

3.19 An Agent-Based Model Of New Venture Creation: Conceptual Design for Simulating Entrepreneurship

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Abstract. There is a growing debate over the means by which regions can foster the growth of entrepreneurial activity in order to stimulate recovery and growth of their economies. On one side, agglomeration theory suggests the regions grow because of strong clusters that foster knowledge spillover locally; on the other side, the entrepreneurial action camp argues that innovative business models are generated by entrepreneurs with unique market perspectives who draw on knowledge from more distant domains. We will show you the design for a novel agent-based model of new venture creation that will demonstrate the relationship between agglomeration and action. The primary focus of this model is information exchange as the medium for these agent interactions. Our modeling and simulation study proposes to reveal interesting relationships in these perspectives, offer a foundation on which these disparate theories from economics and sociology can find common ground, and expand the use of agent-based modeling into entrepreneurship research.

1.0 INTRODUCTION

The field of entrepreneurship has developed a productive momentum in studies that empirically demonstrate growth factors and rates, relationships between entrepreneurs, industry participants, and institutional agents, and macro-level outcomes, such as regional economic vitality, associated with entrepreneurial success. With this momentum, complexity has followed. Rather than a convergence around a core set of theories explaining entrepreneurship, the field has developed into a diverse and loosely-connected confederacy of theoretical lenses [1]. This diversity has led some scholars to call for a systems perspective of entrepreneurship because so

many different participants are involved in this economic process.

2.0 A HETEROGENEOUS SYSTEMS PERSPECTIVE OF ENTREPRENEURSHIP

Two theoretical foundations — agglomeration, and entrepreneurial action — have increasingly been applied to these systems-based explanations of entrepreneurship. Agglomeration emphasizes the environmental factors within which entrepreneurship happens, and the great inertia involved in acquiring resources from the environment that leads entrepreneurs to set up their businesses as close as possible to their prior employers and other local resources providers.

Entrepreneurial action places that evolution of the entrepreneurial ecosystem in the hands of the entrepreneurs, who seek out resources to maximize the potential for their organizations. The challenge with using either of these theoretical anchors is that both conditions exist in any entrepreneurial system. This poses both phenomenological and methodological problems with developing a better understanding of the formation processes of new ventures within economic environments.

Recent work has sought to discern the differences in effect from both theories and provide a methodology for better understanding the systems perspective of new venture formation [2], [3], [4]. This study continues the development of a simulation model for new venture formation that will clarify the relationship between agglomeration and entrepreneurial action. An overview of the competing theories is presented here along with a model for the design of an agent-based simulation to test the relationships between these theories with respect to new venture formation.

The systems perspective of entrepreneurship builds on a set of assumptions and observations that, in any economy, there are domains of activity that spur the emergence and growth of new firms to act on market opportunities. The domains comprise participants and interactions involving socio-economic, institutional, political, and technological factors — the results of which evolve into a heterogeneous complex system. Founders instigate the process by attempting to exploit novel ideas that they believe address market opportunities. These efforts may be hampered or helped by policymakers, regulators, economic development offices, and other political participants. Universities may be involved in the transfer of knowledge that leads to opportunities for exploitation. Financiers and suppliers enable that venture to gain traction, and alliances may be formed with others in the market to expedite product or service

development. Finally, customers emerge who are willing to try something new, completing the cycle of innovation.

Explanations for these dynamics have been drawn along two lines: agglomeration of knowledge exchange to produce concentrated economic activity, and entrepreneurial action that results from founders' asymmetric access to economic and technical knowledge of market opportunities. The main premise of agglomeration is that jurisdictions — primarily cities and regions — absorb extraordinary pecuniary gains through the localized spillover of knowledge from incumbent firms. Further, this spillover acts as the source of new venture creation since it leads potential entrepreneurs outside the boundaries of these firms to acquire the knowledge inexpensively and develop novel product and service offerings from it.

An important source of connection between both theoretical positions is the role of institutional forces in shaping new ventures during the early stages of their growth [4], [5]. In Reference 4 (p.2), the role of institutional action is characterized as perhaps even more important to new venture creation and survival than the competitive dynamics more often associated with entrepreneurship:

The actions most typically associated with entrepreneurs are competitive ones in which new technological pathways are constructed or new models for rent appropriation are devised. However, actions against institutions represent complements to the competitive ones that may shape a new venture's growth. In fact, issues of institutionalization and legitimacy may dominate other forces. As Boulding [6] suggests: "It can be argued indeed ... that the dynamics of legitimacy ultimately dominate all other elements of social systems." Certainly, most scholars agree

institutional forces are fundamental elements of entrepreneurship [7]. What remains less well understood is how new ventures combine competitive and institutional actions to improve the likelihood of success.

