

An Agent-Based Model of Economic Growth in Innovation Ecosystems

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An innovation ecosystem is a collection of firms that are intertwined such that the success of an innovation depends not only on the innovating firms, but also the suppliers and consumers of those firms. Because of this dependence, all firms coevolve: the innovations of one firm result in the innovations of others. Over time, the “technology space” of the ecosystem changes in response to these innovations. We believe that by studying the technology space of an innovation ecosystem, we can gain additional insights into the economic performance of the ecosystem.

We define the technology space of an economy as a directed hypergraph, $H = (V, E)$, such that V is the resource space and E is a set of “hyper” edges that connect all resources used in a production process (i.e. each edge encodes a production process available to the population). We define the resource space of an economy as the set of resources used for production and consumption. These resources can be natural (e.g. trees), manufactured (e.g. tables), or intangible (e.g. labor). We associate each edge of H with a positive weight that denotes the number of companies capable of the associated production process. As companies enter and leave the economy, the weights associated with the edges of H will change. Edges with a weight of 0 are removed from E and added back when their weight becomes greater than 0. Thus, the technology space of an economy changes with the production processes of the population.

We construct an agent-based model of innovation ecosystems to explore the relationship between the technology space of an ecosystem and its economic performance. In particular, we investigate the relationship between the GDP per capita of the underlying economy associated with an innovation ecosystem and the structure of its technology space. We hypothesize that 1) there is a positive correlation between the density of the technology space and GDP per capita; and 2) this relationship holds when money or resources are exogenously injected into the economy. This research is a synthesis of previous research by Garibay and Hollander on the relationship between technology space and economic performance in both static and dynamic environments.