THE CO-EVOLUTION OF INDUSTRIES, SOCIAL MOVEMENTS AND INSTITUTIONS: WIND POWER IN THE UNITED STATES

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ABSTRACT

This study extends theory on the process of industry emergence by developing and testing a co-evolutionary model of the interdependent relationship between social movement organizations (SMOs), institutions, and industries in the context of the U.S. wind energy industry. While extant research suggests that SMOs can influence institutions and the path of emerging industries, we show that the growth of an industry, and industry related knowledge, can also impact the diversity of social movements by motivating the participation of specialist SMOs. This new population of SMOs deploys distinct knowledge, capabilities, goals and strategies to produce institutional changes that are necessary for the continued growth of the industry. Our findings have important implications for understanding the complex, interdependent relationships among industry emergence, social movement diversity, and institutional change.

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1. INTRODUCTION

Recent decades have witnessed the emergence and rapid growth of industries that offer products and services that mitigate social and environmental problems (Dacin et al. 2011, Dean and McMullen 2007, Kistruck et al. In Press, Mair and Martí 2006, Miller et al. 2012). Examples include the recent growth of the renewable energy (Russo 2003, Wiser and Bolinger 2008), natural foods (Hess 2004, Lee 2009), and green building industries (Eichholtz et al. 2010, Hoffman and Henn 2008). While demand for such offerings is rising (Maestas 2012) these emerging industries often confront conditions of market failure (Dean and McMullen 2007, Pigou 1932). Under these circumstances firms are unable to fully reap the rewards of their socially responsible practices because these come at a cost not borne by competitors. As a consequence, firms in such emerging industries often benefit from the mobilization of social movement organizations (SMOs) (McCarthy and Zald 1973, Zald and McCarthy 1986) that work to build legitimacy and support for them (Rao 1998, Rao et al. 2003). SMOs challenge the logics of competing and established industries whose practices are misaligned with the movement's goals (Hiatt et al. 2009) and help institutionalize new policies and norms in ways that favor the growth of the emerging industry (Rao 1998, Tolbert et al. 2011). Social movement activities have been linked with the rise of industries that promote social change including, but not limited to, the recycling (Lounsbury et al. 2003), wind energy (Sine and Lee 2009), consumer watchdog (Rao 1998) and organic food industries (Hess 2004).

To date, the literature in social movements and industry emergence has treated SMOs as exogenous actors that enter the field to contest and disrupt established logics and advocate those carried by the new industry (for a review see Tolbert et al. 2011). However, this important insight does not fully account for the complexity and dynamic character of the relationship between social movements, institutions, and industry emergence (Schneiberg and Lounsbury 2008). In this study, we develop and test a co-evolutionary model that considers the interdependence and mutual influence of SMOs, institutions, and an emerging industry. Co-evolution “refers to the simultaneous evolution of entities and their environments" (Porter 2006: 479) and is defined as a process in which environmental transformation and changes in populations interplay through time, mutually influencing one another (e.g. Baum and Singh 1994, Djelic and Ainamo 1999, Lewin and Volberda 1999, McKelvey 1997, 2002). We empirically test our co-evolutionary model in the context of the U.S. wind energy industry.

Employing our co-evolutionary model, we suggest that just as movement activism influences the development of institutions (e.g., policies) that promote new industry growth (Lounsbury et al. 2003, Rao 1998, Sine and Lee 2009, Weber et al. 2008), so continued industry growth also influences the structure of social movements by contributing to the emergence of a specialized type of SMO. These specialist SMOs arise because; 1) the emergence of the industry provides them with opportunities to promote their social goals, which are inherently tied to the industry's technology, and 2) they possess unique knowledge and capabilities that enable them to supplement the efforts of generalist SMOs. Building from extant sociological work on technology and social movements (Hess 2005, 2007), we characterize these organizations as *technology-focused SMOs* (TSMOs). A TSMO is defined as a specialized SMO that exclusively focuses on supporting the development and adoption of a specific technology to advance its social goals. In this study, we examine the emergence of a group of TSMOs that supported clean energy (renewable energy and energy efficiency) technologies. We refer to these organizations as "clean energy TSMOs". As we discuss below, clean energy TSMOs differ from generalist environmental SMOs in their knowledge, capabilities, goals, and strategies. We propose that TSMOs are an important driver of institutional change and industry growth; we find that these organizations engage in institutional work (Lawrence and Suddaby 2006) to both promote the nascent emerging industry (institutional maintenance) and establish new technology-supporting institutions (institution creation). This work stabilizes and enables the continued evolution of the industry, creating an interdependent cycle of influence between industry emergence, social movement diversity, and institutional change.

We make several contributions to the literature on social movements and industry emergence. First, while this literature has considered the relationship between movement participation, institutions, and industry growth (Lounsbury et al. 2003; Sine and Lee 2009), to our knowledge, we are the first to find that additional industry growth may depend upon the emergence of specialized SMOs that maintain and promote new institutional arrangements. Further, our results suggest that TSMOs leverage distinct knowledge, capabilities, and strategies to provide support that generalist SMOs are less likely to provide. Finally, by offering a more complete model of industry evolution that includes the interdependent relationships between industries, social movements and institutions, this study highlights the importance of broadening our understanding of the institutions, institutional work, and types of SMOs that affect industry emergence. We emphasize that emerging industries do not only depend on generalist SMOs, as typically described in the literature, but on specialized SMOs (specifically TSMOs) whose origins may be dependent on the industry itself.

Second, our study also contributes to the broader social movement literature (e.g. McCarthy and Zald 1977, Soule and King 2008). While scholars have long recognized the complex heterogeneous structure of social movements (e.g. Johnson 2008, McLaughlin and Khawaja 2000, Soule 2012, Soule and King 2008), the literature has not addressed how the diversity of social movements evolves in response to changing environmental conditions, such as industry emergence. As Tolbert and her colleagues have noted, "…the reciprocal relation, the impact of entrepreneurial activity on the trajectories of social movements, has been almost entirely neglected" (2011:1337). Our co-evolutionary model extends beyond the boundaries of social movements to examine relationships at the organizational field level, enabling us to consider the interdependencies among social movement populations, institutions, and emerging industries. In doing so, we extend the social movement literature's competition-based explanation of SMO diversity. Whereas Resource Mobilization theory (RMT) (McCarthy and Zald 1977) and Resource Partitioning Theory (RPT) (Carroll 1985) each explain SMO diversity as the result of competition (Soule and King 2008; Soule 2012), we propose that the emergence of specialized SMOs (TSMOs) may also be explained by the availability and possession of specialized knowledge that serves to promote a particular technology, offering a complementary model of SMO diversity.

Third, our co-evolutionary model extends current conceptualizations of the relationship between social movements, emerging industries, and institutions. Although the co-evolutionary perspective has been used to study processes of change in technological-industrial systems (Geels 2005, Malerba 2002, Murmann and Homburg 2001, Ruttan 2000), relatively few have heeded the call (Koza and Lewin 1998, Lewin et al. 1999, Lewin and Volberda 1999) for a co-evolutionary perspective on organization-environment interactions. Despite the fact that Lewin and colleagues identify social movements as one of the important co-evolutionary "forces of change that are ushering in the postindustrial age" (1999: 544), the few studies that do take a co-evolutionary view of industry emergence (Djelic and Ainamo 1999, Jones 2001, van de Ven and Garud 1993) have paid little attention to the role of social movements. We fill this gap by modeling the co-evolutionary process of social movement influence on an emerging industry. Fourth, our quantitative analysis, which uses instrumental variables in a two stage least-squares (2SLS) simultaneous equation model (Bascle 2008, Greene 2003) is, to our knowledge, the first to systematically address the endogeneity present in the relationship between these industries, social movements, and institutions.

In sum, this study demonstrates a co-evolutionary process of industry emergence, social movement diversification, and institutional change, addressing the call for analysis that examines both the origins and outcomes of social movements (Schneiberg and Lounsbury 2008) and the reciprocal relationship between industry emergence and social movements (Tolbert et al. 2011).

In the following sections, we first review the literature on social movements, institutional change and new industry growth. We then develop our theory and hypotheses using a co-evolutionary perspective to model the mutually influential relationships between social movements, institutions and emerging industries. Subsequently, we test our model through a quantitative analysis of the wind energy industry for all U.S. states for the period 1999-2008. We conclude with a discussion of our results and opportunities for future research.

2. THEORY AND HYPOTHESES

2.1. Social Movements and Industry Emergence

In recent years, management scholars and sociologists have examined the social contentiousness of markets (e.g. Fligstein 1996, 2001, King and Pearce 2010, Rao et al. 2000, Tolbert et al. 2011), recognizing that emerging industries are inherently tied to, and shaped by, social forces. This perspective often examines how social movements, defined as "organized collective endeavors to solve social problems" (Rao et al. 2000, p. 244), intervene in the market system to bring about social and institutional change (King and Pearce 2010). Social movements have been shown to contest the practices of incumbents in existing markets and drive the institutionalization of emerging industries whose products help to solve social issues (Hiatt et al. 2009, Rao 1998). Emerging industries, defined as industries that are still in the growth phase and have not stabilized in sales or firm numbers (Aldrich and Ruef 2006, Klepper and Graddy 1990), face the liability of newness (Stinchcombe 1965) and encounter challenges in gaining critical resources and legitimacy for their practices (Zimmerman and Zeitz 2002, Zott and Huy 2007). In this context, social movement activism can become an important source of industry legitimacy and help to ensure the continued survival and growth of the industry (Aldrich and Fiol 1994).

Prior studies in the area of social movements and industry emergence have considered how movement actors mobilize resources and provide supporting infrastructures such as social networks (Swaminathan and Wade 2001), alliances (Lounsbury and Glynn 2001, Sine et al. 2005), and collective action frames (Benford and Snow 2000, Lounsbury et al. 2003) that help establish new industries addressing underlying social issues. These actions provide normative justification for the industry's offerings, effectively altering systems of values and beliefs that are aligned with the industry's products or services (Hiatt et al. 2009, Wiser and Bolinger 2008).

In addition to fostering normative legitimacy for emerging industries, social movements frequently promote new formalized institutions, such as government regulations, that impose changes in the practices of incumbent firms (Russo 2001, Sine et al. 2007) and favor the competing technologies of an emerging industry (e.g. Bartley 2003, Schneiberg and Bartley 2001, Sine and Lee 2009). These changes are fostered through social movement organizations (SMOs) (e.g. Hiatt et al. 2009, Rao 1998, Sine and Lee 2009), which are "complex, or formal, organizations which identify their goals with the preferences of a social movement or a countermovement and attempt to implement those goals" (McCarthy and Zald 1973: 1218). For example, in the energy industry, environmental SMOs actively attempt to alter the practices of electric utilities, which rely mostly on fossil fuel-based technologies. These SMOs are primarily motivated by ecological goals which emphasize environmental conservation and preservation (Johnson 2008, McLaughlin and Khawaja 2000). In pursuing their agendas, these organizations often advocate institutional arrangements that force increased incumbent utility adoption of renewable energy (Sine et al. 2005).

