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Christian Schwens, Marcus Wagner

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The role of firm-internal corporate environmental standards for organizational performance

Christian Schwens¹ · Marcus Wagner²

Abstract

Firms' environmental approaches frequently encompass strategies for pollution prevention and product stewardship. We apply resource-based theorizing to determine how these two strategies affect the likelihood that a firm will adopt firm-internal environmental-management standards and how such standards relate to organizational performance. We find that pollution prevention improves firms' competitiveness by enabling the implementation of firm-internal standards that subsequently have positive effects on profitability.

Keywords Pollution prevention · Product stewardship · Resource-based view · Econometric analysis

JEL Classification M16 · Q59 · L6

1 Introduction

According to Hart's (1995) natural resource-based view (NRBV), a firm's competitive advantage depends on its environmental-management strategy, which uses environmentally friendly technologies to reduce, change, or prevent emissions in production processes (i.e., *pollution prevention*) and in products' environmentally responsible "gestalt" (i.e., *product stewardship*).¹ The major premise of the NRBV is that firms that innovate green processes and products distinguish themselves from

¹ Sustainable development is the third core strategy of the NRBV. However, since the conceptual underpinnings and the empirical measurement of a sustainable development strategy are less clear, we focus on the former two strategies in the remainder of the manuscript—an approach that is consistent with recent literature that draws on the NRBV (e.g., Gabriel et al. 2018).

✉ Marcus Wagner
marcus.wagner@wiwi.uni-augsburg.de

¹ Heinrich-Heine-University Duesseldorf, Düsseldorf, Germany

² Augsburg University, Universitaetsstr. 16, 86159 Augsburg, Germany

their competitors, resulting in improved organizational performance (e.g., Hart and Ahuja 1996; Porter and van der Linde 1995).

The implications of environmental strategies on organizational performance have attracted considerable research attention (For meta-analytic overviews, see Albertini 2013; Dixon-Fowler et al. 2013; Orlitzky et al. 2003; Wang et al. 2015). However, despite the importance of pollution prevention and product stewardship for firms' competitive advantage, Hart and Dowell's (2011) review of 15 years of NRBV research finds that research "has focused primarily on uncovering the links between pollution prevention and firm profitability" (p. 1464), while research on the performance implications of product stewardship-related strategies is comparatively scant. In addition, the literature on the performance implications of pollution prevention is equivocal at best, as some studies argue that pollution prevention improves organizational performance (e.g., because of cost savings through reduced emissions and waste reduction or enhanced efficiency), while others argue that high investment costs related to pollution prevention strategies offset an organization's performance (Hart and Ahuja 1996). These divergent arguments culminate in largely inconclusive empirical findings. That is, extant studies find positive (e.g., Hart and Ahuja 1996), negative (e.g., Cordeiro and Sarkis 1997; Sarkis and Cordeiro 2001), and even insignificant (e.g., Aupperle et al. 1985) relationships between environmental-management strategies and organizational performance.

The inconclusive empirical findings motivate researchers to examine more complex models to reveal the actual performance implications of firms' environmental-management strategies (e.g., Maas et al. 2014; Surroca et al. 2010; Wong et al. 2012). Studies that examine on more complex relationships are timely and important to advance the current knowledge further through providing more closely differentiated insights. However, this literature is also restricted, as its extant studies examine primarily the role of pollution prevention while largely overlooking the issue of product stewardship. Moreover, despite the acknowledged importance of managerial cognition and organizational capabilities (Hart and Dowell 2011) as factors that capture the complexity that underlies the performance implications of environmental-management strategies, other strategic factors that may be highly relevant—such as the firms' general strategic posture toward environmental issues—attract less attention.

The present study overcomes these deficits and draws on the NRBV to determine how pollution prevention and product stewardship influence organizational performance. Consistent with prior literature that suggests that sometimes corporate responsibility and financial performance have no direct relationship but only an indirect link based on certain mechanisms (Surroca et al. 2010), we argue that pollution prevention and product stewardship, in a first step, influence a firm's propensity to develop and implement stringent firm-internal environmental standards that go beyond compliance. Such firm-internal environmental standards present a proactive, coherent, and systematic strategic posture toward environmental management that exceeds legal requirements and enables firms to distinguish themselves from their rivals. In a second step, we also argue that strict firm-internal environmental standards that go beyond legal compliance have positive implications for organizational

performance. We validate our theoretical predictions empirically on a dataset of German manufacturing firms.

We make two major contributions to the existing literature. First, we address the inconclusive empirical findings regarding environmental-management strategies and organizational performance. We do so by estimating a model that suggests that especially pollution-prevention strategies influence a firm's propensity to develop strict internal environmental standards (rather than just complying with the law) and that this strategic posture enhances performance. Thus, our study is consistent with the literature that derives complex models to explain the performance implications of environmental-management strategies. We add to this research by introducing to the debate a firm's strategic posture, as indicated by strict internal environmental-management standards, thereby complementing existing studies that focus primarily on organizational capabilities and managerial cognition as intervening concepts.

Second, we contribute to the literature by examining the role of pollution prevention and product stewardship as corporate environmental strategies. While pollution prevention dominates the debate in the literature (Hart and Dowell 2011), our simultaneous consideration of both factors obtains more detailed insights into how the two strategies relate to a proactive internal strategic posture toward environmental management. By testing our theoretical predictions on a large dataset, we advance the literature that thus far delves into these complexities based primarily on case-study research (e.g., Fowler and Hope 2007).

