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Spatial proximity and complementarities in the trading of tacit knowledge

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Abstract

We model knowledge-trading coalitions in which the transfer of tacit knowledge is unverifiable and requires face-to-face contact, making spatial proximity important. When there are sufficient “complementarities” in knowledge exchange, successful exchange is facilitated if firms can meet in a central location, thereby economizing on travel costs. When complementarities are small, however, a central location may be undesirable because it is more vulnerable to cheating than a structure involving bilateral travel between firms. We believe that our framework may help explain the structure and stability of multimember technology trading coalitions, such as Sematech and Silicon Valley.

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1. Introduction

It is widely recognized that the creation and dissemination of knowledge are central to modern economic growth, particularly in high-technology sectors, such as com-

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puting, biotechnology, and telecommunications. How best to organize firms and industries to facilitate this process is a topic of ongoing research interest. In many industries, it is impractical for each firm to generate all relevant knowledge within its own vertically integrated structure, and the exchange of knowledge is central to industry success. This fact poses a serious organizational problem, because knowledge is a difficult good on which to contract. It may be virtually impossible to specify in advance the nature of the knowledge to be exchanged or to verify *ex post* whether the promised knowledge has in fact been delivered.¹ Contracting difficulties are especially severe for *tacit* knowledge, i.e., know-how or skills that are embodied in human capital and are difficult to codify.²

Tacit knowledge takes a variety of forms. In a manufacturing setting, learning-by-doing is critical in many industries. For example, the fabrication of silicon wafers is central to modern semiconductors and is a delicate art that is only gradually learned on the job. Managerial processes, more generally, also involve tacit knowledge. While much has been written about total quality management, [Womack \(1991\)](#) points out that American automobile manufacturers took years to learn the process from the Japanese and only began to develop mastery through joint ventures with Toyota and Honda. Critical to these and other examples is that sharing tacit knowledge requires face-to-face contact; reading about the skills involved is not sufficient.³

When meetings are essential to knowledge exchange, spatial proximity plays a natural role in determining the cost of sharing knowledge. [Marshall \(1895\)](#) famously stressed that knowledge spillovers are a driving force for the agglomeration of industries. More recently, [Saxenian \(1994\)](#) and [Porter \(1998\)](#) have provided engaging accounts of the role of spatial clustering in creating regional economic advantages.⁴ There is also a growing empirical literature documenting the importance of spatial proximity for knowledge spillovers between firms. For example, [Jaffe et al. \(1993\)](#) find that patent citations are significantly more likely to come from within the same country, state, and even metropolitan area than would be predicted by the geographical dispersion of similar research.⁵

The foregoing work, while intriguing, has not developed formal models of the role of spatial proximity in knowledge-based industry clusters. Our goal is to build a simple dynamic model in which competing firms trade tacit knowledge, the transfer of which is

¹ [Aydogan \(2002\)](#) studies empirically the governance structures used by Silicon Valley firms to support the transfer of knowledge.

² [Polanyi \(1958\)](#) provides the seminal account of tacit knowledge and its characteristics.

³ [von Hippel \(1988\)](#), for example, stresses the significance of frequent meetings among economic actors who need to transfer and obtain tacit knowledge.

⁴ According to [Porter \(1998, p. 77\)](#), “[c]lusters are geographical concentrations of interconnected companies and institutions in a particular field.”

⁵ The survey work of [Levin et al. \(1987\)](#) documents the importance of interpersonal communication as a means for firms to acquire external knowledge. In particular, the use of publications and technical meetings, informal conversations, and hiring away employees from other firms are all important, and their use tends to be highly correlated. [Leamer and Storper \(2001\)](#) argue that proximity is an important source of competitiveness, in large part because face-to-face meetings are necessary for the exchange of complex knowledge.

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