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Strong ties, weak ties and islands: structural and cultural predictors of organizational innovation

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How does the tendency of entrepreneurs to engage in innovation relate to their structural and cultural embeddedness? Using micro-data on entrepreneurial teams and the organizational innovations they attempt to develop, this article presents a predictive model of creative action to address this question. Capacity for creative action is seen to be a function of the ability of entrepreneurs to (i) obtain non-redundant information from their social networks; (ii) avoid pressures for conformity; and (iii) sustain trust in developing novel—and potentially profitable—innovations. Probit analyses of over 700 organizational startups suggest that these mechanisms exercise effects on innovation via the network ties and enculturation of entrepreneurs.

1. Introduction

An understanding of organizational innovation is critical to analysts who seek to account for industrial change. While considerable scholarly attention has been brought to bear on the issue of innovation, much focuses on the diffusion of existing departures from conventional routines or ideas rather than the creation of new routines or ideas (for reviews see Rogers, 1995; Strang and Soule, 1998). Thus, social scientists have considered how innovations are spread via direct communication (Coleman *et al.*, 1966), role equivalence (Burt, 1987), mesolevel networks (Hedström *et al.*, 2000), and a variety of institutional pressures (DiMaggio and Powell, 1983; Strang and Meyer, 1993). These analyses have led to sophisticated models of the structural, spatial and temporal dynamics of innovation diffusion (e.g. Strang and Tuma, 1993), but have not advanced empirical understanding of how departures from established ideas and routines arise in the first place.

Since Schumpeter (1934 [1911]), economic and organizational researchers have also considered the introduction of new routines and ideas within the context of industrial organizations (see review by Hage, 1999). Like the diffusion literature, much of the research focus has not been placed on the initial appearance of innovations *per se* but, rather, on the *adoption* of innovations or the patent protection and introduction of *viable* innovations to a market. Empirical attention has emphasized a variety of contextual variables, including firm age (Sørensen and Stuart, 2000), firm size

(Damanpour, 1992), inter-organizational networks (Ahuja, 2000; Powell *et al.*, 1996), patent precedents (Podolny and Stuart, 1995) and technological regimes (Malerba and Orsenigo, 1996).

The existing evidence on the diffusion of innovation and organizational adoption of innovation leaves two key questions unanswered. First, how does the micro-level context—both structural and cultural—of entrepreneurs contribute to their tendency to deviate from established ways of thinking or doing things and lead to the introduction of new innovations? In contrast to much prior research on diffusion, this focuses attention on the initial appearance of innovations, seeking to avoid the retrospective bias of studying only successful ideas and practices.[1] Second, how are innovations tied to the emergence of novel organizations and organizational forms? More specifically, what leads individuals to establish organizations that employ radically new routines as opposed to organizations that simply reproduce established ways of doing things (Aldrich, 1999: 80–81)? This emphasis breaks with the majority of organizational research, which examines innovation within established structures, to consider how those structures themselves evolve with entrepreneurial innovation.

In this article, these questions are explored using a framework that adapts existing ideas on the structural embeddedness of economic action (Granovetter, 1985; see also Uzzi, 1996, 1999). Generally speaking, the propensity among entrepreneurs toward innovation as opposed to the reproduction of existing ideas is seen to be a function of the types of social relationships those entrepreneurs are embedded within. Given that much of the existing evidence on network tie strength (Granovetter, 1973; Bian, 1997) and network diversity (Marsden, 1987: 124) focuses on dynamics of information diffusion and social influence, a structural analysis predicting *creative* action requires that the conventional view of embeddeness be amended. The theoretical framework introduced below pays greater attention to role of network ties in inducing conformity and sustaining trust, as well as spreading novel ideas.

The framework informs testable hypotheses that will be examined using an original data set of 766 entrepreneurial teams attempting to start new business organizations. Data were gathered on each of the teams regarding sources of ideas for their ventures, previous career experiences, team structure, patent/trademark applications, and the relative novelty of contributions they hoped to make with respect to a variety of innovation categories. Statistical analyses employ probit models to explore how structural features of the entrepreneur's networks—strength of ties, diversity of ties and content of ties—interact with features of the entrepreneurs' career histories—work experiences, enculturation and role diversity—to generate varying capacities for creative action. Such creative action among the entrepreneurs manifests itself in a number of ways, including the introduction of new types of products or services; the development of new methods of production, distribution, or marketing; the development of new forms

[1]Ibarra's (1993) study of network characteristics and innovation roles is an important exception to the general lack of micro-level analyses of innovation. However, it predicts an individual's role in an innovation process rather than the occurrence of innovation *per se*.

Table 1 Predictors and underlying mechanisms of organizational innovation

	Information	Conformity	Trust	Innovation	Relevant hypotheses
Structural predictors					
Strong ties	0	+	+	0	
Weak ties	+	0	0	+	H1, H7–H8
Directed ties (mimetic)	+	+	n/a	0	H2
Directed ties (expert discourse)	+	0	n/a	+	H3
Network diversity	+	+	+	+	H4
Team size	+	0	0	+	H5
Cultural predictors:					
Team diversity	+	–	(–)	+	H6
Industry LOT	0	+	n/a	–	H9

of external linkages; entry into unexploited market niches; and the restructuring of industries.

2. Theoretical framework

Table 1 summarizes the basic model of organizational innovation. I link creative action to three underlying mechanisms, including the ability of entrepreneurs to access diverse sources of information, to avoid pressures for conformity and to sustain trust with others who are told about a potential innovation. Within this framework, the propensity of individual entrepreneurs to break with convention is *both* encouraged by social relations—which may bring disparate ideas, routines or technologies to an entrepreneur's attention—*and* discouraged by social relations—which may introduce pressures for conformity or concerns about trust. To use Giddens's (1984) terminology, social structure is seen as both enabling and constraining. The balance of tensions toward and away from innovation is largely determined by aspects of an individual's relational context: the strength, diversity and content of network ties. These tensions are not simply seen as reflections of the present structural embeddedness of entrepreneurs, but also of their cultural embeddedness, reflecting a past history of work and educational relationships.

