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In the LEED: Racing to the Top in Environmental Self-Regulation

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Abstract

Does voluntary participation in eco-certification become more substantive over time, or less? Although past research on voluntary programs suggests that later participants are more likely to greenwash by only symbolically adopting voluntary standards, theories of regulatory competition suggest a possible "race to the top." We argue that participation in voluntary programs can facilitate competition that enables a race, and we advance a theory of self-regulatory competition to explain dynamics of participation in voluntary environmental programs. Under this perspective, environmental self-regulation may facilitate a race to the top, despite possibilities for purely symbolic adoption. Analyzing data from a voluntary green building certification program in the United States, we introduce a methodology to distinguish propensities for symbolic certification from more substantive environmental performance. Data demonstrate that later adopters invest additional resources to attain higher certification, becoming greener and suggesting a race to the top in a voluntary greenbuilding certification program.

KEYWORDS
corporate sustainability, environmental policy, green building, green certification, self-regulation, symbolic certification

1 | INTRODUCTION

The rise of self-regulatory programs for sustainability and social responsibility may be consistent with a "race to the top" (RTT; Prakash & Potoski, 2006), in which organizations compete to adhere to increasingly strict environmental quality standards. However, it is not clear whether these voluntary practices are increasingly substantive, or the result of symbolic adoption (Koehler, 2007). We extend theory of regulatory competition to address organizational self-regulation, to better understand the dynamics of voluntary sustainability efforts. Theories of regulatory competition define a RTT[1] as a dynamic competition between political entities, who adopt increasingly stringent regulations to attract firm and household constituents (Tiebout, 1956; Tullock, 1971). The RTT stands in opposition to a possible race to the bottom (RTB), where (political) entities would compete to lower taxes or regulatory costs (Konisky, 2007; Porter, 1999; Potoski, 2001; Woods, 2006). Importantly, the mechanisms driving regulatory transformation may not be exclusive to competition between political entities. Translated to self-regulatory competition, a RTT entails the adoption of increasingly improved standards, practices, or performance. The race literature improves our understanding of firm strategy by explaining why adoption of a voluntary environmental self-regulation may result in environmental performance, which improves (RTT) or declines (RTB) as the practice diffuses.

[1]Abbreviations used throughout this text: Leadership in Energy and Environmental Design (LEED), race to the top (RTT), race to the bottom (RTB), and U.S. Green Building Council (USGBC).

Can participation in voluntary environmental programs catalyze a RTT? Past work on voluntary programs highlights market transformation as a potential outcome (Lyon & Maxwell, 2008), particularly if participation is linked to benefits through differentiating signals (Potoski & Prakash, 2009). In a competition to be green, each firm attempts to exceed the performance of other market participants, creating a RTT. However, firms sometimes participate in these programs without making substantive improvements in environmental performance (Delmas & Montes-Sancho, 2010; Harrison, 1999; Rivera & de Leon, 2004). Symbolic participation may be considered one type of greenwash, where program participants overrepresent their environmental performance as a form of misleading communication (Kim & Lyon, 2015; Lyon & Montgomery, 2015).

Empirical evidence of the impacts of voluntary environmental programs and eco-labels on firm environmental performance is mixed (Erauskin-Tolosa, Zubeltzu-Jaka, Heras-Saizarbitoria, & Boiral, 2020; Koehler, 2007). Wagner (2020) notes positive impacts on pollution prevention and product stewardship, alongside other organizational activities. However, analyses exploring outcomes in a dynamic setting suggest worse environmental performance (more symbolic adoption) among later adopters (Delmas & Montes-Sancho, 2010; Toffel, 2006). Our paper builds on this body of research by leveraging the timing and depth of participation in a voluntary certification program to understand the dynamics of self-regulatory behavior.

We begin by discussing theoretical perspectives describing the dynamics of self-regulatory competition. In this theoretical lens, competitive pressures to differentiate with green signals could drive a RTT between private organizations. We develop a set of hypotheses that, if supported, would suggest a RTT, and test these hypotheses using evidence from 16 years of green building certification. Data are taken from the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) certification, a widely adopted standard with multiple certification tiers. Adoption could be the result of increasingly substantive environmental improvements, or the result of increasing guile that allows participants to receive certification through symbolic adoption. We distinguish between these competing explanations by deploying a notches methodology commonly used in economics (e.g., Ito & Sallee, 2018) and finance (e.g., Kleven & Waseem, 2013) to measure the propensity for symbolic adoption and apply it to patterns of observed building certifications over time. Our results suggest increasingly substantive adoption, in support of a RTT. Our discussion highlights how the study of green building certification dynamics contributes to literatures on self-regulation and voluntary programs.

Highlights

- This article examines evidence of green competition in the real estate industry.
- Our theory joins literatures on self-regulation and regulatory competition.
- We test hypotheses on data from green building certifications in the United States.
- Our methods apply a nonparametric discontinuity technique to tiered certification setting.
- The findings suggest a self-regulatory "race to the top" in green building.

2 | THEORY: FROM REGULATORY TO SELF-REGULATORY COMPETITION

Regulations differentiate competing jurisdictions to attract key stakeholders such as firms (Tullock, 1971) and individuals or households (Tiebout, 1956). In an extreme case, a race may occur when competing jurisdictions seek the most favorable conditions for stakeholders (Stewart, 1977). Theories of regulatory competition anticipate a RTB if decision makers favor industry interests and if regulatory compliance would be costly to firms (Drezner, 2001, 2008). If instead stricter regulations provide social benefits that outweigh the costs of compliance, the RTT is expected, diffusing new practices that improve societal outcomes (Vogel, 1997). Past work has examined whether regulations generate social benefits by mitigating environmental externalities and induce a RTT, with mixed results (Dong, Gong, & Zhao, 2012; Harrison, 1999; Konisky, 2007; Mosley & Uno, 2007; Porter, 1999).