Institutions and the dynamics between these institutions and other participants are the foundations of entrepreneurial activity in economic markets [8], [9]. New ventures may be catalyzed through policy choices regarding intellectual property, financial liquidity, and competitive dynamics. Other policies may act against them, retarding their growth or providing obstacles leading to delays in creation or failure. Thus, a simulation model designed to evaluate new venture formation from distinct theoretical perspectives must account for both competitive *and* institutional forces.

3.0 DESIGN OF AGENT-BASED MODEL OF NEW VENTURE FORMATION

It is important to capture only the important aspects and variables of a system when constructing any agent-based model. This viewpoint is in-line with the Law of Parsimony (or Occam's Razor), which is the well-established principle used with social sciences that states "All things being equal, the simplest solution is the best or Entities should not be multiplied beyond necessity" [10], [11]. This approach does produce problem when building a model around two competing paradigms, namely: business growth happens due to incumbent firms, or business growth happens due to entrepreneurs bring new knowledge to an area. The agent-based model outline in this section captures the essential elements of both paradigms under consideration for the research question.

Following the Law of Parsimony, the key features of the problem-space under consideration should be captured within this

model. A list of these features is given here:

- Businesses form the agents within the model; these include incumbent firms and entrepreneurs.
- Businesses are able to form alliances with one another; these range from informal communication to company mergers.
- There is a geographical space where businesses are physically based; these spatial regions are affected by local laws, resources and taxes.
- Business sell products based on their current knowledge; these products are could be physical or service-based.
- Customer demand determines the survival of a product and ultimately the business with which it relates. A highly demanded product allows a business to grow.

This list does not represent all aspects of business modeling with key features like capital investment and production being missing. This list does, however, allow for the basis of a model that will investigate the research question.

3.1 Model Setup

The model was built around the existing entrepreneur literature and its examples. Using the existing theory to construct a model is called an axiomatic approach as opposed to a realism approach that would model based around real-world data [12]. The advantage of the axiomatic approach is that information required is readily available, i.e. through journals articles. The disadvantage this approach is that any theories acceptance, by the scientific

community, might change over time making the model invalid as well. Given the difficulties of collecting data on entrepreneurs, the realism approach is simply impractical for the research. Using the axiomatic approach, the ENTRABMS agent-base model was developed. The ENTRABMS satisfies all the elements given in the list above. There are some other important features that ENTRABMS has, namely: adaption and multiple spaces.

The authors in Reference 13 argue that see any true emergent behavior within an ABM, the agents must be able to adapt [13]. Emergent behavior is purpose of using ABM and has been argued that it is the foundations of a new scientific method [14], [15]. Emergent behaviors are outputs from a simulation that were not immediately obvious from the on-set but give insight to the analysis about modeled system. As this is kind of result that is required from this research, including adaption within the ENTRABMS is essential. The agents within ENTRABMS are able to adapt through their ability to move through the knowledge space.

The knowledge space within the model represents the abstract landscape with which both the agent-businesses' products and customer demand reside. This space is analogous to a rocky coastline where the water levels represents the customer demand and rock surface represents the currently unknown knowledge. A diagram in Figure 1 shows this analogy. The business-agents could be considered to be crabs that can move around the rock-surface (product change) or burrow into the rock surface (engage in product research).

To understand this knowledge-space, consider the example of smart-phones. There clearly was a customer demand for smart-phones but during the late nineties the computing and cell-phone technology did not exist to produce the smart-phone product. Within our analogy, "smart-

phones" could be considered to be the rock that sits between "computing" rock and "cell-phone" rock. As business-crabs burrowed into "computing" rock and "cell-phone" rock, this opens up the "smart-phones" rock and customer demand flows into it. Now eventually a business-crab will move into that space and take advantage of this demand by producing smart-phones. The knowledge space is not the only space with the ENTRABMS model. The agents in the model exist in the "real-world" geographical space as well. This need for two spaces is due to the research question requirement to investigate incumbent firms in an area and entrepreneurs bring new knowledge to an area.

