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INSTITUTIONAL ACTORS AND ENTREPRENEURIAL CHOICES: NEW VENTURES IN THE BIODIESEL FUEL INDUSTRY

Abstract
Shon Hiatt

Entrepreneurs face a host of potential choices in creating new firms, yet little is known about how multiple institutional actors promoting different practices and technologies can affect entrepreneurial decision-making, especially at the beginning of new sectors and technological lifecycles. Using historical data and quantitative analyses of U.S. biodiesel producer foundings, technological innovation and diversity, I highlight the impact of competing institutional actors (agriculture trade associations) on entrepreneurial decision-making and activity. I posit that greater competition or heterogeneity of trade associations promoting various technologies will result in higher rates of biodiesel foundings as well as technological variation and innovation. I also analyze the moderating influences of competing institutional actors (Sierra Club/environmental lobby actors) and entrepreneurial network relations (captured by de novo and de alio entrants) on trade association effectiveness. In a final analysis, I explore the moderating influence of institutional actor size on actor heterogeneity. The dissertation contributes to the growing nexus of institutions and entrepreneurship research as well as to the research on technology entrepreneurship.

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Executive Report

Shon Hiatt

Introduction

This dissertation attempts to answer an important entrepreneurship question: At the beginning of new technological sectors, what environmental factors influence new-venture innovation and technological diversity? And, more specifically, what impact do competing institutional actors (trade associations and environmental movement actors) promoting different technological processes have on entrepreneurial decision-making? I answer these questions by focusing on the emergence and growth of the U.S. biodiesel sector. Empirically, I measure new-venture founding rates, technological choice, technological diversity, and innovation.

The biodiesel sector is an ideal context in which to address these questions as the industry largely arose from the actions of powerful agriculture trade associations which promoted and sponsored varying production technologies in an effort to create a new market for their products. This report will go as follows. First, I will give a brief description and history of the biodiesel sector. Next, I will report how the findings address the main question. And finally, I will discuss the other findings of the dissertation.

Biodiesel sector

Biodiesel is fuel derived from a variety of organic sources for use in compression-ignition (diesel) engines. Typical feedstock oil includes soybean and canola oils, beef and pork tallow, and fryer oil from restaurants. Once oil is extruded from oil-seed plants, rendered from animal carcasses, or siphoned from restaurant grease traps, it undergoes a transesterification process in a biodiesel production facility where, through varying technologies individualized for

each kind of extracted oil, glycerol is removed from triacylglycerol (triglyceride) leaving alkyl esters, resulting in a liquid compound that has properties similar to petroleum distillates used to power diesel engines. The type of fats and oils used as feedstocks determines the type of chemical and mechanical process or technological design. Thus, the technological design used to process, for example, soybeans is different from that used to process, for example, poultry fats.

The use of vegetable oil as an engine fuel is not new. It traces its beginnings with the invention of the diesel engine. In 1897, Rudolph Diesel successfully created a prototype of the world's first "heat" engine that ran without spark. While the first prototypes ran mostly on petroleum distillates, Diesel spent the latter part of his life tweaking successive models to run on pure vegetables oils and promoting the use thereof. He said: "The use of vegetable oils for engine fuels may seem insignificant today, but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time….Motor power can still be produced from the heat of the sun, always available, even when the natural stores of solid and liquid fuels are completely exhausted." However, Diesel's untimely death in 1913 and the growing abundance of cheap petroleum fuel largely ended research on vegetable-oil fuels.

The technology used today to make biodiesel came about through a series of improvements in soap-making technology and perfected in universities across the nation in response to the energy crises of the 1970s. Despite the ample amount of research and development performed at the university level, the biodiesel industry may never have developed as it has today without the channeling of entrepreneurial attention to this new organizational form by agriculture trade associations. A number of state-based agriculture trade associations became apprised of the research being conducted by academics and began sponsoring their work in order to develop viable technological processes that could convert their farm products into

biodiesel. Then, using their chapter members and resources, they began promoting such technologies. For example, the American Soybean Association promoted feedstock technologies that utilized soybean oil as a raw material while the U.S. Canola Association endorsed technologies that used canola oil. The National Renderers Association drew attention to technologies that utilized animal tallow while the National Corn Growers Association advocated technologies that employed corn oil as a biodiesel raw material.

In an effort to promote and legitimate the new technologies, state trade association members attended agriculture conferences, county fairs, and other public venues to discuss and demonstrate the new technology. After filling up buses, tractors, and trucks, with biodiesel, they would drive thousands of miles across county roads, garnering much attention. They would often bring university scientists to testify of the particular technology's effectiveness and appropriateness. Because the application of soap-making technologies to biodiesel production was very new and entrepreneurs could not simply conduct a cost-benefit analysis of which technological production process they should adopt, the influence of agriculture trade associations promoting the "best" technology had a large influence on the decision of entrepreneurs to found a firm and to adopt or develop a production process.

