VENTURE CAPITAL AND CLEANTECH ENTRY: CONTINGENT EFFECTS OF ENVIRONMENTAL SOCIAL NORMS

ABSTRACT

Research on geographical variability in entrepreneurship has emphasized institutional heterogeneity. Yet much of this work focuses solely on economic institutional factors, ignoring their interplay with broader institutional forces. Drawing on institutional and entrepreneurship theory, we investigate inter-regional variations in entry into the cleantech sector within the U.S. over the period 1998-2007. Specifically, we develop and test a model of how regional agreement in environmental social norms moderates the relationship between venture capital (VC) liquidity (i.e. exit) markets and entrepreneurial entry. We find that U.S. states with stronger cleantech VC liquidity markets have more cleantech entrepreneurial entry; however this relationship weakens and becomes negative as the level of intersubjective agreement in a state increases beyond intermediate levels.

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Significant amounts of private venture funds have been invested in clean technology ventures over the last two decades (e.g. renewable energy, green building, green chemistry, energy management, etc.) encouraged by national policy goals of energy independence and economic growth through entrepreneurship (Petkova, Wadhwa, Yao, & Jain, 2013). However, spectacular failures have led to increasing skepticism regarding the suitability of the venture capital model for cleantech investment, with recent industry trends suggesting that investors are either retrenching or focusing on less risky, later-stage investments. Critics have also consistently argued that the high capital costs and long time-horizons make the cleantech industry over-reliant on public funds and government subsidies (e.g., Hargadon & Kenney, 2012). Therefore with "clean capital" increasingly scarce and its allocation efficiency a matter of concern, an examination of the conditions where cleantech investments have been historically successful in stimulating new venture creation is a topic of relevance to both entrepreneurial strategy and broader public policy.

In this study we examine the regional conditions under which the strength of venture capital (VC) markets stimulates entrepreneurial growth in clean technology. Econometric studies employing institutional and ecological perspectives have primarily documented a positive relationship between the strength of venture capital markets and regional levels of entrepreneurial entry (e.g., Samila & Sorenson, 2011, 2013; Stuart & Sorenson, 2003). However, some studies (e.g., Saxenian, 1996) caution against the widespread generalizability and interpretability of such findings, suggesting that regional differences in socio-cultural factors such as attitudes, values, and norms can impact entrepreneurial entry (Sine & Lee, 2009; Tolbert,

David, & Sine, 2011; York & Lenox, Forthcoming). In this paper we integrate and build on these arguments and find that in the case of clean technology, a context where products and services help to address a normative problem (environmental degradation); regional levels of environmental social norms moderate the efficacy of VC markets in driving new firm creation.

We develop our theory using an institutional view on entrepreneurship (For a review see Tolbert et al., 2011). There is a long tradition of studying the influence of institutions on entrepreneurship from both sociological (Aldrich & Fiol, 1994; Scott, 1995) and economic (North, 1990) perspectives. For instance, sociologists focus on how the strength of institutions can influence the legitimacy of new entrants and hence both the salience and pursuit of entrepreneurial opportunities (e.g., Hiatt, Sine, & Tolbert, 2009; Sine & Lee, 2009; York & Lenox, Forthcoming). Similarly new institutional economics emphasizes how formal and informal "rules of the game" can shape both transaction and opportunity costs, thereby influencing entry rates and competitive dynamics between new entrants and incumbents within an industry.

Despite closely aligned theoretical perspectives and an interest in similar outcomes, there has traditionally been little cross-pollination in these perspectives, especially in empirical work, to understand how different forms of institutions work together and influence each other (Pacheco, York, Dean, & Sarasvathy, 2010). Furthermore, as Ritzer and Ryan (2010) indicate in their review of the field, most *empirical* studies focus on the impacts of one kind of institution (e.g. formal laws); however the most interesting *theoretical* institutional arguments often highlight that the efficacy of a particular institution is likely to be contingent on the strength of other institutions.

In addition to the economic and sociological perspectives discussed above, institutions may also be classified into centralized and decentralized forms (Ritzer and Ryan, 2010). This classification refers to the source of authority; that is, whether institutions are enforced in a top-down fashion or are instead more emergent. Recent work adopting an institutional perspective on entrepreneurship has attempted to study the interactive effects between combinations of these different institutional forms; economic, sociological, centralized, and de-centralized (Tolbert et al., 2011). For instance, Meek et al. (2010) demonstrate that the efficacy of centralized, economic institutions (state-level policy incentives) in encouraging entrepreneurial entry into the solar industry is moderated by decentralized, socio-cultural institutions (social norms of conformity). In a related study, York and Lenox (*Forthcoming, SMJ*) demonstrate that in the context of the green building supply industry, *de novo* entry is predominantly driven by socio-cultural institutions (e.g. social norms, social movements), while *de alio* entry is instead primarily driven by economic institutions (e.g. state-level incentives).

In this paper, we further develop this nascent stream of integrative research by looking at how the relationship between the strength of the cleantech venture capital market in a region (a decentralized, economic institution) and the rate of cleantech entrepreneurial entry is moderated by environmental social norms (a decentralized, socio-cultural institution). While prior research has explored the relationship between venture capital, entrepreneurship, and regional economic growth more broadly (e.g., Samila and Sorenson, 2010, 2011a), it has by and large failed to adopt such a cross-institutional perspective, focusing exclusively on economic institutional factors[1].

[1] An exception is a working paper by Samila and Sorenson (2013) that looks at how the social capital in a region (measured through the presence of voluntary organizations and ethnic diversity) moderates the efficacy of VC in stimulating regional entrepreneurship rates.

Through this study, we contribute to the literature on venture capital, institutions, and entrepreneurship theory. First, we contribute to extant theories of the impacts of venture capital by modeling how such activity may be enhanced in it's efficacy by the surrounding institutional environment. Second, we contribute to the literature on institutions and entrepreneurship (Tolbert et al., 2011) by extending the nascent body of work that look at cross-institutional effects. Our study is one of the very few to focus on the interplay of *decentralized institutions* and venture capital, which have received far less attention than centralized institutions (e.g. regulations or organized social movements) in the literature to-date (York & Lenox, Forthcoming). Lastly, we make a contribution to the entrepreneurship literature by using environmental social norms to operationalize the construct of intersubjective agreement (e.g., Alvarez & Barney, 2013; Davidson, 2001; Venkataraman, Sarasvathy, Dew, & Forster, 2012) which has only been discussed theoretically to-date. Through this approach, we further the bridge between institutional and entrepreneurship theories.

