Utilitarian Ethics
Value	Locus of control	LOC 223A LOC 223B LOC 223C LOC 223D LOC 223E	I do not have enough knowledge to influence my firm's environmental decisions I do not have enough authority to influence my firm's environmental decisions. Improvements in my firm's environmental performance will not impact upon the environment. My firm has no resources to improve the environment. My firm cannot improve environmental performance and remain competitive.
Context	OBS (Internal/External Obstacles)	INT_AW INT_BURD INT_LOWP EXT_CULT EXT_ECON Factor 6: EXT_INFO	INT Factor 1: Lack of Awareness and Trained Human Resources' INT Factor 2: Perception of the Environment as an Additional Cost and/or Burden' INT Factor 3: Low Priority Assigned to Environmental Issues EXT Factor 1: Environmental Culture and Incentives to Perform' (Dominant Promethean Society EXT Factor 2: Economic and regulatory restrictions EXT Factor 3: Lack of Information and Support About Environmental Issues
Context	Obstacles not captured by the factor analysis	V142g V114a	Lack of economic resources in the firm High interest rates to buy technologies
Context	(Drivers of Improvements)	Factor 1: PRS_OP Factor 2: PRS_REG Factor 3: PRS_SCH Factor 4: PRS_INT	Opportunities to improve competitiveness 'Pollution prevention pays' Threats from formal and informal regulations Supply chain requirements Internal organizational stakeholders requirements
Context	Quality of Technologies	Factor 1: LCOSTECH Factor 2: COSTINTEC Factor 3: RECTECH	Low cost environmental technologies Cost intensive environmental technologies Recycling technologies
Context	Demographics	GEND AGE	Gender Age
	Location	DENS LIT	Density Literacy of population
	Firm Characteristics	SIZE OWN EXPO	Firm Size Multinational Ownership Export Orientation

### 3.2.3. Value Variables

Value variables included variables capturing environmental discourses and locus of control. Six environmental discourse indexes were developed, following the typology of discourses developed by [45]. We calculated indexes for Promethean (see Tables A2–A7), survivalist, environmental problem solving, sustainability, and green radicalism. A specific index for green growth/ecological modernization was created due to the increasing importance assigned to green growth narratives in policymaking and discourse literature. Each of the indexes were based on the aggregation of items tapping dominant storylines for the paradigm dimensions analyzed.

Every respondent was assessed on each index and labeled in correspondence with the index obtaining the highest mark. This was an externally constructed index in which all the items were assigned the same weight. The aggregated index for a case was obtained by

adding each scale items valued in a rank from 1 to 5. Likewise, the aggregated item was rescaled to respond to a 1 to 5 scale.

Two sub-indexes were developed for each paradigm with the purpose of discriminating between manager's personal beliefs about nature and those related to the firm. They were called "nature orientation" and "firm orientation". Cases with an index above 3 ("neither agree nor disagree") are interpreted as supporting the paradigm measured by the index. The procedure for computing the index is based on the aggregation of the scores registered in each discourse's storylines regarding principles, the principles of governance individuals use to interpret relations of power in society. It assumes that these different storylines have the same weight regarding the identification of the paradigm, a fact that may not be true a priori.

To measure locus of control, we used 5-items following [26] to assess if managers feel that their firms are in control of the situation and can solve their environmental protection problems. All five items (see Table A8 for means and standard deviations) were used in the analysis since the application of PCA resulted in components with low variance explained and low KMO.

#### 3.2.4. Context Variables

Context variables included obstacles, drivers, quality of technology, demographics, location, and firm's characteristics (controls). Following scales developed by Ref. [35], we collected and tested 57 different variables related to context factors. Factor analysis enabled us to extract 10 factors that captured and synthesized information from 50 of these variables, and entered the other 7 as individual items. Table A11 (bottom half) contains three factors (extracted from 18 variables) summarizing the characteristics of the Argentinean's societal attitudes towards the environment (which are predominantly 'Promethean'), the prevalent lack of useful information about the environment in relation to the firm's activities, and a third reflecting general economic restrictions. Table A11 (top half) contains another three factors extracted from 14 variables characterizing managers' perceptions of internal obstacles such as the lack of awareness about environmental issues, staff inertia caused by perceptions that environment matters are a burden and should not be prioritized over other social matters. One variable related to external obstacles (high interest rates for environmental technologies) and one variable related to internal obstacles (lack of economic resources) cannot be assigned to one factor based on their loadings. Owing to its importance for compliance [35], we also entered the variables in the context model.

Table A12 examines four factors (extracted from 18 variables) that drivers of environmental performance that effectively encourage managers to adopt a pro-environment attitude including perceptions of opportunities (e.g., competitive advantage on rival firms in environmental compliance), regulatory pressures, supply, and internal environmental requirements.

Quality of technology is a key context factor [71,72] which is captured in this paper by three variables obtained by applying factor analysis in a set of 9 environmental technologies. The resulting factors are labeled as 'quality of low cost technologies' (such as energy and water efficiency or closing of open circuits); 'quality of cost intensive technologies' (such as end-of-pipe treatments and mitigation measures', and finally quality of recycling. Table A13 provides of a summary of the factor analysis model for quality of technology.

We also measured demographic variables (age, gender, number of children) and geographical variables (socioeconomic conditions of the population in the geographical location of the firm including levels of literacy and density) that we expect will help classify firms according to environmental compliance patterns. Age, gender, and number of children are related to pro-environmental attitudes [51,57,58]. Density is used as a measure of plant visibility. More specifically, plants located in more densely populated areas are under closer scrutiny by the local community and their polluting activities are more immediate [35,39,47]. Literacy levels reflect the local population's education levels. Since education is correlated with a greater awareness and affinity to environmental



issues [71], we would expect this variable to be positive if significant. These two variables were based in secondary data provided by the Buenos Aires Provincial Environmental Agency and the Buenos Aires Provincial Institute of Statistics.

Firm characteristics used as control variables included firm size (mean number of employees: 97; SD 231), ownership (Foreign 11.3%/Local 88.7%), and export to OECD countries (Yes 34%/No 66%). Previous research showcased that all these aspects tended to be positively associated to implementation of proactive environmental practices [19,21,26,31].