The race literature describes the diffusion and evolution of regulations, explaining adoption patterns as a function of competitive relationships between political entities. The same patterns can appear in the private sector: Firms improve their own local social and environmental performance by adopting the competitors' performance standards, even absent regulation (Cao, Liang, & Zhan, 2019; Mosley & Uno, 2007; Saikawa, 2013). These social and environmental improvements are attractive to stakeholders including investors (Heinzle, Boey Ying Yip, & Low Yu Xing, 2013; Mackey, Mackey, & Barney, 2007), employees (Singh, Syal, Grady, & Korkmaz, 2010; Turban & Greening, 1997), suppliers (Hyatt & Berente, 2017; Josserand, Kaine, & Nikolova, 2018), consumers (Zhang & Zhu, 2019), and society (Anbarasan, 2018; Cadez, Czerny, & Letmathe, 2019). For example, evidence from the voluntary ISO 14001 standard suggests that global competition induced improvements in corporate environmental performance (Prakash & Potoski, 2006). This study suggests that self-regulation can facilitate a RTT in environmental performance. However, other research questions the effectiveness of voluntary environmental initiatives like labels and certifications (Erauskin-Tolosa et al., 2020; Koehler, 2007), suggesting that claims of effective self-regulation are exaggerated or symbolic (Short & Toffel, 2010). We use the lens of regulatory competition to broaden our understanding of the dynamics of substantive and symbolic self-regulatory behavior.

2.1 | Substantive self-regulation and a RTT

The effectiveness of environmental self-regulation hinges on adopters' substantive incorporation of rules, norms, or practices.

Substantive participation entails a break from business-as-usual behavior, requiring a “second-order” reflection into the motives for participation (Groves, Munday, & Yakovleva, 2013). This deeper reflection enables purposeful behavioral change that is aligned with the self-regulatory regime's goals (Wijen, 2014). Substantive participation requires iterative evolution and thus produces learning related to the underlying performance of technologies (Zhang & Zhu, 2019) and practices associated with a voluntary program. Studies suggest a variety of best practices to encourage substantive adoption. These best practices include system design inclusive ofdisparate stakeholders that leads to mutual understanding among groups with distinctly different core values (Bernstein & Cashore, 2007). Further, certification systems can be tailored to fit the institutional environment (Gallego-Alvarez, Ortas, Vicente-Villardón, & Álvarez Etxeberria, 2017; York, Vedula, & Lenox, 2018) and incorporate sufficient monitoring to preserve legitimacy (Potoski & Prakash, 2009; Short & Toffel, 2010).

In a self-regulatory RTT, adopters' compliance with the environmental regime must be increasingly substantive. A RTT goes beyond diffusion to require iterative evolution of environmental practices. The reflection accompanying substantive adoption encourages firms to consider impacts, benefits, and costs associated with self-regulation, generating understanding of opportunities to improve environmental performance (Wijen, 2014). Past studies have demonstrated that environmental self-regulation stokes innovations that minimize resource use (Dutt & King, 2014) and promotes broader innovation investments (Jiang, Wang, & Zeng, 2020). A RTT emerges as a positive feedback loop, with substantive adopters incrementally identifying innovations that improve performance.

Further, the adoption of (self-)regulatory measures must provide a differentiating competitive advantage in a race. We argue that a self-regulatory mechanism only sustains a RTT when advantageous differentiation leads firms to pursue increasingly higher levels of environmental performance. Thus, a RTT through environmental self-regulatory competition is evaluated not just on environmental outcomes (e.g., Dong et al., 2012) but on how these organizations interact with respect to the rules of a self-regulatory mechanism. For example, Japan's Top Runner program provides rewards for the most energy-efficient product in a market each year and appears to drive competitors to set increasingly higher energy efficiency targets in subsequent years (Siderius & Nakagami, 2013). Such a RTT entails (1) substantive firm participation in environmental self-regulation, (2) competitive advantage of differentiation from high environmental performance, and (3) iterative organizational and technological change.

2.2 | Symbolic self-regulation and a RTB

We distinguish substantive adopters of self-regulation from symbolic adopters, who decouple policies from practice (Wijen, 2014). Symbolic self-regulation can be seen as a strategy to cheaply attain legitimacy and status without improving environmental quality (Delmas & Montes-Sancho, 2010). In some contexts, this has been called free riding (Maxwell, Lyon, & Hackett, 2000; Potoski & Prakash, 2009), shirking (Potoski & Prakash, 2005), or greenwash (Kim & Lyon, 2015; Lyon & Montgomery, 2015). Symbolic self-regulation occurs when firms claim compliance with a self-regulatory regime but fail to meaningfully integrate its rules, norms, and practices. Under symbolic self-regulation, environmental performance does not improve, and firms attain legitimacy associated with adoption without accompanying substantive change (DiMaggio & Powell, 1983; Westphal, Gulati, & Shortell, 1997). For example, LEED certification can legitimate real estate developers, improving access to capital and reducing regulatory burdens when investors and policymakers favor the environmental standard (Matisoff, Noonan, & Flowers, 2016). However, because early versions of the standard were based on modeled performance and other technological investments, rather than observed performance, it was possible for some participants to evade substantive performance improvements associated with adherence to the standard (Scofield, 2009). Symbolic self-regulation threatens the effectiveness of environmental initiatives (Short & Toffel, 2010), motivating research on whether these management systems and certifications actually improve environmental performance (Erauskin-Tolosa et al., 2020; Koehler, 2007). We employ the notion of symbolic adoption as key to distinguishing between a self-regulatory RTT and RTB.

In a self-regulatory RTB, the adopters' compliance with the environmental regime becomes increasingly symbolic. A RTB entails the appearance of widespread adoption without improvements to environmental practices. As a new practice diffuses, institutional pressures mount to conform to the new trend (DiMaggio & Powell, 1983; Tolbert & Zucker, 1983; Westphal et al., 1997), fostering incentives to decouple policy from practice (Ansari, Fiss, & Zajac, 2010; Kennedy & Fiss, 2009; Zajac & Westphal, 1995). These pressures explain the ineffectiveness of some voluntary environmental initiatives. For example, the Sustainable Slopes Program for ski resorts was promoted by various regulatory and activist stakeholders, but participation appears correlated with low environmental performance (Rivera & de Leon, 2004). Symbolic adoption limits the “second-order” reflection that would lead to organizational and technological change (Groves et al., 2013) and thus precludes the learning that would otherwise drive a RTT.