In this paper we develop and test a co-evolutionary model of industry emergence. Prior studies portray the influence of social movements on industry emergence as a unidirectional process initiated by social movements, which alter institutions to support the stability and growth of the emerging industry. We offer a richer conceptualization that describes the ongoing mutual influence among industry emergence, social movement diversity, and institutional change over time. Our co-evolutionary model captures not only the influence of social movements on emerging industries, but also the impact of industry emergence on the diversity of SMOs, as well as the repercussions of this diversification for the industry.

2.2 A Co-evolutionary Process of Industry Emergence

Co-evolution has been identified as a process in which environmental transformation and changes in populations interplay through time, mutually influencing one another (e.g. Baum and Singh 1994, Djelic and Ainamo 1999, Lewin and Volberda 1999, McKelvey 1997, 2002). With origins in ecology, co-evolutionary theory extends Darwin's understanding of evolutionary processes by considering how change is driven by the interaction of distinct subjects (e.g., species, people, organizations, or populations) that have the ability to adapt and mutually influence each other's evolutionary paths (McKelvey 2002). Drawing from this perspective, organizational scholars have suggested that organizations, populations, and their environments co-evolve through a complex system of interdependencies (Lewin et al. 1999, Lewin and Volberda 1999) in which changes in one element can simultaneously impact the path of others in the system.

Co-evolutionary processes take place at multiple levels of analysis (Koza and Lewin 1998, Lewin and Volberda 1999, McKelvey 1997, 2002); organizational populations co-evolve with each other and with their changing environments (Koza and Lewin 1998, Lewin et al. 1999, Lewin and Volberda 1999). Co-evolutionary perspectives therefore consider not only the organizational populations of interest, but the institutional arrangements in which these populations are embedded (Lewin et al. 1999). Institutions are the formal and informal rules that constrain and enable organizational action, and include both instrumental (technical-economic) and normative criteria (North 1991, Scott 1995, Suchman 1995). They range from conventions to formalized rules such as government policies (North 1991). Because institutions define the constraints and opportunities that organizations face, they are an important force within co-evolutionary processes (Djelic and Ainamo 1999, Lewin et al. 1999).

We seek to build and test a co-evolutionary model of industry emergence and growth that addresses the interdependencies between organizational populations (specifically, industries and social movements) as well as the interdependencies between these populations and institutions affecting an organizational field. Organizational fields are "*relational spaces* … where disparate organizations involve themselves with one another" to debate and address issues of common concern (Wooten and Hoffman 2008, p. 138). They consist of many different organizational populations, including industries and their stakeholders (e.g. Phillips et al. 2000). This process of debate plays an important role in legitimating (or not) new industries reliant on product or process innovations (Aldrich and Fiol 1994).

Several prior studies of industry emergence have adopted co-evolutionary perspectives to describe the complex interdependence between organizations, institutions and technological development in organizational fields (e.g. Djelic and Ainamo 1999, Jones 2001, van de Ven and Garud 1993, van de Ven and Garud 1994). These studies find that "environmental transformation and organizational change have fed upon each other" (Djelic and Ainamo 1999:622) across a range of contexts, including the American film industry (Jones 2001), international fashion (Djelic and Ainamo 1999), and medical technology (van de Ven and Garud 1993). However, the role of social movements in co-evolution has not been examined.

2.3 Social Movements and Industry Emergence: A Co-Evolutionary Approach

As described above, the extant literature depicts social movements as exogenous forces that intervene in the organizational field to bring about institutional change, which contributes to the growth of emerging industries (Hiatt et al. 2009, Schneiberg and Lounsbury 2008, Sine and Lee 2009). Like the broader social movements literature (Berry 1977, Edwards and Foley 2002, McCarthy and Zald 1977, Soule 2012), the literature linking industries and movements has focused on generalist SMOs (such as the Sierra Club in the environmental movement) that employ a wide range of advocacy and protest tactics to promote government policies, often mandating changes in incumbents' behavior (e.g. Edwards and Foley 2002, Sine and Lee 2009). However, this research tells us little about the continuing process of industry and social movement co-evolution. How might emerging industries and social movements mutually influence each other's evolution over time?

One way that social movements evolve is through tactical and goal specialization amongst SMOs. While social movement scholars often apply organizational ecology to explain the evolution of social movement diversity (e.g. McLaughlin and Khawaja 2000, Minkoff 1997, Soule and King 2008), these studies focus on the population of social movements, rather than the larger organizational field in which they engage. The overall findings of this literature are that as the density of a social movement increases, specialization is more likely to occur, and that movement centrality will positively influence the survival of such specialists (for a review see Soule 2012). These studies focus on competitive dynamics within SMOs, but they do not address the question of how SMO diversity affects other populations in the organizational field and achievement of movement goals. Yet these are critical considerations for understanding the role of social movements in industry emergence. Taking a co-evolutionary perspective, we propose that the emergence of new industries reciprocally influences the diversity of social movements, which in turn further influences the institutional environment and subsequent growth of the industry. This process is illustrated in Figure 1.

Insert Figure 1 about here

In Figure 1, the relationships explained by the extant literature on social movements and industry emergence are labeled as "1" (the influence of SMOs on the incidence of mandatory regulations on incumbents) and "2" (the influence of incumbent regulation on the growth of industries which address social and environmental problems). We extend this established model by proposing that industry growth and industry-related knowledge in turn alters the composition and diversity of the SMOs that participate within the social movement, over and above the effect of SMO density. Specifically, we argue that industry growth brings about the emergence of specialized SMOs that promote their social agendas by applying technology-specific knowledge and capabilities to legitimate the emerging industry's technology. These specialized SMOs in turn drive further institutional maintenance and change, promoting additional industry growth.

The core of our argument is that technology-focused SMOs (TSMOs) emerge to house and coordinate technology-related knowledge and capabilities which generalist SMOs do not possess and cannot efficiently acquire. TSMOs employ this specialized knowledge to contribute to the social movement by helping to maintain and promote new institutions that support emerging industries utilizing their preferred technology. While in our model we hypothesize each of the relationships among industries, social movements, and institutions individually, we consider each to be a part of a co-evolutionary system of change. We assume that the hypothesized relationships do not take place in isolation, and are instead interdependent upon other changes in the system.

Clearly generalist SMOs may have goals that overlap with TSMOs, and also support emerging industry; however, we propose that TSMOs play a distinct and critical role. In Table 1, we compare a proto-typical TSMO to the typical generalist SMO (Edwards and Foley 2002, Soule and King 2006). Our comparison reveals that while TSMOs and generalist SMOs both play important roles in local and regional processes of institutional change, they tend to possess distinct types of knowledge and capabilities and pursue distinct goals and strategies. These differences are summarized in Table 1, and inform the formation of our hypotheses in the following sections.

Insert Table 1 about here

As we develop a co-evolutionary process of industry emergence below, we illustrate our arguments through examples from within the clean energy movement in the state of Colorado. To clarify, we do not intend these examples as evidence, but rather utilize them to ground our theory and bring it to life. These examples are derived from sixteen interviews with firm founders, activists and utility representatives, as well as analysis of 546 newspaper articles related to the key term "wind energy" from the Denver Post, the largest newspaper in Colorado. We chose to examine clean energy in Colorado because the state had: 1) a high concentration of both generalist SMOs and TSMOs over the period of our study and 2) experienced significant changes in renewable energy policy and wind energy growth between 1999 and 2008. While we saw similar patterns in other states, a multi-state comparison was beyond the scope of this study. All of the example organizations are included in our statistical analysis. We summarize our observations from Colorado in Table 2.

Insert Table 2 about here

2.3.1 Social Movement Diversity Influenced by Industry-level Forces: **The Origins of TSMOs**

Social movements are commonly characterized as heterogeneous phenomena. Although the SMOs comprising a movement share common broad goals, they may differ with respect to the specific goals they pursue, the strategies they utilize (Edwards and Foley 2002, Johnson 2008, McCarthy and Zald 1977, McLaughlin and Khawaja 2000, Soule and King 2008), and as we will discuss, their knowledge and capabilities. Following Soule and King (2008), we conceptualize SMOs as either generalists which articulate multiple, broad goals, or specialists, that pursue narrowly defined goals (Soule and King 2008). The social movements literature typically describes generalist SMOs as primarily undertaking advocacy-related work such as influencing public opinion and policy (Andrews and Edwards 2004, Edwards and Foley 2002, Johnson 2008), rather than other generalist activities related to research or fund raising. Soule and King offer the helpful examples of the Sierra Club as an environmental generalist SMO (focused on the broad goal of environmental preservation) and Save Our Cumberland Mountains as a specialist SMO (focused on the specific goal of reducing sulfur dioxide emissions by the TVA). These organizations differ in their foci, yet they are both considered part of the environmental social movement (Soule and King 2008: 1573).

Current explanations of SMO specialization within a movement focus primarily on competition for resources, such as contributions of time and money from supporters (McCarthy and Zald 2001, Zald and McCarthy 1980). RMT explains that SMOs specialize so they do not have to compete (McCarthy and Zald 1977); thus, specialization can be seen as the direct result of competition within the social movement. RPT also explains SMO diversity from a competitive perspective, suggesting that higher market concentration creates room for generalists and specialists to compete in distinct segments (Carroll 1985). Soule and King (2008) offered empirical support for these predictions in their study of SMO specialization in New York, finding that the greater the density of SMOs active within a movement, the greater the goal and tactic specialization amongst SMOs.

We propose that beyond competitive pressures, SMO diversity may also co-evolve with the growth of an emerging industry. We define an emerging industry as one that has not reached stability or maturity, i.e., the number of firms and total industry sales are still growing (Aldrich and Ruef 2006, Klepper and Graddy 1990). When emerging industries seek to commercialize new technology, and that technology mitigates a social or environmental problem, conditions are ripe for SMOs to align with the emerging industry. Specifically, industry growth creates an opportunity for the rise of specialized, *technology-focused SMOs* (TSMOs) (Hess 2005, 2007) which concentrate exclusively on fostering "change in technology, products or material culture" (Hess, 2005: 516) in order to advance the goals of the social movement (Hess 2005, 2007).

Examples of TSMOs, and the emerging industries they support, include Danish nonprofit organizations which provide technical assistance to small-scale wind project developers and lobby for policies promoting wind energy (Hess 2005) to address human-induced climate change; groups that promote standardization and policies for organic farming (Hess 2004, Lee 2009) as a solution to the environmental and health impacts of pesticide use; and supporters of homebirth and drug-free childbirth as methods to educate the public on health issues experienced by mothers and newborns during standardized "medical" births (Mathews and Zadak 1991, O'Connor 1993). While each of these TSMOs focuses on a specific technology (renewable energy, organic farming, drug-free birth respectively) they retain membership in and align with the goals of larger social movements (environmentalism and natural health care respectively).

TSMOs arise to promote the technologies offered by industries, but not the industries themselves. TSMOs support emerging industries because they bring to market a favored technology, but will withdraw that support if the technology is no longer employed. For example, although TSMOs supporting organic agriculture (a specific technology) were early proponents of the organic foods industry, as the industry became highly commercialized and advocated a minimal standard for organic farming, many of these organizations turned their support towards localized farming, and criticized the large-scale offerings of the "organics industry" (Hess 2004).