### 3.3. Method of Analysis

We used sequential discriminant analyses to study the relationships between independent variables representing context and attitudinal factors and a dependent variable capturing compliance. The dependent variables built to measure compliance (COMP\_D; COMP\_D2) are categorical dichotomies. This makes discriminant analysis a suitable procedure to identify what aspects allow us to differentiate between firms in terms of their regulation compliance behavior, since the procedure is 'useful for analyzing data when the dependent or criterion variable is categorical and the predictor or independent variables are either continuous or interval scales' [73]. Discriminant analysis can be used for several purposes, most notably to classify cases into groups using a discriminant prediction equation, but is also recommended to determine the percentage of variance in a dichotomous dependent variable explained by the independents over and above the variance accounted for by control or base variables, applying sequential discriminant analysis where variables are entered into the model in a specific order [74]. We will therefore use sequential discriminant analysis not only to identify what characteristic of firms can be used to classify firms according to compliance patterns, but also to test whether the addition of attitudinal-value and context variables increases the variance of compliance explained by the base variable intention to behave (EMI).

Discriminant analysis assesses the strength of the relationship between independent and dependent variables, (it indicates the % of variance in the dependent variable explained by the independent variables) and also establishes which variables are better for discriminating between both categories in the dependent variable [74]. The discriminant prediction equation (the discriminant function) provides the linear combination of independent variables that better distinguishes between the categories of the dependent variables. The discriminant function can be further used to classify cases to one of the categories based on the values of the independent variables. When the dependent variable has only two categories, the method is termed 'two-group' discriminant analysis.

In this research, DA is used to study the combination of independent variables that better distinguishes between firms going beyond compliance and other firms, and the combination of variables that better distinguishes between offenders and non-offenders. DA also gives us the percentage of variance in compliance explained by a number of alternative models using EMI and context and value variables, and also to compare the percentage of cases correctly classified for these models into potential beyond compliers and potential offenders.

All the variables are previously screened for outliers. To cross-validate the results, (Cross validation refers to the process of assessing the predictive accuracy of a model in a validation sample relative to its predictive accuracy in the 'estimation' sample from which the model was developed. Ideally, with a large sample, two thirds of cases are designated as belonging to the 'estimation' sample and the remaining ones are designated as belonging to the 'validation' sample. The model is developed using the cases in the 'estimation sample' and its predictive accuracy is assessed using the cases in the 'validation' sample [75]) the dataset is randomly split in two parts. One part, the analysis sample, is used for estimating the discrimination function, and the other is reserved for validation and estimation of the number of cases accurately predicted. To generate the analysis and validation sample, a Bernoulli function was created in order to randomly allocate 70% of the cases to the analysis sample. We used a random seed number = 9191972 to create

a classification variable termed ‘Validate’. Approximately 70 percent of the firms had a validate value of 1. These cases were used to create the discriminant function. The remaining cases were used to validate the model results. To obtain a better estimate of what classification results would be in the population, leave-one-out classification procedures are used. Leave-one-out procedure classifies each case using a discriminant function based on all cases except that given case. Classification functions allow us to determine to which group each case most likely belongs. There are as many classification functions as there are groups. The discriminant coefficients estimated by using the analysis sample are multiplied by the values of the predictors variables in the validation sample to classify cases. The hit ratio expresses the percentage of cases correctly classified. Some authors have suggested that classification accuracy obtained by discriminant analysis should be at least 25% greater than that achieved by chance. However, there is no general agreement regarding this baseline [73].

Classification functions are used to allocate cases into categories, but they do not tell us what is the contribution of the model to explain the variance in the dependent variable and to discriminate between groups.

The discriminant function in the two-group discriminant analysis fit a linear equation of the type:

$$L = b_1 \times 1 + b_2 \times 2 + \dots + b_n \times n + c, \quad (1)$$

where “a” is a constant and “b1” through “bn” are the discrimination coefficients. The interpretation of the results is straightforward and closely follows the logic of multiple regression, the variables with the largest standardized discrimination coefficients contribute the most to the prediction of group membership [74]. The unstandardized discriminant function coefficients are partial coefficients, reflecting the unique contribution of each variable to the classification of the criterion variable. The standardized discriminant coefficients, like beta weights in regression, are used to assess the relative classifying importance of the independent variables [75].

Discriminant analysis has two steps. First, an F test (Wilks’ Lambda) is used to test if the discriminant model as a whole is significant. It would not make sense to interpret the results of the analysis if the discriminant functions estimated were not statistically significant. If the F tests shows significance, the individual independent variables are assessed to observe which differ significantly in terms of mean by group and these are used to classify the independent variable [75]. Wilks Lambda tests the null hypothesis that, in the population, the means of all discriminant functions in all groups are equal. If the null hypothesis is rejected (Wilks significant beyond the 0.05 level), this indicates significant discrimination and the results can be interpreted [75]. Wilks Lambda ranges from 0 to 1 where 1 indicates no discriminating power and 0 means the models totally differentiate the groups.

The discriminant function has an associated eigenvalue, which measures explanatory power, large eigenvalues imply superior functions. The canonical correlation (similar to Pearson’s R) is a measure of association between the dependent variable and the predictors. The square of this correlation indicates the percentage of the variance in the dependent variable that is accounted for by the model. Hence, differences in the models’ Wilks’ Lambda and eigenvalues are used to assess the improvements in classification and explanatory power when using discriminant analysis. On the other hand, the hit ratio allows the assessment of the model’s predictive ability to classify cases into groups with a better than chance accuracy.

We will look therefore, for a model that minimizes Wilks’ Lambda and maximizes hit ratio, eigenvalue, and percentage of variance explained.

Moving into the analysis of the predictors, the examinations of the means and standard deviation of the variables in each group gives an intuition regarding what variables better separate the groups. A more concrete analysis is the ‘Test of Equality of Group Means’ that provides Wilks’ Lambda and F ratios for each independent variable in the model. The interpretation is similar to Anova tests. A high F and significance at the 0.05 level

indicates that when the predictors are considered individually, the predictor significantly differentiate between those who comply with regulation and those who not.

The interpretation of the discriminant coefficients is similar to that in multiple regression analysis. Independent variables with relatively large standardized discriminant function coefficients contribute more to the discriminating power of the function, as compared with predictors with smaller coefficients. Multicollinearity in the predictor variables is frequent, and then the coefficients should be interpreted with caution. The signs of the coefficients are arbitrary but the magnitude of the standardized discrimination function coefficients gives an idea of the relative importance of the variables [73].