As adopters reveal opportunities for symbolic self-regulation, they establish precendent for participation at minimal performance standards (Wagner, 2013). Further, symbolic self-regulation may help others learn to game the system, appearing in compliance while making ever-fewer improvements over business-as-usual. Delmas and Montes-Sancho (2010) note that late adopters of the voluntary Climate Challenge program for utilities invested less in environmental improvements compared with early adopters. In that study, only the early-joining participants significantly reduced carbon emissions, whereas the emissions of late joiners remained similar to those of nonparticipants (Delmas & Montes-Sancho, 2010). At the extreme, firms in a RTB even exert influence to lower (self-)regulatory standards (Dal Bó, 2006), leveraging past voluntary abatement as a “preemptive” tool to avoid costly regulations (Maxwell et al., 2000). Thus, a RTB through environmental self-regulatory competition is evaluated

TABLE 1 Changes in certified building characteristics for years 2004–2016

Year	Certified Buildings	Avg. LEED score	Avg. building Size (sq. ft.)	Certification level: Certified (%)	Silver (%)	Gold (%)	Platinum (%)
2000	1	33.0	647,000	0	100.00	0	0
2001	4	35.0	93,541	50.00	0	50.00	0
2002	11	35.1	148,567	27.27	27.27	45.45	0
2003	29	33.1	128,079	41.38	34.48	24.14	0
2004	56	33.1	104,471	42.86	32.14	23.21	1.79
2005	107	34.1	103,510	36.45	36.45	23.36	3.74
2006	142	34.1	118,411	40.85	28.17	29.58	1.41
2007	210	35.5	93,736	34.29	34.76	24.76	6.19
2008	322	36.2	114,909	27.64	34.47	31.68	6.21
2009	599	37.6	105,997	19.70	31.05	43.07	6.18
2010	837	37.6	86,523	17.20	34.53	43.01	5.26
2011	746	37.9	87,794	15.28	35.92	42.49	6.30
2012	440	37.3	94,884	17.95	35.45	40.23	6.36
2013	171	36.9	155,694	22.81	34.50	37.43	5.26
2014	250	38.4	76,448	10.80	36.40	47.60	5.20
2015	332	39.1	104,098	9.64	34.34	47.89	8.13
2016	229	39.0	93,762	7.86	36.68	45.41	10.04
All	4,486	37.3	98,466	19.39	34.37	40.26	5.97

not just on participation rates, but on environmental performance relative to the minimum requirements under the rules of a self-regulatory regime. In the next section, we demonstate this application to the context of green building certification and draw hypotheses for trends within the real estate industry.

3 | EMPIRICAL CONTEXT: RACING TO THE TOP IN GREEN BUILDING

The real estate development industry impacts the natural and human environment in a variety of ways. The USGBC promotes sustainability in this industry by certifying green buildings through the LEED certification systems, which differentiate adopters as environmental leaders. The voluntary regulation has been adopted by as much as 30% of commercial real estate space in rapidly growing cities in the United States (Kok & Holtermans, 2014) and has gained traction abroad (Matisoff et al., 2016). The certification can be awarded at four tiers; adoption trends across these tiers for one version of LEED are depicted in Table 1.[2] LEED's popularity derives in part from rental and sales premiums associated with certification (Eichholtz, Kok, & Quigley, 2010), suggesting the program is a low-cost differentiator in the competitive real estate market. LEED reports a snapshot of overall environmental quality rather than a complete scorecard. Such tiered approaches are thought to provide greater information to the public compared with other information provision initiatives (Harbaugh & Rasmusen, 2018) but create challenges in assessing changes in behavior (Matisoff et al., 2016). Tiered certification approaches have become popular in various industries including restaurant ratings, bond and credit ratings, and several multitier ecolabels (Farhi, Lerner, & Tirole, 2013; Fischer & Lyon, 2014).

We understand LEED as a self-regulatory, voluntary program that might induce a race by stimulating firms to make increasingly extensive investments in energy efficiency and other technologies which improve environmental performance. Participation in LEED signals building and managerial qualities to stakeholders (Matisoff, Noonan, & Mazzolini, 2014). The requirements for LEED certification offer flexibility in the types of investments that firms make, the level of certification received, and whether or not firms go beyond minimum requirements to achieve certification. As a result, the way firms choose to certify at a particular point in time provides a glimpse into firm strategy with respect to environmental performance.

A building may become LEED-certified by making a variety of improvements to the building's holistic environmental footprint, including impacts related to energy, water, habitat, procurement, and innovation. For each improvement made, the building earns "credits" or points toward a LEED score, measured continuously. Descriptive studies of participation in LEED reveal that common credits used for certification include improvements to a building envelope's energy efficiency, increased access to natural and daylighting inside the building, and provision of parking spaces to facilitate low-energy and alternative transit (Da Silva & Ruwanpura, 2009; Flowers, Matisoff, & Noonan, 2019; Wu, Mao, Wang, Song, & Wang, 2016). After receiving

[2] For further details on trends in the location and use of LEED buildings over time, see Tables A.1 and A.2 in Supporting Information (S1).

40% of total possible credits, a building can be certified. Higher certification tiers are awarded for reaching 50 (silver), 60 (gold), and 80 (platinum) percent of credits available. According to conversations with industry professionals, these arbitrary thresholds are not natural cut points in building technology investment. Instead, the certification thresholds inform decision making toward certification, as evidenced by the distinct notches at each certification tier in Figure 1.

3.1 | Hypotheses: Self-regulatory competition in a tiered certification

A naïve interpretation of the shift toward higher tiers of certification (Table 1) suggests a RTT. The increasing LEED scores appear associated with improvements in environmental performance, a key requirement of a RTT. However, multiple mechanisms could explain this trend (Sandoval & Prakash, 2016). On the one hand, the trend toward higher tiers could arise from increasingly substantive adoption, as real estate developers compete to be greener over time. On the other hand, symbolic adoption, whereby firms appear to be green while not changing behavior could drive the trend in Table 1. More detailed analysis is required to ascertain whether the trend toward higher tiers is the result of substantive or symbolic adoption, to then identify sufficient evidence of a RTT. We leverage within-tier shifts in the distribution of LEED scores to provide this evidence.

The trend toward higher certification tiers could be the result of learning that drives increasingly substantive adoption. Over time, experience with and the availability of green building technologies have lowered barriers to certification (Simcoe & Toffel, 2014). As a result, higher tiers of LEED certification become more feasible, and the distribution of LEED scores shifts upward toward higher tiers (Sandoval & Prakash, 2016). Moreover, there are practical returns to adoption and verification of environmental quality at LEED scores between the tiers (Eichholtz, Kok, & Quigley, 2013). As experience reveals the benefits of adopting new green building technologies, adopting those technologies becomes more attractive (Blackburn, Flowers, Moreno-Cruz, & Matisoff, 2020) in addition to the differentiation rewards to certification. If this learning stokes a RTT, we expect increased adoption at higher LEED scores, with less emphasis on meeting the requirements of specific certification tiers. That is, the distribution in Figure 1 becomes smoother over time.

Hypothesis 1. Later adopters smooth the distribution of LEED scores.