We propose that TSMO emergence within a social movement depends not only upon the emergence of an industry utilizing technology that is supported by the TSMO, but also upon the availability of technological knowledge and capabilities related to the emergent industry.

Industry-Related Knowledge and TSMO Emergence. New organizational types often come to exist because of their superior efficiency in coordinating and integrating knowledge (Grant 1996, Kogut and Zander 1992, Nickerson and Zenger 2004). This phenomenon has been mostly studied by strategic management scholars with the intent of understanding why new types of firms may be required to coordinate specialized knowledge, which is necessary for the production of goods and services (Grant 1996, Kogut and Zander 1992, Nickerson and Zenger 2004). This perspective assumes that production requires the input of specialized knowledge, and that given efficiency gains in specialization, a fundamental task of organizations is to coordinate the efforts of specialists (Grant 1996). Organizations exist to integrate the specialized knowledge possessed by a number of individuals because this type of integration cannot be performed as efficiently in alternative arrangements (Grant 1996). In addition, different organizational types are necessary to solve particular problems. In the context of firms, managers must identify valuable problems and search for solutions to these problems in a way that optimizes speed and cost (Nickerson and Zenger 2004). This search often requires extensive information sharing and the use of "common shared languages" that can be housed within distinct organizational types that have efficiency advantages in the creation and sharing of knowledge (Nickerson and Zenger 2004).

Similar to firms, SMOs are in a constant quest for problem resolution and must do so in an efficient manner. Although SMOs are primarily motivated by social goals, they are bounded by limited resources and must therefore consider the efficient utilization of such resources in order to survive (McCarthy and Zald 1977, Zald and McCarthy 1980); this implies that, similar to firms, specialized SMOs must manage and integrate knowledge and exist to do so in a way that is superior to generalist SMOs (Zald and McCarthy 1987). TSMOs in particular search for solutions within the space of the technologies that they promote; thus TSMOs arise when individuals recognize an opportunity to contribute to the achievement of social movement goals by efficiently producing and using technology-specific knowledge. This knowledge allows TSMOs to form a shared language around those technologies, which enables more effective integration and combination of knowledge. In addition, difficulties in integrating knowledge across a variety of problems or issues may call for SMOs that specialize in particular issues or technologies. As such, the boundaries of TSMOs may exist across technological spaces, as these organizations seek to minimize coordinating efforts around the management of technology-specific knowledge. We suggest that TSMOs form to coordinate knowledge related to a new industry's technology and promote it as a solution to social problems. They are built around the availability of industry-related knowledge that can be housed and coordinated within their boundaries.

For example, clean energy TSMOs possess specialized knowledge and capabilities regarding renewable energy and energy efficiency engineering, education and financing. As shown in Table 2, the Colorado Clean Energy Cluster fosters networks and partnerships to assist new renewable energy firms to obtain funding in the startup phase. TSMOs also may interact directly with end-users to provide technical expertise on the adoption of the technology. For example, Community for Sustainable Energy provides "technical assistance and financing to residents and small businesses" in its efforts to increase adoption of renewable energy.

In contrast, generalist SMOs tend to develop knowledge and capabilities in areas in which they enjoy advantages of scale and scope, and therefore efficiency (Soule and King 2008); As shown in Table 2, these areas include fundraising, mobilizing members, and insider politics (Edwards and Foley 2002). Generalist SMOs seek to build large resource bases – of funding, members, personnel and knowledge -- and develop capabilities that enable them to deploy these resources across a range of issues (Edwards and Foley 2002); therefore they are unlikely to try to effectively leverage technology-specific knowledge.

It is the need for specialized support of an emerging industry, the availability of technological knowledge, and the inability of generalist SMOs to leverage such knowledge that encourages TSMO emergence. In Colorado, the case of Western Resource Advocates (WRA), a generalist environmental SMO, and Coalition for New Energy Technologies (CNT), a clean energy TSMO, illustrates this point. WRA was a key proponent of regulatory policies governing the use of renewable energy in Colorado. However, once these policies were established, WRA reallocated resources to issues such as the management of public lands and hydraulic fracturing rather than attempting to develop specialized knowledge related to renewable energy (WRA, 2012). Further, it provided start-up funding to CNT, a TSMO that focused exclusively on building clean energy incentives and technological knowledge in Colorado. This example illustrates how differences in knowledge and capabilities may influence SMO diversity and illustrates our hypothesis that:

> *H1: There is a positive relationship between the availability of technological knowledge related to an emerging industry and the participation of technology-focused SMOs that support that industry.*

Emerging Industry Growth and TSMO Emergence. The reliance of TSMOs on technological knowledge related to an emerging industry has implications for the goals they pursue. Consistent with their knowledge and capabilities, generalist SMOs tend to broadly frame their goals. For example, as indicated in Table 2, Environment Colorado states its goal as "tackling [the state's] top environmental problems", while "protecting public lands" and "ensuring water quality" are among the Colorado Environmental Coalition's goals. In contrast, TSMOs focus on technology adoption as a means to address social issues; this focus leads to significant overlap in goals with emerging industries. Science and technology studies scholars have observed this alliance between social movements and emerging industries, termed "private-sector symbiosis" in the alternative cancer therapy, renewable energy, open-source software (Hess 2005) and organic foods (Hess 2004) industries. While TSMOs share the broad goals of their social movement, they focus on the adoption of the technology they advocate. Table 2 indicates, for example, that the goal of the Colorado Clean Energy Cluster is to "attract, incubate and grow clean energy enterprises…in order to catalyze economic vitality and generate community and environmental benefits."

Thus, social movements and emerging industries co-evolve; emerging industry growth may signal an opportunity for diversification of a social movement through the emergence of TSMOs; this creates changes in the diversity of social movements related to the industry. As an industry grows and its technology and products begin to gain acceptance, TSMOs have the opportunity to advance their social agendas, which are directly tied to the industry's technology. The growth of the industry signals the viability of the commercialization of the new technology, and that an opportunity exists for TSMO to promote their social agendas by providing aid to the emerging industry which, despite initial growth and assistance by generalist SMOs, may continue to be vulnerable to powerful opposition. Consistent with this, we hypothesize:

H2: There is a positive relationship between the growth of an emerging industry and the participation of technology-focused SMOs that support the industry.

While TSMOs tend to engage in private-sector symbiosis, they can and should be distinguished from trade associations in numerous ways. First, their membership is composed of a diverse array of constituents, and not exclusively of industry members. Second, although like trade associations TSMOs support industry growth, their goals are aligned with the broader social movement mission. Third, TSMOs rely on a variety of funding sources that range from private citizen donations and foundation support to government funding and grants. To distinguish between TSMOs and trade associations, it is helpful to contrast the diverse funding sources of the TSMOs included in Table 2 with the American Wind Energy Association (AWEA). AWEA is a nationally recognized wind industry trade association, funded solely by wind energy firm membership, which focuses only on wind power but not other renewables, represents the wind industry's interests alone, and works primarily at the national rather than local level (AWEA 2011).

2.3.2. TSMOs as a Force for Further Institutional Change and Industry Growth

Co-evolutionary processes must examine "change over time by using multiple levels of analysis" to "unpack complex processes such as how new industries, their institutional rules, and their competitive dynamics emerge and change" (Jones 2001). Having explained how knowledge availability and industry emergence positively influence the emergence of TSMOs, we now examine how the resulting social movement diversity can lead to further institutional change and industry evolution. TSMOs employ their specialized knowledge and capabilities to promote the further growth of the industry through strategies that can be differentiated from those of generalist SMOs. TSMOs may support the growth of an emerging industry by engaging in two types of institutional work (Lawrence and Suddaby 2006): 1) they *maintain* existing industry-supporting institutional structures by generating credibility and visibility for the technology and 2) they *create* new institutions that are necessary for the continued growth of the industry (Pacheco et al. 2010).

TSMOs and Institutional Maintenance. TSMOs employ their specialized knowledge to help create cultural-cognitive legitimacy ("taken-for-grantedness") for the technologies that they support (Scott 1995). Efforts such as informational campaigns through media channels create a greater sense of familiarity with, and thus legitimacy for, an emerging industry's technology. Through such initiatives, TSMOs "embed and routinize" (Lawrence and Suddaby 2006) the broader logics promoted by the social movement into the public's perception. As the industry grows, TSMOs undertake this task because of their efficiency and effectiveness relative to generalist SMOs in using technology-specific knowledge to campaign in favor of the industry. Because TSMOs have distinct knowledge of the technologies they promote, they are often able to foster relationships with media sources that allow a forum for promotion and expertise. One clean energy TSMO founder we interviewed described how her organization "gets lots of comments and quotes for different articles...We have very good relations with CoBiz Magazine…it represents how we worked with the press to get excitement and energy" around renewable energy.

The critical role of institutional maintenance is more likely performed by TSMOs rather than generalist SMOs because of TSMOs' commitment to specific and narrow goals. TSMOs tend to be involved only in those issues that relate to their technology-specific knowledge. For example, the Four Corners Office for Resource Efficiency (4CORE), a clean energy TSMO in Colorado, works to develop clean energy-based regional plans for job creation and business attraction by encouraging "the community to integrate…. renewable energy in their daily lives." Like the other TSMOs in Table 2, 4CORE addresses the issue of clean energy but is not distracted by other environmental issues.

Generalist SMOs have a much wider scope of activities. As seen in Table 2, in addition to working on clean energy and the related issues of air quality and climate change, WRA employs its legal and organizing capabilities to address the issues of endangered species, river preservation, water conservation, and the environmental impacts of hydraulic fracturing. Thus, their widely applicable knowledge and capabilities in law and advocacy are applied to a variety of issues over time, leaving TSMOs to maintain momentum for the emerging industry.

In promoting the industry to the general public, TSMOs help stabilize the institutional environment and increase the legitimacy of the emerging industry, which is essential for accessing critical resources (Chiu and Sharfman 2011) and engendering collective learning (Aldrich and Fiol 1994, Zimmerman and Zeitz 2002). This promotion can propel the subsequent growth of the industry (Sine et al. 2007, Sine et al.

2005) and continue the co-evolutionary process between social movement diversity, institutional change, and industry emergence. Accordingly, we hypothesize:

> *H3a: There is a positive relationship between the participation of technology-focused SMOs and public awareness regarding an emerging industry's practices.*
>
> *H3b: There is a positive relationship between public awareness of an emerging industry's practices and the growth of the industry.*

TSMOs and the Creation of Institutions. As noted, TSMOs have the focused goal of stimulating the adoption and diffusion of specific technologies that they believe will address social or environmental problems (Hess 2005). Clean energy TSMOs are an example of this type; they focus exclusively on the adoption of "clean" energy technologies such as renewables (including wind), energy efficiency, and energy conservation. Because of these differences in their goals, knowledge, and capabilities, TSMOs tend to pursue different strategies, and thus, to advocate for different types of institutional changes than those pursued by generalist SMOs.

For example, in Colorado, the Partnership for Sustainability employs the strategy of "approval and administration of zero-interest loans to individuals for installation of renewable energy in their homes and businesses" (see Table 2). In contrast, generalist SMOs seek to achieve their broad goals primarily by employing the knowledge and capabilities in which they enjoy scale and scope advantages. They seek to advocate public agendas for addressing problems (Edwards and Foley 2002) by ensuring that particular institutional arrangements and practices come to be socially constructed as unjust or harmful. For example, the Colorado Environmental Coalition engages in "promoting common sense policies in the state legislature (and) coordination of citizens and other non-profits to contact policy makers", Environment Colorado seeks to use "petitions and campaigns targeted to policy makers."