#### 4. Results

Two discriminant analysis were conducted, each with a different dependent variable. The first analysis classified cases into offenders and non-offenders. The second one classified cases into beyond compliance and non-beyond compliance. Each DA consisted of 6 models, all of them using (EMI) as base variable. In Model 0, the independent variable was EMI. Model 1a added all value variables to Model 0. Model 2a added all context variables to Model 0. Tables 2–5 shows the results of the analysis [35,67]. Financial performance was initially part of the model. We developed a measure based on a scale asking a third respondent—the financial manager of the firm—if several ratios increased, decreased or remain the same. It was included in Model 1, but removed because the response rate was low compared to other questions—150 answers and significantly reduced the number of valid cases for discriminant analysis.

**Table 2.** Summary statistics discriminant analysis Models 1 to 3 (COMP\_D: beyond compliance).

Dependent Variable	Model 0	Model 1a	Model 1b	Model 2a	Model 2b	Model 3
COMP_D	EMI	Model 0 + Value and Discourse Variables	Model 0+ Selected Value and Discourse Variables	Model 0 + All Context Variables	Model 0 + Selected Context Variables	Model 0 + Selected Context Variables + Selected and Discourse Variables
Wilks' Lambda	0.84	0.649	0.69	0.51	0.66	0.60
Chi-Square	68.2	139.9	119.3	155.8	104.2	121.26
Cases correctly classified (%)						
Selected original	70.3	78.2	75.4	80.7	76.8	79.6
Unselected originals	79.6	73.5	76.9	70.11	78.2	78.9
Cross-validated	70.3	71.1	73.1	71.1	73.1	75.1
Eigenvalue	0.192	0.540	0.449	0.963	0.499	0.656
Canonical Correlation	0.40	0.59	0.56	0.7	0.58	0.63
Variance Explained	0.16	0.35	0.31	0.49	0.33	0.40
F						

**Table 3.** Summary statistics discriminant analysis Models 1 to 3 (COMP\_D2: offenders).

Dependent Variable	Model 0	Model 1a	Model 1b	Model 2a	Model 2b	Model 3
COMP_D2	EMI	Model 0 + All Value and Discourse Variables	Model 0+ Selected Value and Discourse Variables	Model 0 + All Context Variables	Model 0 + Selected Context Variables	Model 0 + Selected Context Variables + Selected and Discourse Variables
Wilks' Lambda	0.86	0.69	0.70	0.62	0.75	0.60
Chi-Square	53.5	121.2	114.0	112.6	73.48	122.10
Cases correctly classified (%)						
Selected original	67.8	74.8	75.1	73.4	72.0	78.4
Unselected originals	66.7	63.9	63.9	63.3	63.3	63.9
Cross-validated	67.8	66.1	68.3	63.3	70.0	71.7
Eigenvalue	0.163	0.454	0.422	0.626	0.328	0.66
Canonical Correlation	0.37	0.56	0.55	0.62	0.5	0.63
Variance Explained	0.14	0.31	0.30	0.38	0.25	0.40
F						

Table 4. Reduced discriminant model dependent variable COMP\_D2.

Dependent Variable: COMP_D2		Group Statistics						Equality of Group Means			Std Canonical	Structure	Canonical
		Group 1 N = 95		Group 2 N = 163		Total N = 258		Wilks'	F	Sig.	Discriminant	Matrix	Discriminant
Variable Information		Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Lambda			Function	Function	Function
EMI	IN_EM	−0.2759	0.84491	0.60905	1.06031	0.03958	1.018599	0.82632	72.09	6E−16	0.423275627	−0.227953	0.456471545
Low cost technology	CONT=LCOSTECH	−0.21	0.95	0.47	1.02	0.03	1.03	0.9	38.54	0.00	0.5	−0.25	0.51
Cost Intensive technology	CONT=LCOSTINTEC	−0.26	0.79	0.57	1.21	0.04	1.04	0.85	58.89	0.00	0.5	0.25	0.52
Lack of economic resources	OBS=VI 42g	3.8	1.24	3.1	1.53	3.55	1.39	0.94	21.28	0.00	−0.24	0.24	−0.18
I do not have enough authority to influence my firm's environmental decisions	LOC=V223B	2.36	1.22	1.85	1.16	2.18	1.23	0.96	14.28	0.00	−0.14	−0.34	−0.12
Ecomodernist discourse in the firm	DIS=ECOEMP	3.71	0.47	3.92	0.44	3.79	0.47	0.95	16.36	0.00	0.24	0.28	0.52
Lack of Informative and Support About Env. Issues'	EXOB=EXT_INFO	0.1	0.99	−0.25	1.01	−0.03	1.01	0.97	9.38	0.00	−0.14	0.63	−0.14
Sustainable discourse in the firm	DIS=SUSTEMP	3.87	0.55	4.07	0.47	3.94	0.53	0.97	10.98	0.00	0.11	0.3	0.20
Non utilitarian Ethics	ETHICS=F1_ETH	−0.21	0.99	0.22	1.03	−0.05	1.02	0.96	14.63	0.00	−0.08	0.46	−0.08
Economic and regulatory restrictions' (EPS Paradigm)	OBS=EXT_ECON	0.14	0.96	−0.24	1.07	0.01	1.02	0.97	11.27	0.00	−0.19	0.57	−0.19
Constant													−0.10
		Wilks' Lambda=0.655 **			Eigen value = 0.53			79.0% of selected original grouped cases correctly classified.					
<b>Model Information</b>		Chi-square=142.72			Canonical Correlation = 0.59			78.2% of unselected original grouped cases correctly classified					
		** Significant at the 0.01			Variance explained = 0.34			76.2% of selected cross-validated grouped cases correctly classified.					

Table 5. Reduced discriminant model dependent variable (COMP-D).

