Institutional Geography and the Emergence of New Economic Sectors: Antecedants of Entrepreneurial Activity in the Emerging Wind Power Industry

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Abstract

Sociological investigations of the spatial organization of economic activity demonstrate how social structure and resources influence founding patterns of new organizations. This paper contributes to this growing literature by examining the impact of technical, normative-cultural, and political regional features on entrepreneurial activity. Empirical analyses of the nascent period of the wind energy sector from 1978-1992 demonstrate that the normative-cultural environment—an understudied and underspecified aspect of regional economic activity—is a generative force in the creation and exploitation of entrepreneurial opportunity. Consistent with other work, we also find that technical characteristics of a region foment entrepreneurial activity. Taken together, these results suggest that while entrepreneurial activity is motivated by the existence of resources, the relative value of those resources and their propensity for exploitation are shaped by normative-cultural regional features.

INTRODUCTION

What accounts for regional variation in the exploitation of emerging economic opportunities? Why do some regions with high levels of technical resources (i.e. natural resources) have low levels of entrepreneurial activity while other regions with low levels of technical resources have high levels of entrepreneurial activity? What role does the institutional environment play in shaping how actors respond to similar sets of technical resources? Given the theoretical and practical importance of these questions, a small but growing body of literature has begun to examine how regional attributes shape entrepreneurial activity. In this paper we build on this literature by examining how regional variation in the institutional environment affects entrepreneurial activity in the emerging U.S. wind power industry.

The link between entrepreneurial action and socioeconomic environmental characteristics has historically been of interest to sociologists. Weber (1930, 1947) suggested that both technical features, such as the availability of raw material, and social features, such as cultural understandings of economy, norms of economic activity, and hierarchy, drive economic action. In his classic essay, *The Structure of Social Action*, Parsons (1937) argued that all human action is mediated through the social and technical environment of the actor. Stinchcombe (1965) applied these notions to organizations, arguing that the capacity of new organizations to develop was contingent upon their ability to obtain resources from the broader social structure. Yet despite the historical attention by sociologists to the importance of the social environment in shaping economic action, we know little about how regional differences in the institutional environment shape the emergence of new forms of economic activity.

Organizational scholars have recently begun to examine the economic and social characteristics of particular regions and the effect of these characteristics on regional entrepreneurial activity (Saxenian, 1994, Stuart and Sorenson, 2003, Sorenson and Audia, 2000). For example, studies of footwear production, high technology, and biotechnology reveal that high founding rates within bounded geographical areas persist because industrial activity within those regions creates a fertile environment in which tacit knowledge, social ties (Sorenson and Audia, 2000), liquidation events (Stuart and Sorenson, 2003), venture capital, and the availability of human capital (Saxenian, 1994) provide important resources for entrepreneurial activity. We build on this work in two ways. First, we focus on those regional attributes that drive initial founding and agglomeration, the origin of regional density patterns. We show that these initial trends are not due to "idiosyncratic processes" (Sorenson and Audia, 2000) but instead can be attributed to regional variation in both the technical and institutional environment (Meyer, Scott, and Deal, 1981). Second, we explicitly take into account how differences in the institutional environment motivate and coordinate entrepreneurial activity. Past empirical work on the relationship between regional characteristics and entrepreneurial activity have focused on variation in technical resources. In this study we examine how normative cultural differences shape how populations respond to their resources. That is, given a particular level of technical resources, why is entrepreneurial activity in the U.S. wind industry greater in some regions than others?

This paper makes two significant contributions. First, we direct much needed attention to how regional differences in the institutional context shape entrepreneurial action. We do so by empirically specifying the differential normative-cultural and political elements on regional exploitation of a particular opportunity. Second, much of the prior work reviewed above has focused on extant rather than emerging industries (see Saxenian, 1994 for a notable exception). Our study, by contrast, sheds light on the factors that increase the likelihood of industry emergence in a particular region. Because we study an emerging industry and gather data directly on the regional technical and social characteristics prior to exploitation of these opportunities, we clarify the causal role social structure plays in making an environment more or less fecund for industry emergence. This approach sidesteps the pitfall of relying on density dependence as the key explanatory variable of new organizational forms, niches, and industries. Research that emphasizes density as the key indicator of normative and cultural structure may confound the effects of underlying technical attributes and social structures with the endogenous effects of density (Young, 1988; Zucker, 1989). Our study disentangles the effects of density from technological, cultural, and political conditions in a given region. In brief, we find that the technical and normative cultural environment drives initial density. To begin, we provide a brief history of the U.S. wind power industry. This is followed by our theoretical arguments. We then discuss our empirical sample, methods, and results. These sections are followed by the conclusion.

CONTEXT

Over the past five years, the U.S. wind energy industry has enjoyed an unprecedented 28% growth rate in total installed capacity. Current U.S. wind capacity accounts for approximately 16% of the 39,294 MW of total world wind energy capacity. The American Wind Energy Association (AWEA) predicts that by the middle of 2005, U.S. wind energy generators will produce 16.7 billion Kwh of electricity, enough to serve more than 1.6 million average U.S. households. By using wind energy instead of the average U.S. electricity fuel mix, 11.3 million tons of CO_2 emissions will be avoided (AWEA, 2004).