2.1 The strength of weak ties revisited

Granovetter (1973: 1361) defined the concept of a strong interpersonal tie in terms of the time and emotions invested in a relationship, as well as the reciprocity involved between participating actors (see also Marsden and Campbell, 1984). Typical examples of strong ties include friendship and familial relationships. Weak ties, by contrast, entail

more limited investments of time and intimacy, subsuming an array of social acquaintances. Granovetter's (1973, 1995) influential 'strength-of-weak-ties' thesis maintains that weak ties are often more important in spreading information or resources because they tend to serve as bridges between otherwise disconnected social groups; strong ties lead to less efficient transmission processes because a large number of actors in the strong tie network also know each other, as well as knowing the focal actor. While other network analysts have pointed out that strong ties can also serve as bridges (Burt, 1992: 27–30), their tendency to be redundant sources of information or resources remains a widely accepted tenet of structural theory.

To clarify the relevance of tie strength for *innovation*, rather than simple diffusion, it will be useful to consider two underlying dimensions of social relationships: information and influence. Schumpeter (1934 [1911]) describes innovative action as the novel combination of existing ideas and routines. Innovation thus requires, first and foremost, that corporate actors have access to information on disparate ideas and routines from which elements can be combined. Consistent with the 'strength-of-weak-ties' thesis, both the transmission rate and availability of such disparate information will be higher for individuals relying on weak network ties rather than strong ties.

The impact of influence on innovative propensity is more complex. Recent research on job searches has suggested that influence—entailing pressures for conformity—may explain why strong ties can be more important for status attainment purposes than weak ties (Bian, 1997). The dynamics of influence are quite different, however, when the outcome of interest involves innovative action. The most pertinent influence affecting innovation is not that directed from a focal actor to a set of others, but, rather, that directed from other actors in a network to the focal actor. Although the former influence is relevant to the diffusion and (perceived) success of an innovation, the latter is central to the initial departure from established conventions. Strong ties impose greater demands for conformity on a focal actor. Family members and friends who are consulted regarding new business ideas may be insulted when other elements are introduced that deviate from or clash with their own way of doing things. The affective content of these relationships strengthens the role of their influence, since actors are expected to heed the advice of family and friends. Weak tie relationships, on the other hand, allow for more experimentation in selectively combining ideas from one source with those of another and impose fewer concerns regarding social conformity. The combined effect of information diffusion and influence on innovative propensities thus yields the following hypothesis:

> *Hypothesis 1.* Actors relying on strong ties as sources of ideas are less likely to be innovative than actors relying on weak ties.

2.2 Islands: the strength of directed ties

The problem of conformity that is inherent in many social relationships raises the question of whether relatively isolated entrepreneurs might not be capable of even

greater innovation than those embedded in weak tie networks. In other words, does the atomistic model of *Homo economicus* or *Homo faber*, the lone tinkerer, ring true for the most radical of departures from extant routines? While such insular depictions do seem to free actors from pressures for conformity, they fail to acknowledge the importance of information flows as inputs to innovation. As Uzzi's (1996, 1999) recent studies of business networks have pointed out, the paradox of embeddedness is that economic action often benefits from initial increases in relational ties, but suffers when actors are highly embedded. Similarly, discussions of innovation within established firms suggest the importance of loose coupling among business units, rather than tight coupling or decoupling (Saloner *et al.*, 2001: chap. 5).

For individual innovators, one possible solution to the structural dilemma involves *directed ties*. Such ties attempt to separate the need for information from the constraints of influence. Instead of entailing a social relationship—where two actors are reciprocally directed toward each other—directed ties involve a unilateral monitoring of discourse and activities on the part of other actors (see Weber, 1968 [1924]). Network analyses (e.g. Boorman, 1974) suggest that such social structures—so-called 'islands', with limited communication among subpopulations—can prove important in sustaining innovations that deviate from majority views. In Boorman's mathematical model, the ability of a novel social trait to survive (and, ultimately, take over) depends on its selective isolation from a broader population of social traits. Similarly, isolated entrepreneurs with directed ties to a variety of information sources can be characterized in terms of 'island' network structures, which may encourage the combination of disparate ideas without necessarily imposing demands for conformity.

Whether directed ties actually do lead to innovation depends on the specific character of unilateral monitoring. Scholars examining processes of imitation among entrepreneurs and organizations have long recognized the propensity of some directed ties to produce isomorphism rather than innovation (DiMaggio and Powell, 1983; Miner *et al.*, 1999). An entrepreneur whose attention is directed at relatively *concrete* implementations of ideas and routines (often bundled in the form of extant formal organizations) may reproduce those competencies with minimal modification. At the same time, when ideas and routines are *abstracted* from specific industries—or 'theorized', as institutional scholars have put it (Strang and Meyer, 1993)—then the potential for creative modification of those ideas is enhanced considerably. Insular individuals who direct their attention to public discourse in a topic area are especially well-suited to be innovators for a number of reasons: (i) new information often diffuses more rapidly via such media sources than through interpersonal relationships (Strang and Meyer, 1993); (ii) the unilateral nature of the relationship ('directed' to an expert or a text) does not impose the same demands for conformity as a reciprocal relationship; and (iii) the generalized content of the discourse means that considerable experimentation is often necessary to adapt ideas to the particular circumstances of the entrepreneur or their organization. While the first two mechanisms primarily ensure rapid, unencumbered diffusion of ideas, the third seems more fundamental to

innovation: as entrepreneurs wrestle with abstract ideas presented in the business press, in technical papers or in educational coursework, they are forced to modify and 'ground' them in the specific problems and prospects of their own industries. In summary:

> *Hypothesis 2.* Actors relying on ties directed to the concrete activities of other individual or corporate actors are less likely to be innovative than actors relying on weak ties.[2]

> *Hypothesis 3.* Actors relying on ties directed to the abstract discussion of ideas in expert discourse are more likely to be innovative than actors relying on weak ties.