The remainder of the paper is organized as follows. Next, we provide the theoretical background of our study and derive hypotheses. Then we test our hypotheses on a dataset of German manufacturing firms. The paper closes with a detailed discussion of the empirical findings and by pointing at some limitations of the study.

2 Theory and hypotheses

2.1 The natural-resource-based-view (NRBV)

The NRBV is rooted in the Resource-Based View (RBV) which focuses on the internal perspective of the firm and seeks to explain the sources of a firm's competitive advantage (Barney 1991). The RBV centers on how a firm employs resources to respond to external developments. According to the RBV, resources that are valuable, rare, inimitable, and non-substitutable allow it to achieve competitive advantage (Barney 1991). Given that such strategic resources are heterogeneously distributed among firms, the RBV has emerged as one of the key approaches to explaining organizational performance (For a meta-analysis see Crook et al. 2008).

Drawing on the major assumptions of the RBV, the NRBV highlights the relationship between firm strategy and its association with the natural environment for firms to achieve a sustainable competitive advantage (Hart 1995). The NRBV takes into account that "it is likely that strategy and competitive advantage in the coming years will be rooted in capabilities that facilitate environmentally sustainable economic activity" (Hart 1995, p. 991). Since its emergence, the NRBV has attracted

significant research attention (e.g., Flammer 2015; Maas et al. 2014; Shin et al. 2018) (For a review of the literature drawing on the NRBV refer to e.g., Hart and Dowell 2011).

At the core of the NRBV are the strategies of pollution prevention and product stewardship (Gabriel et al. 2018). Pollution prevention seeks to reduce emissions, effluents, and waste (Hart 1995, p. 992), so it may save the costs of installing and operating end-of-pipe technology, increasing efficiency through cost minimization or profit-maximization (Hart 1995). According to Mass et al. (2014, p. 40), “by preventing pollution, firms can avoid having to invest in expensive pollution control equipment that would be used to trap, store, treat and dispose of emissions and effluents.” Thus, pollution prevention goes beyond pollution control, which (Hart 1997, p. 71) refers to as “cleaning up waste after it has been created.” Therefore, pollution control is understood here as an effective but inefficient baseline strategy that entails expensive, non-productive expenditures on control equipment, against which the effects of pollution prevention can be benchmarked.

The major goal of product stewardship is to reduce the costs and impacts of issues related to products’ life-cycles (Hart 1995). Firms that pursue a product-stewardship strategy widen the scope of their environmental activities beyond their own firm towards an integration of stakeholders (Maas et al. 2014). Therefore, while the key outcome of pollution prevention is continuous process improvement within the firm’s boundaries, resulting in reduced costs, the key outcome of product stewardship is stakeholder integration across the supply chain, with the goal of pre-empting competition (Gabriel et al. 2018). Following the logic of the NRBV, firms must work continuously to develop these “green” strategic resources to be competitive (Aguilera-Caracuel et al. 2012; Hart 1995; Maas et al. 2014).

The RBV and the NRBV have attracted considerable attention from the field of environmental management research. For example, Russo and Fouts (1997) draw on the RBV to posit that firms’ environmental performance has a positive impact on their economic performance and that this relationship is contingent on the growth rate of the respective industry such that the association is stronger in high-growth industries. Aragón-Correa and Sharma (2003) use the NRBV to develop a contingency perspective on firms’ corporate environmental strategy. Fowler and Hope (2007) and Papagiannakis et al. (2013) apply case-study research to gain insights into the sequences of various environmental strategies and investment decisions. Clarkson et al. (2011) develop an RBV-based rationale to test the determinants and consequences of proactive environmental strategies using a longitudinal study design. Maas et al. (2014) draw on the NRBV to study the direct relationship between pollution prevention and product stewardship and its effect on firm differentiation in the third-party logistics industry. Finally, Shin et al. (2018) use the NRBV to examine the association between the use of renewable energy and firm performance.

While the extant studies that draw on the RBV and the NRBV provide valuable insights into the performance implications of firms’ environmental-management strategies, the literature has several shortcomings. First, most studies focus on pollution-prevention strategies and their performance effects as a major element of the NRBV, while research on product stewardship and its association with performance

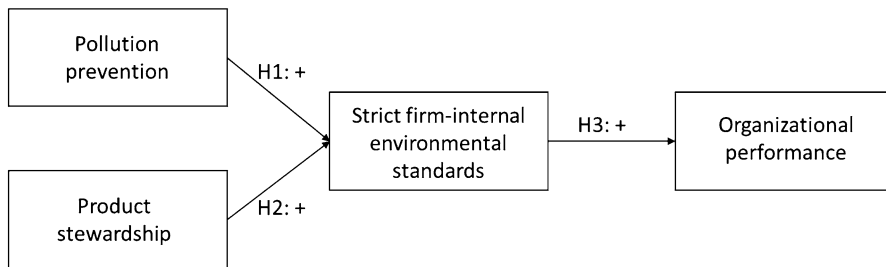


Fig. 1 Research model

is much more limited (Hart and Dowell 2011). Second, empirical findings regarding pollution prevention and organizational performance are mixed, as some studies find a positive relationship between pollution prevention and organizational performance (e.g., Hart and Ahuja 1996), while others find a negative relationship (e.g., Cordeiro and Sarkis 1997; Sarkis and Cordeiro 2001) or an insignificant relationship (e.g., Aupperle et al. 1985). Third, most studies that use comparatively complex models to explain the relationship between environmental-management strategies and organizational performance investigate organizational capabilities and managerial cognition (Hart and Dowell 2011) as intervening factors, giving other strategically relevant constructs less attention.