The contemporary U.S. wind energy industry is largely a product of the Federal Public Utility Regulatory Policies Act (PURPA) of 1978. Until the late 1970s, electric utilities depended almost exclusively on a combination of brown fuel sources and hydroelectricity to generate power. For example, in 1978, of the 2,206 billion kilowatt-hours (KWh) of power generated by utilities, 87% came from coal, petroleum, natural gas, or nuclear plants; 13% came from large-scale hydroelectric; and less than 0.001% came from other renewable sources (U.S. Department of Energy, 2001).

Prior to 1978, the electric utility industry was characterized by large regional monopolies in which vertically integrated utilities generated and distributed electricity to captive customers. Because utilities controlled both power generation and distribution in a particular region, there were virtually no successful foundings of independent power facilities. Utilities could lock out potential competitors by refusing interconnections, offering below market prices for independently produced power, and charging higher-than-average prices for back-up power (Hirsh, 1999: 81-83). In some areas it was illegal for non-utilities to sell power to the grid. The electric utility monopolies were reinforced by low oil and coal prices, which made it difficult for new technology using alternative sources of power to compete. Monopolistic industrial structure coupled with low fuel prices prevented independent power producers from gaining access to distribution channels and ultimately to the market. Prior to 1973, virtually no independent power plant sold wholesale power to utilities.

This situation changed dramatically in the late 1970s. In 1973, an oil embargo by Saudi Arabia on the United States caused severe disruptions in domestic oil and gas markets. By 1974, oil prices more than doubled, from $10 per barrel to $25 and by 1978, had doubled again to $50, causing electric prices to increase sharply. Despite efforts by utilities to reduce their reliance on oil and gas by converting to expensive solid-fuel plants, electric prices remained high. These price increases motivated policymakers to search for other ways to generate electricity that would decrease the country's dependence on foreign oil. This in turn provided institutional entrepreneurs opportunities to promote new technological agendas (Sine and David, 2003).

Environmental activists brought these agendas to national attention by calling into question existing energy policies and practices. As early as the late 1960s, growing awareness of the harmful environmental effects of coal and oil burning plants and the fear of nuclear power increased the hostility of many environmental groups towards public utilities (Fenn, 1984: 51-52). Activists pressured government agencies to investigate the environmental impact of the growing electric power industry. Working with policy makers, these groups helped craft the National Environmental Policy Act of 1969 that required utilities to prepare and defend environmental impact statements. The oil crisis provided environmental activists with an opportunity to promote the use of renewable energy-producing technologies to policy makers as a way to reduce dependence on foreign oil (Sine and David, 2003). In the wake of the OPEC embargo, this agenda was formalized as social activists and technologists banded together and founded several grass-roots organizations, such as the American Wind Energy Association in 1974 and the Solar Lobby in 1978[1], whose purpose was to lobby for policies friendly to solar and wind energy. These new social-cum-technological movements played a key role in shaping public policy by promoting environmentally friendly strategies for generating power.

In response to the energy crisis and the lobbying efforts of these groups, President Jimmy Carter pushed through the National Energy Act (NEA) in 1978. The most significant portion of the NEA was the Public Utility Regulatory Policies Act (PURPA), which allowed entrepreneurs to construct qualifying non-utility facilities free from the constraints of regulation. Independent power plants qualified under PURPA if they used alternative energy resources such as wind, solar, biomass, garbage, wood, sewage sludge, and other lower-grade fuels or used cogeneration technology[2]. Under PURPA, utilities were required to interconnect with non-utility power plants and purchase power from qualifying facilities at utilities' generation cost (e.g. avoided cost). PURPA provided the legal structure needed for wind entrepreneurs to successfully found firms, interconnect with utilities, and sell electricity.

THEORY

From the perspective of an entrepreneur, the technical, social, and political context of an economic activity affects the perceived value of that activity and the probability of successfully founding a new venture. Thus, various types of entrepreneurial action are more probable in the presence of particular types of technical, political, and cultural resources. Locations that have greater abundance and/or accessibility to those resources are more likely to experience particular types of entrepreneurial activity. For example, lumber mills are more likely to be founded in heavily forested regions. Similarly, a region's political environment may also be more or less conducive to particular types of industries than others. For instance, the extent to which political actors and legal infrastructure are more or less supportive of land development will either inhibit or encourage activities ranging from building houses to strip malls. Finally, populations that have normative and cultural characteristics that are congruent with particular types of entrepreneurial activity will increase the likelihood of that activity. For example,

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[1] This lobbying organization consisted of the eight largest environmental groups in the U.S.
[2] Cogenerators produce energy by capturing excess energy (heat or steam) from existing industrial processes and using it to generate electricity.

entrepreneurs attempting to establish bars in Saudi Arabia are more likely to face opposition than entrepreneurs engaging in similar activity in
College town, USA. In sum, the technical, normative-cultural, and legal environments shape both the perception by entrepreneurs of whether or not an opportunity exists and their ability to exploit that opportunity.