In addition, our study raises practical implications by quantifying regional variations in the marginal returns to VC liquidity events (our proxy of VC institutional strength) on new firm creation, albeit specific to the cleantech sector. The results are likely to be of significant interest to private investors and policy-makers alike given the current contraction of "clean capital" and the overall poor performance of private equity exit markets.

Below, we discuss the extant research on VC, entrepreneurship, and regional economic growth. We then theorize on how the literature on social norms and entrepreneurship can extend extant theories, in the context of the cleantech sector. Last, we present findings from our econometric analysis, and discuss both practical and theoretical implications.

THEORY AND HYPOTHESIS

Venture Capital and Entrepreneurship

There is widespread interest in VC as a catalyst for entrepreneurship and economic growth. The Silicon Valley model for VC is one that has been held up in as an ideal to emulate; regions around the United States and nations around the globe have attempted to engineer "Silicon Valleys" of their own (e.g., Bottazzi & Da Rin, 2002; Gilson, 2003), albeit with varying levels of success (Lerner, 2009).

At a regional level a vibrant VC market as part of an entrepreneurial ecosystem can be theoretically conceptualized as a decentralized economic institution that promotes new venture growth. For instance, Keuschnigg (2004) suggests that since access to capital is one of the binding constraints to engaging entrepreneurship, venture capitalists as financial intermediaries between prospective entrepreneurs and institutional investors such as pension funds (e.g., Amit, Brander, & Zott, 1998; Gompers & Lerner, 2001), serve a critical institutional role in fostering entrepreneurship. Hence, while VC is only directly responsible for a small portion of the total amount of entrepreneurship (Aldrich, 2010) , from this perspective it still plays the critical institutional function of legitimizing nascent, inchoate markets, especially in the context of fostering technologically oriented, and high-growth companies (e.g., Gompers & Lerner, 2001; Lerner, 1995).

However, the empirical research to support this stance is surprisingly limited, with few rigorous studies quantifying the relationship between VC markets and entrepreneurial entry at a *regional* level (but see Samila & Sorenson, 2011). Rather, the focus of entrepreneurship research has predominantly been on the impact of VC investment practices on *firm-level* issues such as the growth and survival of startups (e.g., Davila, Foster, & Gupta, 2003; Rosenbusch,

Brinckmann, & Müller, 2013). In this study we address this gap in the literature by using the strength of regional VC liquidity (i.e. exit) markets as a proxy of regional VC institutional strength.

From a startup (i.e. demand-side) perspective, liquidity events serve an important function in releasing both financial and human capital back into the economy, which can then be reallocated in the form of new enterprises. The literature on the geographical nature of founder location choices and entrepreneurial activity (e.g., Dahl & Sorenson, 2012; Gambardella & Giarratana, 2010) shows that much of the firm creation process is highly spatially localized, and suggest that regional rates of liquidity events are strongly predictive of subsequent rates of entrepreneurial activity in the same locale (e.g., Deeds, 2004; Stuart & Sorenson, 2003).

In a complementary fashion from an investor (i.e. supply-side) perspective, since VC investments are often finite in duration (a fund cycle is often for 8-10 years) and invested on behalf of limited partners, strong VC liquidity markets serve a critical institutional purpose by decreasing information asymmetries and increasing investor confidence that a successful return can be achieved on their investments in a timely manner (e.g., Black & Gilson, 1998; Jeng & Wells, 2000; Wright, Pruthi, & Lockett, 2005). Hence the strength of VC liquidity markets are often used in the entrepreneurial finance literature as a predictor of future venture fund allocation decisions across regions and nations (e.g., Black & Gilson, 1998; Cannice & Goldberg, 2009; Cumming, Fleming, & Schwienbacher, 2005; Jeng & Wells, 2000).

Therefore, taking into account both demand and supply side arguments, *ceteris paribus,* we hypothesize that across regions (i.e. U.S. states):

> *H1: The number of liquidity events (IPOs & acquisitions) in a given region in the cleantech sector will be positively related to the number of cleantech entrants in that region.*

However, we expect that this baseline relationship between VC and entrepreneurial entry is likely to be contingent on the role of other institutional factors. For example, research on venture capital clusters and regional economic growth (e.g., Saxenian, 1996) has highlighted that regions vary on a number of socio-cultural dimensions such as attitudes towards risk, failure, and collaboration. Hence, despite outward similarities in economic resource endowments, regions might have different informal institutional logics (e.g., Greenwood, Díaz, Li, & Lorente, 2010) that impact the efficacy of decentralized market-based institutions (Rodríguez-Pose & Storper, 2006) such as VC.

We focus our attention on the contingent effects of socio-cultural cognitive institutions; the shared understanding and mental schemas among actors that define the appropriateness and legitimacy of particular courses of action (Scott, 1995). Specifically, in the cleantech context we focus on the impacts of regional environmental social norms, a decentralized socio-cultural institution that has been previously found to impact rates of environmental entrepreneurship at a regional level (Meek et al., 2010; York & Lenox, Forthcoming).

Environmental Social Norms and Clean Technology

Our arguments for how and why environmental social norms will affect entry in the cleantech context build upon how norms as regional institutions relate to fundamental entrepreneurship theories on uncertainty, intersubjectivity, and opportunities. Entrepreneurship scholars have developed a number of perspectives on the role of uncertainty and its impact on the likelihood of entrepreneurial action (e.g., Eckhardt & Shane, 2003; McKelvie, Haynie, & Gustavsson, 2011; McMullen & Shepherd, 2006; Milliken, 1987). Much of this research builds on Knight's (1921) seminal writings on the difference between risk, uncertainty and the implications for profit. From a Knightian perspective, profit is the return for bearing uncertainty since uncertainty is

inestimable and not possible to insure against. In contrast risk, provides no opportunity for true entrepreneurial profit, since it can be predicted and hence insured against by competitors. Hence under this view, differences among individuals in the willingness to act under conditions of uncertainty form the foundation for all entrepreneurial action (McMullen & Shepherd, 2006).