Conversely, TSMOs' strategies involve less emphasis on the politics of protest and more on "building and diffusing alternative forms of material culture" (Hess 2005: 516). Given this focus, we suggest that TSMOs tend to advocate incentives such as grants, subsidies, and tax credits that spur the diffusion of an emerging industry's technology. A government representative we interviewed attested to the policies pursued by TSMOs in Colorado stating they "…know how to connect the dots…to have the right markets…to have the right kind of technology out there …they interact closely with legislators."

TSMOs' promotion of these incentives continues the co-evolutionary process between the industry and the social movement. As the growth of industry, and industry related knowledge, drives diversity in a movement, specialized TSMOs emerge to drive further institutional change beyond that fostered by generalist SMOs. These institutional changes provide competitive advantages to the new industry, grant it further legitimacy, and therefore propel continued co-evolutionary change and industry growth. Following this rationale, we hypothesize:

H4a: There is a positive relationship between the participation of technology-focused SMOs and the incidence of market incentives related to an emerging industry's technology.

H4b: There is a positive relationship between market incentives for an emerging industry's technology and the growth of the industry.

The Distinct Role of TSMOs. We have argued that institutional work by TSMOs raises awareness and promotes market incentives, contributing to the co-evolutionary process of industry emergence. In sum, TSMOs possess the knowledge and capabilities (Cohen and Levinthal 1990) required to perform this work; generalist SMOs generally work towards broader goals, such as general environmental conservation, and do not have the strategic intent of initiating industry-specific campaigns. For example, as observed in Table 2, Environment Colorado, a generalist SMO, seeks to "overcome the opposition of powerful special interests and win real results for Colorado's environment." In contrast, the Community for Sustainable Energy, a TSMO, encourages support "for policies for renewables including financing and incentives". As outlined in Table 2, TSMOs and generalist SMOs differ in their knowledge and capabilities, and these differences have implications for their goals, strategies, scope of activity, and funding sources. TSMOs specifically focus more on narratives and institutions that promote the emerging industry, whereas generalist SMOs focus on advocacy for regulations of incumbent industries and firms. Hence, we hypothesize:

H5a: The relationship between the participation of technology-focused SMOs and public awareness of an emerging industry's practices is stronger than the relationship between the *participation of generalist SMOs in the movement and public awareness of the emerging industry's practices.*

H5b: The relationship between the participation of technology-focused SMOs and the incidence of market incentives related to an emerging industry's technology is stronger than the relationship between the participation of generalist SMOs in the movement and the incidence of market incentives related to an emerging industry's technology.

Collectively, hypotheses 3 (a and b), 4 (a and b), and 5 (a and b) highlight the importance of TSMOs to the continued growth of an industry, and distinguish their role from that of generalist SMOs; thus, our co-evolutionary model examines how institutional change and changes in populations interplay through time, mutually influencing one another (e.g. Baum and Singh 1994, Djelic and Ainamo 1999, Lewin and Volberda 1999, McKelvey 1997, 2002), and supporting industry emergence.

3. METHODS

3.1 Sample and Context

We conduct our analysis on the U.S. wind energy sector for various reasons. First, the link between social movements and wind industry emergence has been established in prior work (Sine and Lee 2009, Vasi 2009). Second, the total number of TSMOs in the U.S. dedicated to renewable energy and energy conservation has exploded; between 1989 and 2006, total revenues for this group increased over fourteen-fold, even as revenues for other environmental SMOs as a whole were steady (Straughan and Pollak 2008). Third, because clean energy TSMOs and generalist SMOs within the environmental movement are heterogeneously represented at the state level across the U.S., wind energy provides a unique context in which to explore the co-evolution of industry, TSMOs, and other SMOs. Fourth, because these organizational changes occurred alongside the proliferation of state-based clean energy policies (Rabe 2006), we are also able to examine the co-evolution of institutions and organizational populations. Our data set covers the wind energy sector across all 48 contiguous U.S. states. We chose the state as the central unit of analysis because: 1) legislative action in favor of wind energy technologies has mostly taken place at the state level (Straughan and Pollak 2008) and, 2) many environmental SMOs are organized by geographic and jurisdictional boundaries and undertake state-level initiatives.

We test our hypotheses through a longitudinal study for the years 1999-2008 (up to 2007 for hypotheses H3 and H5a due to data limitations). This period brought an increased number of state-level legislative actions related to renewable energy, specifically Renewable Portfolio Standards (RPS) (Rabe 2006), which are described below. Moreover, the U.S. wind energy industry was an emerging industry during this period as it continued to experience significant growth without reaching stability (Aldrich and Ruef 2006, AWEA 2007, Klepper and Graddy 1990).

3.2 Data

Participation of TSMOs. Consistent with extant research in social movements (McVeigh et al. 2003), we used data from the National Center for Charitable Statistics (NCCS) to create a measure of clean energy TSMO participation. We coded the category "Renewable Energy and Energy Conservation" to create a count of the number of TSMOs registered in a state for a given year. To ensure that this category was comprised of clean energy TSMOs, we investigated the goals, strategies, knowledge, capabilities, scope and funding of the Colorado, Minnesota and Oregon organizations included in this category because these states have some of the largest relative populations of TSMOs. Through internet searches, analysis of organizations' web sites, and primary interviews in Colorado, we gained confidence that the organizations included in the Renewable Energy and Energy Conservation category are indeed TSMOs, and are a distinguishable type of SMO. A subset of this analysis is presented in Table 2 above.

Industry-Related Knowledge. To gauge the availability of wind energy industry-related knowledge in a state, we used data from the Consolidated Federal Funds Report that specifies annual federal spending on renewable energy research and development programs. Arguably, states that have more qualified labor and related knowledge in renewable energy technologies are more likely to receive such funds. This measure includes annual spending (in thousands of dollars) in a particular state in the following areas: Renewable Energy Research & Development (81.087); Regional Biomass Energy Programs (81.079); and two programs which have been eliminated (but have some spending during 1983-present): Solar Energy Partnership Support and Barrier Elimination (81.118, deleted in 2001). The final measure of this variable is based on thousands of dollars distributed annually to a particular state. This measure was subjected to a log transformation due to a pronounced positive skew in its distribution.

Wind Energy Growth. We measure the growth of the wind energy industry in a state through the total number of megawatts (MW) of wind energy installed capacity in that state for a given year. Data from the National Renewable Energy Laboratories were used to construct this measure.

Public Awareness of Wind Energy Industry Practices. To capture the extent to which the wind energy industry's practices and technology are known to the public, we used an annual count of articles on wind energy found in the top circulated newspaper in each state for all 48 states as reported by the Audit Bureau of Circulation. We identified wind industry articles by employing keywords that were selected based on a detailed assessment by multiple renewable energy experts. We constructed a final measure entitled "Ratio of Newspaper Articles" that expresses the annual number of newspaper articles on wind energy topics as a proportion of the average circulation of the newspaper. Due to limited accessibility of local newspaper content data, this measure is available only up to the year 2007.

Market Incentives. Our measure of market incentives is based on the sum of the cumulative state-level incentives that increase the attractiveness of wind power markets. These include financial rewards such as tax credits towards the purchase of wind energy technology and state-sponsored programs to attract new investments in the industry (e.g., grants, loans, and tax credits). Data from the Database of State Incentives for Renewables and Efficiency (DSIRE) were collected to construct this measure. Here again, the final variable required a log transformation.

Participation of Generalist SMOs. To measure the participation of generalist SMOs within the environmental movement in a state, we again relied on NCCS data to construct a variable of the number of registered "Alliances and Advocacy" non-profit organizations within the "Environmental and Conservation" group for a given state and year. We term this variable "*Advocacy Generalist SMOs*" within our methodology. The classification used for this variable is defined by the NCCS as including "Organizations whose activities focus on influencing public policy within the Environment major group area. [It] includes a variety of activities from…influencing public opinion to lobbying national and state legislatures". This classification is distinct and does not overlap with the "Renewable Energy and Energy Conservation" category described earlier. This definition of generalist SMOs corresponds to the definitions in prior studies (Soule and King 2008), as well as to the generalist Colorado environmental SMOs identified in Table 2. In addition, we used a measure of the sum of total assets of advocacy generalist SMOs in a state to gauge differences in the strength of these organizations across states and years. We conducted a robustness analysis that substitutes the count variable described earlier with this measure of strength and found consistent results throughout all the relevant models.

To further validate the robustness of our findings, we substituted our measure of advocacy generalist SMOs on all respective models with a measure of the sum of the number of all "other SMOs" participating in the movement. This measure considered all environmental SMOs registered in a state that are not listed in the renewable energy category described above. This enables us to contrast the distinct role of TSMOs in promoting an industry as compared to all other SMOs in a movement. Our findings for the models using this measure were statistically consistent with those employing the advocacy generalist SMO measure.

Control Variables. We included controls for the natural wind energy potential of a state in all models. To do so, we use a measure of the percentage of total electricity consumption in a state that could be produced with wind power (Elliot and Schwartz 1993). These data were not available for the states of Hawaii and Alaska, which prevented their inclusion in the analysis. Similarly, we control in all equations for the regulatory environment of electricity markets. In the U.S. the electric industry has experienced a trend towards deregulation and opening markets to competition that give consumers the ability to choose their electricity providers (Warwick 2002). Differences in the regulatory environment of a state could impact electric utility reliance on cleaner forms of energy (Delmas et al. 2006) and the overall involvement of state governments on energy markets (Warwick, 2002). To control for these effects, we include a categorical control variable at the state-year level that is coded as "-1" for regulated and "1" for deregulated states. Data for this variable come from the Energy Information Administration.

We used a variety of controls for each dependent variable of interest. First, when analyzing the participation of clean energy TSMOs we included controls for the participation of advocacy generalist SMOs as described above as well as for the annual growth rate of all other organizations in the environmental social movement. These variables allow us to control for the ability of related SMO populations to bring traction to new organizational forms such as TSMOs (Ruef 2000). As these populations grow and become more prevalent, it is possible that they might foster the development of novel forms that share similar identities (Ruef 2000). In addition, to control for the effect that other related industries might have on the emergence of TSMOs we control for the density of solar energy businesses in a state (number of establishments for a given state and year). Because solar energy represents another powerful force in the growth of renewable energy in the U.S. (NREL, 2010), we chose to consider its effect on greater social movement support. Finally, to control for the effect that the general availability of technical labor may have on the number of TSMOs, we include a variable that measures the number of science and engineering degrees that are granted annually in a state.