Alternatively, the increasing prevalence of certification at higher tiers could arise from symbolic adoption. This occurs if firms exploit loopholes to achieve certification without full compliance. For example, two buildings could have identical environmental footprints, each having adopted technologies corresponding to 32 LEED credits. If one exaggerates its environmental performance in just a single aspect, it could earn 33 LEED credits, achieving a higher silver certification tier, compared with its honest peer who earns the minimum certified tier. Without almost perfect auditing, it would be impossible to ascertain whether one building was truly greener than the other.

The costs and audit process required for certification are thought to limit greenwash by firms with low environmental performance (Delmas & Burbano, 2011; Delmas & Keller, 2005; Potoski & Prakash, 2005, 2009; Spence, 2002), but no system is perfect. For example, LEED requires firms to submit evidence of environmental improvements, but there was no on-the-ground or on-going audit process for the initial certification standards. Other points, such as energy efficiency points, are awarded based on relative performance to a modeled "standard" building envelope, which might be prone to gamesmanship. Exploiting these LEED credits may allow firms to exaggerate environmental qualities and cheaply purchase legitimacy by moving to a higher certification tier.

Incentives for such symbolic adoption include both marketing and legitimacy benefits. Financial premiums increase greatly as a building moves up to a higher certification tier (Eichholtz et al., 2010). Many organizations appear to invest just enough in LEED credits to gain marketing benefits related to higher tiers of certification but do no more than required (Corbett & Muthulingam, 2007; Matisoff et al., 2014). Certification is also associated with favorable permitting and local regulatory treatment (Matisoff et al., 2016), among other intangible benefits (Devine & Kok, 2015). Others could achieve the

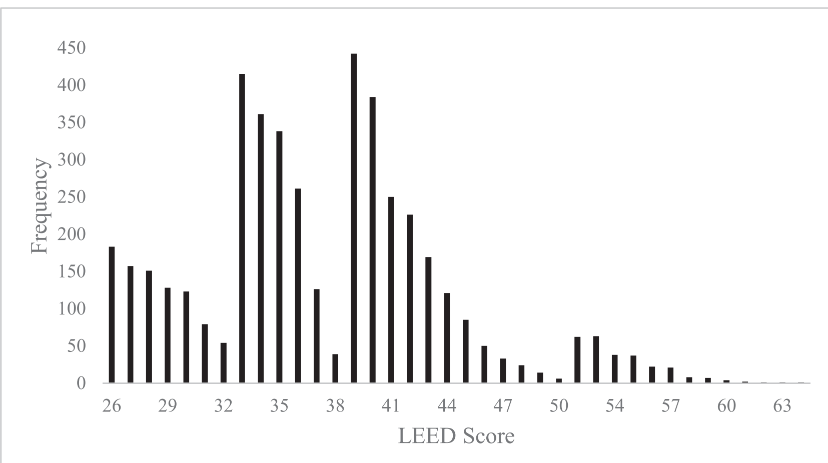


FIGURE 1 Observed distribution of Leadership in Energy and Environmental Design (LEED) building scores

same benefits by simply exaggerating their true degree of sustainability, particularly as local governments, advocacy groups, and various market intermediaries mount further pressures to adopt the LEED standard (York et al., 2018).

As LEED certification gained traction throughout cities in the United States (Kok & Holtermans, 2014) and abroad (Matisoff et al., 2016), the voluntary standard gained legitimacy (York et al., 2018) and transitioned from a niche differentiator to something expected of well-managed real estate firms. Late-comers adopting in response to such pressures may be less likely to couple certification to substantive improvements (Delmas & Montes-Sancho, 2010; DiMaggio & Powell, 1983; Westphal et al., 1997). Although any LEED-certified building is motivated by a combination of environmental performance and marketing benefits (Corbett & Muthulingam, 2007), those closer to the threshold are more likely to have overstated their performance to gain a higher certification level (Matisoff et al., 2014). If these pressures stoke a RTB, we expect increased adoption but with greater emphasis on appearing to meet the minimum requirements at certification tiers. That is, the distribution in Figure 1 becomes more clustered at the thresholds over time. Thus, our second hypothesis contrasts the first:

Hypothesis 2. Later adopters increase clustering in the distribution of LEED scores.

Finally, we acknowledge that self-regulatory competition may not impact all real estate subsectors equally. Real estate developments serve a variety of organizations, including those in the public, nonprofit, or private sectors. Competition and other pressures may be most pronounced in the private sector of firms competing for talented employees, well-endowed investors, and regulatory favor. In this sector, we expect a stronger need to differentiate relative to other sectors (Wysman, Simcoe, & Wang, 2020). As a result, the movement toward more substantive or more symbolic adoption of LEED certification may be more pronounced.

Hypothesis 3. Changes in the distribution of LEED scores are larger in the private sector.

The multitier structure of LEED's certification system provides us a unique opportunity to disentangle substantive from symbolic adoption and to examine longitudinal trends indicative of either a RTT or RTB. Specifically, we investigate trends within tiers, rather than across tiers. Our methodology is adapted to evaluate propensities for symbolic adoption over time in the tiered certification structure.

4 | LONGITUDINAL DATA AND METHODOLOGY

We apply the arguments developed above to LEED certification trends for green buildings in the United States. The publicly available Green Building Information Gateway provides a complete listing of all LEED-certified buildings in the United States.[3] The available data include LEED point total, certification level, building name and address, LEED scoring system used, building type, buildings size, and site context. We restrict our analysis to the buildings within the LEED New Construction (LEED NC) Versions 2.0–2.2, in which building scores are computed similarly, in order to maintain consistent reference points for certification and simplify results to comparable metrics based on a single set of building codes. By limiting our analysis to newly constructed buildings, we gain the dual advantage that the design of the building is largely by choice (rather than fixed by historic construction decisions and technologies), and we assure that each building appears only once in the data.

Under LEED NC 2.0–2.2, buildings must achieve at least 26 points to become certified, at least 33 points for silver certification, 39 points for gold certification, and 52 points for platinum certification. These thresholds correspond to steep notches in the distribution of LEED scores (Figure 1). About 46% of buildings earn point totals that are either at or just above these certification thresholds. While many buildings score between thresholds, scores just below each threshold are rare.

We divide our data into categories by owner type and building use. Of the 4,486 total buildings, 2,039 are owned by government agencies, with a little over half of these owned by federal or state governments and the remainder by local governments. For-profit entities own 1,445 of the buildings, and nonprofits own 1,018. Buildings are also separated by primary use according to the information provided to the USGBC at the time of LEED registration or certification. This partitions buildings by intended use as commercial offices (N = 1,338), retail (427), healthcare (268), restaurants (159), hotels (92), or schools at the primary (513) or higher education (773) levels. Altogether, commercial buildings make up 1,758 observations, or almost 40% of our data.