In turn, extant theory also suggests that the level of uncertainty regarding a said opportunity is driven by the level of intersubjective agreement, that is the degree of understanding among relevant actors on subjective states or issues (Davidson, 2001; e.g., Dew, Velamuri, & Venkataraman, 2004; Gillespie & Cornish, 2010; Venkataraman et al., 2012). In the context of a market economy, a high level of intersubjective agreement at a societal level results in relatively complete markets where the existing price-mechanism works efficiently. Under such conditions, uncertainty is low and incumbent firms are able to estimate risks and generate rents by providing goods and services. Hence the opportunity for profit via entrepreneurial action by individuals seeking to introduce new services and products to the market is reduced. However, when there is a lack of intersubjective agreement among actors, existing markets are imperfect or incomplete in some fashion. It is in such situations, that entrepreneurs, who by definition are willing to act under the resultant uncertainty, are most likely to attempt to capture the potential profits that might arise.

In the context of technology that can address environmental problems, York and Venkataraman (2010) propose that there is generally little intersubjective agreement at a societal level on both the need for, and type of, “clean” solutions that are viewed as appropriate alternatives to traditional, but environmentally harmful, options. This lack of intersubjective agreement occurs because environmental degradation is a complex, multi-faceted issue laden with moral and normative implications that often conflict with short-term economic goals. For

instance, the recent debates on hydraulic fracturing as an alternative energy source reflect the degree to which there is divergence in public opinion on the viability and desirability of appropriate solutions. In such cases it is the fundamental lack of intersubjective agreement about environmental degradation that has lent itself to a host of solutions, all encompassed under the broad umbrella term of cleantech (Pernick & Wilder, 2007).

The substantial regional variation on societal attitudes towards the environment allows us to explore how intersubjective agreement, and hence the exploitation of opportunities by entrepreneurial and incumbent firms, might be dispersed across space and time. That is, operationally, we propose that environmental social norms in a region capture the measure of intersubjective agreement among actors located there. As we discuss below, our basic thesis is that entrepreneurial entry is most likely to occur when there is little intersubjective agreement at a regional level about the value of innovations that address environmental issues.

At extreme norm levels for environmentalism, either low or high, intersubjective agreement is high among actors. More specifically, when environmental norms are low, such that there is high intersubjective agreement that protection of the natural environment is not important, both entrepreneurs and incumbents are likely to perceive low social support for cleantech opportunities. In such situations where this is an absence of a socially acceptable "cleantech market", there is a low legitimacy (Aldrich & Fiol, 1994) and opportunities for both incumbents and entrepreneurs are likely to be reduced.

Conversely, when norms are high, such that there is high intersubjective agreement for protecting the natural environment, we suggest that opportunities for entrepreneurs are again likely to be reduced. In such situations, the market for cleantech is likely to be highly efficient, with minimal uncertainty. That is, there is unlikely to be "radical ignorance" in the market (e.g.,

Kirzner, 1979) about the nature and availability of cleantech opportunities and incumbent firms are more likely to compete extensively with new entrants. Therefore, it is in the zone of intermediate norms, where intersubjective agreement is low, and uncertainty is high, that new entrants are most likely to perceive opportunities, and hence enter the market in an effort to exploit them. Accordingly:

> *H2: Intersubjective agreement about environmentalism in a region will be negatively related to the number of cleantech entrants. That is, when intersubjective agreement is low (i.e. regions with intermediate environmental social norms), there will be more cleantech entrants than when intersubjective agreement is high (i.e. regions with high or low environmental social norms).*

To summarize, our arguments suggest that these two decentralized economic and socio-cultural institutions, venture capital markets and environmental social norms, both impact the degree of entrepreneurial entry, albeit in slightly different ways. We expect that regions with stronger venture capital markets, which we proxy through the number of liquidity events in cleantech, are likely to have an increased ability to support new ventures relative to less munificent regions. Hence, a thriving venture capital market as a regional institution in an entrepreneurial ecosystem is likely to increase the attractiveness of high technology, high-growth opportunities to both prospective investors and entrepreneurs. In a complementary manner, low intersubjective agreement in a region (i.e. intermediate norms) increases the salience and recognition of opportunities, in essence providing the socio-cognitive conditions that are most likely to allow individuals to perceive entrepreneurship as a career option. As indicated by McMullen & Shepherd (2006), the pursuit of an entrepreneurial opportunity by an individual requires him/her to have a combination of both motivational and knowledge-based drivers.

Applying their core logic to our theoretical discussion above, our aforementioned arguments would suggest that while strong venture capital markets would increase entrepreneurial (and investor) motivation through increased opportunity attractiveness, low intersubjective agreement would provide the opportunity for entrepreneurs to leverage unique, context-specific knowledge. Hence, we expect the effects of these two de-centralized institutions to be complementary and reinforce each other. Accordingly:

> *H3: Intersubjective agreement about environmentalism in a region will negatively moderate the relationship between the number of cleantech liquidity events and the number of cleantech entrants. That is, when intersubjective agreement is low (i.e. regions with intermediate levels of environmental social norms), the relationship between cleantech liquidity events and cleantech entrants will be more positive than when intersubjective agreement is high (i.e. regions with high or low levels of environmental social norms).*

METHODS

Study Context, Sample, and Data Sources

We utilized the *i3* database as our primary source of information on cleantech investments and startups. Consistent with Pernick and Wilder (2007), this database uses a broad-based definition of cleantech capturing both startup and venture investment activity in a wide array of technologies that seek to address issues of sustainability and/or environmental degradation. Startups in the database are categorized in a number of custom-defined industry segments such as solar, recycling and waste, water, energy efficiency, biofuels, transportation, agriculture, energy storage, and smart grid. For this study, we used all available industry segments but restricted our analysis to startup and investment activity within the continental United States over

the period 1998-2007, a period during which the cleantech sector experienced continual growth. We chose this ten-year window as accurate investment information is unavailable prior to 1998 in the *i3* database. We also ended our observation window at 2007 to minimize any confounding effects from the economic crisis that occurred in early 2008.

During this period, companies active in the database received 1,415 VC investment rounds representing an aggregate investment amount of $17.1 billion. The comparable amount for *overall* VC over the same period and geographic location was 79,574 investment rounds representing an aggregate investment amount of $1.43 trillion. Hence, it is important to recognize that while entrepreneurial entry and investment in cleantech was growing during the study period, it still represented a small fraction of *overall* VC investment (~ 1.8 % of investment rounds, and 1.2 % of investment dollars)[2].