To overcome these shortcomings, we examine the impacts of both pollution prevention and product stewardship on organizational performance. However, rather than assuming direct relationships, we develop a more detailed rationale for how pollution prevention and product stewardship impact firms' propensity to implement strict internal environmental standards—that is, a proactive, coherent and systematic internal stance toward environmental management that goes beyond compliance—and how such standards impact performance. In so doing, and consistent with the recent literature (e.g., Singh et al. 2016; Surroca et al. 2010), we establish that environmental-management strategies do not impact organizational performance directly but that pollution prevention and product stewardship are a first step toward enhancing firms' propensity to follow a strict internal environmental-management strategy, which then has positive performance implications. Figure 1 depicts our research model.

Next, we develop the theoretical rationale that underlies our research model.

2.2 Hypotheses

2.2.1 Pollution prevention

Pollution control based on end-of-pipe technologies involves environmental investments representing high extra costs for firms (Porter and van der Linde 1995). In contrast, pollution prevention is based on environmental technologies that are integrated into the entire process, lowering the environmental impacts of production by improving process efficiency while also reducing costs, future liabilities, and

environmental risks. The concept of pollution prevention includes approaches that are aimed at reducing, changing, or preventing emissions, effluents, and waste at the source, before they occur (Hart 1995). Approaches under the paradigm of pollution prevention therefore relate to material substitution, process innovation (e.g., closed-loop processes), materials recycling (e.g., internal and external recycling or reuse), and better housekeeping (Hart 1995; Porter and van der Linde 1995). Consequently, protection of the value of a firm including brands and other intangible assets is an important benefit of this approach to environmental management (Reed 1998). Thus, pollution prevention activities enable the firm to develop important knowledge and routines that are necessary for the implementation of a strategic posture toward environmental management.

A pollution prevention-based strategy also implies a stronger propensity for firms to adopt strict firm-internal environmental standards as more efficient processes that are proactively shaped, improved productivity and lower compliance costs often make it more likely that regulatory targets are exceeded, leading to a “race to the top” (Bu and Wagner 2016; He 2006; Kolk 2016; Kolk and Van Tulder 2010). Pollution-control strategies usually increase the cost of compliance, partly because regulators prescribe the use of specific technologies (Porter and van der Linde 1995). At the same time, to protect their reputation and to differentiate from firms pursuing pollution control makes it again advisable for pollution prevention-oriented firms to proactively develop and use more stringent environmental management standards. Finally, the lower capital expenditure required under a pollution prevention strategy for achieving a defined level of environmental performance is an additional factor why firms pursuing such a strategy are more inclined to adopt strict firm-internal environmental standards because they are able to maintain their competitive advantage at relatively lower cost. These arguments lead to the following hypothesis:

H1: Firms that pursue a pollution prevention strategy are more likely to adopt strict firm-internal environmental standards.

2.2.2 Product stewardship

A focus on process efficiency improvements still allows firms that seek to prevent pollution to produce less socially desirable products, albeit with less waste. Dedicating resources to process efficiency and clean technologies may hinder firms from developing innovative and/or radically improved products (e.g., those with increased durability or service intensity), re-defining their business objectives or markets, or developing new markets (Day 1998). However, product stewardship enables the firm to benefit from creating sustainable products in a comprehensive way, as integrating stakeholders into the effort can provide fresh knowledge and insights that benefit the development of a strict internal environmental standard. Therefore, product stewardship should be considered equally with pollution prevention in the effort to assess a firm’s proactive strategic posture.

Hart (1995) describes product stewardship as integrating environmental concerns, including those of external stakeholders, into the design and development of products by minimizing the use of non-renewable materials, avoiding toxic materials, and

using renewable resources below or at their rate of replenishment. In this respect, Esty and Porter (1998) stress the importance of finding ways to improve products' quality, features, and functionality by reconfiguring product definitions, designs, production, delivery, and disposal. The approach used most often to integrate environmental considerations systematically into initial product designs is Design for Environment (DfE). Therefore, a strategic posture that is based on product stewardship is focused on product innovation and has an organizational focus on DfE while considering the whole production chain, including customers and suppliers, rather than the focal firm alone (Porter 1980). Thus, firms that pursue environmental innovation have strong incentives to develop strict environmental-management standards so they can engage stakeholders and benefit from their perspectives.

Markets for environmentally friendly products are usually comparatively small, and adopting strict environmental-management standards can be a useful strategy to increase market share in these markets. Measures related to product stewardship provide the firm with the necessary knowledge and routines to develop an internal environmental strategy. Firms that learn from product stewardship are also likely to be able to develop new markets, as product stewardship provides an additional reason for applying strict environmental-management standards. These arguments lead to the following hypothesis:

H2: Firms that pursue a product-stewardship strategy are more likely to adopt strict firm-internal environmental standards.