Over time, the data confirm prior findings about the growth of LEED's popularity. Each year, the number of new buildings added under the LEED NC 2.2 certification standard grows, peaking just after 2010, when a new version of the LEED NC (v2009) standard was initiated. The distribution of LEED certifications generally shifts toward higher tiers over time (Table 1). Roughly one third of buildings certify at the silver level during each year, but the annual portion of buildings certifying gold rose from less than 25% to over 40% of new buildings over the period from 2005 and 2009. The portion of buildings certifying platinum remains between about 5% and 7% each year, although the number of platinum buildings added annually grows almost every year. Notably, 2008 seems to be an outlier year, where gold certification dropped and silver spiked.

A race requires a trend in buildings becoming greener over time—and that necessary condition is met by the increasing frequency at higher tiers (Table 1). But, from this trend across tiers, we cannot verify whether shifts are due to substantive certification (RTT) or symbolic certification (RTB). To examine the extent to which exaggeration plausibly drives some of the differences in LEED scores, we limit our

[3]For more information, see www.gbig.org.

analysis to comparisons within tiers. In this approach, we consider those who barely reach the minimum requirements as more likely to have overstated their environmental performance compared with those that exceeded the minimum. We develop our identification strategy to distinguish whether the results are the product of increasingly substantive or symbolic certification. We use a notches methodology that follows past work on tiered contexts, including prior studies of LEED certification.

4.1 | Identification through notches

Hypothesis testing is conducted by examining not just the tier of certification but the likelihood that certification was achieved by exaggerating sustainability (symbolic adoption). Measuring the extent to which adoption is substantive versus symbolic is nontrivial, especially in a multitier setting like LEED. Examining tier information alone (e.g., Table 1) offers only limited insight about a race because it cannot discern between substantive and symbolic adoption. Our identification strategy leverages a notches methodology that identifies smooth versus clustered distributions of LEED scores around each certification threshold. This approach cannot identify which specific buildings are symbolic adopters but rather allows us to assess propensities for symbolic adoption across the population of buildings. This allows us to examine evidence regarding each hypothesis above, at and within each certification tier. We derive propensities for symbolic adoption based on LEED scores and compare these propensities to those of other LEED scores within the same tier. By examining within-tier propensities for symbolic adoption and comparing these across time and across the four LEED tiers, we are able to generate rich statistical insight.

Following Kleven and Waseem (2013), we begin by constructing a counterfactual distribution of LEED scores in the absence of the multitier thresholds, without making restrictive assumptions about how that counterfactual should be shaped. A similar approach has recently been applied to income taxes (Chetty, Friedman, Olsen, & Pistaferri, 2011; Kleven & Waseem, 2013; Saez, 2010) and fuel economy regulation (Ito & Sallee, 2018; Sallee & Slemrod, 2012). The counterfactual imagines a setting without certification thresholds, where environmental performance drives the entire distribution, with no benefits related to the reaching certification thresholds. Using this counterfactual as a plausible estimation of what would have occurred in the absence of tiered thresholds, we can then compare it to the observed distribution. To measure the propensity for symbolic adoption of LEED certification, we use the difference between the observed distribution (containing both substantive and symbolic adoption) and the counterfactual distribution (containing only substantive adoption).

This analysis relies on the assumption that symbolic adoption is more likely to occur at the certification thresholds, because of incentives to upgrade to higher tiers (Matisoff et al., 2016), independent of actual environmental performance. If all LEED certification is substantive, the distribution would be smoother, peaking in density at the most cost-effective extent of environmental self-regulation (Corbett & Muthulingam, 2007). The counterfactual distribution therefore consists of a locally smooth polynomial function, generated based on the observed, saw tooth distribution (Kleven & Waseem, 2013). This smooth distribution estimates substantive adoption by eliminating extreme clustering at notches local to thresholds, where symbolic adoption is most likely. This counterfactual distribution represents the expected distribution of LEED scores in the absence of tiers. The difference between the observed density and the counterfactual density at the certification thresholds, “excess bunching” (Saez, 2010), approximates the extent of symbolic adoption in our context. This excess for each LEED score *i* is expressed based on the difference in observed (*o*) and counterfactual (*c*) frequencies, as in Equation 1. Because we are interested only in the excess share of buildings at the thresholds due to symbolic adoption, differenced values are censored to preserve only nonnegative values:

$$excess_i = \left\{ \begin{matrix} freq_{io} - freq_{ic} \text{ if } freq_{ic} < freq_{io}; \\ 0 \qquad\qquad \text{if } freq_{ic} > freq_{io} \end{matrix} \right\}. \tag{1}$$

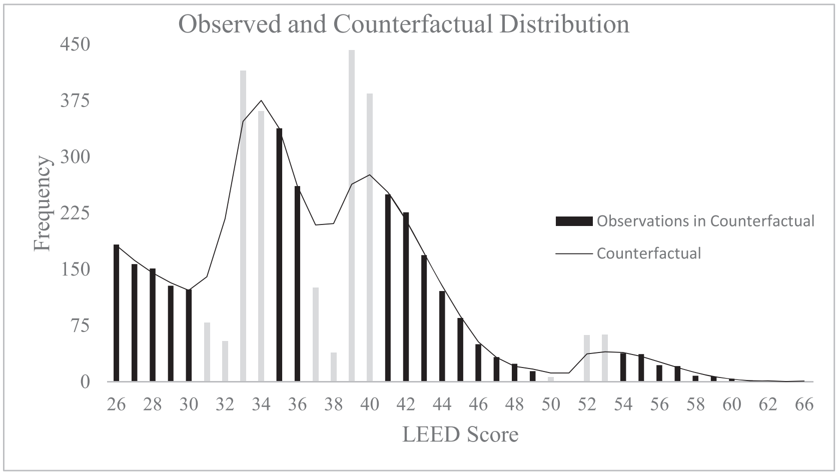
In constructing the counterfactual, the regions immediately above and below the cutoff are effectively dropped, eliminating the pronounced discontinuities visible in the observed distribution. The counterfactual estimate does not consider data “near” the notches, namely, scores within one or two points of a threshold. For example, scores 37–40 are near the minimum gold score of 39 and so are excluded as inputs in the counterfactual calculation. We then generate a locally smooth polynomial based on the remaining observations, estimating a plausible and empirically-determined counterfactual distribution unaffected by incentives to exaggerate environmental performance. In this way, the counterfactual estimates only substantive certification. We fit a second-degree locally smooth polynomial using a smoothing bandwidth of two and the frequencies of all buildings at each LEED score in the observed distribution, after omitting the observations close to the tier thresholds.[4]

Notably, this approach does not impose additional theoretical assumptions about the shape of the counterfactual, as used in past work by Corbett and Muthulingam (2007). We instead remain agnostic about how organizations optimize environmental performance. Our empirically-determined counterfactual is conservative relative to such theoretically-imposed counterfactuals, in that the smooth polynomial retains some of the original shape of the distribution, shrinking the difference between observed and counterfactual distributions. The Supporting Information discusses various other trade-offs to the choice among alternative counterfactuals.