For information on environmental social norms, we contacted the National Opinion Research Center (NORC) at the University of Chicago to obtain geo-coded data on environmental social norms from the sensitive data files of the General Social Survey (GSS)[3].

For the control variables in our econometric models, we combined data from a range of publicly available sources such as the US Department of Energy, the Department of Commerce Longitudinal Business Database, the Census Bureau, the DSIRE database of state incentives for renewables, and the Sierra Club.

All measures were matched and organized in a state-year panel, consistent with prior research on environmental social norms and entrepreneurship (e.g., Meek et al., 2010; Sine and Lee, 2009). Environmental social norm data was unavailable for the states of Nebraska, New

[2] Comparison figures for overall VC investment were computed from the *Thomson VentureXpert* database.

[3] Some of the data used in this analysis were derived from the sensitive data files of the GSS, obtained under special contractual arrangements designed to protect the anonymity of respondents. These data are *not* available from the authors. Persons interested in obtaining GSS sensitive data files should contact the GSS at GSS@NORC.org.

Hampshire, Nevada, Rhode Island, and Utah. These six states were therefore excluded from empirical models. Across the remaining 45 states, our dataset captures 2,461 cleantech entry events over the 10 year study period.

Dependent Variable

Number of cleantech entrants: To compute the rate of entrepreneurial entry into the cleantech sector, we aggregated the number of entrants in the *i3* database for each of the 44 states in the sample by year. To do so, we used the founding year and location information for each of the companies in the database. We also used a variety of manual online searches (e.g., company website, secretary of state websites, http://www.findthecompany.com, http://www.manta.com, http://www.investing.businesweek.com) to triangulate and backfill missing founding date and location information for 1,246 companies in the database.

Independent Variables

Liquidity events: Following prior research in corporate and entrepreneurial finance (e.g., Black and Gilson, 1998; Bruton et al., 2005; Jeng and Wells, 2000; Stuart and Sorenson, 2003), we considered the number of liquidity events in equity markets as our proxy of the strength of VC markets as a decentralized economic institution. In addition to this being a well validated measure in the literature, we also preferred to use this "exit market" measure as a proxy of VC institutional strength instead of an "entry market" metric (e.g., lagged regional venture capital dollars invested or counts of VC deals). While the latter measure captures the aggregate supply of VC, it is likely to be highly correlated with entrepreneurial entry rates by definition, and introduce endogeneity issues into our analysis. Hence, for each of the 44 states in our sample, we created a yearly summation of the number of initial public offerings (IPOs) and announced acquisitions for companies founded in the state. While IPOs are commonly solely used a

measure of positive liquidity in the literature, acquisitions are far more common as a form of exit for private companies but more difficult to measure (e.g., Gompers and Lerner, 2001; Stuart and Sorenson, 2003). However, the *i3* database catalogs both sets of events for the companies that it covers, facilitating this computation in our study context.

Intersubjective agreement: The moderating variable (of VC institutional strength) in our analysis captured the degree to which states' vary in the importance (or non-importance) ascribed to environmental issues. This variable was derived from state-level scores on environmental social norms as described below.

Following prior research (Meek et al., 2010), we first created state-level averages of a composite factor measuring environmental social norms by year. This was based on two specific items in the GSS that asked respondents to rank on a scale of 1-5 the amount of money spent on environmental issues, and the need to improve and protect the environment. For each year, we computed the average norm scores across all states to arrive at an average measure across our population.

For each year and state in our sample, intersubjective agreement was computed as the absolute value of the difference between a states' norm score and the sample (i.e. all states) norm score (the sample average was 2.13 ± 0.32 units). Since our econometric model focuses on explaining differences in investment *between* states, while controlling for *within* state effects, this measure was used to capture the degree to which state norms deviate from the sample average. Higher values of intersubjective agreement were therefore found in states on the tails of the distribution with more extreme norm scores; that is states where there was a strong consensus on the *relevance* of environmental issues (high norm scores), *and* states where there was a strong consensus on the *irrelevance* of environmental issues (low norm scores). On the contrary, lower

values of intersubjective agreement were found in states with intermediate norm scores, such that there was relatively weaker consensus with respect to the relevance and/or the irrelevance of environmental issues.

Control Variables

As a macro-level control of economic conditions we included the *median income (in thousands of dollars)* in a state[4]. We also controlled for the total amount of *energy generated by renewable sources* in a state, a variable that is likely to drive both the supply and demand for cleantech VC investment. We logged this variable as it was positively skewed. To control for centralized economic and socio-cultural institutions such as regulations (e.g, Sobel, 2008) and organized social movements (e.g., Sine and Lee, 2009) that might influence entrepreneurial entry into cleantech, we computed the total number of *state-level incentives* for clean energy generation and membership in the *sierra club* respectively. We normalized the count of sierra club membership by the *state population*, and took the log this measure to reduce right-skewness.

Lastly, since prior work (e.g., Stuart and Sorenson, 2003) testing the relationship between liquidity events and entrepreneurship has emphasized the importance of taking into account the mobility of the labor market, we also controlled for the *enforceability of non-compete agreements*. This measured was derived from prior research that has computed this measure at a cross-sectional, inter-state level (e.g., Garmaise, 2011; Marx, 2011).

Model

[4] We initially included the *gross state product* in our econometric models, but it was collinear with the state population. Since we use the state population to normalize the sierra club membership variable, we removed this control from our model specifications.

Since our dependent variable is count data and left bounded at zero, OLS estimation models would lead to biased coefficient estimates. Poisson based estimation models are generally better suited to fit such data; however the basic poisson model (stata command xi: xtpoisson) implicitly assumes that the mean and variance are equal. However, the dependent variable in our study was highly overdispersed, with the mean number of cleantech entrants in a state-year of 5.10 and a variance of 128.83, rendering the poisson estimation inaccurate as well.