2.2.3 Performance effects

We argue that implementing strict-internal environmental standards enables firms to distinguish themselves from their rivals, which enhances performance. The core argument is that a firm-internal strategic posture towards environmental management enables the firm to develop a unique positioning that is valuable and rare to find for major internal and external stakeholders of the firm as well as hard to imitate and substitute by the firm's rivals, thus leading to better performance of the focal firm. In the following, we lay out our arguments in greater detail.

From an internal perspective, strict environmental standards signal to the firm's employees consistency and a clear strategic positioning toward environmental management. Strong "green" positioning improves organizational performance, as it creates an atmosphere of social responsibility among employees, increasing the motivation to learn that enhances employees' skills (Surroca et al. 2010). Sørensen (2002) similarly argues that a strong corporate culture is positively related to organizational performance, as it facilitates the internal consistency of firm behavior. Studies also show that a strong organizational climate enhances organizational performance, as employees "share a common interpretation of what behaviors are expected and rewarded" (Bowen and Ostroff 2004, p. 203). A firm with well-developed environmental standards signals to its employees a coherent and systematic message about what "green" elements the firm's strategy encompasses and effectuates. This signal is likely to enhance employees' identification with the firm's "green" posture and to increase their motivation to engage in supporting the firm's overall strategic intent.

As motivation-enhancing practices increase organizational performance (Subramony 2009), an improved performance is likely to occur when strict internal environmental standards are implemented.

From an external perspective, we argue that strict internal environmental standards help the firm to develop a unique position in its industry, which results in improved relationships between the firm and its suppliers and customers, resulting in enhanced performance. With regard to suppliers, Wong et al. (2012, p. 285) find that a firm's performance depends on the its suppliers' environmental management "because 87% of customers would accuse firms of environmental negligence when their suppliers are environmentally irresponsible." Govindan et al.'s (2015) review supports this observation, finding that suppliers' environmental-management system is the prime factor that firms consider when choosing suppliers. We argue that adopting a strict internal environmental standard signals a unique approach that fits these "green" suppliers' own strategy, increasing their willingness to establish long-term business relationships with the focal firm. Improving the quality of the focal firm's supplier network in this way strengthens the firm's overall environmental positioning in the market, enhancing feeding forward into improved organizational performance. This effect is less likely to occur when firms refrain from adopting their own strict standards, as having no such standards does not signal to the supplier anything unique about the firm's "green" strategy. Similarly, firms with strict internal environmental standards signal a valuable and rare positioning to their customers that is difficult to imitate (Menon and Menon 1997). Strict internal environmental standards lower rivals' ability to imitate the firm's competitive strategy, so the firm can establish a unique positioning also in the eyes of its customers. Such a strategy also creates high entry barriers for potential new rivals, reducing the likelihood that the firm's customers will find new suppliers for their demands. These arguments lead to the following hypothesis:

H3: Firms that adopt strict firm-internal environmental standards achieve significantly higher levels of organizational performance.

3 Data and methods

The empirical analysis builds on two waves of surveys of German manufacturing firms. The surveys, which took place in 2001 and 2011, respectively, were part of a larger research project that, among other things, explored international environmental-management activities and their perceived outcomes. A number of questions also elicited responses on characteristics like firm size, the presence or absence of a quality-management system (QMS) and an environmental-management system (EMS), and the industry in which the firm primarily operated.

The first survey in 2001 addressed a random sample of 2000 firms drawn from the AMADEUS database of Bureau van Dijk. Firms were mailed a printed questionnaire, and 342 companies responded. The second survey carried out in 2011 addressed the firms from the first wave plus additions (due to firm exits) to

Table 1 Descriptive statistics

Variable	Minimum	Maximum	Mean	Std. dev.
Observation from 2011	0	1	0.35	Binary var.
Employees	1.79	12.90	5.88	1.87
Wood and paper	0	1	0.10	Binary var.
Chemicals	0	1	0.13	Binary var.
Materials	0	1	0.15	Binary var.
Machines	0	1	0.18	Binary var.
Electric	0	1	0.11	Binary var.
Other	0	1	0.16	Binary var.
Product stewardship	0	1	0.40	0.26
Pollution prevention	0	1	0.41	0.25
Market development	1	5	3.09	1.07
QMS	0	1	0.79	Binary var.
Breadth	0	8	1.45	2.21
EMS certification	0	1	0.49	Binary var.
Firm type	0	1	0.57	Binary var.
International market	0	1	0.72	Binary var.

re-balance the sample. Thus, 2300 firms were invited by electronic mail to participate in a web questionnaire, resulting in 213 responses.²

To assess response bias, comparing early and late responses for both included survey waves in terms of their characteristics revealed no significant differences in the mean values of the responses of all variables other than late-responding firms in 2001 being somewhat smaller and in 2011 having a somewhat higher likelihood of a certified EMS. Furthermore, as Table 1 shows, a large variation across the responses indicates that firms that were not particularly active in terms of environmental management did respond to the survey, suggesting that response bias is not an issue.