2.3 Network diversity

Entrepreneurs depending exclusively on one type of network tie or another—strong, weak or directed—can be rank-ordered readily in terms of their propensity toward innovation. However, many innovators derive their ideas from multiple sources, often involving a mixture of family members, friends, acquaintances, or individuals and firms with whom they have had no prior contact. Studies of business startups among nascent entrepreneurs (Renzulli *et al.*, 2000) suggest that such network diversity can have beneficial effects above and beyond the cumulative effect of networks ties considered individually. By the same token, diversity can be seen as an impetus to creative action insofar as the relative advantages of each type of tie (with respect to information and influence) tend to offset the disadvantages of other ties.

Ties directed to the discourse of experts generally have the most favorable structural properties for information diffusion, considering the lack of relational intermediaries and consequent fidelity of the information received. At the same time, directed ties do not include any mechanism for iterative feedback with respect to a potential innovation. This means that actors relying *exclusively* on such ties will tend to adapt ideas to their own circumstances and needs without necessarily engaging in further innovation. Those actors that are *also* embedded in weak or strong tie networks, on the other hand, may subject new combinations of ideas to further modification, as they receive feedback on the innovation from family, friends and acquaintances. This is especially true for strong tie networks, in which entrepreneurs are able to place trust in other actors and have some confidence that novel ideas will not be coopted.

The drawbacks of conformity in strong and weak tie networks can also be ameliorated by diversity. The influences of family members or friendship circles are strongest when a focal actor has relatively limited access to other sources of ideas. Pressures toward conformity are offset to some extent when an entrepreneur is also able to gather insights from more casual acquaintances and claims made in public discourse. More generally, as Burt (1992: 195) points out, individuals who enjoy greater

[2]In particular, this is likely to be true when the actors being observed are active within ego's own industry. Adoption of ideas from other industries typically entails greater experimentation.

heterogeneity in their role relationships can 'be less concerned about getting [their own] role "right"'.

> *Hypothesis 4.* Actors embedded in a diverse set of network ties are more likely to be innovative than actors relying on homogenous ties.

2.4 Team structure and internal ties

The discussion of structural embeddedness thus far has continued to maintain one bias of undersocialized conceptions of action—that of the solo entrepreneur. While the concept of the solo entrepreneur is convenient from the standpoint of classical economic models, it has been superseded by the recognition that innovation is often undertaken by entrepreneurial teams (e.g. Stewart, 1989). Aside from considering the *external* ties within which actors are situated, the analysis of creative action must also address aspects of team structure and the nature of *internal* network ties.

In this respect, perhaps the simplest predictor of innovative propensity is team size. New combinations of ideas are encouraged when a number of entrepreneurs choose to work together and apply multiple perspectives to a problem. Solo entrepreneurs, by contrast, are more likely to reproduce familiar routines from their own life experiences. Beyond team size, the diversity of functional roles represented among one or more entrepreneurs is likely to have a marked impact on the creativity of action. A team composed of members with accounting, marketing and engineering backgrounds is more likely to produce new combinations of ideas than a team composed only of accountants. Similarly, a solo entrepreneur with backgrounds in both marketing and engineering may combine ideas from these disciplines in novel ways. Burt (1992: 18–20) suggests that the lack of role equivalence among entrepreneurs (or their contacts) is often as important in obtaining non-redundant information as avoidance of cohesive ties. The multiplicity of role structures that individuals or entrepreneurial teams may invoke can therefore contribute substantially to deviations from established ways of doing things.

> *Hypothesis 5.* Large entrepreneurial teams are more likely to be innovative than small teams or solo entrepreneurs.

> *Hypothesis 6.* Entrepreneurial teams or actors drawing on a diverse set of functional roles are more likely to be innovative than those drawing on homogenous roles.

The information-theoretic benefits of entrepreneurial teams need to be balanced with the recognition that such groups, like external network ties, can also impose some demands for conformity on their members. When the internal ties among team members reflect limited prior acquaintance, this influence tends to be small and the benefits of team structures are maximized. Innovative propensity is likely to be reduced, however, when there have been some prior 'arm's length' relationships between team members ('weak ties') and reduced even more when team members know each other

well ('strong ties'). Naturally, the benefits of low structural embeddedness only accrue if we assume that the problem of trust is overcome within entrepreneurial teams by providing each team member with an equity stake in the venture.

> *Hypothesis 7.* Entrepreneurial teams composed of weak ties are less likely to be innovative than teams involving members with limited prior acquaintance.

> *Hypothesis 8.* Entrepreneurial teams composed of strong ties are less likely to be innovative than teams involving members with weak tie relationships.

2.5 Cultural embeddedness

Cultural embeddedness reflects the amount of experience that actors have in a particular task domain, the extent to which they consciously draw ideas from that experience, and whether the experience involved conventional routines and competencies or attempts to deviate from conventions. Actors (or entrepreneurial teams) with extensive experience in an industry are less likely to be innovative than those with limited experience. Examining organizational innovation, researchers have noted that it is 'indifference to industry routines and norms [that] gives an outsider the freedom to break free of the cognitive constraints on incumbents' (Aldrich and Kenworthy, 1999: 20). Moreover, the performance of experienced participants in an industry tends to become increasingly predictable and reliable. These features of performance are generally valued by society (Hannan and Freeman, 1984), but they can also inhibit entrepreneurial exploration (March, 1991). As Sewell (1992: 18) emphasizes, the unpredictability of performance—especially, on the part of inexperienced actors—is a key predictor of creative action, since it contributes to the reconsideration of established cultural schema. Consequently:

> *Hypothesis 9.* Actors (or entrepreneurial teams) with extensive experience in an industry are less likely to be innovative than those with limited experience.

When this proposition is applied to multi-member teams, there is one clear complication, insofar as the *dispersion* of industry experience on the part of members—as well as average—may influence innovation rates. If cohort effects are crucial, then the level of innovation will depend on whether all team members entered the industry around the same time period or during different periods. This issue is explored empirically in the analyses below.