Yet, as the budding sector started to take form, other powerful actors already present in the institutional environment opposed most of the promoted production technologies mentioned above. Environmental movement organizations such as Sierra Club and to a lesser extent Friends of the Earth and Greenpeace attacked what they defined as intensive agriculture practices to produce the raw materials that were transformed into biodiesel and engaged their members to frame, label, and sponsor research claiming such production technologies as unsustainable and wrong. As they sought to discredit certain technologies through member mobilization, they had

an influence in shaping individual values and understandings, and in turn, affected entrepreneurial decision-making.

Main findings

Entrepreneurs endeavoring to start an organization in a new sector with a variety of unproven technologies face a number of challenges. First, they must decide to enter into an emerging sector characterized by high uncertainty and little cognitive and sociopolitical legitimacy. Second, they are presented with the dilemma of choosing an uncertain technology that will have a long and successful trajectory. In every new technology cycle, eras of substitution and direct competition occur wherein emerging technologies vie to become the accepted market standard or dominant design, with practices enjoying the greatest support among government, professions and other organizations becoming ascendant.

During the early-cycle period, entrepreneurs must sort through unproven practices and select or develop a technology that has the greatest probability of surviving the competition. The complexity of and uncertainty about new technologies, the lack of consensus about the technology's ultimate form or function, and the high amounts of raw data as well as individual processing capabilities needed to understand or use the technology can make it difficult for entrepreneurs to adopt a particular technology. After founding a firm and deciding on a technology, they face the challenge of convincing key constituents such as creditors, investors, suppliers, and buyers that their sector and product or service rendered from the new technology is appropriate and desirable. If the sector or technology lacks substantial cognitive and sociopolitical legitimacy, entrepreneurs will find it difficult to obtain the resources they need to start and grow their organization.

Institutional actors, who can legitimate, promote, and provide meaning to new practices and technologies, can have a profound influence on the technological choice of entrepreneurs. Given that trade associations and environmental movement organizations can change individual perspectives and values surrounding practices and technologies, they can serve as powerful institutional actors. I analyzed how trade associations and environmental movement organizations affected entrepreneurial decision-making in the U.S. biodiesel fuel sector. The window of observation is from 1990 to 2008. A total of 267 biodiesel production plants were founded and 23 different biodiesel production technologies were developed and adopted by biodiesel producers over the eighteen-year time period. The first biodiesel founding occurred in 1993 in Missouri, with one or two more a year in a few other states. Foundings began to increase beginning in 2002 and by 2007, the states averaged 1.70 foundings per year with Texas leading the way with 8.5 foundings per year.

The findings showed that among several competing trade associations (i.e. institutional actors), greater strength or membership size of a specific trade association promoting technological prescriptions and understandings had a positive impact on the rate of biodiesel firms adopting that particular technology. Additionally, competition between trade associations and Sierra Club members who opposed certain biodiesel production technologies in a state created a blending as well as a magnifying effect on the influence of the trade association. When the promoted technologies were environmentally unsustainable, a greater presence of Sierra Club actors did not reduce biodiesel foundings. Instead entrepreneurs founded ventures but developed new technologies that were in harmony with the values and interests of the Sierra Club, not the technology promoted by the trade association. In contrast, when a promoted technology was environmentally sustainable, the presence of Sierra Club actors had a magnifying effect on the

influence of the trade association, wherein more entrepreneurs founded biodiesel ventures that implemented the promoted technology.

I also analyzed how entrepreneurial network relations can moderate the influence of institutional actors by measuring how de novo and de alio ventures react to the actions of trade association and the Sierra Club. De novo ventures are started without direct linkages to or sponsorship from other organizations, while de alio ventures are sponsored by other companies. I found that de novo entrants were more susceptible to the actions of both trade associations and Sierra Club actors than de alio entrants because they generally were more concerned about legitimacy and relied more upon resources in the local environment than de alio ventures. In sum, the results indicate that competing actors and network relations can have significant moderating effects on the influence of focal institutional actors and entrepreneurial decision-making. They also show that the development and adoption of new technologies occur in environments where actors compete for entrepreneurial attention.