Comparing responses with data from the German Bundesanstalt für Arbeit (federal employment agency in Germany) showed that firms with more than 500 employees are over-represented in the responses relative to the population of manufacturing firms in Germany, so some size bias in the data must be acknowledged. This over-representation, which was not significantly more marked in the second wave than in the first wave, is a persistent issue in empirical management research in general, likely because larger firms have more resources available to respond to survey requests. (Armstrong and Overton 1977; Lindgreen et al. 2009).

In line with our theorizing, we followed a two-step approach to test our hypotheses. In the first step, which focuses on hypotheses 1 and 2, we assessed the effects of a pollution-prevention strategy and a product-stewardship strategy on the employment of an internal environmental standard. The dependent variable of an internal environmental management standard is measured as a binary variable based on the question, “Does your company have own environmental-management standards that

² The response rates are similar to those of surveys on related topics (Belz and Strannegard 1997).

Table 2 Items for calculation of pollution prevention and product stewardship indices (based on the question “Please specify which technological actions your company has undertaken in the last 3 years”)

Pollution prevention: reduced water use in production; material recycling within the firm; use of waste streams of other firms; measures to reduce emissions to air; measures to reduce emissions to surface water; measures to reduce solid waste; implementation of cleaner technology

Product stewardship: ‘green’ design of a new product; using less material per unit of product; substitution of non-renewable materials; substitution of hazardous inputs; product recycling; packaging recycling; using less packaging per unit of product

exceed legal requirements which it applies internationally in foreign direct investments outside Europe?” Given the nature of our dependent variable, we employed a binary logit regression to test hypotheses 1 and 2.

In step two, we tested hypothesis 3, which addresses the impact of strict internal environmental-management standards on the firm’s profitability. We operationalized our second dependent variable (organizational performance) by means of a five-level indicator based on the question, “In assessing the overall business performance of your company, was the gross revenue over the past 3 years ‘so low as to produce large losses’ [(coded 1)], ‘insufficient to cover costs’ [(coded 2)], ‘enough to break even’ [(coded 3)], ‘sufficient for a small profit’ [(coded 4)], or ‘well in excess of costs’ [(coded 5)]?” Given the ordinal nature of this construct, we used an ordered logit model to test hypothesis 3. Capturing performance with a subjective performance rating was necessary since German firms are notoriously unwilling to provide actual profit figures in surveys, as they are often not required by law to publicize such data, so most refrain from doing so. This approach is common in extant work in our field (e.g., Sharma 2001).

For the main explanatory variables of the first-stage regressions, pollution prevention and product stewardship, two indices were constructed based on the survey questions shown in Table 2. Based on theoretical considerations (e.g., Waddock and Graves 1997), the survey items were allocated to either pollution prevention or product stewardship. The individual items within each of these two areas, which were measured in a binary manner (yes = 1 and 0 otherwise), were added up into an aggregated score that was then normalized by dividing it by the maximum number of seven activities.

Our measurement of pollution prevention and product stewardship was not perfectly orthogonal, which is also evident in the empirical correlation between them in our data. However, given that this imperfection does not raise issues of multi-collinearity and that Hart (1995) argues that the measurements’ only partially differing focus on processes versus products conceptually implies some link between the two constructs, the imperfect orthogonality does not impede our analysis.

We included several control variables in our analyses. We measured firm size, based on the survey request to “Please specify (or estimate) the number of people who are presently employed by your company,” as the logarithm of the number of employees because the untransformed employee data was right-skewed. We controlled for firm size, as implementing environmental-management standards is often resource-intensive and since firm size is frequently used to indicate resource

availability (Lindgreen et al. 2009). Whether the firm had a QMS (based on the question, “Did your company acquire a quality standard?” as a binary dummy variable with yes = 1, and 0 otherwise) or an EMS (based on the question “Is your EMS certified?” as a binary variable with EMAS or ISO 14000 certification = 1 and 0 otherwise) was included since QMS and EMS have been suggested as substitutes for a firm’s own environmental standards (Christmann 2000; Wagner 2009). Firm type, based on the question, “Is your company in any way (e.g., as a subsidiary) part of a larger company, or is it completely independent?” was included in the analysis as a dummy variable coded 1 if the firm was completely independent and 0 otherwise because corporate governance structures have been suggested to be more or less supportive of environmental management. For example, a parent firm may or may not prescribing the use of an internal standard (Wagner 2010). Breadth, measured as the number of corporate functions that are tasked with environmental-management activities, was included as a predictor of internal standards since broad functional coverage makes a firm’s own standards increasingly cost-effective (Belz and Strannegard 1997). The breadth measurement was based on the request to “Please specify the area of activity in which your company has undertaken actions” for the eight areas of procurement, research and development, production, marketing and sales, logistics, recycling and waste disposal, accounting, and human resource management, with breadth calculated as the number of areas in which the firm has taken action.

Finally, a dummy variable to indicate whether the firm is oriented to domestic or international markets was based on the question, “How would you describe the market(s) for your company’s main products?”. The measure, which was included to account for market effects on the type of standard chosen and on profitability, assumes unity if the market is European or worldwide and 0 otherwise. The employment of strict internal environmental-management standards is likely to be contingent on a firm’s main industry, since different industries have different levels of depth and breadth in terms of the availability and use of industry-wide standards. For example, the chemical industry has a long tradition adopting standards based on its industry-wide “Responsible Care” program, rather than developing them on their own (Hoffman 1999). Therefore, we control for possible industry effects by including binary indicator variables for five sectors: consumer goods, chemical products, materials, machinery and equipment, and electric and electronic devices. Industry controls are also necessary in the second step of our analysis to control for industry differences in profitability (Schmalensee 1989).