3. Data, measures and methodology

3.1 Data

Schumpeter (1934: 66) noted that innovation is often embodied in the creation of new formal organizations, a viewpoint that has been echoed in studies of organizational

demography (Carroll and Hannan, 2000). The present analysis pursues this insight by examining innovation among a sample of 766 entrepreneurial teams who attempted to start business ventures. The entrepreneurs were drawn from a population of business professionals receiving MBA (masters of business administration) degrees from a graduate program in the western United States. The sampling frame explicitly controls for the wide variety of educational experiences and business competencies typically found among nascent entrepreneurs (see Reynolds and White, 1997), but also limits the representativeness of the entrepreneurs studied. Given that the emphasis of the present study is on how structural and cultural embeddedness affect innovation—rather than on the impact of individual traits—this trade-off appears to be justified.

In 1999, surveys were sent to the 1786 individuals in the sampling frame who were identified as entrepreneurs in alumni records—with 'entrepreneurs' being defined as individuals who had *tried* to start a business, either as a primary or secondary career activity. I received 766 non-duplicate surveys, yielding a response rate of nearly 43%.[3] The respondents were asked to identify the nature of their entrepreneurial effort, the types of innovations they hoped to introduce, primary sources of business ideas, the composition of their founding team, and any external partners or advisors that may have been involved in the founding process. Where possible, secondary data sources were used to confirm details of startup activities. Additional tests of measure reliability were applied, as discussed below.

Because the data were generally collected for a given period in time (organizational startup), some precautions were taken to minimize problems of endogeneity. To ensure causal precedence, the factors contributing to the structural and cultural embeddedness of entrepreneurs should pre-date attempts at innovation. Such causal precedence was established exhaustively for the industry experiences of the entrepreneurs, based on surveys of their career histories. Moreover, 88% of valid respondents reported formal network-building activities (e.g. founding team formation) *prior* to, or simultaneously with, formal innovation activities (e.g. patent or trademark applications). While endogeneity cannot be ruled out in the remaining cases, it does appear that the structure of teams and entrepreneurial networks pre-dated innovative propensity in many of these startup efforts.[4]

3.2 Dependent measure

Given the inherent difficulties in measuring innovative action, I employed two operationalizations of the dependent variable—one emphasizing objective behaviors on the part of entrepreneurs and the other emphasizing subjective perceptions of innovation. Following previous studies of innovation, the behavioral measure examines patent and trademark applications advanced by an entrepreneur during the creation of

[3]Three duplicate surveys were used to validate information, but were subsequently removed from the sample to ensure that each team contributed only one case to the analysis.

[4]Clearly, repeated measures of innovation—coupled with data on changes in network structure—are desirable in addressing the endogeneity issue more directly.

a new startup.[5] The decision to sample *applications*, in particular, rather than patents or trademarks issued, hinges on the potential success bias among startups that manage to legally protect their ideas or routines. Patent protection may be as much a function of the resources and stakeholders that are backing a startup, as the actual creativity of ideas involved.[6] At the same time, the input of legal and management counsel during the patent/trademark application process renders this indicator less subjective than individual perceptions of innovation.

Subjective perspectives on innovation consider the opinions of participants in an institutional arena, including experts and entrepreneurs. While the opinions of experts seem a likely candidate for judging innovation, they suffer from one major shortcoming: the attention of many experts—e.g. industry specialists, stock market analysts, academics—is directed largely at *successful* instances of creative action. There is a considerable risk that their assessments of creativity may be conflated with assessments of success. Moreover, expert evaluations are not publicly available for large numbers of unsuccessful innovations.

An alternative measure of innovation focuses on the perspective of entrepreneurs themselves—to what extent are they *attempting* to combine disparate ideas or routines, independently of the success of those combinations? This is the second measurement strategy employed in the present analysis, considering categories of economic innovation that elaborate on Schumpeter's widely used approach (see Schumpeter, 1934). Nine categories are addressed, including: (i) the attempted introduction of a new type of product/service in a local or regional market niche; (ii) the attempted introduction of a new type of product/service in a national or international market niche; (iii) the attempted introduction of a new method of production, (iv) distribution or (v) marketing; (vi) the development of new supplier linkages; (vii) attempted entry into an unexploited market niche; (viii) reorganization of an industry or organizational population; and (ix) a residual category of innovations identified by the entrepreneurs. Any number of these categories can be applied to a given organizational startup. Table 2 summarizes the frequencies with which the sampled entrepreneurs aligned their ventures with various attempts at innovation.[7]

[5]As Damanpour (1988) notes, other *a priori* sampling designs that impose the investigators' definitions of innovation are likely to miss significant aspects of creative action.

[6]For an embedded theory of innovation, one of the principal difficulties with the conflation of innovation and success is that it becomes very difficult to disentangle the effects of information and resource flows. Thus, research on successful organizational patent introductions (e.g. Ahuja, 2000) is forced to jointly consider knowledge spillover and resource sharing among firms.

[7]The nine categories of innovation are logically independent, with the exception of (i) and (ii). Product/service entry into a national or international market (ii) subsumes entry into regional and local markets (i). This operationalization allows considerations of geographic scope to weigh into the index of innovation: e.g. introducing a new product that has not been seen before in the global market is considered to be more innovative than introducing a product that has not been seen before in a regional market.

Table 2 Descriptive statistics for entrepreneurial teams (total $n = 766$)

Variable	Mean/proportion	Valid *n*
Innovation index	2.16	737
Introduce new product/service type	0.56	
—into national or international market	0.34	
Introduce new production method	0.09	
Introduce new distribution method	0.13	
Introduce new marketing method	0.19	
Develop new supplier linkages	0.11	
Enter unexploited niche	0.51	
Reorganize organizational population	0.10	
Other Innovation	0.14	
Patent or trademark application filed	0.30	737
Structural embeddedness		
Strong ties	0.38	753
Weak ties	0.52	753
Directed ties (discourse)	0.19	753
Directed ties (mimetic)	0.33	753
Network diversity	0.16	753
Cultural embeddedness		
Years of experience	9.88	766
Reliance on entrepreneurial experience	0.52	766
Reliance on work experience	0.39	753
Team composition		
Number of entrepreneurs	2.28	766
Role diversity	2.89	766
Strong ties[a]	0.52	437
Weak ties	0.30	437

[a]Tie composition is only applicable for teams with more than one member; 'no ties' represents the omitted structural category.