Next, I analyzed how the degree of competition, or organizational heterogeneity, among competing actors affected the decision of potential entrepreneurs to found a firm, impacted technological diversity, and influenced the development of innovative recombinatorial technologies. I found that increased competition or heterogeneity among agriculture trade associations fostered biodiesel foundings by appealing to a broad variety of individual tastes and values. Moreover, the results indicated that trade association heterogeneity had a greater effect on new-venture foundings than sheer size or strength of the associations involved. In another analysis, I found that greater competition as measured by heterogeneity among trade associations had a positive effect on technological diversity and that the effect was greater than the impact of

size or strength of the competing associations. As new ventures adopted a variety of promoted technologies, technological variation in a given state also increased.

Finally, I explored how greater competition among agriculture trade associations affects entrepreneurial innovation. I found that by providing entrepreneurs with a wide repertoire of technologies, values, and ideas, greater competition among trade associations can lead to the development of innovative recombinatorial technologies. When there were many equal voices promoting various new technologies, entrepreneurs were more likely to create a technological process that combines two or more technologies. And, similar to previous findings, the impact of institutional actor competition on recombinatorial technologies was greater than the overall size effect of the actors. I also analyzed the interaction between trade association size and heterogeneity. The results indicated that greater overall size of competing trade associations moderately increased state technological diversity as well as the effect of trade association competition on entrepreneurs' decision to found a firm in a new sector and innovate. Thus, competition among actors promoting various technologies can be a significant factor behind entrepreneurial activity, innovation, and technological diversity at the beginning of new sectors.

Additional findings

The results also demonstrate that certain laws have a positive effect on biodiesel foundings. State trade associations actively lobbied for beneficial state and federal laws such as mandates and incentives. Production mandates include laws that mandate a certain percentage of biodiesel be produced in a state and blended with petroleum fuel at local gas pumps. Incentive policies include tax credits for biodiesel production, grants for the construction of biodiesel refineries, biodiesel blending credits, and reduced excise tax on biodiesel sales. The findings indicate that state biodiesel production mandate laws have a positive effect on biodiesel

foundings, while state biodiesel incentive laws did not. The federal subsidy on biodiesel production also had a positive impact on biodiesel foundings, though less significant than the effect of state mandate laws. Additionally, technology-specific profitability and the availability of technology-specific raw materials had a positive impact on the adoption of that practice for most technologies.

Finally, in results not reported in the dissertation, I found that the interaction of trade associations with universities conducting biodiesel research had a profound impact on the transfer of university technology and on biodiesel foundings. Biodiesel chemical production processes were largely developed, perfected and tested in the university setting. Interestingly, without the presence of trade associations to promote and facilitate technology transfer, universities technology largely stayed within the walls of the professors' laboratories and had no significant effect on the sector.

Contributions

This paper makes several contributions. First, this paper contributes to the nexus of institutions and entrepreneurship research by considering how actor competition or heterogeneity can affect the emergence of new organizations and spur technological diversity and innovation. Interestingly, the results indicate that trade association heterogeneity or competition had a greater effect than the strength or net size of actors on founding rates, recombinatorial innovation, and technological diversity. Given the power that heterogeneity has in shaping new sector development and entrepreneurial activity, scholars may want to pay greater attention to heterogeneity in future institutional and organizational studies.

Second, this paper builds upon the technology entrepreneurship research which is concerned about how new technologies develop and evolve over time. Prior studies largely focus

on technological adoption and development after the inflection point of the technological s-curve, largely overlooking other factors that affect entrepreneurial decision-making in the early periods. Building on past research this paper finds that greater trade association competition can profoundly influence technological development and variation at the beginning of new sectors and technological lifecycles by stimulating new-venture technological innovation and variation.

Third, this paper also contributes to the research on institutional actor collaborations and alliances. While the trade associations in this study competed with each other regarding the kind of biodiesel technology they promoted, they also collaborated at times to move the sector forward by endorsing and becoming members of the biodiesel sector's trade association, the National Biodiesel Board. The results suggest that for trade association collaboration to have the greatest effect on new organizational development, influence among members must be nearly equal (maximum heterogeneity). While the strength or size of the collaboration does make a difference on impact, collaborations or alliances must make sure to strike the right balance between heterogeneity and size in order to maximize the differences of information and characteristics among organizational members.

Finally, this paper empirically contributes to our understanding of trade associations. Trade associations are entities that arise after a new sector has been formed with the purpose of defending and promoting the interests of their business firms. In contrast to previous studies that have traditionally cast trade associations as opponents of innovation and institutional change, this paper finds that trade associations can actually be antecedents to and catalysts of new sectors and technologies by promoting prescriptions and scripts outside of their domain that change individuals' perceptions of organizations and technologies. Thus, instead of just representing and defending existing business sectors, trade associations can actually create new ones.