Technical Environment

Technical attributes include those physical and resource related characteristics necessary for producing a product or service. For example, in the oil refining industry in the mid 1800s, access to crude oil and transportation routes (rail or water) shaped regional foundings of oil refineries and in the steel industry, manufacturers tended to locate near deposits of iron (Chernow, 1998; Harris, 1994). Similarly, founding a particular type of high technology firm may require access to highly trained scientists and university research labs and close proximity to sources of capital, which is often geographically constrained (Stuart and Sorenson, 2003; Saxenian, 1994).

Electricity from wind power is easily moved from one location to another if one is connected into the national electricity grid, an infrastructure of wires that connects generating facilities to customers in the continental U.S. and Canada. Therefore, being close to the customer is not as significant an issue as being close to the grid. Given access to the grid, the ability of wind generation facilities to distribute their electricity is independent of location. Thus, we would expect that wind power would be generated in locations that had the richest natural resources required for this activity.

The development of wind energy requires the presence of available land with high quality wind. The concept of wind power is rather simple. Large blades catch the wind and turn, which spin a shaft connected to a generator that generates electricity. Large-scale turbines range in size from 50 to 2000 kilowatts. The quality of the wind is typically judged by its average speed: class 1 wind, the weakest class, has an average speed of 4.4 meters per second (9.8 mph) or less at 20 meters while class 7 winds, the highest class, blow at a minimum of 7 meters per second (15.7 mph) at 20 meters. Wind classes of 3 or higher provide rich opportunities for exploitation by wind entrepreneurs. We argue that regions with greater amounts of available land with high quality wind will experience more entrepreneurial activity in this emerging sector.

Hypothesis 1: Greater availability of land with high quality wind flows will increase wind energy entrepreneurial activity.

Normative-Cultural Environment

While technical resources play an important role in shaping regional founding activity, sociologists argue that to understand human action researchers must account for not only the objective conditions of an environment, but also actors' subjective interpretation of those conditions (Berger and Luckman, 1966; Scott, 2000). The recognition of a set of technical features of an environment as an enticing opportunity is mediated by social values, norms, and cultural frameworks that define where opportunities may be found and prescribe what types of behavior are acceptable. For example, Weber (1930) claimed that broader cultural frameworks shaped the very nature of entrepreneurial activity. He argued that in Western culture, religious norms defined not only the appropriateness of entrepreneurship but also the relations between the investor/entrepreneur and his or her employees. Similarly, Durkheim (1893, 1897) held that technical and social features constitute social systems and that action in the technical environment is articulated by moral orders that are internalized as individual values. More recent empirical work has underscored the centrality of cultural meaning systems to economic life. Institutional analyses have shown how changes in these systems have led to the creation of new practices, organizational forms, and industries (Haveman & Rao, 1997; Ruef & Scott, 1998; Thornton & Ocasio, 1999; Rao, Monin, & Durand, 2003). By taking cultural meaning systems seriously in explaining entrepreneurial activity, we posit that collective norms and cultural meaning systems shape how potential entrepreneurs: (1) look for opportunities, (2) view particular types of opportunities as socially desirable,

(3) are motivated to take risks to exploit particular opportunities, and (4) are supported or ignored by proximate local actors in their attempts to garner the necessary resources to start a firm.

Shane and Venkataraman (2000) argue that opportunity discovery is largely a subjective process driven by variation in the beliefs about the relative value of resources and their potential configuration. There is a small and growing body of evidence that suggests that social norms and values help shape the kinds of circumstances potential entrepreneurs see as opportunities. Sarasvathy, Simon, and Lave, (1998) found that entrepreneurs are more likely to "frame their problems" with personal *values* than bankers who are more focused on avoiding risk. Similarly, Sine and David (2003) found that cognitive searches are shaped by extant social norms and cultural understandings of socially appropriate action. We argue that normative values and cultural frameworks shape the perceived value of particular resources. Institutional actors that advocate these values and undertake the institutional work necessary to change cultural understandings of economic activities increases participation in these activities. In the case of wind power, environmental organizations were primary advocates of the wind power industry. From its early inception in the 1960s, the environmental movement advocated the use of environmentally friendly methods for generating electricity. By the late 1960s, some of the largest environmental groups and prominent government officials rallied behind wind, solar, and biomass technologies to generate energy. For instance, Stuart Udall, Secretary of the Interior under John F. Kennedy, referred to wind generators as "symbols of sanity in a world that is increasingly hooked on machines with an inordinate hunger for fuel and a prodigious capacity to pollute," (Righter, 1996: 152). Other environmentalists such as William Heronemus, a former nuclear engineer turned wind entrepreneur, actively sought opportunities to generate power in more environmentally friendly ways (Righter, 1996). Potential entrepreneurs who internalize the values of protecting natural resources and reducing pollution are more likely to see windy areas as an opportunity than potential entrepreneurs who do not share these same values.