We therefore estimated conditional fixed-effect negative binomial regression models (e.g., Allison & Waterman, 2002; Greene, 2004) which take the overdispersion of the data into account, using states as a grouping variable in a panel design (stata command xi: xtnbreg). Hausman tests indicated that a null hypothesis for coefficient differences between a fixed and random effects specification with this model could not be rejected ($p<0.001$); hence we opted for a fixed-effects specification. In addition to the independent and control variables described above, we also included time dummy variables for each year in our sample window to capture any unobserved heterogeneity due to yearly changes in macroeconomic conditions. Note that since our analysis was designed to explain investment differences *between states*, any influences common to all states (e.g. federal laws, overall economic conditions) should not have influenced our results. We also lagged all explanatory variables by one time period (one year) relative to our dependent variable to rule out concerns of reverse causality.

RESULTS

Not surprisingly, our descriptive results confirm that across the sample, entrepreneurial entry into cleantech is highly heterogeneous between states. The sample mean of 5.10 ± 11.35 entrants in a state-year suggests that most states had comparatively little entry into cleantech, even taking into account that our study sample covered a consistent growth phase of the sector. This statistics was

also verified in the raw data with three states (e.g. California, Massachusetts and Texas) accounting for approximately 41 percent of new entrants, and approximately 50 percent of cleantech venture investment.

Table 1 presents descriptive statistics and pair-wise correlations from our analysis. Most coefficients of interest are in the expected direction and statistically significant. For example, the number of cleantech entrants was positively and strongly correlated to the strength of VC institutions which we proxy through the number of liquidity events in a state ($r=0.68$, $p<0.001$). The correlation with intersubjective agreement was negative as expected and statistically significant ($p<0.01$), but relatively weak ($r=-0.13$). In general, the intersubjective agreement variable was weakly correlated with the rest of the model variables (correlation coefficients range from -0.05 to -0.17). Pair-wise correlations between the number of entrants and the control variables in the models were all in the expected direction and strongly significant ($p<0.001$). Hence, these descriptive statistics taken as a whole suggest that while the economic drivers were, as expected, strongly correlated with rates of entrepreneurial entry, the socio-cultural cognitive drivers captured by the intersubjective agreement variable might have *little direct effect* on entrepreneurial entry rates in this context.

Insert Table 1 about here

With respect to the multivariate model specifications, models 1-3 in Table 2 show results from a series of regressions. In Model 1, we only entered control variables. In Model 2, we introduced our independent variables to assess the main effects of VC institutional strength and intersubjective agreement. Lastly in model 3, we modeled the contingent effects of intersubjective agreement on the relationship between VC institutional strength and the number

of entrepreneurial entrants. We included year dummies in each of these regressions, and allowed the model constant to vary.

Insert Table 2 about here

Coefficients for the control variables in model 1 are generally in the expected direction. States with more policy incentives and more energy generated through renewables had higher levels of cleantech entrepreneurial entry. Consistent with Stuart and Sorenson (2003), states that enforced non-compete agreements more stringently had lower levels of entrepreneurial entry. However, the negative coefficient on the sierra club variable was somewhat unexpected. Note however that none of the control variable effects were statistically significant, even at the 0.1 level.

With respect to main effects, results from model 2 indicate that the number of liquidity events resulted in an increase in the number of cleantech entrants. Since negative binomial models are maximum likelihood models that model the log of the expected count of the dependent variable, coefficient effect sizes could not be interpreted directly as with an OLS model. Instead the model indicated that each additional liquidity event led to a 0.02 increase in the (logged) number of entrants in a state ($p=0.053$). Given the significance level of this effect, we concluded that hypothesis 1 was marginally supported at the 95 percent confidence level and strongly supported at the 90 percent confidence level.

With respect to the intersubjective agreement variable, econometric findings from model 2 did not confirm to our theoretical predictions that entrepreneurial entry levels would be higher under conditions of low intersubjective agreement. Instead we find that intersubjective agreement and cleantech entry have a positive relationship, such that each unit increase in

intersubjective agreement led to a 0.48 increase in the (logged) number of entrants in a state. However, this effect was not statistically significant. In general therefore, hypothesis 2 was not supported.

Turning to the interaction effect between the number of liquidity events and intersubjective agreement in model 3, we found that it was in the expected direction. A unit increase in intersubjective agreement attenuated the positive marginal impact of liquidity events on cleantech entry by 0.20 units ($p<0.05$). To ease the interpretation of these effects, the interaction effects were graphically plotted, and are illustrated in figure 1 below.

Insert Figure 1 about here

Since both the intersubjective agreement variable is positive and left-bounded at zero, the 25^{th}, 50^{th} (median), and 75^{th} percentile values were used used to plot low, intermediate and high values instead of means and standard deviations from the mean. To ensure a more accurate plot, control variables were also standardized as is typical with log-link interaction plots[5]. Interestingly, as can be observed in figure 1, as the level of intersubjective agreement increases beyond its median level, the relationship between liquidity of equity markets and entrepreneurial entry inverted. In fact, *under conditions of high intersubjective agreement*, the model indicates that the strength of the exit market actually had a *negative* relationship with respect to entrepreneurial entry[6].

Sensitivity Analysis

[5] Standardization ensures that the units on the y-axis (dependent variable) are accurate. Note that not standardizing the control variables would not change the *direction* of the relationships observed.

[6] The precise "cross-over" value is at the 55^{th} percentile. That is, for values of intersubjective agreement in the 56^{th} percentile or higher (>0.14 units) the relationship (i.e. slope) between the number of liquidity events and entrepreneurial entry is negative, while for values of intersubjective in the 55^{th} percentile or lower (<0.14 units) the relationship between the number of liquidity events and entrepreneurial entry is positive.

We executed a series of tests to ensure that our results were robust to alternate specifications.

We parsed the *liquidity events* variable using just IPOs and acquisitions instead of a summation of the two. As expected, effect sizes were weaker when using each of the individual variables in isolation, although the pattern of results remained the same.

For each state-year, we re-computed *intersubjective agreement* as a dichotomous variable. To do so, we first calculated descriptive statistics of environmental norms across all 45 states with complete norm score information. For each year, we then dummy coded states as having low intersubjective agreement if norm scores were one standard deviation below or above the mean, or high intersubjective agreement if norm scores were within one standard deviation of the mean. To confirm our coding procedure, we also computed our dichotomous variable for intersubjective agreement using quartile (25^{th} and 75^{th} percentile) and decile (10^{th} and 90^{th} percentile) based cutoffs, identifying high intersubjective agreement as scores that were either in the highest or lowest percentiles. Results were qualitatively similar to models reported here when using these different metrics.