For each entrepreneurial team, an ordinal scale was derived by summing the number of applicable innovation categories. This subjective scale—reflecting how innovative the entrepreneurs *believed* their organizational startup to be—was then analyzed further for construct validity. Rank orderings on the scale were compared across two categories of sampled organizations known to have very different propensities for innovation: franchises and 'true' startups. By definition, franchises tend to reproduce existing organizational templates and routines, introducing few innovations in the process. A comparison of rank sums for the two subsamples confirms that the subjective scale clearly picks up on this distinction, with franchises being significantly less

innovative than other startups at the $P < 0.001$ level (Mann–Whitney $U = 1848.5$; one-tailed test).

Construct validity was also considered by analyzing the pairwise correlation between the two operationalizations of the dependent variable. A significant, though moderate, level of correlation was expected, insofar as the behavioral and subjective measures tap into somewhat distinctive aspects of innovation—i.e. application for patent protection primarily addresses product and method innovations within the subjective scale (categories i–v, above) and trademarks are often associated with 'branding' efforts in unexploited markets (category vii). Consistent with this expectation, the non-parametric (Spearman) correlation of the behavioral indicators with the subjective scale is 0.32 and statistically significant at the $P < 0.001$ level.

3.3 Independent measures

Table 2 lists the descriptive statistics for all of the independent variables employed in the analyses, reflecting the embeddedness of the entrepreneurs, the composition of their teams, and some control variables. Listwise deletion of missing values produced 730 cases for the analysis of all entrepreneurs and 421 cases for the analysis of multimember entrepreneurial teams.

Structural embeddedness. Individual entrepreneurs and teams were asked to identify what sources inspired their initial business idea, using a *non*-mutually-exclusive coding scheme. The sources were classified into four categories of structural embeddedness: (a) discussions with family members or friends ('strong' ties); (b) discussions with business associates, such as customers or suppliers ('weak' ties); (c) discussion in the general media or specialized trade press (ties 'directed' toward discourse); and (d) observation of existing competitors in an industry (ties 'directed' toward a set of concrete others). Descriptive statistics suggest substantial reliance on weak ties (52% of the cases), consistent with the prevalence of such ties in status attainment processes (Granovetter 1995). Reliance on strong ties was more limited (38%), while comparatively few respondents indicated that business ideas developed from attention to the discourse of experts (19%).

Network diversity was calculated based on the teams' list of external partners, advisors and other sources of information. Prior relationships with these sources were again classified in terms of strong ties, weak ties and no prior contact. For purposes of calculating network diversity, family members were distinguished from friends within the category of strong ties. Diversity (D) was then computed in terms of an information entropy measure proposed by Shannon and Weaver (1963):

$$D = -\sum_{i=1}^{n} \left(\frac{\log y_i}{\log n} \right) y_i \tag{1}$$

where n is the number of categories for social ties and y_i is the proportion of others

listed by the respondent within each category *i*. The measure varies from 0 for completely homogenous networks to 1 for completely heterogeneous networks.

Cultural embeddedness. The enculturation of entrepreneurs in a task domain is expected to increase with industry tenure. For purposes of our analysis, this experience is measured by the average number of years that entrepreneurs have been in an industry.[8] Among entrepreneurial teams, the dispersion—as well as mean—of this variable is of interest, since it may tap into the extent to which team members come from different cohorts and are familiar with different product/service paradigms.

Team members were also asked whether ideas from previous work experience were used in developing their new venture and whether the team included any serial entrepreneurs. As shown in Table 2, 39% of the teams imported ideas from other work contexts, while 52% could rely on the previous entrepreneurial experience of one or more of their members.

Entrepreneurial teams. The size distribution of the teams reveals that 65% include more than one member, with 2.28 members representing the mean for the sample. Role diversity is measured as the number of business functions filled within the teams, considering the following specialties: accounting; finance; human resources; legal; marketing; operations; business strategy; information systems; engineering; and research and development. On average, the sampled individuals and entrepreneurial teams subsume a little under three of these functional roles.

For multimember teams, data were also collected on the prior relationships connecting team members. Those teams composed exclusively of family members, friends or work colleagues were classified as consisting of a set of 'strong' ties. Those teams composed exclusively of members with no prior contact with one another (often introduced via an intermediary, such as a venture capitalist) were classified as having no ties. Those teams composed of acquaintances—or a mixture of family members, colleagues, acquaintances, etc.—were classified as consisting of a set of 'weak' ties. Interestingly, the majority of multimember teams fall into the 'strong' ties category, suggesting that the requirements for trust and emotional support *within* the team are much more pronounced than they are with respect to external advisors or sources of information.

Control variables. Fixed effects were included in all models to address the fact that propensity toward innovation may vary by industry. Many economists have maintained that organizational innovation rates in service sectors are lower (or lead to fewer increases in productivity) than in manufacturing sectors (cf. Sundbo, 1998: 99–102). I distinguish among eight industry categories, organized broadly by Standard Industrial

[8]It could be argued that interpreting the effects of industry tenure in terms of enculturation requires that the confounding effect of the entrepreneurs' ages be controlled for. I conduct a sensitivity analysis below to ensure that the impact of industry experience on innovation is distinct from the chronological maturity (and possible risk aversion) of the entrepreneurs.