In our model that predicts awareness of the wind energy sector's practices, we applied controls for the organizational density of the wind energy sector which is measured as a count of the total number of wind energy companies in a state for a given year (Carroll and Hannan 1989, Hannan and Carroll 1992). We constructed this measure from the World Directory of Renewable Energy Suppliers and Services, which is the sole annual publication dedicated to providing a yearly summary of the renewable energy industry's trends and participants. We also control for educational attainment. Using the U.S. Census Bureau data we measure the percentage of a state population that has a bachelor's or higher college degree. Finally, to consider the effect that predominant political views may have on newspaper coverage, we control for whether a state legislature is controlled by the Republican Party, the Democratic Party, or neither (split). This measure comes from the National Conference of State Legislatures. We constructed two categorical variables with contrast codes to represent each of these groups. The first one is coded as "-2" for split and "1" for Democratic and Republican dominated legislatures. The second one is coded as "0" for split, "-1" for Democratic, and "1" for Republican controlling legislatures.

In our model that has wind energy capacity as the dependent variable, we controlled for the state median income as reported by the U.S. Census Bureau. This variable controls for the ability of state residents to enroll in green pricing or marketing programs that require a price premium. In addition, to consider the overall size of the electricity market of a state, we control for the annual total megawatt hours of electricity generated. Finally, we include a measure of the number of state-level mandatory policies that encourage renewable energy generation in a state through regulating incumbent firms. To do so, we track the cumulative number of instances in which a state has enacted a renewable portfolio standard (RPS), mandatory green power options, or generation disclosure rules. An RPS mandates that a certain percentage of a state's electricity sales be generated from renewable energy sources, such as wind power, by a specified target date. Mandatory green power rules require electric utilities to offer customers the choice to buy electricity that is generated from renewable energy sources. Finally, generation disclosure rules mandate that utilities disclose full information regarding fuel mix percentages and pollution discharges to utility consumers. Data for each of these types of rules were gathered from the Database of State Incentives for Renewables and Efficiency (DSIRE). The final measure of this variable required a log transformation that assisted in reducing the effects of heteroskedasticity related to its distribution.

For the model that predicts state-level market incentives, we apply the control variable for state legislature control described above. We also control for educational attainment and for the density of wind energy firms. Finally, to consider the effect that the opposition of electric utilities to renewable energy may have on state-level incentives, we include a measure of the annual spending in lobbying efforts of electric utilities operating in a state. Because environmental regulation is a top driver for electric utility lobbying efforts (Center for Responsive Politics 2000) this measurement allows us to gauge the general perceptions of the electric utility industry around environmental issues. Data for this measurement was obtained from the Center for Responsive Politics.

Finally, we include yearly dummy variables and unconditional state fixed effects that enable us to control for any unobserved heterogeneity that may remain at these levels of analysis.

3.3 Analysis

We use the following equations to test our hypotheses:

CleanEnergyTSMOs = f_1 (WindEnergyCapacity, Gov. R&D Spending, Z_1, ϵ_1) (1)
Ratio Newspaper Articles= f_2 (Advocacy Generalist SMOs, CleanEnergyTSMOs, Z_2, ϵ_2) (2)
WindEnergyCapacity= f_3 (Market Incentives, Ratio Newspaper Articles, Z_3, ϵ_3) (3)
MarketIncentives = f_4 (Advocacy Generalist SMOs, CleanEnergyTSMOs, Z_4, ϵ_4) (4)

where Z_i are vectors of controls and instruments particular to each dependent variable and ϵ_i are the error terms associated with each equation. In these models, *Clean Energy TSMOs, Ratio of Newspaper Articles, Wind Energy Capacity,* and *Market Incentives* are considered endogenous, while the remainder variables are treated as exogenous including all control and instrumental variables. We utilize a one-year lag between the independent variables (measured at time t-1) and the dependent variables (measured at time t) of interest.

The endogeneity in our system of equations prevents the use of OLS techniques, since the latter would yield inconsistent and biased estimates when regressors are correlated with the disturbance term (Greene 2003). To address the presence of endogeneity we used instrumental variables (IV), which focus on the variations of the predictors that are uncorrelated with the error term and disregard those that bias the OLS coefficient. Two-stage least squares (2SLS) has become one of the most commonly used methods that produce IV estimation in a system of simultaneous equations (Murray, 2006). A variety of studies in management have used this and related methods to account for endogeneity (Garud and van de Ven 1992, Glomb and Liao 2003, Gulati and Sytch 2007, Shrader et al. 2000). We used 2SLS with autocorrelation robust standard errors to conduct our analysis (Greene 2003), allowing us to account for serial autocorrelation which is often inherent in panel data analyses (Baum et al. 2007).

2SLS follows two main steps (Greene 2003). In the first stage, this method uses instrumental variables that are uncorrelated with the error terms to compute estimated values of the endogenous predictor(s). In the second stage, it uses these estimates on a linear regression model of the dependent variable. The results are optimal since the final estimates are based on variables that are uncorrelated with the error terms.

Selection and use of instrumental variables for 2SLS. The use of instrumental variables requires that there is a strong fit between the endogenous variables and their respective instruments, but that the instrument does not influence the dependent variable of an equation, so as to minimize its correlation with the disturbance term (Nelson and Startz 1990). Specifically, if the instrument is weakly correlated with the endogenous variable, large inconsistencies in the instrumental variable (IV) estimates could occur; this issue is known as "bias" related to weak instruments. Moreover, the magnitude of the bias in IV estimates grows as the R squared of the first-stage regression between the instruments and the endogenous variable gets close to zero. This is typically known as the "size" issue resulting from weak instruments.

Stock and Yogo (2005) define "weak instruments" as: 1) the bias of the instrumental variable (IV) estimator relative to the bias of the ordinary least squares (OLS) exceeds a certain threshold *b* (for example, 10%) and, 2) "the conventional α-level Wald test based on IV statistics has an actual size that could exceed a certain threshold r, for example r = 10% when α = 5%." (Stock & Yogo, 2005: 81). With this definition of weak instruments, Stock and Yogo (2005) developed a test for the null hypotheses that a given group of instruments is weak (and an alternative hypothesis that it is strong). This test involves calculating an F-statistic testing the hypothesis that the coefficients of the instrument equal zero in the first stage of the analysis. Stock and Yogo (2005) offer critical values based on asymptotic distributions that are necessary to satisfy the relevance or "strength" of instruments dependent upon the number of endogenous regressors in the model. Hence, an F-statistic higher than the critical values specified by Stock and Yogo (2005) on the basis of size and OLS bias, allows us to suggest that the instrument satisfies the condition of relevance or "strength".

In Equation 1 we predict the number of clean energy TSMOs in a state and instrument wind energy capacity with a variable measuring the number of total megawatt hours of electricity generated in a state. We propose that as the amount of electricity produced in a state increases, this rise in demand will be reflected in the installation of new sources of energy such as wind power. Therefore, we expect to see a direct relationship between the size of the energy sector and the amount of wind energy generated in a state. In contrast, we do not anticipate such a relationship between the size of the energy sector and the number of clean energy TSMOs. As illustrated in Table 2, the latter are more driven by social concerns as compared to market conditions, and as such may be very active even in states with smaller energy sectors. In addition, clean energy TSMOs may arise to promote specialized energy technologies and solutions and their emergence may be more driven by the need to fulfill certain gaps in the market than by the size of the market itself. We find through a Stock and Yogo test of all excluded instruments that the capacity of wind power is well instrumented by the total amount of electricity generated in a state (F=14.60/ Fcrit=10.26 for size and 6.71 for relative bias).

In equation 2 where the ratio of newspaper articles is the dependent variable, we instrument our endogenous variable—the number of clean energy TSMOs—using a measure of the total assets of the "resource" nonprofits in a state—those that are dedicated to the conservation and protection of natural resources from abuse or neglect (e.g., wildflower conservation). We propose that the assets and population of these nonprofits is related to the participation of clean energy TSMOs in a state because membership in the former organizations attracts individuals whose values or experiences are likely to be aligned with the conservation of energy resources and concerns for climate change. The presence of these other types of environmental organizations, however, should not necessarily impact newspaper coverage of wind energy, as "natural resource" SMOs tend to undertake other initiatives outside of the energy domain. The Stock and Yogo test for the excluded instruments in equation 2 confirms that they are relevant to the endogenous variable of interest (F=6.73/ Fcrit=5.39).

For Equation 3, in which we predict wind energy capacity, we instrumented our wind energy market incentives variable using a variable based on the per capita revenues received by a state in a given year. We propose that the financial health of a state is related to its ability to focus and enact more policies that are geared towards wind energy because incentives for renewable energy often require investments or lost revenue opportunities for states. However, we have no a priori reason to theorize that the financial health of a state is related to the growth of the wind energy sector (other than through economic policies), which strengthens its role as an instrument. Based on the Stock and Yogo test for all excluded instruments, we find support for the use of per capita state revenues (amongst other excluded instruments) as a strong instrument for our wind energy policy and state incentives variables (F=7.93/ Fcrit=6.28 for size and 5.57 for relative bias). In addition, to instrument the ratio of newspaper articles in a state, we utilized a variable in Equation 3 that measures the state-level membership of the U.S. Green Building Council (USGBC). The USGBC is a non-profit organization that represents a variety of constituents such as environmentalists, corporations and concerned citizens who work together to promote the design and construction of buildings that feature environmental and health benefits such as energy efficient designs and the use of non-toxic materials. We propose that in states where wind power received more newspaper coverage there is likely a greater interest in green building designs that deliver similar ecological results. We do not, however, expect that USGBC membership significantly impacts the growth of wind power in a state directly, as there is little application for wind power in buildings as compared to other small-scale sources of renewable energy such as solar power. We confirmed our choice for this and other excluded instruments through the Stock and Yogo test (F=7.93/ Fcrit=5.57 for size and 6.28 for relative bias).

Finally, in Equation 4 where we predict the ratio of newspaper articles on wind energy, we apply a similar rationale to the choice of instruments used in the second equation. In this case, we construct an instrument for the number of clean energy TSMOs based on the total revenues of "natural resource" organizations in a state. We propose that total revenues of environmental SMOs are likely to be related with the levels of activity by clean energy SMOs in a state. However, because the incentives that we analyze are very specific to renewable energy and wind energy in particular, we do not expect that the presence of resource conservation organizations will directly influence the likelihood of such policies. We find through a Stock and Yogo test of all excluded instruments that the number of clean energy TSMOs is well instrumented by the strength of these other types of environmental organizations (F=8.97/Fcrit=7.80 for size and 6.76 for relative bias).

Analysis for count-dependent variables. For this study, we analyze our data using 2SLS because we are primarily interested in modeling endogeneity in a system of relationships. For the equations that predict the number of clean energy TSMOs (eq. 1) and the number of market incentives (eq. 4), the dependent variables are based on count measures that could potentially violate the assumptions of homogeneity and normality in the distribution of errors of 2SLS (and OLS regression more generally). Maximum likelihood estimation through negative binomial models (for over-dispersed data) provide ground for modeling that is not limited to such restrictions (Cameron and Trivedi, 1998). However, to our knowledge, this type of modeling is not yet available with the simultaneous use of instrumental variables. We took a few measures to address this limitation for equations 1 and 4. First, for 2SLS estimation, we transformed our dependent variables using a logarithmic scale that assists in reducing the potential heteroskedasticity of error terms. Second, using 2SLS, we conducted sensitivity analyses with standard errors that are robust to heteroskedasticity and found statistically similar results. Third, we used negative binomial estimation (without the use of instrumental variables) to confirm the direction and statistical significance of the relationships of interest. These results are presented in Table 5. For this analysis, we present results for models with yearly fixed effects and Huber-White robust standard errors clustered at the state level (White, 1980). The latter allows us to account for the potential non-independent and non-identical distribution of errors in panel data, and in our case, adjusts the standard errors for correlations across observations pertaining to the same state[12].