In addition to the control variables employed in stage 1 (except for EMS certification, which is conceptually expected to affect only standard choice development of the main market was included in the second stage, based on the question “Over the last three years, did the market to which you sell your main product ‘increase significantly’ [coded 1], ‘increase’ [coded 2], ‘stay the same’ [coded 3], ‘decline’ [coded 4], or ‘decrease significantly’ [coded 5]?” Measuring development of the main market was done to account for effects on profitability, as suggested in the literature (Dess and Beard 1984). The main explanatory variable of the second stage regressions was the binary variable indicating the use of a firm-individual standard.

All models were implemented using the STATA software and included industry and other control variables (as detailed above) for the two dependent variables, the firm's own standard and profitability. EMS certification was an additional variable for the first of the dependent variables, and market development was an additional variable for the second. We tested hypotheses H1 and H2 using a binary probit regression specification. Consistent with extant literature, we instrument pollution prevention and product stewardship using industry membership, EMS certification and implementation, firm type, presence of a QMS, munificence, year (i.e., 2001 or 2011), and firm size (Greene 2003; Roodman 2009). Then we examine hypothesis H3, which concerns the effect of a firm's own environmental standards on profitability, using an ordered logit regression model (Long 2002).

4 Results

The correlations reported in Table 3 suggest that multicollinearity between the explanatory variables is not a major issue. The variance inflation factors' (VIFs) ranging between 1.11 and 2.59 (with a mean of 1.77) strongly support this assessment, so it is safe to continue with a multivariate analysis using the models described above. All estimations were done by pooling the two samples while controlling in all regressions for the two waves by means of a year dummy because missing values on individual variables resulted in a reduced usable sample in the multivariate estimations (353 observations). In addition, the number of firms that responded to both survey waves was insufficient to carry out either a longitudinal analysis or a panel data analysis.

Even so, and despite the age of our data, the lack of large-scale studies involving product stewardship or considering pollution prevention and product stewardship together allows our analysis of German manufacturing firms to provide useful insights and contributions. The period between 2001 and 2011 was characterized by accelerated growth in firms' environmental approaches, which increases our ability to observe our hypothesized relationships. At the same time, environmental management during this period was sufficiently mature for reliable inferences from our data to be made and generalized to the global manufacturing industry.

Table 4 shows the results of testing hypotheses H1 and H2 for the first stage: H1 is supported, whereas H2 is not.

The findings from the second stage, displayed in Table 5, lend support to hypothesis H3 because of the significant positive effect of an internal standard and profitability.

The results of our analysis remain stable with a number of modifications and robustness checks. For example, when the product stewardship and pollution prevention indices are included in the second stage as explanatory variables for profitability, the results on internal standards do not change (Table 5). The finding that product stewardship and pollution prevention strategies remain insignificant in this variant estimation suggests that our two-stage model is appropriate. In fact, even

Table 3 Correlation of variables in the estimation sample

Variables	Obs- vation from 2011 (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Employee (2)	0.12**														
Wood/ paper (3)	0.03	-0.15***													
Chemicals (4)	0.04	-0.01	-0.13**												
Materials (5)	-0.09*	-0.14**	-0.14***	-0.17***											
Machines (6)	0.03	0.26***	-0.16***	-0.18***	-0.17***										
Electric (7)	-0.08	-0.05	-0.12**	-0.14**	-0.14**	-0.15***									
Other man- ufac- turing (8)	0.21***	0.06	-0.15***	-0.20***	-0.19***	-0.21***	-0.16***								
Product steward- ship (9)	-0.29***	0.16***	-0.04	0.05	-0.11*	0.15***	0.07	-0.11**							
Pollution preven- tion (10)	-0.19***	0.25***	-0.05	0.02	-0.04	0.09	-0.02	-0.04	0.51***						

Table 3 (continued)

Variables	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Observation from 2011 (1)														
QMS (11)	0.14**	0.23***	-0.19***	0.11**	0.08	0.19***	0.09	-0.05	0.03	-0.002				
Breadth (12)	0.20***	0.25***	0.02	0.07	0.01	0.16***	-0.06	-0.08	0.41***	0.37***	0.11*			
EMS certification (13)	0.23***	0.26***	-0.01	0.12**	-0.13**	0.11*	0.05	0.08	0.02	0.03	0.21***	0.29***		
Firm type (14)	0.09	-0.13**	0.05	-0.01	0.05	-0.13**	-0.11*	-0.10*	-0.003	-0.01	-0.12**	-0.03	-0.18***	
Market growth (15)	0.09*	0.15***	0.10*	0.06	-0.005	0.25***	0.06	-0.06	0.18***	0.09	0.18***	0.20***	0.07	0.09*
International market (16)	-0.09	0.25***	-0.27***	0.11*	0.06	0.25***	0.17***	-0.25***	0.10*	0.07	0.25***	0.12**	0.23***	-0.18***