Lastly, we also ran models that included a series of additional control variables, accounting for the overall state of the VC market in a region (i.e. not specific to cleantech). To do so, we used the *VentureXpert* database to compute the total number of IPOs (acquisition data was unavailable), the total number of investment rounds and dollars invested at a state level. Results were similar with these additional control variables with cleantech entry rates *insignificantly* impacted by the overall state of the VC market over and above predictors specific to cleantech VC.

DISCUSSION

Our results suggest that strong VC institutions are more likely to lead to cleantech entry. However, when the impact of intersubjective agreement regarding environmental issues is taken into account, we find that the said relationship only holds true in states where intersubjective agreement is at low to intermediate levels, and actually inverts when intersubjective agreement is at high levels. We therefore provide an empirical test of the proposition suggested by York and Venkataraman (2010) that under societal conditions of low intersubjective agreement, rates of entrepreneurial entry are likely to be higher as entrepreneurs are likely to have a relative advantage over incumbents in bringing products to the marketplace. However, we find that in the context of our study this occurs not through a direct effect as they postulate (hypothesis 2 was not supported), but *indirectly* by influencing the efficacy of private equity markets that are critical to the decision calculus of venture capital investors.

Our findings, have a number of important implications to both theory and practice. Specifically, we make three main contributions. First, we add to the nascent body of empirical work on venture capital and entrepreneurship at the regional level by empirically quantifying the marginal impacts of liquidity events on new firm formation in the cleantech sector. Furthermore, by showing that these impacts differ by region and are impacted by environmental social norms, we complement existing case-based research (e.g. Saxenian, 1996) which have suggested that the benefits of venture capital on entrepreneurship might be highly context dependent. Our panel-based econometric approach also allows us to provide much needed generalizability to some of the insights drawn from this earlier narrative based research as it avoids the problem of sampling on the dependent variable; that is it includes regions which vary widely on both explanatory variables of interest and have both low and high levels of entrepreneurial entry.

Second, we extend current studies linking institutions and entrepreneurship (e.g., Tolbert et al., 2011) by looking at the cross-institutional, interactive effects of economic and socio-cultural institutions. Although the lenses of institutional theory and new institutional economics have been applied extensively to entrepreneurship, extant research has largely focused on the impacts of one form of institution within the scope of a single study. Hence, for instance we know a significant amount about the role of centralized institutions, such as social movements and regulatory policies, in fostering entrepreneurship across an array of industries (e.g., Hiatt et al., 2009; Sine & Lee, 2009; Sobel, 2008). However, as Ritzer and Ryan (2010) indicate, there is very little research about how the efficacy of any given institution in driving entrepreneurship is contingent on the strength of other institutions, despite the recognition that institutional influences are often interlinked and interdependent (but see Meek et al., 2010). Our study is also novel in its focus on *decentralized cross-institutional effects*, independent of the impacts of state level policies that we found to be largely insignificant in our empirical models.

Third, we make an important contribution to entrepreneurship theory more broadly by operationalizing the construct of intersubjective agreement and linking it to observed differences in entrepreneurial entry. While the construct of intersubjective agreement has received some limited attention over the last decade in the entrepreneurship literature (e.g., Dew et al., 2004; Venkataraman et al., 2012; York and Venkataraman, 2010) it has been discussed entirely in theoretical terms to-date. Since regional social norms, in our case pertaining to environmental issues, capture the shared cognitive schemas in a region and can be measured on a large scale both temporally and spatially, we believe that they are an excellent proxy to measure the degree to which intersubjective agreement does or does not exist within and across regions. Furthermore, while our arguments extend extant theory to their logical conclusion in the study

context, the implications as corroborated by our findings are potentially counter-intuitive. For example, our suggestion that there are threshold effects to the benefits provided by agreed upon environmental social norms have interesting implications to important entrepreneurial decisions, such as firm location choices. Hence for instance, our analysis suggests that *ceteris paribus,* a prospective entrepreneur seeking to enter the cleantech space might be better off choosing a locale with there is some level of disagreement regarding the relevance of environmental issues (i.e. where intersubjective agreement is on the intermediate to lower end) rather than in locales with high levels of environmental social norms, counter to the simple institution that stronger norms are always better.

Limitations, Future Research & Conclusions

As with all studies, ours is not without limitations. Our definition of cleantech is broad with entrants in our models from a wide variety of industries, a fact that we do not explicitly control for. The dynamics suggested here might be stronger and weaker depending on the stage of industry evolution and dynamism (e.g. wind vs. solar). While the *i3* database does provide a taxonomy to categorize these entrants, the data needs to be verified and backfilled as this information is sometimes missing or ambiguous. We are currently in the process of doing so to improve our models. Once this process is completed, our data structure would also allow us to capture the entry of *de alio* (i.e. diversifying) firms, although inferences would have to be made about the time-frame at which industry is considered nascent. Doing so would also allow for a more robust test of our hypotheses, for instance by directly testing whether *de alio* firms are more likely to enter under conditions of high intersubjective agreement (for environmental issues) than *de* novo entrants. Lastly, the generalizability of our models is limited to a degree due to our analysis window exclusively covering a growth phase of the sector. In future work, we

aim to extend the models to the present day, and have contacted the NORC to obtain the most recent data from the GSS.

The findings in this study provide ample opportunities for additional related research. While we have focused exclusively on entrepreneurial entrants in these models, future research might extend these models to investigate effects on different kinds of entrants, as suggested above. For instance, existing research on industry dynamics has shown that there is significant heterogeneity in the kinds of entrants (e.g. de novo entrants vs. entrepreneurial spinoffs vs. diversifying entrants) that choose to enter an industry (e.g., Agarwal, Echambadi, Franco, & Sarkar, 2004). Since these entrants have varying levels of industry experience, and hence perceptions of opportunities prior to entry, one might expect that the institutional impacts of both venture capital availability and environmental social norms would vary across significantly these groups.

Moving beyond entry decisions, there is also the potential for research looking at other related issues with similar data. For example, in a similar vein to the cross-national work by Jeng and Wells (2000), it would be interesting to investigate regional differences in the allocation of venture capital funds to cleantech. Such an analysis would essentially look at the investor side of the current study, studying how the nature of entrepreneurial entry and decentralized socio-cultural institutions impact the allocation of entrepreneurial finance. Furthermore, such an analysis could be carried out at both regional and venture firm-levels to understand how differences between investors might interact with institutional factors to impact such resource allocation decisions.