Normative values and cultural frameworks also shape the extent to which entrepreneurs see particular resource configurations and technologies as desirable. Parsons explained that human action, the essence of entrepreneurship, is motivated by normative systems that are internalized as "dispositions in the actor's own personality structure" (1951:137). Entrepreneurial activity involves extensive risks, resources, and time commitments. Potential entrepreneurs, who view a particular opportunity as congruent with their current values and as socially desirable, may be more likely to accept the risks associated with that opportunity than potential entrepreneurs who do not share similar values. For example, potential entrepreneurs with access to fertile southern land and who are ideologically opposed to promoting smoking may very well refuse to exploit the opportunity to start a tobacco farm even if tobacco prices are high. Similarly, Russel Wolfe, an engineer "harboring deep idealism" was prompted to investigate wind power and start a new venture based on using wind power to produce electricity by a challenge from his daughter to do something "as worthwhile as developing renewable energy sources" (Asmus, 2001).

Finally, entrepreneurs depend on their resource environment to support their efforts. Their ability to garner, organize, and deploy resources toward a particular opportunity both defines the action of entrepreneurship and determines chances of success (Aldrich, 1999). Entrepreneurs engaged in constructing ventures that are congruent with local values and cultural understandings are more likely to acquire the necessary resources for start-up (Aldrich and Fiol, 1994). Moreover, forming a new venture in a supportive normative-cultural location decreases the risks associated with local resistance. There are many instances in which local resistance to various types of opportunities have resulted in costly delays and even failure (Keen and Watson, 2001; Moore, 2003; Pospisil, 1995). Similarly, ventures that are congruent with local norms may find local leaders more likely to facilitate the start-up process of a new venture. Because the normative-cultural characteristics of a region affect the extent to which potential entrepreneurs discover opportunity, are motivated to engage in new venture formation, and acquire resources, we theorize that regional cultural differences will affect entrepreneurial activity.

Hypothesis 2: States with cultural and normative environments that are more supportive of environmental conservation will increase wind energy entrepreneurial activity.

Political Environment

Recent work in sociology has emphasized the influence of political environments on entrepreneurial activity (Sine, Haveman, and Tolbert, 2005) and the artificiality of the historical separation between the sociology of law and organizations (Edelman and Suchman, 1997). By questioning this separation, scholars have shown how organizations shape and are shaped by the norms of their political environment (Edelman, 1990, 1992; Dobbin and Sutton, 1998; Edelman, Uggen, and Erlanger, 1999). Clemens posits that new organizations are created in a political environment and are "conditioned by the . . . *character* of existing political institutions" (1993: 1403 italics added). Similarly, Edelman (1990) argues that political and legal environments have critical indirect normative influences on organizations. Political environments that are hostile to founders' activities may cause entrepreneurs costly delays, more intense regulatory scrutiny, and difficulty in obtaining necessary permits. By contrast, in political regimes that are more supportive of a particular economic activity, political actors and civil servants at various bureaucratic levels may carry out their duties in ways that facilitate entrepreneurial activity in that sector.

California provides a good example of how political environments shape entrepreneurial activity. Its political environment in the early 1980s favored environmental conservation and renewable energy production. Righter (1996) described important state political actors such as the governor, congressmen, public utility commission (PUC), the legislature, and other state officials and staff as supportive of renewable energy projects. "The state of California created a hospitable atmosphere" for wind power; environmental sensitivity and pro-renewable energy ideology and values permeated all levels of government from state regulatory agencies to state legislatures (Righter, 1996: 203). Jan Hamrin, the founder of California Independent Energy Producers, reported that in the early 1980s, many California state politicians and regulators worked *with* renewable energy producers in an effort to increase their viability[3]. California's government supported wind power entrepreneurship formally through policies such as mandatory standard contracts and generously defined avoided costs. Governmental staff also supported wind entrepreneurs informally by minimizing the potentially negative impact of burdensome regulatory processes and by providing useful services such as wind reports that enabled entrepreneurs to identify fertile project locations. We argue that states that have a political environment that is more supportive of environmental conservation and renewable energy—like California—will foster greater wind entrepreneurial activity.

State political environments can also affect entrepreneurial activity by influencing how incumbent organizations that are dependent on the state treat new ventures. Organizations whose resources and business activities depend on their political environments are more likely to be influenced by political norms (Edelman, 1990, 1992). The performance of organizations in a highly regulated industry, such as the power industry, is tied to organizations' ability to work cooperatively with regulatory oversight bodies. Failure to do so could result in formal fines and informal sanctions such as increases in intrusive and costly reviews of organizational practices (Sine and David, 2003; Joskow and Schmalensee, 1983). In the case of wind power, while federal law required utilities to allow independent power producers to purchase their power at the utility's avoided cost, many utilities saw wind entrepreneurs as competitors and resisted interconnection in at least three ways: (1) prolonging the contract negotiation process which resulted in a loss of time and increased legal fees for small entrepreneurial firms, (2) charging high interconnection fees, and/or (3) refusing to interconnect which required new independent power ventures to take them to court to force interconnection (Hirsch, 1999). Because resources are a central concern for small emerging ventures, resistance to interconnection discouraged founding (Hirsch, 1999). A pro-renewable energy political environment sends strong signals to utilities to work cooperatively with wind energy entrepreneurs. We suggest that utilities in states with political environments that were favorably disposed towards renewable energy technology, in an effort to