This is not the first ABM that has agents existing in multiple spaces. An insurgency model presented at last year MODSIM World conference contain insurgent-agents that existing in both a social network space and an "inclination" space [16]. The model was developed using the U.S. Marine Corps War-fighting Laboratory's Pythagoras ABM package [17].

3.2 Implementation

The business-agents exist in two different spaces, they have ability to move around and they can make connections with other business. With this knowledge in mind, the ENTRABMS was built. The model was constructed using Repast Symphony. Repast Symphony is a Java-based agent-based modeling environment [18]. It was chosen because it can handle agents existing in multiple spaces and gives the flexibility of programming which is required for such a complex model as ENTRABMS. The difficult issue that now must be resolved is what initial configurations should be used to adequately investigate the research questions.

ENTRABMS MODEL

Businesses are able to move within the knowledge space through partnerships and innovation, which allows them to dig deeper.

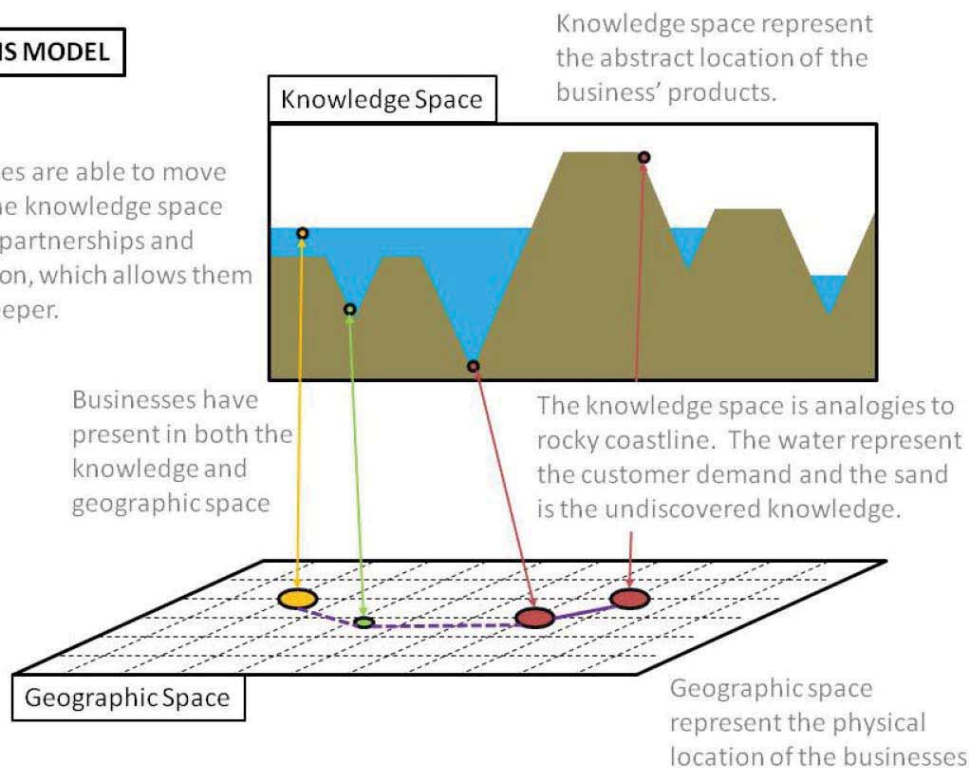


Figure 1: Diagram representing the main mechanics of the ENTRABMS mode

4.0 CONCLUSION

Our study uses an agent-based model to study new venture formation. The primary variables of interest that are examined include the levels of new venture formation across different locations in the geographic space and the rate of survival of new ventures in this space. The results measured by these variables will display variable results from the dynamics of the system and its initial conditions, which are established with several systemic parameters. These include the number of competitors, distribution of customer demand, presence of institutional agents, and the rate of entry.

The anticipated results from this simulation study will reinforce the existing premise in the literature that formal networks are important to the formation of new ventures,

but also introduce evidence that the structure of those networks may have dramatically different outcomes based on the nature of the institutional environment the venture resides in. New ventures should seek out and develop the 'right' networks for their situation and location. What 'right' looks like depends on nature of the new venture and its knowledge appropriation process, and the type of environment the entrepreneur is operating in.

In addition, this study will demonstrate how simulation may be used to evaluate the presence of competing theories of behavior on heterogeneous agents in a landscape model. This work contributes to the scholarly direction of entrepreneurship research while advancing the agent-based modeling methodology in the social sciences domain.

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