Dependent Variable: COMP_D2		Group Statistics						Equality of Group Means			Std	Canonical
		Group 1 N = 216		Group 2 N = 120		Total N = 336		Wilks'	F	Sig.	Discriminant	Discriminant
Variable Information		Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Lambda			Function	Function
Lack of Information and Support About Environmental Issues'	EXOB=EXT_INFO	0.10	0.99	−0.27	1.02	−0.03	1.01	0.97	10.18	0.00	−0.12	−0.12
Economic and regulatory restrictions' (EPS Paradigm)	EXOB=EXT_ECON	0.14	0.97	−0.24	1.08	0	1.03	0.97	11.09	0.00	−0.22	−0.21
Lack of Awareness and Trained Human Resources'	INOB=INT_AW	0.15	1.00	−0.25	1.09	0.01	1.05	0.97	11.34	0.00	−0.12	−0.12
Low Priority Assigned to Environmental Issues'	INOB=INT_LOWP	0.17	1.02	−0.31	1.05	0	1.05	0.95	16.47	0.00	−0.13	−0.12
I do not have enough knowledge to influence my firm's environmental decisions	LOC=V223A	2.88	1.25	2.31	1.30	2.68	1.29	0.95	16.01	0.00	0.00	0.00
I do not have enough authority to influence my firm's environmental decisions	LOC=V223B	2.35	1.21	1.80	1.10	2.15	1.2	0.95	16.77	0.00	−0.13	−0.11
My firm has no resources to improve the environment	LOC=V223D	3.05	1.30	2.33	1.32	2.79	1.35	0.93	23.23	0.00	−0.09	−0.07
My firm cannot improve environmental performance and remain competitive	LOC=V223E	2.77	1.29	2.06	1.27	2.51	1.33	0.93	23.50	0.00	−0.05	−0.04
Ecomodernist discourse in the firm	DIS=ECOEMP	3.70	0.47	3.91	0.43	3.78	0.47	0.96	15.56	0.00	0.23	0.51
Survivalist discourse in the firm	DIS=SRVEMP	3.81	0.57	4.02	0.48	3.89	0.55	0.97	11.27	0.00	0.26	0.47
Green discourse in the firm	DIS=GREENEMP	3.71	0.53	3.86	0.46	3.76	0.51	0.98	6.77	0.01	0.43	0.86
High interest rates to by technologies	OBS=V114A	3.82	1.38	3.25	1.59	3.62	1.48	0.97	11.76	0.00	0.04	0.03
Low cost technology	CONT=LCOSTECH	−0.21	0.96	0.48	1.00	0.04	1.03	0.90	38.61	0.00	0.48	0.49
Cost Intensive technology	CONT=LCOSTEINTEC	−0.26	0.80	0.59	1.21	0.04	1.04	0.85	59.02	0.00	0.51	0.53
Lack of economic resources	OBS=V142G	3.79	1.24	3.08	1.54	3.54	1.4	0.94	21.55	0.00	−0.14	−0.11

Table 5. Cont.

Dependent Variable: COMP_D2		Group Statistics						Equality of Group Means			Std Canonical	Canonical
		Group 1 N = 216		Group 2 N = 120		Total N = 336		Wilks' Lambda	F	Sig.	Discriminant Function	Discriminant Function
Variable Information		Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev					
Outsourcing of environmental issues	OUTS	0.46	0.50	0.63	0.48	0.52	0.5	0.97	9.17	0.00	0.01	0.02
EMI	IN_EM	−0.28	0.85	0.62	1.06	1.03	1.03	0.82	71.94	0.00	0.36	0.38
	Constant											−0.10
		Wilks' Lambda=0.655 **			Eigen value=0.53		81.0% of selected original grouped cases correctly classified.					
<b>Model Information</b>		Chi-square=142.72			Canonical Correlation=0.58		82.0% of unselected original grouped cases correctly classified					
		** Significant at the 0.01			Variance explained=0.34		77% of selected cross-validated grouped cases correctly classified.					

Models 1a and 2a' results were analyzed and those variables significant to discriminate between categories of the dependent variable were included in Models 1b and 2b. This third model uses both context and 'value' variables, accounting for discourse indexes capturing the discourse dominant in the firm at the individual level and at the corporate level. Each index represents the level of agreement of managers with storylines that reflect one specific paradigm. The whole procedure is repeated twice since compliance is measured using two different variables (COMP\_D, COMP\_D2). DA assumes the dependent variable is a true dichotomy, since data which are forced into dichotomous coding are truncated attenuating correlation [74]. If we define the dichotomy in compliance as offenders versus non-offenders, we may have truncation. The compliance data available classifies firms into total non-compliance, compliance, and beyond compliance. There is no additional information regarding firms with partial compliance to decide how close to full compliance these firms are. The dichotomies are then defined as firms having beyond compliance versus not having beyond compliance and as firms having total NO compliance versus firms not having total no compliance.

The results of the analyses, summarized in Table 2 (dependent variable = COMP\_D) and Table 3, (dependent variable = COMPD\_2) show that both the value-discourse models and the context models have similar explanatory power and both are better explaining the variable COMP\_D than the variable COMPD\_2, (recall that COMP\_D captures beyond compliance in one category and compliance plus non-compliance in the second, while COMPD\_2 has a category for non-compliance and captures compliance in the same category than beyond compliance). This suggests that the variables considered in both models are more efficient to explain cases of beyond compliance than cases of total non-compliance. The value model is, on the other hand, better than the context model to discriminate between offenders and non-offenders. This implies that offender firms and non-offenders firms are more different in terms of the values they hold than in terms of the context and structural features (size, ownership). Finally, the discriminant analysis performed in the third model shows that combining selected value and discourse variables with context variables both increases the discriminatory and the predictive power of the model with respect to these models using only one type of variables, the latter sustaining the validity of the hypothesis tested.

A first examination of the test of equality of groups means in Model 1a and Model 2a was aimed to isolate those variables more efficient to discriminate. It revealed that, when individually considered, EMI is an important discriminant variable, followed by all locus of control variables, sustainable and eco modernist corporate discourse (eco-modernist is one of the terms used to describe those with a green-growth mindset [76,77]), variables representing perception of external obstacles such as lack of access to information, and inadequacies in the regulation; variables capturing perceptions of internal blockers (i.e., low priority attached to environmental issues and lack of internal awareness); and two variables representing quality of environmental technologies, followed by size and supply chain pressures. A further reduction of variables aimed to retain only those significant and with relatively large, standardized discrimination coefficients leads to the models showed in Table 4 (dependent variable COMP\_D) and Table 5 (dependent variable COMP\_D2).

The models summarized in Tables 4 and 5 differ in the variables captured but have similar hit ratios, 77% for COMP\_D and 76.4% for COMPD\_2, respectively. These results indicate that (a) the classification functions obtained in the analyses correctly differentiate between categories of compliance in three out of four cases, (b) the variables that classify cases for beyond compliance are not the same than the variables that classify cases for non-compliance (a set of common variables notwithstanding).

Note that more variables are required to discriminate beyond compliance than are required to discriminate non-compliance, suggesting the motivations for beyond compliance are rather more complex than for non-compliance. Table 5 also shows that several of the variables retained in the final model are significant (they influence compliance when considered individually) but do not have large standardized coefficients (their relative

importance in the model is low). However, elimination of these variables leads to models with reduced hit ratio. This may imply the existence of second order effects owing to the set of variables; and supports our original assumption that mindsets (fixed sets of values and attitudes) have further explanatory power than values considered individually.