4. RESULTS

Table 3 reports basic descriptive statistics and correlations. The average installed capacity of wind power in our sample is 180 megawatts (MW). Average capacity increased from 49.45 MW in 1999 to 508.20 in 2008, and is positively correlated with both the number of market incentives and the number of clean energy TSMOs.

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[1] We also attempted a fixed effects negative binomial specification, but were unable to obtain a solution with maximum likelihood estimation, which can occur in data panels with relatively small numbers of observations per subject (i.e., state).

[2] The use of clustered standard errors is common in studies with repeated measures (e.g., Diestre and Rajagopalan, 2012; Marcel, Barr, and Duhaime, 2010) and could provide an alternative specification for panel analysis to the use of fixed effects (Petersen, 2009). A recent study found that the use of clustered standard errors at the group level (while parametrically addressing the time effect with dummy variables), was unbiased to a group level effect (e.g., state) regardless of whether the effect is permanent or temporal (Petersen, 2009).

Insert Table 3 about here

Table 4 presents the results for the 2SLS analysis for the simultaneous equation system with unconditional fixed effects. Each model in the table corresponds to an equation from the description above. Model 1 displays the results for the model that predicts the number of clean energy TSMOs. Results show that as proposed in H1, there is a positive relationship between the amount of federal R&D allocated to renewable energy in a state and the number of clean energy TSMOs that are located in that state, suggesting that these TSMOs locate in areas with greater availability of renewable energy-related knowledge (Z=1.99; p=.046). These TSMOs may in turn use some of that knowledge to develop internal capabilities necessary to promote the wind energy sector. Model 1 also confirms H2, suggesting that the number of clean energy TSMOs in a state is positively related to the installed wind energy capacity in that state (Z=1.94; p=.05). This supports our theory that TSMOs may arise from the growth of the emerging industry. Our analysis shows that with everything else constant, an increment of 180 megawatts (MW) of wind power installed in a state (the average in our sample) is associated with 5.7 percent increase in the number of clean energy TSMOs in a state. This effect is stronger when considering states that have experienced much greater increases in their wind power capacity. For example from 2006 to 2007, Colorado added 776 MW of wind power, which is associated with a 27 percent increase in the number of clean energy TSMOs.

Results from Model 2 reveal that consistent with H3a, the number of clean energy SMOs is positively related to newspaper coverage of wind energy topics (Z=2.10; p=.036). Furthermore, to test H5a, we conducted Wald tests that examine whether the estimated parameters of TSMOs and advocacy generalist SMOs are simultaneously equal to zero. We were unable to reject the null hypothesis for the advocacy generalist SMO estimate, which suggests that this variable does not significantly improve the overall fitness of Model 2 (p=.77). In contrast, the results for the Wald test reveal that the coefficient for

TSMOs is substantially different from zero and that this variable significantly improves the performance of Model 2 (p=.03). Given these results, we conclude that there is sufficient evidence in support of H5a.

Insert Table 4 about here

Model 3 predicts the installed capacity of wind energy for a given state and year. It requires the introduction of multiple endogenous regressors (the number of TSMOs and the ratio of newspaper articles). In this particular case, we were unable to find valid instruments for a model with state-level fixed effects. These instruments, however, are strong when the state-level fixed effects are removed from the model. To address this, we constructed two models: 1) Model H3a, which contains instrumental variables that consider the endogeneity of our two predictors of interest (with robust standard errors), and 2) Model H3b, which uses OLS estimation (without instrumental estimation), but includes fixed effects to account for any unobserved heterogeneity remaining at the state level. Results for these two models suggest that there is no relationship between public awareness of the industry's practices and installed wind capacity (Z=1.17, p=.242 for Model 3a/t=1.40, p=.161 for Model 3b). Hence, we cannot reject the null hypothesis for H3b. We further discuss this finding below. In addition, as theorized in H4b, models 3a and 3b reveal that the number of market incentives for wind energy is positively related to installed wind capacity (Z=3.15; p=.002 for model 3a/ t=5.65; p=.000 for model 3b). Based on model 3a, we expect about a 71 percent increase in installed capacity for every 10 percent increase in market-based incentives when all other predictors are held constant. Finally, although not hypothesized, we did not find a relationship between our control variable that measures state-level "number of mandatory rules" and wind energy growth in Model 3. Since this relationship has been established in prior research, we conducted a sensitivity analysis to understand these results further. We found that this relationship is positive when longer time lags such as two and three years are used. This in turn illustrates the temporal dimension of this relationship, since rules such as RPS impose future goals on renewable energy generation that are not effective immediately. Model 4 tests hypothesis H4a, and shows a positive relationship between the number of clean energy TSMOs and the number of enacted market incentives for wind energy (Z=2.01; p=.044). We find that with everything else constant, a ten percent increase in clean energy TSMOs is associated with a 5.5 percent increase in the number of market incentives. This suggests that TSMOs may play an important role in bringing about these types of incentives. In addition, to test H5b, we conducted a Wald test for model 4 that examines the relative importance of the variables that measure the participation of advocacy generalist SMOs and TSMOs respectively. We find that as hypothesized, including advocacy generalist SMOs in this model does not significantly improve its fitness (p=.28), while the participation of TSMOs does seem to substantially improve the prediction for market incentives (p=.04).

Table 5 presents the results of the robustness tests for count-dependent variables using negative binomial modeling. Model 1 reveals that consistent with previous findings, there appears to be a positive relationship between government R&D spending in renewable energy and the likelihood of clean energy TSMO participation in a state (Z=3.35; p=.001). We note that, holding other variables at their means, the effect of a unit increase in renewable energy R&D on the number of TSMOs (i.e., the marginal effect) is also positive and significant (marginal effect =.166, p=.001). Similarly, the direction and statistical significance of the coefficient for wind energy capacity in this model is consistent with the findings of Model 1 in Table 4 (Z=2.29, p=.022). The marginal effect of this variable at mean values for all predictors is also positive and significant (marginal effect=.108, p=.029). The analysis in Model 2 reveals that when predicting the likelihood of wind energy market incentives, the coefficient for the number of clean energy TSMOs is positive (Z=2.05, p=.040). Likewise, the marginal effect of the number of TSMOs on the likelihood of market incentives is positive at variable means (marginal effect=.555, p=.04). Consistent with prior analysis, we find through a Wald test that the number of TSMOs substantively contributes to the fitness of this model (p=.04), while we cannot make such conclusion for the number of advocacy generalist SMOs (p=.24). Collectively, the direction and statistical significance of these results support the findings obtained from the 2SLS analysis in Table 4.

Insert Table 5 about here

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5. DISCUSSION AND CONCLUSION

This study provides support for a co-evolutionary model of industry emergence. We find that when emerging industries address underlying social issues, industry emergence may be described as a co-evolutionary process in which social movements, the institutional environment and emerging industries mutually influence one another over time. We found support for our arguments suggesting that social movement diversity, and specifically TSMO emergence, can be driven by both specialized knowledge availability and industry growth. Our findings suggest that specialized TSMOs may increase both the public awareness of an emerging industry and market-based incentives supporting that industry, and that they have a greater impact on each of these drivers than generalist SMOs. These market incentives then lead to greater industry growth, supporting our theory that a co-evolutionary process of interdependence can help to explain the growth of new industries. Our findings are consistent with prior studies on the relationship between SMOs and industry emergence (Sine and Lee 2009), and we significantly extend this literature by theorizing and empirically testing the co-evolutionary relationship between industry emergence, social movement diversity, and institutional change. While prior studies of industry emergence have taken a co-evolutionary perspective (Djelic and Ainamo 1999, Jones 2001, van de Ven and Garud 1993), ours is the first to consider the important role of social movements, and social movement diversity, in this process.

Our research contributes to the study of organizations and social movements in a variety of ways. First, we show that not only do social movements influence industry growth, as previous studies have found, but that this growth propels the rise of a new type of SMO. While the impact of social movements on entrepreneurial activity has been explored by numerous studies (Tolbert et al. 2011), to our knowledge ours is the first to suggest that industry growth leads to the emergence of specialized SMOs. In addition, while the social movements literature primarily depicts SMO specialization as the product of competitive forces between SMOs (e.g. McCarthy and Zald 1977, Soule and King 2006), we find that specialization may also be the product of knowledge availability and changes in the movement's external environment—in this case, the growth of an industry whose technology contributes to achieving movement goals. Under these conditions, SMO specialization occurs because social change can be supported through the use of technology-specific knowledge that generalist SMOs may not possess, nor seek to develop.

Furthermore, we find that TSMOs play a unique role in the emergence of new industries by contributing to the enactment of specialized institutions such as market-based incentives, and that these incentives contribute to the subsequent growth of the emerging industry. TSMOs are more likely than generalist SMOs to promote these incentives because they have a focused set of goals, seek to follow strategies that promote the emerging technology, and possess the knowledge and capabilities needed to advocate for industry-specific incentives. In addition, TSMOs are more likely than generalist SMOs to engage in institutional maintenance to provide greater stability to the industry because their narrower focus allows them to dedicate resources to consistently supporting the emerging industry. By identifying these different types of institutional work done by TSMOs, we provide a more complete model of the impact of social movements on new industry growth.

While we observed that TSMOs bring stability to an emerging industry by embedding awareness of its practices and technologies, surprisingly, we did not find that this increased awareness of the industry led to its future growth. We undertook further sensitivity analysis to explore this relationship and found that when institutions (mandatory rules and market incentives) are removed from the system of equations, our measure of public awareness was positively related to industry growth ($Z=1.94$, $p= .053$ for the 2SLS model). Hence, it appears that while public awareness may influence emerging industry growth, the effect of mandatory rules and market incentives takes precedence.

We note that although our findings are consistent with those of Sine & Lee's (2009) study of the wind industry, there are important differences in our theoretical and methodological approach. First, Sine and Lee's study ended in 1992, while the greatest growth in the wind power industry has occurred in more recent years (Energy Information Administration 2011). Second, we depart from the custom of using Sierra Club membership to represent the environmental movement in the U.S. and rather employ a more precise measure of SMOs at the state level that captures the evolving diversity and complexity of the movement. In doing so, we respond to recent calls to account for the regional and focused character of the environmental movement, as opposed to generalizing its character on the basis of a few national organizations (Straughan and Pollak 2008).