The observed histogram and counterfactual polynomial distributions are graphed in Figure 2. For each LEED score, we calculate a

[4]Because LEED does not score buildings that do not get certification, we have no observations below 26, the minimum score for the certified tier. We therefore cannot drop the data around this threshold.

FIGURE 2 Observed and (locally smooth) counterfactual building distributions



propensity for symbolic adoption by taking the *excess* observations, then dividing by the observed frequency of observations. This propensity for symbolic adoption is a share of observations, which appear to obtain each LEED score by exaggerating their environmental performance. Propensities are unique to each LEED score and are assigned to each building with that score according to Equation 2, which expresses propensities for each LEED score *i* in certification tier *T* as

$$propensity_i = 100\% \times \left(\frac{\sum_{i \in T} excess_i}{\sum_{i \in T} freq_{io}} \right). \quad (2)$$

Thus, a building scoring at or just above a certification threshold, where the observed frequency is much higher than expected by the counterfactual, will have a relatively high propensity for symbolic adoption. If the frequencies observed in the data and predicted by the counterfactual are similar at a LEED score, buildings with this score have little or no propensity for symbolic adoption. Certification for these observations is more likely substantive, in that adoption is not the result of exaggerated environmental quality.

$$propensity_{T_s} = \frac{\sum_{i \in T} (propensity_i \times freq_{ios})}{\sum_{i \in T} freq_{ios}}. \quad (3)$$

We then aggregate symbolic adoption propensities by τ and by subsamples *s* according to industry subsector or building types (Equation 3). For instance, the aggregate propensity of gold-certified buildings to be symbolic adopters is the excess gold observations divided by the count of all gold buildings. Subsample propensities draw on counterfactuals derived from the entire sample. These propensities help illustrate the types of buildings driving patterns within each tier of the overall LEED distribution. We interpret this measure as a percent of the overall population (or subsamples) of LEED-certified buildings at a specific tier that appears to have symbolically certified to a higher certification tier by making exaggerated sustainability claims.

4.2 | Trends over time

After characterizing the extent to which symbolic adoption drives the observed distribution for various subsamples, we observe changes overtime to directly test our core hypotheses. Though data summarized in Table 1 show a rise to higher certification tiers over time, a race is distinguished by trends within tiers. A RTT requires observations that organizations increasingly adopt by going "above and beyond" minimum requirements. This suggests that later adopters drive the emergence of a smoother distribution that is increasingly similar to the counterfactual constructed, so that propensities for symbolic adoption fall (Hypothesis 1). By comparison, the distribution could become more clustered around the thresholds, driving the observed distribution farther from the counterfactual and increasing the measured propensity for symbolic adoption (Hypothesis 2). From there, we can compare dynamics across sectors of the real estate industry (Hypothesis 3).

These calculations require the composition of separate counterfactuals for each of the time periods of interest, so that the counterfactual is based only on what has been observed by a given time. This assumes that certification decisions are impacted by the current building stock (Wysman et al., 2020) and prevents relatively thin data near the beginning of the program from skewing the overall trends.[5] We assess trends over time by calculating counterfactual distributions in each year τ, including only observations in year $t \leq \tau$ and not including future buildings. Figure 3 provides a graphical depiction of the counterfactual estimation at 4 points in time. We use the counterfactuals to compute propensities for symbolic adoption by tier in each year. We then examine population-level trends and compare across subsamples by owner types.

It should be emphasized that this approach to hypothesis testing relies on within-tier comparisons of the propensity for symbolic adoption. Testing these hypotheses looks exclusively at variance in symbolic adoption propensities within tiers over time. It thus avoids

[5]Alternative treatments of the counterfactual estimation over time are also possible. These are discussed in the Supporting Information (S2).

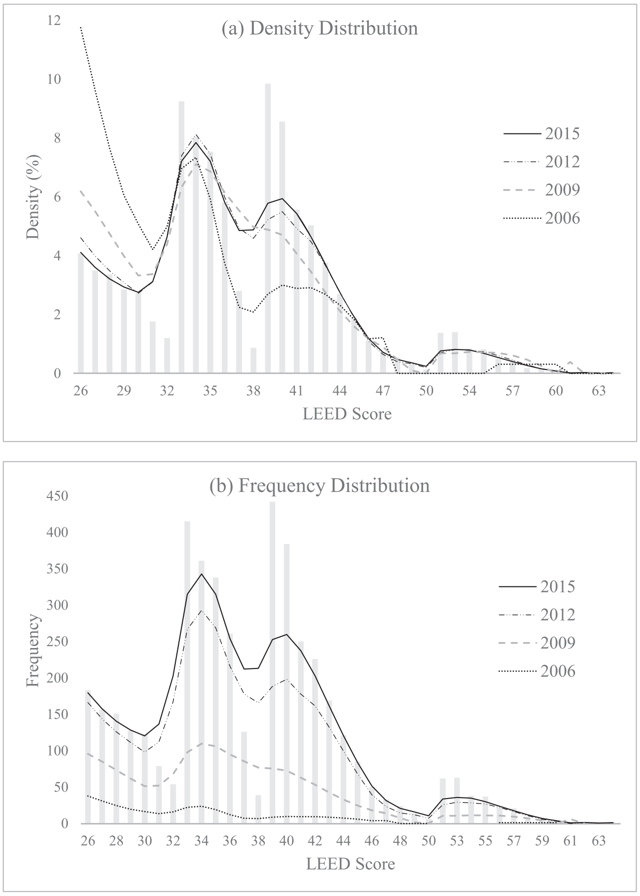


FIGURE 3 Changes in counterfactual distribution over time, compared with final (2016) observed distribution of Leadership in Energy and Environmental Design (LEED) scores. The two panels reflect these changes in terms of the (a) relative density and (b) absolute frequency of the overall distribution

comparing across tiers, as excess observations at higher tiers may reflect both symbolic adoption and substantive environmental improvements. This symbolic adoption propensity, calculated as a share, is independent of the overall popularity of a particular tier.