Our study is therefore an initial attempt at uncovering the complex interplay between different institutional drivers, both economic and socio-cultural, that impact entrepreneurship in

the cleantech sector. The nuances highlighted by us indicate that regional differences in venture capital exit markets and environmental social norms can and do significantly influence the ability of environmental entrepreneurs to bring solutions to the market. Furthermore, given that "clean capital" has become increasingly scarce over the recent past, the results of our study and its relevant future extensions, are likely to be of significant interest to entrepreneurs, investors, and academics interested in understanding how best to bring about a cleantech revolution.

REFERENCES

Agarwal, R., Echambadi, R., Franco, A. M., & Sarkar, M. B. 2004. Knowledge transfer through inheritance: Spin-out generation, development, and survival. ***The Academy of Management Journal***, 47: 501–522.

Aldrich, H. E. 2010. Beam me up, Scott (ie)! Institutional theorists' struggles with the emergent nature of entrepreneurship. ***Research in the Sociology of Work***, 21: 329–364.

Aldrich, H. E., & Fiol, C. M. 1994. Fools rush in? The institutional context of industry creation. ***Academy of management review***, 19: 645–670.

Allison, P. D., & Waterman, R. P. 2002. Fixed–effects negative binomial regression models. ***Sociological methodology***, 32: 247–265.

Alvarez, S. A., & Barney, J. B. 2013. Epistemology, opportunities, and entrepreneurship: Comments on Venkataraman et al. (2012) and Shane (2012). ***Academy of Management Review***, 38: 154–157.

Amit, R., Brander, J., & Zott, C. 1998. Why do venture capital firms exist? Theory and Canadian evidence. ***Journal of business Venturing***, 13: 441–466.

Black, B. S., & Gilson, R. J. 1998. Venture capital and the structure of capital markets: banks versus stock markets. ***Journal of Financial Economics***, 47: 243–277.

Bottazzi, L., & Da Rin, M. 2002. Venture capital in Europe and the financing of innovative companies. ***Economic Policy***, 17: 229–270.

Cannice, M. V., & Goldberg, C. S. 2009. Venture Capitalists' Confidence, Asymmetric Information, and Liquidity Events. ***Journal of Small Business & Entrepreneurship***, 22: 141–164.

Cumming, D., Fleming, G., & Schwienbacher, A. 2005. Liquidity risk and venture capital finance. ***Financial Management***, 34: 77–105.

Dahl, M. S., & Sorenson, O. 2012. Home sweet home: Entrepreneurs' location choices and the performance of their ventures. ***Management Science***, 58: 1059–1071.

Davidson, D. 2001. ***Subjective, intersubjective, objective***. UK: Oxford University Press.

Davila, A., Foster, G., & Gupta, M. 2003. Venture capital financing and the growth of startup firms. ***Journal of Business Venturing***, 18: 689–708.

Deeds, D. L. 2004. Increasing the rate of new venture creation: Does location matter? ***The Academy of Management Executive***, 18: 152–154.

Dew, N., Velamuri, S. R., & Venkataraman, S. 2004. Dispersed knowledge and an entrepreneurial theory of the firm. ***Journal of Business Venturing***, 19: 659–679.

Eckhardt, J. T., & Shane, S. A. 2003. Opportunities and entrepreneurship. ***Journal of management***, 29: 333–349.

Gambardella, A., & Giarratana, M. S. 2010. Localized knowledge spillovers and skill-biased performance. ***Strategic Entrepreneurship Journal***, 4: 323–339.

Garmaise, M. J. 2011. Ties that truly bind: Noncompetition agreements, executive compensation, and firm investment. ***Journal of Law, Economics, and Organization***, 27: 376–425.

Gillespie, A., & Cornish, F. 2010. Intersubjectivity: Towards a dialogical analysis. ***Journal for the theory of social behavior***, 40: 19–46.

Gilson, R. J. 2003. Engineering a venture capital market: lessons from the American experience. ***Stanford Law Review***, 55: 1067–1103.

Gompers, P., & Lerner, J. 2001. The venture capital revolution. ***The Journal of Economic Perspectives***, 15: 145–168.

Greene, W. 2004. The behavior of the maximum likelihood estimator of limited dependent variable models in the presence of fixed effects. ***The Econometrics Journal***, 7: 98–119.

Greenwood, R., Díaz, A. M., Li, S. X., & Lorente, J. C. 2010. The multiplicity of institutional logics and the heterogeneity of organizational responses. ***Organization Science***, 21: 521–539.

Hargadon, A. B., & Kenney, M. 2012. Misguided policy? Following venture capital into clean technology. ***California Management Review***, 54(2): 118.

Hiatt, S. R., Sine, W. D., & Tolbert, P. S. 2009. From Pabst to Pepsi: The deinstitutionalization of social practices and the creation of entrepreneurial opportunities. ***Administrative Science Quarterly***, 54: 635–667.

Jeng, L. A., & Wells, P. C. 2000. The determinants of venture capital funding: evidence across countries. ***Journal of corporate Finance***, 6: 241–289.

Keuschnigg, C. 2004. Venture capital backed growth. ***Journal of Economic Growth***, 9: 239–261.

Kirzner, I. M. 1979. ***Perception, opportunity, and profit: Studies in the theory of entrepreneurship***. Chicago, IL: University of Chicago Press.

Lerner, J. 1995. Venture capitalists and the oversight of private firms. ***The Journal of Finance***, 50: 301–318.

Lerner, J. 2009. ***Boulevard of broken dreams: why public efforts to boost entrepreneurship and venture capital have failed–and what to do about it***. Princeton, NJ: Princeton University Press.

Marx, M. 2011. The Firm Strikes Back Non-compete Agreements and the Mobility of Technical Professionals. ***American Sociological Review***, 76: 695–712.

McKelvie, A., Haynie, J. M., & Gustavsson, V. 2011. Unpacking the uncertainty construct: Implications for entrepreneurial action. ***Journal of Business Venturing***, 26: 273–292.

McMullen, J. S., & Shepherd, D. A. 2006. Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. ***Academy of Management Review***, 31: 132–152.