Following RMT (McCarthy and Zald 1977), an alternative explanation for our results is that as the wind industry grew, SMOs began to specialize so that they would not have to compete directly with one another (Soule and King 2008, Zald and McCarthy 1980). To address this, we controlled for both the density of generalist SMOs and overall growth in environmental SMOs in our models predicting the emergence of TSMOs. We did not find a relationship between the density of generalist SMOs and the number to TSMOs in our main models. Interestingly, a positive relationship does exist when the wind power industry is not considered in the analysis (p=.000 for generalist SMOs in the negative binomial model). This signals the importance of more complete models that explain the origins of TSMOs from the perspective of the industries that they support. RPT provides another alternative explanation for our results based on the nature of competition amongst SMOs (Soule and King, 2008). This perspective suggests that higher market concentration creates room for specialists to carve out distinct segments (Carroll 1985). To account for this explanation, we conducted a sensitivity analysis that included a measure of the environmental social movement concentration in a state (based on a Herfindahl (1950) index[3]) in our model that predicts TSMO emergence (Model 1). We did not find a relationship between this measure of SMO concentration and the rise of specialist TSMOs. We believe these findings strengthen our contribution, suggesting that factors beyond competition, specifically technological knowledge and industry growth, may influence SMO specialization.

In contrast to theories based on competitive dynamics, our explanation of SMO diversity places emphasis on symbiosis among SMO types. While we do not deny that specialist SMOs seek to differentiate their products, as RMT posits, or to avoid competition with SMOs that enjoy scale advantages, as RPT posits, we emphasize that these specialists may not only compete with generalists, but

[3] We calculated the Herfindahl index of the population of environmental organizations within a state. This involved estimating the sum of squared market share values (based on total revenue) of environmental organizations for every state and year.

also seek to complement their efforts, in order to contribute to the social movement. Our theory adds nuance to RMT explanations; it could be that for TSMOs, knowledge availability, and the opportunity presented by an emerging industry are greater drivers than competition. Thus, our model offers a complementary, cooperative model for social movement diversity. A promising avenue for future research is to establish boundary conditions under which competitive, versus cooperative forces lead to SMO specialization, and how such specialization differentially impacts social movement goals.

In addition to augmenting and expanding prior theory and empirical finding, this study makes several methodological contributions. First, our use of simultaneous equation models through 2SLS allowed us to embrace and control for rather than disregard the inherent endogeneity in the processes we studied. In addition, we have controlled for unobserved variable bias, that is, the possibility that a general shift towards more environmentally responsible norms produced the industry, movement, and institutional changes that we witnessed. We have done so through the use of fixed effects, rigorous controls, robustness tests, and most importantly, instrumental variables.

Our finding that new industries and SMOs co-evolve raises theoretical and empirical questions for future research. First, while we examined the role of particular SMOs in the emergence of new industries, we did not address the relationship of these organizations to the larger social movement. Future research could explore how multiple organizations with differing goals and strategies come together to support institutional change. In addition, while we found that TSMO emergence was driven by knowledge and industry growth in a region, we cannot generalize these findings to other types of specialist SMOs. Further studies could examine a range of specialized SMOs to differentiate both drivers of emergence, and subsequent goal and strategy specialization.

A limitation of this study is that we do not examine the very earliest days of the wind industry. It could well be that the relationships we observe do not hold at the nascence of emerging industries, and only take place once specialist SMOs enter the organizational field. This limitation suggests that future studies could explore how the relationships between TSMOs and generalist SMOs evolve over time, perhaps bridging knowledge-based and competition-based explanations of social movement diversity.

We expect that the co-evolutionary process we observed in the wind energy industry is typical of other emerging industries characterized by market failures, in which technological solutions to address social issues are not fully rewarded by the market. Under such circumstances, social movement activists are more likely to intervene in the emergence of an industry (Rao et al. 2000). Future research could assess whether other contexts follow similar patterns of industry co-evolution. Recent research indicates, for example, that a similar co-evolutionary process may have played out in the green building industry, which seeks to address the negative environmental externalities of the built environment (Eichholtz et al. 2010, Hoffman and Henn 2008). Additional contexts could include industries that experience market failures outside of the environmental realm. For example, information asymmetry in the food supply industry (Lee et al. 2010, Weber et al. 2008) and monopoly power in medical care (Conrad 1992) have led to both emerging industries (local foods and homeopathic medicine respectively) and SMOs specifically focused on supporting the alternative technology offered by these industries. While we cannot generalize our results to all emergent industries, when there are prevalent market failures, and alternative technologies, we would expect to see a co-evolutionary process between SMOs, institutions and industry. For entrepreneurs and managers in emerging industries, our study suggests that encouraging and supporting symbiosis with specialized TSMOs can help to encourage institutional change, and public awareness, to build legitimacy for an emerging industry. Further, strategically locating in regions that have a strong presence of TSMOs may be one route to ensure that current institutional support for an emerging industry is likely to be maintained and built upon. While generalist SMO support is helpful in bringing broader institutional changes to an industry, the emergence of TSMOs may be critical for further industry emergence and maturity.

This study deepens our understanding of the co-evolutionary processes that unfold as a result of the interdependent influence among social movements, institutions and emerging industries that address social issues. The recent rise of firms and industries with social missions (Dacin et al. 2011, Mair and Martí 2006, Short et al. 2009) highlights the importance of understanding these dynamics. This study suggests that as firms seek to provide products that help to address social problems, social movements will support these insurgents and challenge incumbents, and consequently, will themselves be shaped by the industries they support.

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FIGURE 1: Theoretical Model of Industry Emergence Co-evolution

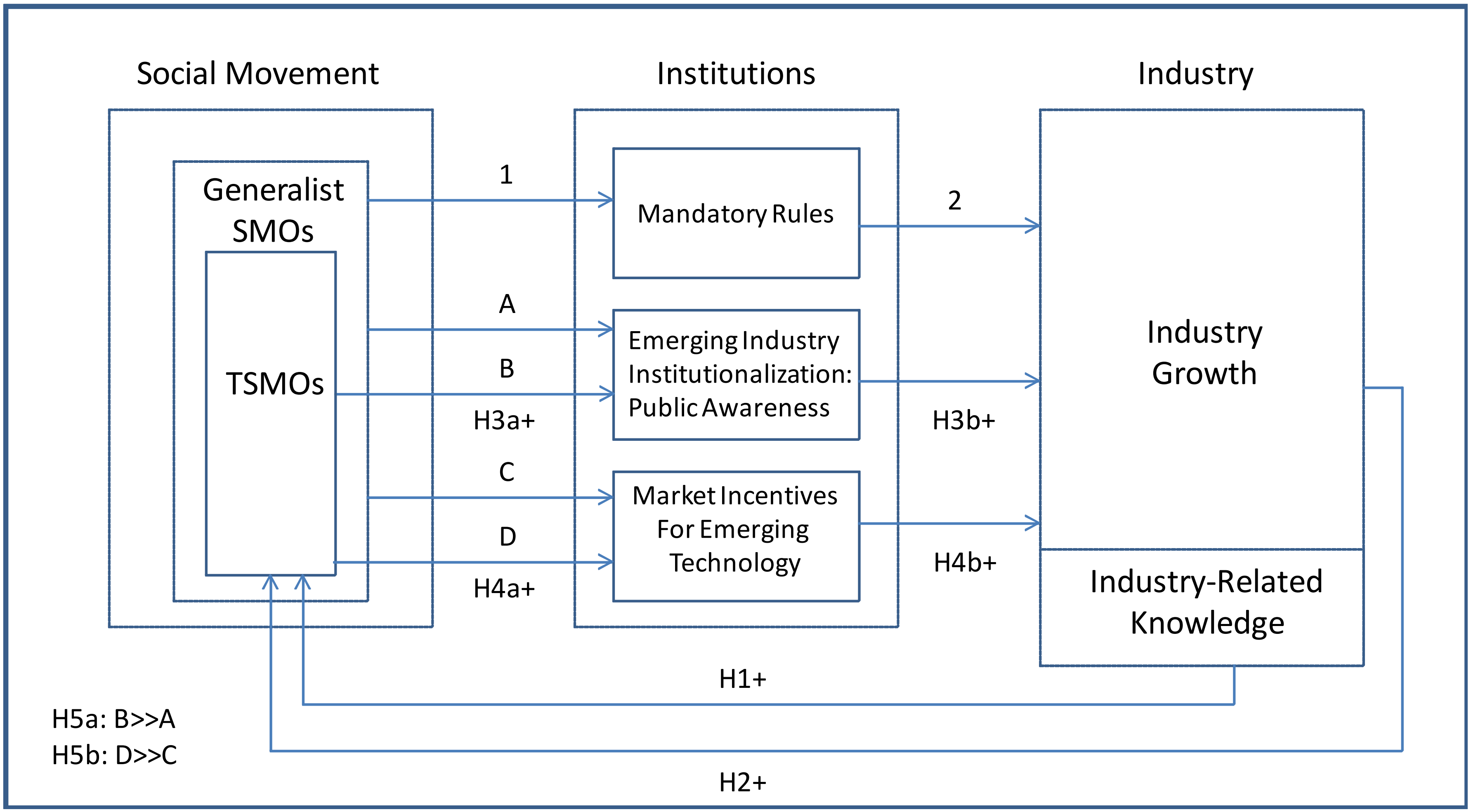

TABLE 1. Comparison of Ideal Type Generalist SMOs and Technology-focused SMOs (TSMOs)

SMO Form	Knowledge and Capabilities	Goals	Strategies	Scope of Activities	Funding
Generalist SMOs	Knowledge and capabilities in areas where scale and scope advantages may be achieved	To challenge existing institutions and practices and create new ones which mitigate social problems	To influence the opinions of the public and powerful decision makers to regulate harmful practices	A potentially wide range of issues because specialized knowledge and capabilities are transferable across issues	Predominantly individuals who share the SMO's goals
State-based Environmental Advocacy SMOs	*Knowledge and capabilities in areas such as fundraising, membership mobilization, and environmental policy and politics*	*To challenge existing institutions and practices and establish new ones that are more environmentally beneficial*	*To influence government and corporate decision makers to change institutions and practices so that they are more environmentally beneficial*	*Wildlife preservation, ecosystem conservation, human-induced climate change, air and water quality, clean energy, and other environmental issues*	*Individuals concerned with environmental protection*
Technology-focused SMOs (TSMOs)	Specialized technology-specific technical, economic, and policy knowledge and capabilities	To stimulate the adoption and diffusion of specific technologies which address social and environmental problems	Influence policy makers to provide incentives for emergent technology, and influence technology purchasers and users to adopt technology	A narrow range of technology-specific issues	Government agencies, foundations, and individuals promoting clean energy
Clean Energy TSMOs	*Specialized expertise in clean energy engineering, economics, financing, public policy, and environmental impacts*	*To promote the adoption of clean energy*	*Technical assistance, education, and policy advice related to clean energy*	*Clean energy*	*Energy-related agencies, foundations (renewable energy, energy efficiency, energy conservation) technologies)*

TABLE 2. Illustrative Examples of Environmental Advocacy Generalist SMOs and Clean Energy TSMOs in Colorado [a]