[3] Interview with the first author April 2003.

conform to their political environment, and avoid formal and informal sanctions, were less likely to resist interconnection (Edelman, 1992). In summary, we argue that political environments that are more supportive of environmental conservation and renewable energy result in greater formal and informal aid for fragile new wind energy ventures and less resistance by incumbents. Therefore we posit the following relationship,

Hypothesis 3: State legal environments that are more supportive of environmental conservation will increase entrepreneurial activity in the wind energy sector.

DATA AND METHODS

Data

The Federal Energy Regulatory Commission (FERC) requires all owners or operators of independent generating facilities seeking qualifying facility status under PURPA to file a notice reporting basic facts about their proposed facility. A project automatically receives the status of qualifying facility once FERC receives the filing if the filing demonstrates that the facility meets the ownership and technical requirements outlined by PURPA. FERC maintains and publishes a database of these filings, including information about the applicant's name, address, filing date, type of generator (new, existing, or both), ownership (utility or non-utility), and energy type (hydroelectric, wind, solar, biomass, wood waste, municipal solid waste, biomethane, other waste, waste natural gas, geothermal, coal, fuel oil, natural gas, nuclear, other).

In 1992, the regulatory environment changed dramatically and many organizations that would have previously been classified as qualifying facilities were no longer classified as such. Thus we have narrowed the sample to wind power plants founded between 1978 and 1992 (FERC, 2000).

Dependent Variable

Wind energy entrepreneurial activity. We extracted from the FERC data the number of foundings of qualifying facilities using wind energy at the state level during a given year.

Independent Variables

State and national economic variables. Because entrepreneurial activity may be related to national and regional economic characteristics (Shane, 1996; Saxenian, 1994), we controlled for several national and state level economic variables. These variables include change in the gross domestic product, prime rate, the natural log of gross state product, and change in the gross state product.

State regulation variables. We also controlled for important regulatory differences between states over time. Analyses by Russo (2001) show that whether or not state regulators explicitly defined avoided costs and mandated the use of standard contracts significantly impacted foundings of independent power facilities. He suggests that states that mandated the use of a common standard contract reduced the expense and uncertainty that new ventures face when trying to obtain contractual agreements from powerful utilities. While PURPA vaguely defined the parameters for determining avoided costs, which are the wholesale price that utilities would purchase electricity from independent generators, it was left up to state regulatory bodies to specify exactly how this price would be calculated. Some state commissions provided instructions about how to calculate avoided costs while others did not. Because utilities had the upper hand in negotiations with qualifying facilities, ambiguity surrounding the wholesale price of electricity increased the difficulty and expense of founding a wind generation facility. Therefore some states explicitly defined avoided costs and mandated the use of standard contracts in an effort to reduce barriers to entry.

We contacted each state regulatory commission and obtained commission orders that pertained to policies of avoided costs and standard contracts for the period 1978-1992. We coded defined avoided costs 1 if the state had explicitly defined avoided costs and 0 if it had not. Similarly, we coded standard contracts 1 if the state had mandated the use of a standard contract during a particular year and 0 if it did not.

State Population. Because larger populations may have a greater number of potential entrepreneurs, we included a logged measure of the population within a state in a given year.

Density. Past research suggests that density impacts an industry's competitive environment in at least two ways (Hannan and Freeman, 1977). Early in the industry's development, extant organizations legitimate the emerging sector by confirming its appropriateness. As the sector becomes crowded and reaches carrying capacity, firms begin to compete with one another and the impact of density becomes negative. We include the number of operating wind facilities in a state in a given year as a measure of density to control for these effects. Because we examine an emerging industry with low density levels, we did not include density squared in the final analysis. However, in models not reported here we included density squared, but it was not significant.

Technical Environment. We obtained data from the United States Department of Energy on the number of acres of available land in each state that had wind quality rated at a wind class greater than 3.

Political Environment. The League of Conservation voters (LCV) annually tracks voting records of individual congressmen on environmental-related legislation. Congressmen receive scores based on the frequency with which they vote in favor of legislation intended to protect the natural environment. A higher LCV score indicates a voting record that is more supportive of environmental conservation. We measured the extent to which a state's political environment is more or less supportive of environmental conservation in a given year by averaging the average LCV score of a state's representatives with the average LCV scores of a state's senators in a given year. Because the use of green power technology is advocated as a method for protecting the environment from pollution, we expect that a political environment supportive of environmental conservation will also be supportive of wind energy.