## 5. Discussion

Examining standardized discriminant coefficients in Tables 4 and 5, their signs and how they differ between both measurements of compliance help us understand the determinants of compliance in the Argentinean industry. We will also contrast our results with previous literature. While there are no previous studies similar to ours, we will refer to the body of literature in factors influencing corporate impacts on environmental protection.

Our results show amongst other things that two of the context variables related with technologies (quality of resource intensive technology and quality of low-cost technology) are strongly and negatively associated with non-compliance. These results are similar to findings in the literature analyzing the influence of technology in environmental compliance [35,53,67,71]. In addition, in accordance with the literature in proactive environmental practices [11,14,18,19,21], firms beyond compliance will tend to be those that invest more heavily in environmental management systems and environmental technologies. Unexpectedly, compliance levels for larger firms with headquarters overseas do not have significant differences with those for smaller local firms. Similarly, neither exporting orientation nor supply chain pressures translates into differences in the degree of compliance. Previous research in environmental responsiveness and proactivity had showcased that all these aspects tended to be positively associated to implementation of environmental practices [19,21,26,31]. This clearly suggests that foreign headquarters, external markets, and industrial customers will not always use local regulation as a benchmark for environmental performance, and may be satisfied with evidence of high levels of environmental management (i.e., ISO 14001) [71,78,79]. Large firms might be also able to resist more efficiently regulatory pressures through political lobbying or negotiating the amount of fines imposed by local authorities [7,10,80]. Although the headquarters will typically be located in more developed countries with higher environmental standards that the subsidiary will be expected to comply with, local authorities might be seen as low in legitimacy and little importance attached to regulators, internal audits rather than regulation compliance may be used to assess performance [10,67,81,82].

The literature on environmental behavior suggests that perceptions of managers regarding obstacles have an important influence to explain non-compliance [11,16,31,35,83,84]. Our results also show that, as it was the case with environmental management systems, non-compliance levels will be higher for managers of these firms that think they are unduly constrained by financial resources when making decisions about the environment either because the firm has limited budget allocated to environmental issues and/or it is financially more unsuccessful. Individuals who perceive the regulation framework as overlapping, costly, and inadequate for local standards will also populate firms that do not comply with regulation. This suggesting that either a revision of the regulation or/and an extensive communication campaign bringing awareness of the regulations and a restructuring of enforcement authorities are important.

On the other hand, managers that are aware of the impacts of their firms' activities on the environment, empowered to influence firms' decisions and working for companies that assign priority to environmental issues, are associated with environmental behavior beyond regulation compliance and these managers differ significantly not only from non-compliers but also from colleagues working in firms just abiding regulation. This result is in line with studies on the greening of corporate strategies that suggest an increase in the proactiveness of environmental performance when firms are aware of environmental issues and integrate them to its business strategy [7,13,31]. Interestingly, managers with high ethical drives do not differ significantly from less committed colleagues in their compliance patterns. A possible explanation is that the effect of ethical drives is already captured by the



existence of an EMI. Another explanation could be that ethical managers do not legitimate regulators' standards and prefer other environmental behaviors than compliance.

The importance of discourses as predictors of environmental performance highlighted by previous conceptual [45,46,48] and empirical studies [50,66] is supported, and linkages refined with our analysis for the case of performance in terms of compliance. Our analysis suggests differences in discourses not only between firms with no compliance and firms complying, but also between firms going beyond compliance and firms either complying or non-complying. Non-compliers will more often than not lack discourse related to the environment or they will be more likely supporters of EPS discourse than advocates of sustainability, eco modernists (green growth), green radicals, or survivalists (degrowth). Interestingly, firms exhibiting beyond compliance performance will tend to have managers that either endorse green growth or support the more extreme pro-environmental discourses such as survivalist, or green radicalism. Survivalist and green radicalism have in common the perception of a structural crisis and use fear to convince. They claim that a catastrophe is imminent if measures are not taken. Managers who support this view may feel more intensely regarding the urgency of environmental affairs and push for full compliance and more in its firms. Greener discourses may also be signaling alliances with non-governmental organizations (Influential non-governmental organizations such as Greenpeace remain reluctant or openly critical to join the dominant discourse coalition of sustainability. Instead, they support survivalist and green radical discourses [45]) to help companies to understanding regulation and compliance [85–88]. These alliances may not only spur improvements in performance but also changes on firm's corporate discourses that [89] calls intertextuality: the adoption of fragments of 'alien' discourses as a signal of new coalitions [90]. In other words, firms will use the language of NGOs when reporting environmental issues or may even allocate the task of writing the reports to NGOs.

Another relevant relation is the connection between the survey responses to the potential link between green growth and compliance with economic and financial performance. Although it is recognized that environmental compliance is not necessarily linked to environmental performance [91,92], the win-win paradigm explains how firms that improve environmental performance may also improve economic and financial performance [93–95]. In this process, the role of managers is a crucial role because the individual perceptions of environmental beliefs affect the firm's behavior, especially in managers [83,92,96,97]. The importance of discourse supported in our analysis may be interpreted as part of the planned behavior or the manager [84,98] because the connection between compliance and planned behavior is assumed in literature [99]. Therefore, beliefs and values closer or further away from both green growth perspective may affect the firm behavior and environmental and/or economic performance.

## 6. Conclusions

Our results provide an answer to our initial questions. What characteristics, and specifically, what discourse have firms that are more likely to go beyond compliance and what are the characteristics of firms that are likely to be offenders? Will beyond compliance firms be those supporting degrowth, green growth, or sustainability? Our theoretical framework proposed that beyond compliance could be expected from those supporting either green growth or degrowth, while offenders would not endorse neither degrowth, green growth, nor sustainability paradigms but rather believe that environmental concerns are irrelevant (promethean paradigm). Our findings supported the framework but—paradoxically—showed that offenders also tend to support a discourse arguing that environmental protection is a matter of compliance with regulation providing environmental fixes (problem solving paradigm). In turn, those going beyond compliance are likely to have managers either endorsing green growth (eco modernists) or degrowth (survivalist). Our paper contributes to theory in organizations and the natural environment showing the effect in environmental performance of differences in the type of pre-environmental paradigm endorsed by a firm. We also found, as conceptualized, that offenders are likely

to have weaker environmental management than other firms, while those beyond compliance have stronger environmental management. Overall, we conclude that different configurations of paradigms, drivers, and barriers are needed to characterize firms beyond compliance and firms with non-compliance, with quality of available technology being common to both but positively related to beyond compliance and negatively related to non-compliance. Interestingly, lack of financial resources is positively associated to both non-compliance and beyond compliance, supporting research proposing that a same factor can be a barrier or an opportunity depending on the paradigm endorsed by the firm. Finally, further research can explore with qualitative analysis the discursive mechanisms behind these configurations of exploratory factors or use quantitative approaches to identify moderators and mediators.