5 | RESULTS

Measurements of symbolic adoption propensities are assigned to each building based on the counterfactual distribution obtained from the locally smooth polynomial, and the building's LEED score. Many LEED buildings cluster at and above each certification threshold (seen in Figure 1), where scores corresponding to strong motivations to overstate environmental quality. We note that calculated shares are in part a product of the particular counterfactual selected, and we caution against strict interpretation of the values. Instead, we emphasize relative differences in the statistics across industry subsectors and time periods. Propensities for symbolic adoption vary by certification tier, industry subsector, intended building use, and construction year.

5.1 | Cross-sectional variation

Table 2 displays the aggregate propensities for symbolic adoption at each tier, for the entire sample, and for various industry subsectors defined by the building's owner and use. For all 4,486 LEED buildings, a little over 4% appear to be symbolically adopting at the silver certification level. That is, 1 in 25 LEED silver buildings overstated environmental performance to achieve silver certification. Across all tiers, these estimates suggest that about 1 in 10 LEED-certified buildings

TABLE 2 Symbolic adoption, by tier and industry subsector

			Symbolic adoption propensities (%)[a]				
Subsample type	Subsample	Observations	Certified	Silver	Gold	Platinum	Overall
	All	4,486	0.94	4.40	16.68	20.81	9.64
Ownership	Federal/state government	1,006	0.96	4.05	16.69	20.33	10.23
	Local government	880	0.94	4.39	15.85	22.76	9.07
	For-profit	1,143	1.00	4.12	17.81	20.75	9.12
	Nonprofit	930	0.86	4.69	14.97	19.81	9.76
Building use	Universities	773	0.92	4.62	15.42	26.12	11.31
	Local schools (K-12)	513	0.97	4.32	15.73	25.52	8.95
	Health	268	0.88	4.08	20.47	16.45	9.47
	Hotel	92	1.22	7.21	19.79	28.62	11.19
	Restaurant	159	0.66	6.00	17.24	27.04	10.44
	Retail	427	1.07	3.51	18.43	20.81	8.58
	Office	1,338	1.05	4.64	15.65	17.67	9.32
	Mixed commercial	1,758	1.05	4.41	16.84	18.89	9.39

[a]Symbolic adoption based on the category's aggregate propensities for symbolic adoption at each LEED score within a tier.

TABLE 3 Symbolic adoption over time, by tier

Symbolic adoption propensities (%)[a]						
All owners						
From 2000	Observations	Certified	Silver	Gold	Platinum	Overall
2004	101	6.20	21.78	35.14	100.00	19.80
2005	208	4.35	20.34	45.00	60.00	21.03
2006	350	2.05	22.65	40.96	71.43	20.19
2007	560	1.53	16.60	28.75	21.00	14.15
2008	882	1.08	18.60	18.37	29.91	13.07
2009	1,481	1.34	8.97	22.51	17.45	11.85
2010	2,318	1.02	2.63	21.28	9.80	9.55
2011	3,064	1.93	4.58	17.05	16.97	9.48
2012	3,504	1.00	5.14	19.15	21.38	10.58
2013	3,675	1.09	5.88	18.54	20.77	10.56
2014	3,925	1.00	6.13	17.10	22.85	10.28
2015	4,257	0.87	5.42	16.02	23.04	9.75
2016	4,486	0.94	4.40	16.68	20.81	9.64
Government						
From 2000	Obs.	Certified	Silver	Gold	Platinum	Overall
2004	30	6.06	8.45	30.63	–	14.23
2005	75	3.88	15.97	45.78	–	20.29
2006	128	2.00	21.70	40.46	100.00	19.46
2007	198	1.60	16.32	28.00	30.16	13.66
2008	308	0.99	19.37	16.52	29.56	11.96
2009	486	1.28	10.35	22.69	16.78	11.55
2010	765	1.13	2.76	21.78	9.64	9.61
2011	1,097	1.89	4.71	16.84	19.46	9.70
2012	1,306	1.02	4.95	18.66	24.31	10.57
2013	1,367	1.10	5.60	18.17	22.66	10.49
2014	1,500	1.01	5.89	16.63	24.96	10.18
2015	1,723	0.87	5.10	15.54	24.48	9.68
2016	1886	0.95	4.21	16.32	21.27	9.69
Private						
From 2000	Obs.	Certified	Silver	Gold	Platinum	Overall
2004	39	6.73	28.67	44.79	–	23.65
2005	59	4.99	26.34	57.39	50.00	25.46
2006	86	2.29	25.13	45.46	50.00	21.56
2007	158	1.12	13.15	31.76	11.78	13.14
2008	260	1.10	13.94	19.51	35.88	12.14
2009	468	1.36	6.28	23.68	20.56	11.52
2010	739	0.90	2.12	22.10	9.49	9.28
2011	895	2.09	3.94	18.27	15.14	8.93
2012	978	1.04	4.60	20.59	19.80	10.04
2013	1,031	1.16	5.36	19.71	19.38	10.11
2014	1,083	1.07	5.61	18.22	22.40	9.84
2015	1,126	0.93	5.09	17.16	22.75	9.26
2016	1,143	1.00	4.12	17.81	21.12	9.12
Nonprofit						

(Continues)

TABLE 3 (Continued)

Symbolic adoption propensities (%)[a]						
From 2000	Obs.	Certified	Silver	Gold	Platinum	Overall
2004	16	7.95	14.08	34.79	100.00	24.39
2005	35	4.94	13.50	32.73	50.00	16.01
2006	74	1.64	14.71	41.32	66.67	18.35
2007	112	1.78	16.94	31.75	19.20	15.03
2008	185	1.20	20.71	20.36	24.19	14.54
2009	320	1.44	9.43	21.21	16.57	12.44
2010	508	0.97	2.71	18.48	9.88	9.34
2011	670	1.76	4.74	14.61	16.46	9.35
2012	768	0.91	5.49	17.03	20.13	10.78
2013	807	1.01	6.34	16.53	20.39	10.82
2014	849	0.95	6.56	15.44	21.63	10.64
2015	893	0.82	5.85	14.57	22.02	10.15
2016	930	0.86	4.69	14.97	19.81	9.76

[a]Symbolic adoption based on the category's aggregate propensities for symbolic adoption at each LEED score within a tier.

have exaggerated their environmental performance to reach a higher certification tier. (For robustness, alternative specifications were assessed to be less conservative. Results from one alternative, anti-conservative estimate show an overall effect of 17%.)