Table 3 Distribution of represented industries (valid $n = 737$)

Industry	Standard industrial classification	No. of firms	% applying for patent/trademark
Agriculture and mining	divisions A and B	15	13
Construction	division C	76	7
Manufacturing (electronic and computer components/industrial machinery)	division D, major groups 35 and 36	69	64
Manufacturing (other)	division D, major groups 20–34, 37–39	64	58
Transportation and utilities	division E	40	20
Wholesale/retail trade	divisions F and G	107	37
Finance, insurance and real estate	division H	132	10
Other services	division I	234	30

Classification (SIC) (see Table 3). Extractive industries (agriculture and mining) serve as the reference category in the analyses.

3.4 Methodology

Given that the subjective scale of innovation is measured on an ordered scale, multivariate methods for ordinal variables were applied to predict the level of perceived innovation within each entrepreneurial team. Zavoina and McElvey's (1975) ordered probit model was estimated based on the following specification, stated in terms of a continuous latent measure of innovation (Y^*):

$$Y^* = X\beta + \varepsilon \quad \text{with } Y = \begin{array}{l} 0 \text{ if } Y^* \le \mu_0 \\ 1 \text{ if } \mu_0 < Y^* \le \mu_1 \\ 2 \text{ if } \mu_1 < Y^* \le \mu_2 \ldots \\ J \text{ if } Y^* > \mu_{J-1} \end{array} \tag{2}$$

where Y is the observed counterpart to Y^* and the μs are free threshold parameters that distinguish different ordered values. Maximum likelihood estimates were derived using Greene's (1998) LIMDEP software, with the constraint that the first threshold parameter (μ_0) equal zero.

Applications for patents or trademarks by entrepreneurial teams were treated as dichotomous outcomes (whether or not an application was filed as part of the teams' startup activities). A simple probit model was applied in these cases, again employing maximum likelihood estimation.

Table 4 Ordered probit models predicting subjective perception of innovation based on experience, embeddedness and team structure of entrepreneurs

Variable	Model 1	Model 2	Model 3	Model 4
Intercept[a]	2.019 (0.269)***	1.958 (0.278)***	1.903 (0.283)***	1.627 (0.279)***
Industry context[b]				
Construction	–0.663 (0.280)*	–0.604 (0.284)*	–0.600 (0.286)*	–0.541 (0.277)
Manufacturing (computers/electrical components)	–0.031 (0.319)	–0.007 (0.317)	–0.056 (0.316)	–0.098 (0.304)
Manufacturing (other)	0.116 (0.286)	0.168 (0.292)	0.124 (0.295)	0.154 (0.285)
Transportation and utilities	–0.208 (0.292)	–0.263 (0.298)	–0.328 (0.306)	–0.295 (0.304)
Wholesale/retail trade	0.211 (0.259)	0.192 (0.267)	0.164 (0.272)	0.228 (0.265)
Finance and insurance	–0.563 (0.264)*	–0.558 (0.268)*	–0.516 (0.271)	–0.444 (0.263)
Other services	–0.274 (0.254)	–0.289 (0.259)	–0.282 (0.262)	–0.200 (0.254)
Cultural embeddedness				
Years of experience	–0.012 (0.004)**	–0.011 (0.004)**	–0.010 (0.004)**	–0.009 (0.004)**
Reliance on entrepreneur's experience	0.040 (0.140)	–0.008 (0.140)	–0.057 (0.140)	–0.191 (0.142)
Reliance on work experience	–0.156 (0.144)	–0.223 (0.145)	–0.260 (0.145)	–0.297 (0.144)*
Structural embeddedness				
Strong ties	—	–0.080 (0.084)	–0.101 (0.085)	–0.091 (0.086)
Weak ties	—	0.230 (0.085)**	0.229 (0.086)**	0.227 (0.087)**
Directed ties—discourse	—	0.300 (0.101)**	0.242 (0.101)**	0.240 (0.103)**
Directed ties—mimetic	—	–0.061 (0.093)	–0.075 (0.094)	–0.099 (0.094)
Network diversity	—	—	0.993 (0.183)***	0.903 (0.182)***
Team Composition				
Number of entrepreneurs	—	—	—	0.071 (0.037)*
Role diversity	—	—	—	0.059 (0.031)*
–2 log likelihood	2359.86	2340.95	2303.64	2287.48
Number of cases		730		

[a]Inclusion of intercept requires that m_0 be constrained to zero.

[b]Extractive industries (agriculture/mining) represent the omitted category.

*$P < 0.05$; **$P < 0.01$;***$P < 0.001$ (one-tailed tests for hypotheses; two-tailed tests otherwise).

4. Results

The effect of structural and cultural embeddedness on creative action was analyzed in three stages. Table 4 considers the entrepreneurs' own perceptions of innovation, reporting estimates for all sampled entrepreneurs ($n = 730$ after listwise deletion). Table 5 develops a parallel series of models for the behavioral indicator of innovation–patent/trademark application. Table 6 summarizes selected parameter estimates pertaining to the effect of team composition, considering multimember teams only ($n = 421$ after listwise deletion). The reference category for all comparisons is a simple caricature of *Homo economicus*—an isolated entrepreneur, with no social ties (directed or undirected) to external sources of information, no prior enculturation in an industry and no entrepreneurial team.

Table 5 Probit models predicting likelihood of patent/trademark application based on experience, embeddedness and team structure of entrepreneurs