Our paper includes limitations: notably, this is a one country and a cross-sectional survey. Although potential social desirability bias associated with the compliance of environmental protection was controlled, having different respondents for the independent and dependent variables, we could not find suitable secondary source information for checking the independent variable. However, although our analyses require refinement and further testing, their classificatory power is promising. Future research may focus on exploring other firm characteristics and contextual factors that have not been analyzed in this work; for instance, enforceability of legislation, economic cycles, industry initiatives, or organizational capabilities such as dynamism and stakeholders integration. Scholars can also attempt to conceptualize non-linear relations and explore classification methods such as quadratic discriminant analysis. An interest area for research would be the relation between green growth discourse, environmental protection, and economic performance. The paper makes a strong contribution to policymaking in Argentina, allowing regulators to better allocate resources for enforcement of compliance by targeting firms with an array of characteristics that help classify offenders, and supporting other firms to develop the characteristics they need to move from compliance to beyond compliance.

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## Appendix A. Mean and Std. Deviation of Variables

**Table A1.** Environmental Management Index (EMI)—Component Indicators. Source [68].

Indicators		Variable Values	Mean (S.D)	Final Weights
PA *	Environmental Plan	0: no environmental plan—1: environmental plan	0.47 (0.49)	0.32
ISO *	Environmental Management System	0: no EMS 1: EMS	0.17 (0.38)	0.28
CAP *	Environmental training	0: no environmental training 1: environmental training	0.31 (0.46)	0.31
AUD *	Environmental Audits	Variable ranging from 0–1 where 0: no assessment; 1: monthly assessments	0.30 (0.14)	0.28
POL *	Environmental Policy	0: not implemented 1: implemented	0.44 (0.49)	0.26

\* PA, ISO, CAP, AUD, and POL are retained in the final computations of the EMI.

**Table A2.** Variables representing Promethean discourse. Source [45].

Statement	Mean	Std. Deviation
Nature has unlimited ability to regenerate itself and can absorb the impact of human activity.	1.62	1.13
Environmental concerns should be subordinate to people's needs.	2.48	1.31
Humankind has the right to use nature as a resource.	2.73	1.31
A firm's responsibility to its customers, stockholders, and employees is much more important than its responsibility towards the environment.	2.37	1.20
Ethic responsibility of firms is to be profitable.	2.84	1.25
As far as economic growth is sustained, our responsibility to future generations is fulfilled.	2.63	1.27
It is necessary to scientifically prove that an activity is significant in damaging the environment before imposing economic or legal restriction on the activity.	4.05	1.10
There is no real need for measures to protect the environment.	2.30	1.38
The potential environmental damage of many activities has been largely overestimated.	2.88	1.31
A certain amount of environmental damage is tolerated if there is to be economic growth.	2.34	1.20
Only if the current socio-economic structure assures continued growth, future generations will have the economic and technical resources needed to solve environmental problems.	2.74	1.35
Nature is like a horn of abundance, providing resources and replenishing itself as the resources are used.	1.99	1.19

**Table A3.** Variables representing EPS (environmental problem solving) discourse. Source [45].

Statement	Mean	Std. Deviation
In the long-term, nature could regenerate itself for most impacts.	2.92	1.36
Natural resources should be rationally managed to avoid depletion.	4.59	0.83
Advances in technology will eventually solve almost all the problems related to environmental degradation.	2.50	1.21
A firm's responsibility is to act as a good citizen by complying with regulations set by the State.	3.16	1.22
Ethic responsibility of firms is to abide regulation to remediate the damage caused to the environment.	4.43	0.87
It is our responsibility to future generations to find substitutes for depleted critical resources.	4.43	0.87
Polluters should pay fully for the damage they cause and be responsible for cleaning up their pollution.	4.35	0.98
Users of goods produced using energy intensive processes should pay for the environmental damage caused by their pollution.	2.30	1.38
There is not an environmental crisis, only environmental problems which can be solved through governmental regulation, social intervention, or economic incentives.	2.37	1.28
It is the role of the government, not of the enterprise, to define how to protect the environment.	2.62	1.34
Government regulation is effective in protecting the environment.	2.77	1.17
Earth is a machine which enables human life, and with adequate knowledge, any malfunction of this machine can be repaired and/or parts of it replaced.	2.09	1.19
There is a trade-off between economic performance and environmental performance (if one goes up, the other must come down).	2.28	1.17

**Table A4.** Variables representing sustainable discourse. Source [45].

Statement	Mean	Std. Deviation
Nature has the ability to regenerate itself for most impacts but there is a limit to this ability and this limit should not be exceeded	2.92	1.36
Humankind should protect and preserve nature in balance with the protection of human interests.	3.34	1.42
Technology is a useful tool in the protection of the environment, but most environmental problems cannot be solved by technology alone.	4.14	0.99
Ethic responsibility of firms is to protect the triple bottom line: planet, people, and profit.	4.40	0.92
It is our responsibility to future generations to avoid depleting critical resources.	4.16	0.97
Those who use natural resources should pay the full cost of using them, even though the resources are public.	3.96	1.14
It is necessary to scientifically prove that an activity is significant in damaging the environment before imposing economic or legal restriction on the activity.	4.05	1.10
Those firms which use energy inefficiently are as responsible for environmental damage as those firms which directly pollute their immediate environment.	3.94	1.15
The inequities between developed and developing countries underlying world trade must be substantially revised if we aim to protect our environment successfully.	4.10	1.08
The role of each individual, no matter his/her position, is to see that the environment is protected.	4.33	0.92
Nature is a complex organism which grows and develops constantly.	3.18	1.32
It is less costly to let firms decide how to meet environmental targets than to impose rules about how these targets should be met.	2.85	1.15
Environmental preservation is vital to the survival of my firm.	3.61	1.19
Sustainable firms are more profitable in the short run.	3.52	1.06