Generalist Environmental SMOs					
Organization	**Knowledge and Capabilities**	**Goals**	**Strategies**	**Scope of Activities**	**Funding**
Colorado Environmental Coalition	Environmental science, policy, politics, advocacy, building and mobilizing its membership base	"Protecting public lands Ensuring water quality Preserving wildlife habitat and opportunities for recreation Environmentally beneficial transportation and growth practices"	"Promoting common sense policies in the state legislature." "Providing technology resources to other non-profits." "Coordination of citizens and other non-profits to contact policy makers"	Wilderness and public land protection Climate change Impacts of oil and gas development	Private citizen donations and membership fees
Environment Colorado	"Independent research, practical ideas and tough-minded advocacy" Building public support, running campaigns, etc.	"Tackling [Colorado's] top environmental problems"	"Overcome the opposition of powerful special interests and win real results for Colorado's environment" through petitions and campaigns targeted to policy makers, citizens and media	Protection of forests, deserts, and threatened and endangered species River preservation Air quality Wind energy	Private citizen donations and foundation support
Western Resource Advocates	Environmental law and advocacy Building public support, running campaigns, etc.	"- Reduce air and water pollution and harmful climate change. - Protect habitat for threatened, endangered, and sensitive plant and animal species. - Achieve environmentally sustainable management of energy, land, and water resources. "	Pro bono legal counseling and litigation against polluting firms Advocacy coordination for renewable portfolio standard (RPS) in Colorado	Impacts of oil and gas development Endangered species River preservation Water conservation Air quality Climate change Clean energy	Private citizen donations

Clean Energy TSMOS					
Organization	**Knowledge and Capabilities**	**Goals**	**Strategies**	**Scope of Activities**	**Funding**
Four Corners Office for Resource Efficiency (4CORE)	Technical and business knowledge of clean energy	To “encourage the community to integrate resource conservation, energy efficiency and renewable energy in their daily lives” To “help regional resource conservation, energy efficiency and renewable energy businesses to succeed and thrive”	Develop regional plans for job creation, business attraction, and education through the implementation of clean energy (energy conservation, energy efficiency and renewable energy)	Renewable energy and energy conservation and efficiency	Local government Partner donations Private donations
Community for Sustainable Energy	Knowledge of clean energy technology, financing, policy, and outreach	“To bring about a sustainable energy policy for Colorado: Increase energy efficiency by providing technical assistance and financing to residents and small businesses Increase renewable energy power generation by promoting rooftop solar, community solar gardens, geothermal resources, and modernizing the power grid to handle distributed generation”	Coordination and education to encourage private citizens to contact local and state officials and voice support for policies for renewables including financing and incentives	Renewable energy and energy conservation and efficiency	Private citizen donations
Partnership for Sustainability	Knowledge of renewable energy technology and financing	“To encourage environmental and domestic resource sustainability by increasing the use of renewable energy and the consumer market for such energy.” “To support community sustainability by enabling individuals and organizations to make capital investments that increase their assets and reduce their monthly expenses.” “To develop non-profit sustainability by generating integrated revenue streams to cover overhead costs.”	Approval and administration of zero-interest loans to individuals for installation of renewable energy in their homes and businesses	Renewable energy	Private donations
Colorado Clean Energy Cluster	Knowledge of renewable energy project and business development	To “attract, incubate and grow clean energy enterprises” in order to catalyze economic vitality and generate community and environmental benefits.”	Networking and partnership management to help renewable energy firms attract funding and stakeholder support	Renewable energy	State grants Private citizen donations Partner donations

[a]Source: Individual web pages of each organization and interviews with organization members

TABLE 3

Descriptive Statistics and Correlations[a]

	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 No. of clean energy TSMOs	4.322	5.899	0	58	1.00																		
2 Ratio of Newspaper Articles	0	0.001	0	0.008	-0.12	1.00																	
3 Wind Energy MW Installed	180.086	548.853	0	7112.67	0.55	-0.03	1.00																
4 No. of Market Incentives	1.464	1.711	0	9	0.24	0.03	0.17	1.00															
5 Gov. Renewable Energy R&D $	3417.687	5774.707	0	55915	0.48	-0.14	0.32	0.19	1.00														
6 No. of Advocacy SMOs	11.4	11.838	0	82	0.84	-0.15	0.45	0.22	0.45	1.00													
7 Annual Growth of Env. SMOs	0.122	0.076	-0.455	0.359	-0.03	-0.06	-0.02	-0.11	-0.07	0.00	1.00												
8 Wind Energy Potential	3.477	7.115	0.1	36	-0.12	0.44	0.14	0.15	-0.09	-0.22	-0.11	1.00											
9 Density Solar Businesses	59.648	107.195	4	995	0.80	-0.14	0.54	0.08	0.45	0.76	-0.02	-0.11	1.00										
10 No. of Science and Eng. Degrees	11440.24	12956.3	559	84579	0.77	-0.23	0.50	0.20	0.54	0.86	-0.06	-0.20	0.78	1.00									
11 Electric Market Regulation	-0.321	0.948	-1	1	0.19	-0.15	0.01	0.30	0.15	0.18	0.02	-0.25	0.06	0.29	1.00								
12 Density of Wind Energy Firms	1.768	3.887	0	44	0.84	-0.04	0.61	0.17	0.49	0.74	-0.07	-0.06	0.81	0.75	0.09	1.00							
13 Educational Attainment	25.929	4.66	14.8	38.1	0.43	0.04	0.09	0.31	0.19	0.37	-0.06	-0.01	0.20	0.27	0.36	0.30	1.00						
14 Political Party Control 1	0.22	1.317	-2	1	0.05	0.12	0.05	-0.01	-0.03	0.00	0.01	0.05	0.09	-0.01	0.04	0.05	0.03	1.00					
15 Political Party Control 2	-0.016	0.859	-1	1	-0.19	0.11	-0.04	-0.04	-0.02	-0.12	-0.02	0.33	-0.04	-0.05	-0.03	-0.14	-0.04	-0.01	1.00				
16 Median Income	45038.46	7687.019	29297	68059	0.30	0.04	0.14	0.23	0.28	0.24	-0.06	-0.11	0.17	0.18	0.27	0.26	0.75	0.01	0.00	1.00			
17 No. of Mandatory Rules	0.806	0.911	0	3	0.46	-0.03	0.32	0.48	0.30	0.41	-0.03	-0.09	0.29	0.33	0.36	0.32	0.49	-0.07	-0.16	0.48	1.00		
18 State Total MWh Generated	7.87E+07	7.05E+07	4.94E+06	4.05E+08	0.34	-0.26	0.46	0.05	0.29	0.40	-0.02	-0.16	0.50	0.68	0.19	0.38	-0.13	-0.02	0.08	-0.15	0.08	1.00	
19 Lobby Spending Utilities	1.08E+06	1.66E+06	0	1.50E+07	0.38	-0.17	0.34	0.02	0.26	0.39	-0.03	-0.16	0.53	0.58	0.15	0.39	-0.02	0.09	0.01	-0.02	0.12	0.75	1.00

[a]n=432 observations in 48 states; n=381 for newspaper article ratio variable correlations.
Correlations greater than .08 are significant at $p<.05$; correlations greater than .12 are significant at $p<.01$

TABLE 4

Results for Two Stage Least Squares Analysis with Instrumental Variables[a]

	Model 1	Model 2	Model 3a	Model 3b	Model 4
	Number of Clean Energy TSMOs[b]	Ratio of Newspaper Articles[b]	Wind Energy MW Installed[b]	Wind Energy MW Installed[b]	Number of Wind Energy Market Incentives[b]
Number of Clean Energy TSMOs[b]		0.00120*			0.569*
		(0.000574)			(0.283)
Advocacy Generalist SMOs	0.00152	-3.76e-06			-0.00860
	(0.00875)	(1.31e-05)			(0.00810)
Wind Energy Potential	0.0387**	4.60e-05*	-0.0557	0.0421	-0.0225*
	(0.0142)	(1.94e-05)	(0.0683)	(0.0235)	(0.0109)
Density of Wind Energy Firms		-4.21e-05**			-0.0265**
		(1.50e-05)			(0.0101)
Electricity Market Regulation	0.0639*	5.04e-05	-1.949***	-0.240	-0.0514
	(0.0321)	(5.97e-05)	(0.467)	(0.134)	(0.0358)
Educational Attainment		3.61e-05			-0.00116
		(2.87e-05)			(0.0116)
Political Party Control 1		-7.25e-05*			-0.0268
		(3.24e-05)			(0.0138)
Political Party Control 2		5.66e-05			-0.0846**
		(6.51e-05)			(0.0321)
Wind Energy MW Installed	0.000311*				
	(0.000160)				
Government Renewable Energy R&D Spending[b]	0.00966*				
	(0.00485)				
Annual Growth of Environmental SMOs	0.254				
	(0.195)				
Density of Solar Energy Businesses[b]	-0.588				
	(0.305)				
Number of Science and Engineering Degrees	2.69e-05**				
	(1.01e-05)				
Number of Market Based Incentives[b]			5.637**	1.202***	
			(1.790)	(0.213)	
Ratio of Newspaper Articles[b]			1330	155.4	
			(1137)	(110.6)	
Median Income			9.49e-05*	7.86e-06	
			(4.11e-05)	(2.93e-05)	
Number of Mandatory Rules[b]			-0.887	-0.311	
			(0.911)	(0.282)	
State Total MWh Generated			1.53e-08***	-1.33e-08	
			(3.31e-09)	(1.11e-08)	
Lobby Spending by Electric Utilities					-3.26e-08*
					(1.41e-08)
Constant	1.400*	0.000118	-9.048**	-0.364	1.198***
	(0.644)	(0.000508)	(2.762)	(1.615)	(0.252)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	No	Yes	Yes
Instrumented	Yes	Yes	Yes	No	Yes
Observations	387	381	428	428	432
F-statistic	5.09***	7.73***	10.00***	44.43***	27.46***

[a] Model 3b is based on OLS regression with fixed effects (not 2SLS estimation)

[b] Logarithmic scale used

[c] Autocorrelation robust standard errors in parentheses

[d] *** p<0.001, ** p<0.01, * p<0.05

TABLE 5

Results for Negative Binomial Analysis for Count Dependent Variables

	Model 1 Number of Clean Energy TSMOs	Model 2 Number of Wind Energy Market Incentives
Government Renewable Energy R&D Spending[a]	0.156*** (0.0464)	
Wind Energy MW Installed[a]	0.101* (0.0441)	
Number of Clean Energy TSMOs[a]		0.449* (0.219)
Number of Advocacy Generalist SMOs	0.0351 (0.0183)	0.0125 (0.0107)
Political Party Control 1		0.00806 (0.0487)
Political Party Control 2		-0.00875 (0.143)
Wind Energy Potential	-0.00666 (0.0244)	0.0527** (0.0162)
Educational Attainment		-0.0175 (0.0314)
Density of Wind Energy Firms		-0.0320 (0.0320)
Electricity Market Regulation	0.130 (0.101)	0.443*** (0.114)
Lobby Spending by Electric Utilities		-1.35e-07 (7.33e-08)
State Total MWh Generated	-2.17e-09 (1.59e-09)	
Annual Growth of Environmental SMOs	0.708 (0.867)	
Number of Science and Engineering Degrees	-2.25e-05 (1.35e-05)	
Density of Solar Energy Businesses[a]	0.395* (0.168)	
Constant	-2.052*** (0.554)	0.727 (0.798)
Year Fixed Effects	Yes	Yes
Observations	432	432
Log Pseudolikelihood	-601.06	-637.35
Chi-squared	229.53***	106.59***

[a] Logarithmic Scale, Robust standard errors clustered at the state-level in parentheses
*** p<0.001, ** p<0.01, * p<0.05