Cultural Normative Environment. To measure the extent to which populations are more or less supportive of environmental conservation, we obtained membership data at the state level from the Sierra

Club, one of the largest environmental organizations in the United States. Because there is no national longitudinal survey that measures the overall state climate for environmental conservation, Sierra Club membership data provide a suitable proxy. Because the Sierra Club has also been a strong advocate of renewable energy, state level membership in this organization reflects the degree to which a state's cultural environment is supportive of wind power.

Model Specification

Our model estimates the founding count per state in a specified year. Although we initially estimated a common Poisson model, closer examination revealed that the variance exceeded the mean, violating a standard assumption of Poisson models. The violation of this assumption causes over-dispersion, resulting in the estimation of biased standard errors. When the assumption of equal mean and variance is violated in a Poisson model, a gamma-Poisson or negative-binomial model is appropriate (Cameron and Trivedi, 1996). Accordingly, we re-specified the model using a random effects negative binomial regression (Table 2). To check the robustness of the results, we also ran the analysis using generalized estimating equations with a negative binomial distribution and a log linear link function (Liang and Zeger, 1986). An advantage of this model is that it does not assume that panels are uncorrelated. We used robust variance estimators in our analyses, reducing problems associated with heteroskedasticity and misspecification of the error structure (White, 1981). We also ran all models using fixed effects regressions. In these regressions, the results were quite similar to the random effects and generalized estimating equation in both their direction and significance, except for the availability of land with class 3 and higher wind which was not significant. This is most likely due to the fact that this variable did not change appreciably during the study period. Sierra Club membership remained significant. We do not include these results in this paper because fixed effects models for panel data cannot estimate effects for observations for which there is no variation in the dependent variable over time. Because this applied to approximately 25 percent of our sample, the resulting fixed effects regressions are biased because states with no foundings of wind facilities over the observation period are systematically different from those in which there was founding activity. Dropping those observations, and thereby enabling the use of fixed effects models, bias the estimates.

RESULTS

We provide summary statistics for the variables in our regression analysis in Table 1. In Table 2, we present the results of the regression analysis. Model 1 provides a base model that includes the control variables. Model 2 adds technical variables, model 3 adds political variables, and model 4 adds normative-cultural variables. Table 3 provides a robustness checks by examining the effect of the controls and the three hypothesized predictor variables using generalized estimating equations.

Among the control variables, our results show that increased state population, gross domestic product, and prime rate increases founding activity while increases in gross state product decreases founding activity. Both density and defined avoided costs are significant in models 1 and 2 but defined avoided cost effects go away once the political environment is accounted for and the effects of density are no long significant once Sierra club membership is added in Model IV. This suggests that density and defined costs may have been proxies for underlying political and cultural-normative structures.

As hypothesized, we find that the greater the availability of land with high quality wind resources, the greater the founding rate (H1). Our results indicate that an increase in available high quality wind land of 1000 acres increases the expected count of wind facilities by approximately three percent. Similarly, we find that the normative-cultural environment also significantly increases wind foundings; an increase of 1000 members in the Sierra Club increases the expected count by 1.5 percent (H2). Contrary to hypothesis 3, net of other variables, the political environment did not significantly influence wind foundings. Robustness checks using generalized estimating equations in Table 3 support these findings.

DISCUSSION

This paper examines why entrepreneurial activity in the U.S. wind energy sector was more pronounced in some states than others. We find that technical and normative-cultural regional characteristics explained differences in entrepreneurial activity in the emerging wind energy sector. While our measure of political environments was not significant, this does not necessarily suggest that political and legal factors did not play a fundamental role in this sector's emergence. Indeed, prior to the passage of PURPA there were virtually no independent power companies. This legislation provided the necessary political and regulatory framework to support the emergence of this relatively new economic activity. Within this legal framework, regional attributes such as the number of available acres of land with high quality wind and populations that valued environmental conservation shaped the relative fertility of the opportunity to turn wind into electricity. This paper contributes to the growing literature concerned with how regional attributes shape entrepreneurial activity. In particular, this research emphasizes the importance of technical and normative-cultural regional characteristics and downplays the role of efficient contracting explanations for entrepreneurial activity. Our results show that, net of technical and cultural state attributes, regulations that minimize the costs and risks associated with contracting play an insignificant role in driving entrepreneurial activity. It is noteworthy that whether or not a state had defined avoided costs is a significant predictor in the first two models (Table 2), supporting efficient contracting explanations. However, once measures of political and cultural normative characteristics are included, the effects of regulation intended to minimize contracting costs are no longer significant. This demonstrates that in the case of wind energy, the effects of defined avoided cost regulations are not a direct cause of increased entrepreneurial activity as suggested by past empirical work (Russo, 2001), but instead a proxy for the underlying environmental values of a state's population. This indicates that although particular kinds of regulations can facilitate or retard the growth of populations of organizations, it is important to take into account the wider social structural context in which such arrangements are made.