**Table A5.** Variables representing “green growth” or “ecological modernization” discourse. Source [45].

Statement	Mean	Std. Deviation
Nature has the ability to regenerate itself for most impacts but there is a limit to this ability and this limit should not be exceeded.	1.62	1.13
Humankind should protect and preserve nature in a way that also benefits human interests.	3.34	1.42
Advance in technology will eventually solve almost all the problems related to environmental degradation.	2.50	1.21
A firm’s environmental efforts could be aligned with improvement in its overall economic performance through increased productivity.	2.86	1.15
Firms must improve environmental performance because by doing this, they not only assume responsibility, but they also do good business.	3.83	1.09
Preserving the environment to create value for the firm and society should be a central corporate value.	4.16	0.97
It is our responsibility to assure that the impact of our activities on the environment will not prevent future generations’ welfare.	4.49	0.84
Those firms which use natural resources inefficiently are as responsible for environmental damage as those firms which directly pollute their immediate environment.	4.35	0.98
Those firms which use energy inefficiently are as responsible for environmental damage as those firms which directly pollute their immediate environment.	3.94	1.15
The role of each individual, no matter his/her position, is to see that the environment can continue providing services to humankind.	4.33	0.92
Earth is a huge treatment plant, provider of resources, and recycler of contaminating substances, whose capacity and balance should not be saturated.	3.38	1.42
Green firms are more profitable not only in the long run but also in the short run.	3.68	1.14

**Table A6.** Variables representing “survivalist” or “degrowth” discourse. Source [45].

Statement	Mean	Std. Deviation
Nature’s balance is extremely fragile and small changes can produce damaging consequences.	3.74	1.25
When humans interfere with nature, it often produces disastrous consequences.	4.59	0.83
Advance in technology should be combined with restrictions in growth to solve all the problems related to environmental degradation.	2.63	1.27
Ethic responsibility of firms is to assure that its activities will not damage the environment.	4.43	0.87
It is our responsibility to future generations to stop depleting natural resources.	4.43	0.87
Those who use natural resources should find alternatives to replace virgin materials.	3.96	1.14
The role of each individual, no matter his/her position, is to see that the environment is protected as a matter of necessity.	4.33	0.92
The most efficient way to prevent pollution is to reinforce legislation and controls to curb economic growth.	3.73	1.12
There is urgent need for measures to protect the environment.	3.70	1.38
The potential environmental damage of many activities has been largely underestimated.	3.12	1.31
Earth is like a spaceship with limited space and resources.	3.84	1.27
Zero environmental impact is a condition for the existence of the firm.	3.61	1.19

**Table A7.** Variables representing “green radical” discourse. Source [45].

Statement	Mean	Std. Deviation
Nature’s balance is extremely fragile and small changes can produce irreversible consequences.	3.74	1.25
Humankind should live in harmony with nature and respect it rather than modify it according to its own needs.	4.06	1.12
The bad effects of technology outweigh its advantages.	3.10	1.14
Preserving the environment should be the central corporate value in the firm.	4.16	0.97
Ethic responsibility of firms is to implement activities that are not only not damaging to the environment but also restorative.	4.40	0.92
It is our responsibility as human beings to regenerate natural resources affected by human activity.	4.43	0.87
All types of inequities between developed and developing countries must be substantially revised if we aim to protect our environment successfully.	3.94	1.15
It is the role of civic society to monitor that governments and firms protect the environment.	2.62	1.34
There is a real need for radical and system-disruptive measures to protect the environment.	3.70	1.38
The potential environmental damage of most activities has been largely underestimated.	3.12	1.31
Earth as a whole is a living entity (Gaia) and humankind is just a part of it.	4.03	1.20
The depletion of one type of natural resources cannot be compensated by increase in other types.	3.61	1.19
Firms must reinvent themselves to make protection of the environment a core concern for all activities.	2.32	1.52

**Table A8.** ‘Locus of control’. Source [31].

Description	Mean	S.D.
I do not have enough knowledge to influence my firm’s environmental decisions.	2.7038	1.27406
I do not have enough authority to influence my firm’s environmental decisions.	2.1925	1.25507
Improvements in my firm’s environmental performance will not impact upon the environment.	3.0895	1.39933
My firm has no resources to improve the environment.	2.7877	1.36433
My firm cannot improve environmental performance and remain competitive.	2.5179	1.33900

**Table A9.** ‘Ethics’. Source [53].

Description	Mean	S.D.
Protecting the environment is the right thing to do.	3.6038	1.24760
Environmental regulations should be followed even if there is not enforcement.	3.1952	1.23214
Everybody has a duty to care for the environment.	3.3784	1.32132

## Appendix B. Factor Analysis Results

**Table A10.** Environmental management index: factor analysis model.

Variable	Indicator	Factor Loadings
PLAN_AMB	Environmental Plan	0.320
ISO	Environmental Management Certification	0.276
CAPACITA	Environmental training	0.314
AUDIT	Environmental Internal Audits	0.276
POLI_AMB	Environmental Policy	0.255

**Model Summary:** Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. KMO = 0.789% of Variance Explained = 68%; Cronbach  $\alpha$  0.7833.

**Table A11.** Managerial perceptions \* of context: internal/external obstacles [35,41].

Managerial Perceptions of Internal Obstacles	1	2	3	Internal Obstacles: Extracted Components Interpreted
Lack of internal information about implementation of clean technologies	<b>0.797</b>	0.273	0.210	Component 1: ‘Lack of Awareness and Trained Human Resources’ <b>INT_AW</b>
Lack of awareness of the environmental impact of processes/emissions	<b>0.788</b>	0.262	0.183	
Lack of training at management level	<b>0.760</b>	0.225	0.277	
Lack of training of employees	<b>0.745</b>	0.188	0.220	
Lack of internal knowledge about environmental technologies	<b>0.735</b>	0.314	0.207	
Lack of prioritization of the environment by firm’s executives	<b>0.718</b>	0.169	0.311	
Inability to identify and punish non-compliance	<b>0.708</b>	0.402	0.135	
Lack of environmental impact measurements	<b>0.646</b>	.507	0.101	
Pressures to meet environmental standards within shorter time scales	0.302	<b>0.772</b>	0.127	Component 2: ‘Perception of the Environment as an Additional Cost and/or Burden’ <b>INT_BURD</b>
High costs and long-time scale-up associated with cleaner performances	0.246	<b>0.758</b>	0.297	
Lack of resources for end-of-pipe technologies	0.374	<b>0.579</b>	0.366	Component 3: ‘Low Priority Assigned to Environmental Issues’ <b>INT_LOWP</b>
Other priorities dominate the firm’s agenda and budgets	0.143	0.171	<b>0.795</b>	
Lack of environmental capabilities	0.225	0.401	<b>0.691</b>	
Lack of time	0.445	0.085	<b>0.598</b>	

Table A11. Cont.