Meek, W. R., Pacheco, D. F., & York, J. G. 2010. The impact of social norms on entrepreneurial action: Evidence from the environmental entrepreneurship context. ***Journal of Business Venturing***, 25: 493–509.

Milliken, F. J. 1987. Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. ***Academy of Management Review***, 12: 133–143.

North, D. C. 1990. ***Institutions, institutional change and economic performance***. Cambridge, MA: Cambridge university press.

Pacheco, D. F., York, J. G., Dean, T. J., & Sarasvathy, S. D. 2010. The coevolution of institutional entrepreneurship: A tale of two theories. ***Journal of Management***, 36: 974–1010.

Pernick, R., & Wilder, C. 2007. ***The clean tech revolution: The next big growth and investment opportunity***. New York, NY: HarperCollins.

Petkova, A., Wadhwa, A., Yao, X., & Jain, S. 2013. Reputation and decision making under ambiguity: a study of us venture capital firms' investments in the emerging clean energy sector. ***Academy of Management Journal***. http://amj.aom.org/content/early/2013/05/28/amj.2011.0651.short, August 31, 2013.

Ritzer, G., & Ryan, J. M. 2010. ***The concise encyclopedia of sociology***. Hoboken, NJ: John Wiley & Sons.

Rodríguez-Pose, A., & Storper, M. 2006. Better rules or stronger communities? On the social foundations of institutional change and its economic effects. ***Economic Geography***, 82: 1–25.

Rosenbusch, N., Brinckmann, J., & Müller, V. 2013. Does acquiring venture capital pay off for the funded firms? A meta-analysis on the relationship between venture capital investment and funded firm financial performance. ***Journal of Business Venturing***, 28: 335–353.

Samila, S., & Sorenson, O. 2011. Venture capital, entrepreneurship, and economic growth. ***The Review of Economics and Statistics***, 93: 338–349.

Samila, S., & Sorenson, O. 2013. Community and Capital in Entrepreneurship. http://druid8.sit.aau.dk/acc_papers/nnrdn2fh9i12hx7lvugvlh873l2p.pdf, June 30, 2013.

Saxenian, A. 1996. ***Regional advantage: Culture and competition in Silicon Valley and Route 128***. Cambridge, MA: Harvard University Press.

Scott, W. 1995. ***Institutions and Organizations***. Thousand Oaks, CA: Sage.

Sine, W. D., & Lee, B. H. 2009. Tilting at windmills? The environmental movement and the emergence of the US wind energy sector. ***Administrative Science Quarterly***, 54: 123–155.

Sobel, R. S. 2008. Testing Baumol: Institutional quality and the productivity of entrepreneurship. ***Journal of Business Venturing***, 23: 641–655.

Stuart, T. E., & Sorenson, O. 2003. Liquidity events and the geographic distribution of entrepreneurial activity. ***Administrative Science Quarterly***, 48: 175–201.

Tolbert, P. S., David, R. J., & Sine, W. D. 2011. Studying choice and change: The intersection of institutional theory and entrepreneurship research. ***Organization Science***, 22: 1332–1344.

Venkataraman, S., Sarasvathy, S. D., Dew, N., & Forster, W. R. 2012. Reflections on the 2010 AMR decade award: Whither the promise? Moving forward with entrepreneurship as a science of the artificial. ***Academy of Management Review***, 37: 21–33.

Wright, M., Pruthi, S., & Lockett, A. 2005. International venture capital research: From cross-country comparisons to crossing borders. ***International Journal of Management Reviews***, 7: 135–165.

York, J. G., & Lenox, M. J. Forthcoming. Exploring the socio-cultural drivers of de novo versus de alio entry in emerging industries. ***Strategic Management Journal***.

York, J. G., & Venkataraman, S. 2010. The entrepreneur–environment nexus: Uncertainty, innovation, and allocation. ***Journal of Business Venturing***, 25: 449–463.

Table 1. Means, Standard Deviations, and Pair-Wise Correlations

Variable	Mean	Stdev	1	2	3	4	5	6	7
1.Number of Cleantech Entrants	5.10	11.35							
2.Liquidity Events	0.65	2.01	0.68***						
3.Intersubjective Agreement	0.19	0.24	-0.13**	-0.04					
4.Sierra Club Memebership Per Capita (Log)	-6.37	0.60	0.30***	-0.15***	-0.09†				
5.Energy from Renewable Sources in MwH (Log)	14.53	1.75	0.32***	0.17***	-0.17***	0.29***			
6.Median Income ($1,000)	43.84	7.46	0.25***	0.30***	-0.05	0.60***	0.03		
7.Non-Compete Enforceability	4.24	1.81	-0.22***	-0.10*	-0.05	-0.08	-0.02	-0.02	
8.Incentives for Renewable Energy	4.43	8.27	0.45***	0.55***	-0.05	0.26***	0.22***	0.29***	-0.02

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Table 2. Conditional Fixed-Effects Negative Binomial Regression

DV: Number of Cleantech Entrants	(1)	(2)	(3)
		Main	*Interaction*
Variables	*Controls*	*Effects*	*Effects*
Liquidity Events		0.02†	0.03**
		(0.01)	(0.01)
Intersubjective Agreement		0.48	0.69*
		(0.32)	(0.33)
Liquidity Events * Intersubjective Agreement			-0.20*
			(0.10)
Sierra Club Membership Per Capita (Log)	-0.11	0.09	0.12
	(0.29)	(0.33)	(0.34)
Energy from Renewable Sources in MwH (Log)	0.01	-0.01	-0.03
	(0.07)	(0.07)	(0.07)
Median Income ($1,000)	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)
Non-Compete Enforceability	-0.03	-0.03	-0.04
	(0.17)	(0.17)	(0.17)
Incentives for Renewable Energy	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Year Dummies	Yes	Yes	Yes
Constant	14.20	16.77	18.09
	(432.92)	(435.93)	(499.91)
Observations (State-Years)	441	396	396
Number of States	50	45	45
Log-likelihood	-640.2***	-582.1***	-580.1***

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Figure 1. Conditional effects of intersubjective agreement on the relationship between the strength of VC institutions and cleantech entry. Since intersubjective agreement is bounded at zero (0.18 ± 0.23, max: 1.8) low, intermediate, and high values are plotted at the 25th, 50th (median), and 75th percentile values of 0.06, 0.12, and 0.21 units respectively.