A second important finding of this research informs work on ecological conceptions of new venture founding. Our analysis suggests that, in the context of the emerging wind power industry, the effects of density early in the industry's emergence is a proxy for regional technical and normative-cultural attributes. Models 1-3 show that density significantly increases founding activity. However, when underlying normative-cultural aspects of a state's population are included in model 4, density effects disappear, indicating that the effects of density are driven by broader cultural structures that predate initial entrepreneurial activity (Table 2). This contributes to a set of studies that examine the causal relationship between density and increased foundings. Baum and Oliver (1992) found that the density of ties to important institutions were a much better predictor of the foundings of day care facilities than the density of organizations, indicating the importance of cultural work by entrepreneurs in creating legitimate industrial identities. Sorenson and Audia (2000) argued that the positive effects of regional density and agglomeration come from the formation of critical social networks, production and acquisition of critical knowledge of the business, and increased confidence on the part of the entrepreneur (Sorenson and Audia, 2000). Our results build on these studies by demonstrating how cultural frameworks directly shape initial entrepreneurial activity in emerging economic sectors and the resulting organizational density. This study answers a call by scholars for more research on the emergence and maturation of new populations (Zucker, 1989; Delacroix and Rao, 1994; Baum and Powell, 1995) by taking into account social structures that underlie entrepreneurial action.

A third implication of our results contributes to economic sociology by examining the role technical and cultural attributes play in the emergence of new economic sectors. A central tenet of the field is that economic action is socially situated and that economic institutions are social constructions (Granovetter and Swedberg, 2001). Building on these notions, our findings suggest that the emergence of the wind energy sector was not due entirely to the presence of available land and a stiff wind, but also driven by regional cultural characteristics and normative values. Because culture shapes entrepreneurs' understandings of environmental characteristics and their economic possibilities and how ambitions are expressed through action (Aldrich, 1999), the cultural moorings that hold sway in a geographic area drive economic behavior. State populations that place particular value on environmental conservation are more likely to have a penchant for economic practices that resonate with those values. Entrepreneurs can leverage these cultural values and related social support in ways that enable the emergence of new economic practices.

Finally, our research responds to calls to develop a more structural approach to entrepreneurship (Schoonhoven and Romanelli, 2001; Thornton, 1999; Eckhardt and Shane, 2003). Our results validate the claim that "much of the entrepreneurial process depends heavily on factors *beyond the control of individual entrepreneurs*" (Eckhardt and Shane, 2003, italics added). For example, the desirability of a windy land area to an entrepreneur is dependent on the force of the wind, the amount of urbanization, and land use laws—all of which are beyond the immediate control of the entrepreneur. Likewise, we argue that the normative-cultural aspects of a state can increase or decrease the feasibility of exploitation of a particular opportunity independent of the efforts of an individual entrepreneur. Our claim is grounded in Stinchcombe's theoretical arguments that suggest that social structure influences the capacity to organize which then in turn impacts the ability of organizations to be founded and thrive (1965).

Most explanations of the entrepreneurial process have neglected this role of broader cultural, political, and technical forces on opportunity discovery and exploitation (Bhave, 1994; Ardichvili, Cardozo, and Ray, 2003). The structural approach we take in this paper is necessary if entrepreneurship scholars are to make sense of how "… resource availabilities and known technological possibilities…" (Kirzner, 1997: 70) translate into Kirznerian opportunities such as entrepreneurial errors, shortages, surplus, and misallocated resources (1997). We find that cultural norms provide a vital link between unexploited regional technical possibilities and entrepreneurial action. Thus, our approach broadens past analyses by investigating not only what environmental factors dictate the existence of opportunity, but also which ones shape their exploitation and facilitate subsequent industry emergence (Aldrich and Fiol, 1994).

CONCLUSION

There has been little work in entrepreneurship that examines the effects of regional technical, political, and cultural attributes on entrepreneurial activity in emerging economic sectors. We find that technical and normative-cultural attributes explain variation in wind power plant foundings. States that had greater amounts of available land with high quality wind and populations that value environmental conservation experience greater founding rates. Regional political differences did not significantly affect amounts of wind energy entrepreneurship. However, we do not claim that political and legal structures did not affect this emerging sector. Instead, federal passage of PURPA constituted a new industrial framework that enabled entrepreneurs to organize technical and cultural resources and found wind energy facilities. Our results suggest that a more refined understanding of the factors that both shape the possibilities of entrepreneurial opportunities and lead to variation in the exploitation of those opportunities is a critical next step towards a richer understanding of the entrepreneurial process.