Managerial Perceptions of External Obstacles	1	2	3	External Obstacles: Extracted Components Interpreted
Lack of government incentives (tax breaks and subsidies)	<b>0.818</b>	0.380	0.407	Component 1: 'Environmental Culture and Incentives to Perform' (Dominant Promethean Society) <b>EXT_CULT</b>
Lack of an environmental culture in Argentinean society	<b>0.818</b>	0.385	0.401	
High rates of non-compliance	<b>0.818</b>	0.383	.406	
Economic crisis makes environmental concerns a low social priority	<b>0.817</b>	0.384	0.406	
Lack of support from industry associations	<b>0.814</b>	0.381	0.414	
Lack of government resources for environmental training at the firm	<b>0.744</b>	0.491	0.237	
Excessive and overlapping governmental regulation	0.352	<b>0.878</b>	0.225	Component 2: 'Economic and regulatory restrictions' (Dominant Foreign Environmental-Problem-Solving (EPS) Paradigm in Local Regulations) <b>EXT_ECON</b>
Inefficiency and non-availability of national technologies	0.354	<b>0.818</b>	0.347	
Inappropriate and costly environmental standards for Argentina	0.299	<b>0.810</b>	0.304	
Excessive cost of imported technologies	0.468	<b>0.753</b>	0.279	
Lack of information about environmental standards	0.442	0.200	<b>0.825</b>	Component 3: 'Lack of Information and Support About Environmental Issues' <b>EXT_INFO</b>
Government bureaucracy	0.225	0.461	<b>0.821</b>	
Lack of information about implementation of clean technologies	0.572	0.246	<b>0.749</b>	
Lack of access to environmental consultants	0.575	0.245	<b>0.746</b>	
Lack of information about end-of-pipe technologies	0.318	0.522	<b>0.745</b>	

\* **Principal Component Analysis was used to extract the component.** The initial factor matrix was rotated using Kaiser's varimax method. The rotation converged in 5 iterations (internal obstacles) and 8 iterations (external obstacles). KMO = 0.765. The total variance explained by the components vector of the internal and external obstacles is 65% and 93%, respectively.

Table A12. Managerial perceptions \* of context: drivers of improvements [35,41,67].

Drivers of Environmental Performance	1	2	3	4	Components Interpreted
To gain a competitive advantage over rival firms	<b>0.860</b>	0.112	0.211	0.100	Component 1: 'Opportunities to improve competitiveness' or 'Pollution prevention pays' <b>PRS_OP</b>
To gain product differentiation	<b>0.817</b>	0.054	0.213	0.217	
To avoid being left behind by rival firms	<b>0.812</b>	0.204	0.264	0.022	
To improve corporate reputation	<b>0.808</b>	0.212	0.105	0.211	
To improve product quality	<b>0.661</b>	0.030	0.133	0.519	
To improve efficiency/productivity	<b>0.643</b>	0.086	0.044	0.529	
To avoid bad publicity from the media	<b>0.585</b>	0.435	0.124	0.204	Component 2: 'Threats from formal and informal regulations' <b>PRS_REG</b>
To avoid judicial closures	0.096	<b>0.884</b>	0.143	0.160	
To reduce legal liabilities on managers	0.088	<b>0.837</b>	0.171	0.206	
To avoid non-compliance fines	0.134	<b>0.787</b>	0.024	0.110	
To avoid complaints and boycotts from the community	0.067	<b>0.665</b>	0.157	0.375	
To avoid potentially more stringent regulations	0.223	<b>0.585</b>	0.135	0.279	Component 3: 'Supply chain requirements' <b>PRS_SCH</b>
To satisfy the requirements of foreign customers (e.g., bids)	0.152	0.164	<b>0.861</b>	0.008	
To satisfy the requirements of national customers (e.g., bids)	0.144	0.234	<b>0.826</b>	0.023	
To gain access to new markets	0.413	0.103	<b>0.605</b>	0.400	
To satisfy customer preferences (e.g., green consumers)	0.295	0.034	<b>0.592</b>	0.404	Component 4: 'Internal organisational stakeholders requirements' <b>PRS_INT</b>
To avoid health and safety –related risks	0.334	0.261	0.003	<b>0.726</b>	
To comply with the company's internal policy	0.210	0.244	0.194	<b>0.660</b>	

\* **Principal Component Analysis was used to extract the component.** The initial factor matrix was rotated using Kaiser's varimax method. The rotation converged in 6 iterations (drivers). KMO = 0.750. The total variance explained by the components vector is 70%.

**Table A13.** Factor analysis on quality of technologies [35,41].

Quality of available Environmental Technologies to Increase:	Components			Technology: Extracted Components Interpreted
	1	2	3	
Efficiency in water and energy consumption	0.814	0.207	0.053	Component 1: 'Low cost environmental technologies' <b>LCOSTECH</b>
Efficiency in the use of materials and components	0.766	−0.003	0.279	
Reduction of hazardous waste	0.674	0.198	0.202	
Minimization of waste generation	0.603	0.477	0.258	
Clean production processes	0.572	0.416	0.053	
Efficiency in the treatment of effluents (end of pipe)	0.094	0.835	0.161	Component 2: 'Cost intensive environmental technologies' <b>COSTINTEC</b>
Continuous improvement in environmental protection	0.348	0.724	0.254	
Use of recycled inputs	0.177	0.107	0.891	
Use of parts of products after end-of-life (remufacturing)	0.225	0.461	0.821	Component 3: 'Recycling technologies' <b>RECTECH</b>
Use of packaging and pallets which can be returned after being used	0.217	0.385	0.728	

Principal component analysis was used to extract the component the matrix was rotated using Kaiser's varimax method. The rotation converged in 5 iterations. KMO = 0.819. The total variance explained by the components vector is 75%.

**Table A14.** Non-utilitarian ethics: factor analysis model.

Variable	Indicators	Loadings
Non-Utilitarian Ethics (F1-ETH)	Caring for the environment is the right thing to do	0.350
	Environmental regulations should be followed even if there is not enforcement	0.276
	Everybody has a duty to care for the environment	0.314

Model Summary: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. KMO = 0.659% of Variance Explained = 60%; Cronbach  $\alpha$  0.7522.

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