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	–2.160 (0.825)**	–2.262 (0.841)**	–2.342 (0.846)**	–3.003 (0.867)***
Industry context[a]				
Construction	–0.587 (0.898)	–0.529 (0.899)	–0.510 (0.901)	–0.408 (0.904)
Manufacturing (computers/electrical components)	2.229 (0.811)**	2.271 (0.812)**	2.259 (0.814)**	2.182 (0.816)**
Manufacturing (other)	2.592 (0.815)**	2.627 (0.817)**	2.617 (0.819)**	2.705 (0.822)**
Transportation and utilities	0.429 (0.865)	0.332 (0.868)	0.301 (0.870)	0.304 (0.877)
Wholesale/retail trade	1.358 (0.796)	1.304 (0.796)	1.297 (0.798)	1.408 (0.801)
Finance and insurance	–0.353 (0.827)	–0.371 (0.827)	–0.325 (0.829)	–0.277 (0.835)
Other services	1.101 (0.783)	1.086 (0.782)	1.105 (0.784)	1.265 (0.788)
Cultural embeddedness				
Years of experience	–0.032 (0.011)**	–0.030 (0.011)**	–0.030 (0.011)**	–0.029 (0.011)**
Reliance on entrepreneur's experience	0.868 (0.334)**	0.819 (0.336)*	0.795 (0.337)*	0.505 (0.346)
Reliance on work experience	0.105 (0.348)	0.032 (0.351)	0.019 (0.352)	–0.037 (0.356)
Structural embeddedness				
Strong ties	—	–0.052 (0.192)	–0.061 (0.193)	–0.025 (0.196)
Weak ties	—	0.173 (0.190)	0.174 (0.190)	0.183 (0.193)
Directed ties—discourse	—	0.495 (0.224)*	0.460 (0.226)*	0.458 (0.231)*
Directed ties—mimetic	—	–0.079 (0.198)	–0.089 (0.198)	–0.130 (0.201)
Network diversity	—	—	0.562 (0.364)	0.336 (0.376)
Team composition				
Number of entrepreneurs	—	—	—	0.259 (0.078)***
Role diversity	—	—	—	0.051 (0.067)
–2 log likelihood	736.89	730.98	728.61	710.24
Number of cases		730		

[a]Extractive industries (agriculture/mining) represent the omitted category.

*$P < 0.05$;**$P < 0.01$;***$P < 0.001$ (one-tailed tests for hypotheses; two-tailed tests otherwise).

4.1 Perception of innovation

Cultural embeddedness has a substantial impact on the perception of innovation among entrepreneurs (see Table 4, Model 1). Every year of industry tenure decreases the likelihood that entrepreneurs will introduce what they consider to be fresh organizational ideas in their startups. Following Hypothesis 9, it can be suggested that this reflects both the increasing predictability of means—given the internalization of standardized routines and competencies—and the increasing predictability of performance with industry tenure. As individuals become socialized in a task domain, they are less likely to change organizational methods they view as either appropriate or effective. Sensitivity analyses (not shown) indicate that this effect continues to hold when the chronological ages of the entrepreneurs are entered into the model. Other control variables related to cultural embeddedness—such as the tendency of entrepreneurs to draw on previous work or entrepreneurial experiences—are not statistically significant.

The addition of covariates assessing the structural embeddedness of entrepreneurs improves model fit substantially (Model 2 vs. Model 1, likelihood ratio $\chi^2 = 18.91$, Δd.f. $= 4$, $P < 0.001$). Consistent with the 'strength-of-weak-ties' proposition (Hypothesis 1), entrepreneurs who rely heavily on information from acquaintances are more likely to engage in what they see as innovative activity than those who rely on information from family and friends {odds ratio = exp[0.23 — (–0.08)] = 1.36}. The reduction of information redundancy and conformity in weak-tie networks creates a milieu where attempts at creative action are more likely than in strong-tie contexts. The impact of conformity may be reduced further when entrepreneurs direct their attention to claims made in public discourse, rather than to the ideas of acquaintances (Hypothesis 2). *Ceteris paribus*, these entrepreneurs are nearly 1.5 times as likely to view themselves as innovators than those who rely on strong ties and slightly more likely (1.1 times, not significant) than those who rely on weak ties. By contrast, entrepreneurs who direct their attention to the concrete behaviors of existing competitors in an industry, rather than the discourse of experts, tend to reproduce conventional routines and ideas (Hypothesis 3). While errors in the mimetic process can ultimately lead to unforeseen innovation (Alchian, 1950), these mutations lie outside the initial subjective purview of the entrepreneurs.

A third model explores the impact of network diversity on perceptions of creative action. Entrepreneurs who are embedded in heterogenous networks, comprising a mixture of strong ties, weak ties and advisors with no prior relationship, are significantly more likely to attempt innovation than entrepreneurs in homogenous networks (Hypothesis 4). In particular, social networks with maximum information entropy (completely heterogenous ties) encourage innovation at almost three times the rate of networks with no entropy (completely homogenous ties). Considering the other structural covariates, it is worth noting that the inclusion of the diversity variable slightly dampens the statistical significance of discourse-directed ties. Quite possibly, one principal benefit of such directed ties—lack of information redundancy—is addressed to some extent by the network diversity measure.

Since the data analyzed in Table 4 include both individual entrepreneurs and entrepreneurial teams, only a few features of team composition can be addressed for the full sample (see Model 4). As predicted, innovative propensity increases with the size of entrepreneurial teams. When large numbers of entrepreneurs are brought together, new combinations of ideas or routines become more likely (Hypothesis 5). Attempts at innovation are also encouraged by a diverse set of functional roles within a team. The multiplicity of role structures that entrepreneurs may invoke in a given context can lead to role conflict (both inter- and intrapersonal), contributing to the modification of conventional scripts (Hypothesis 6).

4.2 Applying for patents or trademarks

Results for a behavioral indicator of innovative propensity—patent or trademark application—suggest a number of parallels with subjective perceptions of innovation

(see Table 5). Embeddedness in a particular industry tends to dampen attempts by entrepreneurs to patent or trademark their ideas (Hypothesis 9), while such attempts are encouraged by attention directed to public discourse as a source of ideas (Hypothesis 3), as well as large entrepreneurial teams (Hypothesis 5). A number of other estimates are consistent with predictions—including those for strong–weak ties (Hypothesis 1), mimetic activity (Hypothesis 2), diverse advice networks (Hypothesis 4) and functional diversity (Hypothesis 6)—but these do not attain statistical significance for this operationalization of the dependent variable.

One control variable that deviates from the analysis of subjective perceptions of innovation involves serial entrepreneurs. Prior entrepreneurial experience increases the propensity of startup founders to seek legal protection for their ideas in the form of patents or trademarks, while it has no marked impact on the likelihood that founders will view their ideas as being unusually creative (cf. Table 4). These empirical results are consistent with the interpretation that serial entrepreneurs are relatively sophisticated innovators, with greater awareness of other novel ideas in their business domain and, moreover, awareness of how those ideas may pose competitive threats to their own creative efforts.