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TABLE 1: Correlations and summary statistics

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Mean	0.81	0.50	2.87	7.34	0.24	1.09	10.78	10.68	14.87	49.33	4.97	9.07
Standard Deviation	6.65	0.50	2.21	4.97	0.43	10.04	1.06	3.31	1.02	79.79	2.07	23.03
Minimum	0.00	0.00	-2.00	-27.96	0.00	0.00	8.29	6.00	12.90	0.00	0.00	0.27
Maximum	157.00	1.00	7.30	43.09	1.00	135.00	13.65	18.87	17.25	286.90	10.00	208.86
1. Foundings	1.00											
2. Defined Avoided Cost	0.08	1.00										
3. Change in the Gross Domestic Product (%)	0.05	0.02	1.00									
4. Change in the Gross State Product (%)	0.05	-0.03	0.49	1.00								
5. Standard Contract	0.12	0.51	0.01	-0.06	1.00							
6. Wind Facility Density	0.23	0.11	0.00	0.02	0.21	1.00						
7. Gross State Product (ln)	0.17	-0.10	-0.02	0.04	0.01	0.31	1.00					
8. Prime Rate (%)	0.04	-0.05	-0.16	0.07	-0.03	-0.05	-0.17	1.00				
9. State Population (ln)	0.18	-0.12	0.00	0.07	-0.02	0.30	0.97	-0.02	1.00			
10. Availability of Class 3 & Class 4 Wind/1000	0.01	0.38	0.00	-0.21	0.13	-0.04	-0.24	0.00	-0.26	1.00		
11. Congressional Voting Record/10	0.04	0.00	0.06	0.20	0.10	0.07	0.17	0.05	0.13	-0.22	1.00	
12. Environmental Group Membership/1000	0.43	0.08	-0.02	0.02	0.22	0.86	0.53	-0.04	0.51	-0.08	0.15	1.00

TABLE 2: Predictors of Foundings of Wind Energy Facilities

Variable/Model #	1[a]	2[a]	3[a]	4[a]
Control Variables				
Defined Avoided Cost	1.54**	1.13**	0.77	0.63
	[0.42]	[0.42]	[0.47]	[0.49]
Change in Gross Domestic Product (%)	0.17**	0.19**	0.15*	0.22**
	[0.06]	[0.06]	[0.07]	[0.06]
Change in Gross State Product (%)	-0.09**	-0.11**	-0.08*	-0.11**
	[0.03]	[0.03]	[0.04]	[0.04]
Standard Contract	-0.05	0.26	0.46	0.05
	[0.39]	[0.37]	[0.40]	[0.41]
Wind Facility Density[b]	0.01*	0.01*	0.01*	-0.00
	[0.01]	[0.01]	[0.01]	[0.01]
Gross State Product (ln)	-0.96	-0.72	-1.68*	-1.91*
	[0.69]	[0.71]	[0.84]	[0.82]
Prime Rate (%)	0.14**	0.17**	0.11+	0.23**
	[0.05]	[0.05]	[0.06]	[0.08]
State Population (ln)	1.12	1.16	2.17*	2.24**
	[0.71]	[0.74]	[0.88]	[0.84]
Technical and sociopolitical characteristics				
Availability of Class 3 & Class 4 Wind/1000		0.01*	0.01*	0.01*
		[0.00]	[0.00]	[0.00]
Congressional Voting Record/10			-0.03	0.03
			[0.09]	[0.09]
Environmental Group Membership/1000				0.02*
				[0.01]
Constant	-10.57**	-14.83**	-18.41**	-18.37**
	[3.53]	[3.97]	[4.40]	[4.50]
Observations	585	585	568	568
Chi Squared Statistic	40.29***	49.35***	42.37***	57.85***

Standard errors in brackets

+ significant at 10% * significant at 5% ** significant at 1%

[a]Models 1-4 are random effects negative binomial regressions

[b]In regressions not shown here we included density squared but it was not significant and because this is a new industry, there was no theoretical reason to include this variable.

TABLE 3: Predictors of Foundings of Wind Energy Facilities

Variable/Model #	1[a]	2[a]	3[a]
Control Variables			
Defined Avoided Cost	1.263**	0.761+	0.634
	[0.313]	[0.403]	[0.416]
Change in Gross Domestic Product (%)	0.275**	0.164**	0.188**
	[0.053]	[0.058]	[0.062]
Change in Gross State Product (%)	-0.118**	-0.041	-0.069+
	[0.029]	[0.036]	[0.040]
Standard Contract	0.798**	0.996**	-0.355
	[0.256]	[0.325]	[0.385]
Wind Facility Density[b]	0.027**	0.009+	-0.012
	[0.005]	[0.005]	[0.008]
Gross State Product (ln)	-1.394*	-4.179**	-4.041**
	[0.548]	[0.765]	[0.874]
Prime Rate (%)	0.187**	0.008	0.164*
	[0.045]	[0.052]	[0.079]
State Population (ln)	2.771**	5.898**	4.607**
	[0.602]	[0.854]	[0.950]
Technical and sociopolitical characteristics			
Availability of Class 3 & Class 4 Wind/1000	0.010**	0.01*	0.01*
	[0.001]	[0.00]	[0.00]
Congressional Voting Record/10		-0.03	0.03
		[0.09]	[0.09]
Environmental Group Membership/1000			0.02*
			[0.01]
Constant	-31.971**	-18.41**	-18.37**
	[3.333]	[4.40]	[4.50]
Observations	585	568	568
Chi Squared Statistic	179.6***	186.5***	332.5***

Standard errors in brackets

+ significant at 10% * significant at 5% ** significant at 1%

[a]Models 1-4 are generalized estimating equations with a negative binomial distribution