Significance levels are denoted as follows: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4 Model estimation for effects on firm-internal standards

Variables	Firm-internal standard
Observation from 2011	- 0.07 (0.29)
Employees	- 0.12 (0.12)
Wood/Paper	0.18 (0.37)
Chemicals	- 0.11 (0.25)
Materials	- 0.22 (0.27)
Machines	0.43 (0.30)
Electric	0.57 (0.26)**
Other manufacturing	0.07 (0.23)
Product stewardship	- 2.52 (1.76)
Pollution prevention	4.92 (0.34)***
Breadth	0.02 (0.06)
QMS	- 0.02 (0.16)
EMS certification	- 0.03 (0.10)
Firm type	- 0.05 (0.31)
International market	0.14 (0.39)
Constant	- 0.68 (1.80)

Robust and clustered standard errors in brackets; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; omitted industry: consumer; model fit: Wald $\chi^2 = 1763.15$ ***, Log-likelihood = - 7.78, $n = 353$

Table 5 Model estimation for effects of standards on profitability

Variables	Profitability	Profitability (with pollution prevention and product stewardship included)
Firm-internal standard	0.53 (0.31)*	0.52 (0.31)*
Observation from 2011	0.12 (0.06)*	0.13 (0.07)**
Employees	- 0.73 (0.43)*	- 0.73 (0.43)*
Paper	0.36 (0.44)	0.38 (0.45)
Chemicals	- 0.35 (0.39)	- 0.29 (0.40)
Materials	- 0.05 (0.40)	- 0.13 (0.40)
Machines	- 0.12 (0.50)	- 0.21 (0.50)
Electric	- 0.08 (0.45)	- 0.07 (0.45)
Other manufacturing	0.19 (0.12)	0.17 (0.13)
Breadth	0.21 (0.11)*	0.20 (0.12)*
Market growth	- 0.37 (0.27)	- 0.37 (0.27)
QMS	0.33 (0.23)	0.32 (0.23)
Product stewardship	-	0.69 (0.46)
Pollution prevention	-	- 0.66 (0.50)
Firm type	- 0.06 (0.27)	- 0.08 (0.27)
International market	0.53 (0.31)*	0.52 (0.31)*

Robust and clustered standard errors in brackets; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; omitted industry: consumer; model fit for column 2: Wald $\chi^2 = 36.65$ ***, Log-likelihood = - 418.70; model fit for column 3: Wald $\chi^2 = 39.69$ ***, Log-likelihood = - 417.46; $n = 353$

Table 6 Model estimation for effects on firm-internal standards with separate indices

Variables	Firm-internal standard (product stewardship)	Firm-internal standard (pollution prevention)
Observation from 2011	0.34 (0.40)	0.10 (0.19)
Employees	0.08 (0.22)	- 0.14 (0.14)
Paper	0.38 (0.56)	0.18 (0.39)
Chemicals	- 0.07 (0.43)	- 0.25 (0.28)
Materials	0.31 (0.33)	- 0.08 (0.27)
Machines	- 0.42 (0.49)	0.07 (0.23)
Electric	- 0.26 (0.42)	0.29 (0.24)
Other manufacturing	0.06 (0.40)	0.19 (0.24)
Product stewardship	3.46 (2.05)*	-
Pollution prevention	-	4.47 (0.33)***
Breadth	0.10 (0.11)	0.05 (0.07)
QMS	- 0.08 (0.22)	- 0.07 (0.17)
EMS certification	0.03 (0.16)	- 0.02 (0.08)
Firm type	- 0.47 (0.27)*	- 0.18 (0.27)
Markt orientation	0.51 (0.38)	0.26 (0.35)
Constant	- 2.91 (1.47)**	- 1.53 (1.54)

^a Robust and clustered standard errors in brackets; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; omitted industry: consumer; model fit for column 2: Wald $\chi^2 = 353.01$ ***, Log-likelihood = - 127.47; model fit for column 3: Wald $\chi^2 = 930.33$ ***, Log-likelihood = -105.17; $n = 353$

when ordered probit models are applied in the second stage, the results remain unchanged.³

Except for product stewardship's effect becoming significant and in this variant supporting H2, the results also remain stable when estimating the regressions of the first stage separately for pollution prevention and product stewardship, as reported in Table 6. The exception for product stewardship's effect helps to explain why an integrated analysis of pollution prevention and product stewardship is important to avoid spurious effects. Therefore, we are confident that our findings are based on conservative estimations, are robust across different specifications, and can be used for further discussion and generalization.

5 Discussion

The primary goal of the present research was to use the NRBV to determine how pollution prevention and product stewardship influence firm performance. Consistent with prior literature (Suroca et al. 2010), we argued that there is not necessarily a direct relationship between pollution prevention and product stewardship and firm performance, but that they influence a firm's propensity to implement stringent

³ Detailed results on this are available from the authors on request.

internal environmental standards, which improve organizational performance. In testing our theoretical model, we found empirical evidence for pollution prevention's impact on firms' propensity to implement strict internal environmental standards and support for our proposal that such standards lead to improved performance. In the following, we discuss the paper's findings in greater detail in light of prior literature and derive future research directions.