All subsamples demonstrate some evidence of symbolic certification. Results show higher propensities for symbolic adoption within the platinum and gold tiers than lower tiers. Across all ownership types, 15% to 20% symbolically certify to reach these highest tiers. At the platinum tier, nearly 30% of certified educational facilities, hotels, and restaurants appear to have exaggerated their environmental performance through symbolic certification. LEED-certified hotels appear to cluster exceptionally around each certification tier, consistently above-average propensities for symbolic adoption at each tier of certification.

5.2 | Racing to the top?

Table 3 displays changes in propensities for symbolic certification over time. For the full sample, symbolic certification falls erratically over time, from 20% during the first 5 years, then falling sharply to under 10% by 2010, where it levels off through the end of the study period. This decline in symbolic adoption corresponds to an increase in substantive certification and is consistent with Hypothesis 1. This trend is reflected within the certified, silver, and gold certification levels but is partially offset by relatively erratic changes in symbolic adoption at the less-popular platinum tier.

Table 3 also shows these trends for subsamples based on industry subsector. The decline in symbolic adoption is stronger among the private companies than governments and nonprofits, mostly due to an abundance of symbolic adoption in the early years of the study. Among firms, evidence of symbolic certification declines at the certified, silver, and gold tiers. Around 30% of privately owned LEED gold buildings certified symbolically in the early period from 2000 to 2004, decreasing to about half that by 2016. By the end of the study period, for-profit firms were no more or less likely to upgrade through symbolic adoption than the typical government or nonprofit entity. This result suggests that the outcome of self-regulatory competition is more pronounced in the private sector than others in our data, consistent with our third hypothesis.

6 | DISCUSSION

This work extends our understanding of regulatory competition to better understand the dynamic outcomes of self-regulation through voluntary standards (Erauskin-Tolosa et al., 2020). Under this view, adoption of self-regulatory measures may become more substantive over time, in a RTT. Alternatively, adoption may become more symbolic as practices worsen over time in a RTB. These races are distinct from ordinary diffusion or learning due to iterative evolution in response to competitive pressures to differentiate.

In the context of green building certification, we leverage a notches methodology to identify propensities for symbolic adoption of LEED certification and explore trends over time. This work goes significantly beyond past studies that merely explain the saw-tooth distribution within the multitier program (e.g., Corbett & Muthulingam, 2007; Matisoff et al., 2014), by identifying the relationship between that distribution and dynamics of competitive pressures. We find evidence that overall propensities for symbolic adoption of LEED certification gradually diminished. Trends are consistent with expectations of a RTT (Hypothesis 1) and are especially pronounced among competitive, for-profit organizations (Hypothesis 3). This outcome supports past suggestions that a tiered certification structure is an efficient way to provide information (Harbaugh & Rasmusen, 2018) and induce market transformation (Maxwell et al., 2000). The RTT observed may be surprising, because many assert that symbolic adoption is expected to increase over time (Ansari et al., 2010; DiMaggio & Powell, 1983; Kennedy & Fiss, 2009) for self-regulatory schemes (Delmas & Montes-Sancho, 2010).

These findings inform our understanding of the dynamic outcomes of voluntary, environmental, and self-regulatory programs more broadly. The finding that symbolic certification became less likely as LEED diffused affirms that early adopters drive market transformation by revealing benefits to substantive adoption of new environmental technology (Blackburn et al., 2020; Jiang et al., 2020; Maxwell et al., 2000). Further, we note that the USGBC actively cultivates a network of associated professionals through trainings and online platforms that showcase advances from the United States and around the world. This network may help sustain the observed RTT by fostering social learning and diffusion to new organizations.

In an era of regulatory gridlock and deregulation, recent literature notes both opportunities and limitations of self-regulation (Short & Toffel, 2010). Within this conversation, our findings speak to the dynamic relationship between competition and self-regulation. Competitive pressures to differentiate appear to sustain a RTT in the case of LEED. The perspective that self-regulation induces a race may generalize to other (self-)regulatory programs aimed at market transformation. For example, Japan's Top Runner program appears to induce iterative quality competition, or a RTT. In healthcare markets of developing countries, quality advances fostered through peer learning networks are rewarded with performance-based financing, with apparent iterative improvements for social outcomes (Nahimana et al., 2016). Voluntary adoption of ISO and energy efficiency standards have also been observed in relation to global competitive pressures (Prakash & Potoski, 2006; Saikawa, 2013), despite potential inefficiencies of applying a global standard across diverse national business and regulatory systems (Wagner, 2020; Wijen, 2014).

Finally, this analysis extends the notches methodology used in the finance (e.g., Kleven & Waseem, 2013) and economics (e.g., Ito & Sallee, 2018) literatures to evaluate propensities for symbolic adoption of a sustainability standard. The notches methodology helps us identify trends within LEED certification, which suggest greener practices over time, consistent with a RTT. Our methodology permits observation of population-level trends in propensities for symbolic versus substantive adoption of LEED certification, without requiring nuanced environmental performance data on the numerous metrics addressed by the green building program.

These methodological advantages are not without limitation: We cannot control for rival explanations as in a traditional multivariate analysis. Rival explanations could arise from two potential sources. First, the financial and housing crisis disrupted real estate development markets and limited capital for new buildings in the middle of the study period. Second, risk aversion among late adopters is often elevated (Kennedy & Fiss, 2009) and may drive organizations to "buffer" their LEED scores. In any case, the trends toward more certification, toward higher certification tiers, and toward higher scores within tiers over time all suggest improving environmental performance.

Our findings offer several areas for future research in business strategy and sustainability. First, behavioral strategy scholars should more closely examine the role of thresholds in determining how a firm responds to regulations and standards. This could help further disentangle the differentiation, legitimation, and risk aversion mechanisms driving the dynamics of business strategy with respect to the environment. Second, our results do not provide insight on the environmental significance of the improvements achieved through LEED certification. Past studies assessing energy performance suggest LEED buildings are more energy efficient (Asensio & Delmas, 2017; Da Silva & Ruwanpura, 2009; Wu et al., 2016), but the RTT findings in this study suggest elevated environmental performance among recently certified LEED buildings, extending the scope of positive environmental impact. This may have practical environmental implications, and policy implications for the design of voluntary standards that leverage competitive markets to mitigate habitat loss, urban sprawl, heat islands, and even climate change.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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