4.3 Team composition

Table 6 considers the impact of team composition in greater detail. Because the analyzed subsample is 'biased'—comprising startup efforts involving at least two entrepreneurs—only selected parameter estimates are shown. The impact of internal team structure follows the rank ordering implied by hypothesized predictions (7 and 8),

Table 6 Selected estimates from ordered probit models predicting subjective measure of innovation based on team composition

Variable	Model 1
Cultural embeddedness	
Years of industry experience	–0.016 (0.007)**
Diversity of experience	0.019 (0.013)
Team composition	
Number of entrepreneurs	0.029 (0.056)
Role diversity	0.043 (0.041)
Strong ties[a]	–0.229 (0.179)
Weak ties	–0.066 (0.200)
–2 log likelihood	1338.91
Number of cases	421

[a] 'No ties' represent the omitted structural category.

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

with teams composed of strong tie networks being slightly less innovative than those built on weak-tie networks and those composed of weak ties being less innovative than those involving no prior relationships. However, differences in the rank ordering are not statistically significant. In comparison to external ties, the modest effect of internal ties probably results from the 'reconstruction' of tie strength once teams are formed. While team members may have only limited familiarity with one another initially, relatively frequent interaction during the formation of a new organization tends to foster group integration. Consequently, pressures for conformity in the innovation process may grow and largely obscure the initial benefit that interpersonal anonymity holds for creative activity.

The parameter estimates indicate that the effects of team size and role diversity are attenuated once attention is restricted to multimember entrepreneurial teams. Partially, this may be attributed to data attrition and the resulting reduction in statistical power. However, it is also possible that the principal benefit of team size—in terms of encouraging creative action—occurs only as one moves beyond individual entrepreneurs to multimember teams, with few marginal benefits accruing to the addition of team members beyond that point. Similarly, the principal benefit of role diversity may apply to individual entrepreneurs who assume several functional backgrounds, rather than to heterogenous multimember teams. The analysis also suggests that industry experience makes its main contribution through the average level of tenure among founding team members, *not* by drawing on members with diverse industry experiences from different cohorts.

5. Discussion

The results provide strong support for the thesis that capacity for business innovation is both enabled and constrained by existing social structure. While treatments of innovation and discovery often suggest that new combinations of ideas be treated *sui generis* as largely random occurrences among isolated actors (e.g. Popper, 1959), these undersocialized conceptions ignore the importance of embeddedness in triggering combinations of ideas. Embeddedness is crucial to the flow of non-redundant information to innovative entrepreneurs, particularly those who are able to draw on weak ties, directed ties or non-equivalent role structures. At the same time, propensity for innovation requires that entrepreneurs not fall prey to the conformity that might be encouraged by social embeddedness. As a long-standing research tradition on interpersonal expectations (e.g. Blanck, 1993) has emphasized, deference to the opinions of others can serve as a significant constraint on creative experimentation. Our results suggest that entrepreneurs can avoid the pitfalls of conformity by diversifying their networks to include a wide range of social contacts and by emphasizing abstract conceptions of ideas rather than concrete implementations.

In many respects, the cultural embeddedness of entrepreneurs appears to be as important to their innovative tendencies as their structural embeddedness. Extensive

experience in an industry leads to predictability of means and achievement of ends, inhibiting organizational innovation in the process. While 'oversocialization' is thus inimical to innovation, the internalization of norms and ideas cannot be ignored from an empirical standpoint in predicting capacity for creative action (cf. Granovetter, 1985). The internal structure of an emerging venture also factors into the tendency for it to deviate from established organizational forms or to reproduce them. In contrast to structural and cultural embeddedness, the direction of causality seems less clear on this point. Do large entrepreneurial teams (or diverse functional roles) encourage innovation? Or do the risks inherent in an innovative business plan push entrepreneurs to expand their teams and incorporate additional functional backgrounds? In this case, it seems more appropriate to talk about the 'co-evolution' of internal organizational structure and innovation, rather than one-sided causal determination. More precise timing data on the formation of entrepreneurial teams and codification of business ideas can be examined to disentangle the relationship. Additional timing data is also desirable to clarify the interplay of initial network ties within a team, innovation, and the tendency toward team integration.

6. Conclusion

While the analyses presented here are a first step in addressing the embeddedness of innovation, further empirical development is needed to connect these findings to industrial evolution. In contrast to the micro-level view of innovation advanced in this article, the study of industrial evolution requires an understanding of (i) the way that innovation may actually translate into durable changes in market structure; and (ii) whether and how such changes come to be recognized by actors outside the social sphere of the innovator. Much that passes for 'innovation' from the standpoint of an entrepreneur will seem little more than a flight of fancy (or madness) from the standpoint of his or her contemporaries. Indeed, the majority of business innovations seem doomed to fates of failure or cultural amnesia. The intersection of perspectives on embeddedness and diffusion processes promise to contribute further insights to our understanding of how innovations become durable features of the industrial landscape.

From a substantive viewpoint, it is also important to clarify how the micro-dynamics of *organizational* innovation, in particular, relate to the macro-dynamics of the emergence of novel organizational forms (see Hannan and Freeman, 1986; Ruef, 2000). Researchers have suggested that, 'among entrepreneurs and the new ventures they create, we mostly find mundane replications of organizational forms' (Aldrich and Kenworthy 1999). Even when deviations from these 'mundane replications' do occur, this does not automatically translate into the emergence of a new form. Many innovative ventures disband before they capture any public attention that serves to legitimate their distinctiveness. Others persist but fail to activate the social movements, technological imitation and/or regulatory transformations needed to constitute the identity of a new organizational form on a wider scale (Ruef, 2000). In these respects,

the relationship between organizational innovation and the emergence of new organizational forms serves as a special case of broader theoretical questions connecting creative action and corporate transformation.

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