Our empirical analysis, which was based on large-scale survey data, contributes to filling a gap in the literature because prior research is almost exclusively case-based as it concerns product stewardship and is equivocal as it concerns pollution prevention. In addition, while some large-scale studies on pollution prevention are extant (e.g., Sarkis and Cordeiro 2001; Hart and Ahuja 1996), joint analyses of pollution prevention and product stewardship are rare, perhaps because even important standards like ISO 26000 refer primarily to pollution prevention (Hahn 2013).

Given this gap in the literature, our analysis contributes insights into how product stewardship and pollution prevention are related to firm performance. Specifically, we confirm that the findings of Dowell et al. (2000) for multinational firms also hold for smaller and mid-sized firms.

In line with the extant literature (e.g., Clarkson et al. 2011), we find that pollution prevention and product stewardship are interrelated strategies both conceptually and empirically. This conclusion is also reflected in the correlation we find empirically for our operationalization of the strategies (Table 2), which shows that the two strategies cannot be fully separated in practice. At the same time, given that the correlation is not perfect, it is also clear that, while pollution prevention and product stewardship overlap to a degree, their joint analysis can provide insights beyond those derived from focusing on only one strategy [as Sarkis and Cordeiro (2001) also point out].

One focus of our paper is on the antecedents of implementing environmental standards, so we contribute to the ongoing discussion on "why companies go green" (Bansal and Roth 2000, p. 717) and extend the underlying debate by developing arguments for the impacts of pollution prevention and product stewardship on a firm's strategic posture toward environmental management. Consistent with Hart (1995) and more recent research that builds on that work (e.g., Gabriel et al. 2018; Maas et al. 2014), we distinguish between a pollution-prevention strategy and a product-stewardship strategy as possible drivers of the decision to implement strict internal environmental standards. In so doing, we expand the literature that focuses primarily on pollution prevention while largely neglecting product stewardship, and encourage future research to delve more deeply into the role of product stewardship.

In fact, one reason that the prior literature is ambivalent regarding pollution prevention effects may be that most studies do not consider product stewardship when testing models empirically based on large-scale data. Based on our findings, we infer that pollution prevention is particularly important as a driver of organizational performance, while product stewardship's effect is less clear, perhaps because of timing issues. For example, it is unlikely that an environmentally sound product can be manufactured using highly polluting production processes, which would suggest that pollution prevention precedes product stewardship. In this regard, Fowler and Hope (2007) perform a case study of one company to determine whether different

environmental strategies unfold in parallel or sequentially. We encourage longitudinal studies drawing on large-scale data to investigate in an integrated manner the sequencing patterns of pollution prevention and product stewardship and how this sequencing influences a firm's strategy and ultimately its organizational performance.

Our findings also contribute to the literature by offering fine-grained results on how environmental strategies improve competitive advantage by implementing strict internal environmental standards. We advance the literature (e.g., Flammer 2015; Maas et al. 2014; Shin et al. 2018) by showing that, even when product stewardship activities are controlled for, pollution prevention is an important determinant of firms' propensity to implement stringent internal environmental standards and that these standards affect the firm's competitive advantage of the firm that improves organizational performance. As a way forward in determining how decisions are made to implement such standards, we encourage future studies to consider, consistent with Berry and Rondinelli (1998), the effect of regulatory demands, stakeholder requirements, and competitive forces on these decisions and the normative implications that result. Future research could also undertake theoretical reflection on and empirical testing of the conditions that may intervene in the consistency of these effects (Bansal and Roth 2000), as boundary conditions in the current globalized economic context, where formal and informal institutions and regulations vary across states, have increased in complexity. Contributions to the literature are limited in this regard, so we encourage future research to determine which factors affect firm behavior in this volatile context.

Given that our study finds that internal environmental standards enhance organizational performance, we contribute to the wider literature on the relationship between corporate environmental strategies, standards, and organizational performance (Boons and Wagner 2009; Johnstone and Labonne 2009; Orlitzky et al. 2003; Wang et al. 2015). We help to resolve inconclusive results in this literature by demonstrating that whether the firm implements internal environmental standards should be considered when assessing performance effects.

6 Limitations

As is the case with most empirical studies, our paper has limitations. First, it draws on data only from German companies. Since Germany has a developed economy and demands in Germany regarding environmental-management standards are relatively high, the study's findings may not hold for companies in other types of economies. Therefore, we recommend replication studies that focus on other empirical settings. Second, we follow Hart (1995) in considering pollution prevention and product-stewardship strategies and their impact on internal (as opposed to industry-wide) environmental-management standards. However, Hart (1995) suggests as a third core strategy of the NRBV "sustainable development" which is characterized by a focus on clean technology and a fully developed vision of sustainability. Given that a sustainable development strategy is more encompassing and so is less frequently adopted than either pollution prevention or product stewardship (e.g., Gabriel et al.

2018; Maas et al. 2014), an agreed empirical operationalization is lacking. Therefore, we encourage future studies to consider the sustainable development strategy more comprehensively, given its increasing relevance. Doing so requires identifying suitable indicators or items that allow empirical measurement of this strategy and enable its incorporation in large-scale empirical studies. Third, our study does not reflect to the fullest extent possible on the boundary conditions of the relationships it examined. To reduce equivocal findings, we encourage future studies to reflect more extensively on the boundary conditions of the relationships to provide additional support to managerial decision-making and policy-making.

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