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Regional Innovation Potential: The Case of the U.S. Machine Tool Industry

Steven R. Nivin



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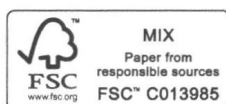
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REGIONAL INNOVATION POTENTIAL: THE CASE OF THE U.S. MACHINE TOOL INDUSTRY

To Laura and Brennan

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1 Introduction

Introduction

This study analyzes a process vital to economic development - technological change. It is an attempt to further understand the processes driving innovation, so that we may gain a deeper insight into the development of economies. Specifically, the study explores the concept of *innovation potential* and the factors that result in variations in innovation potential across metropolitan areas, using the U.S. machine tool industry as a case study.

Innovation Potential

Given the importance of innovation potential in economic development, it is essential to know what influences the development of this potential. Borrowing from a similar conception of innovative capacity developed by Suarez-Villa (1993), innovation potential will be operationalized as the number of United States machine tool patents granted from 1990 through 1992 across metropolitan areas. Suarez-Villa had defined innovative capacity as the sum of all patents across multi-state regions over a seventeen year period. The measure used here provides more geographic detail for a less aggregative time period, thereby creating a measure of both the urban region's ability to invent and its potential to innovate.

While not all inventions¹ are patented and not all inventions become innovations,² patent data is a reliable measure of invention (Acs and Audretsch, 1989; Basberg, 1987; Boitani and Ciciotti, 1990; Comanor and Scherer, 1969; Griliches, 1990; Griliches, Pakes, and Hall, 1987; Narin, Noma, and Perry, 1987; Pakes and Griliches, 1984; Suarez-Villa, 1993). Since

¹ Invention is "the discovery of basic scientific and technological knowledge" (Suarez-Villa 1993, 148).

² Innovation is "the application and development of inventions in ways that may directly determine economic change" (Suarez-Villa 1993, 148).

invention is the precursor to innovation, the more inventions created the greater the potential that some of them will register an economic impact as innovations. Hence, the use of patent data in this study should provide an adequate measure of regional innovation potential.

Innovation potential has a significant impact on the rate of growth and development of an economy. It is of interest to know what influences the development of this potential. Innovation potential can be derived from both indigenous and exogenous sources. The indigenous sources of innovation potential include the institutions, infrastructures, social systems, and stocks of human capital present within the economy. The influence of exogenous sources depends on the capacity of economic agents to be creative adaptors of fundamental innovations imported from elsewhere. This study focuses on the influences of the indigenous sources.

The Sectoral Dimension

It seems plausible that these indigenous influences can have varying degrees of impact on the innovation potential of the industries within a region (Malecki, 1991; Porter, 1990; Suarez-Villa, 1993; Suarez-Villa and Hasnath, 1993). The focus of this study is sharpened by analyzing the factors influencing the innovation potential of one industry - the United States machine tool industry.³

This industry is of interest "because machine tools are the foundation for almost all of manufacturing" (Ashburn, 1988, p.19). In other words, the machine tool industry is the provider of all the capital goods upon which the manufacturing sector is so dependent. This means that this one industry sets the bounds or parameters for the performance of other industries. Since capital goods embody the state of technology, the more sophisticated the products of the machine tool industry, the more sophisticated the products of other manufacturers can be.

³ By framing the discussion in terms of the innovation potential of the machine tool industry, it is not meant to imply that all of the patents produced within the region were created only by inventors within a machine tool firm. Some of the patents were granted to inventors not associated with a firm, or at least, the patent did not have a firm as the assignee. Either way, the invention adds to the innovation potential of the machine tool industry.

Machine tools is a nodal industry. It is the transmission point of new technology to the rest of manufacturing industry. An innovative and competitive machine tool industry contributes significantly to the rapid diffusion of new technology and to the realization of the competitive benefits that this makes possible for the rest of manufacturing industry (Sciberras and Payne, 1985, p.63, quoted in Ashburn, 1988, p.20).

Ultimately, then, it is innovation within the machine tool industry that allows the manufacturing sector of the economy to innovate and reap the competitive benefits, which gives the machine tool industry its importance. The need for an innovative machine tool industry, combined with the fact that innovation requires a constant source of new knowledge (i.e. invention patents), imposes on us the need to know where this new knowledge is created and the factors that make some metro-regions more conducive to inventive activity within this industry than others.

Innovation Potential and Regional Economic Development

The innovation potential of regions plays a significant role in their growth and development (Brugger and Stuckey, 1987; Griffin, 1978; Grossman and Helpman, 1994; Landau, 1988; Malecki, 1991; Ogburn, 1933; Quinn, 1986; Romer, 1986; Romer, 1994; Rosenberg, 1986; Schmookler, 1966; Schumpeter, 1950; Solow, 1957; Stewart, 1978; Suarez-Villa, 1993; Suarez-Villa and Hasnath, 1993; Westphal, 1987). It is technological change, according to Schumpeter (1950), that causes the creative destruction which drives the capitalist economy. Increasing innovation potential within a region can spawn the new industries, make existing ones more efficient, enhance the international competitiveness of the region, and attract highly skilled labor catalyzing economic development (Suarez-Villa, 1993; Suarez-Villa and Hasnath, 1993). Thus, those economies whose innovation potential lags will also lag in the rates of growth and development they experience: "the innovation gap among regions is a primary source of regional development disparities..." (Malecki, 1991, p.28). But what is meant by a *regional* economy? How is a regional economy defined in this study?

The Spatial Dimension

Although regional scientists have struggled for many years trying to find the most appropriate definition of “region”, a consensus has yet to be reached. Regions have historically had three different definitions: (1) areas that are homogeneous physically, socially, or economically, (2) nodes around a central urban economic center, and (3) areas defined by political boundaries (Meyer, 1963). Markusen (1987) defines a region as

an historically evolved, contiguous territorial society that possesses a physical environment, a socioeconomic, political, and cultural milieu, and a spatial structure distinct from other regions and from the other major territorial units, city and nation (Markusen, 1987, pp.16-17).

Gilbert (1988) provides a synopsis of the concept of region as defined by English and French-speaking regional scientists. There are three definitions. First, region is defined “as the spatial organization of the social processes associated with the mode of production” (Gilbert, 1988, p.209). Second, “the region is defined as a specific set of cultural relationships between a group and particular places” (Gilbert, 1988, p.210). Third, the region is conceptualized “as a medium for social interaction” (Gilbert, 1988, p.212). This last definition is essentially the region defined by political boundaries. Hence, it is evident that the concept of region presents a difficult definitional dilemma for regional scientists.

Being unable to agree upon a single all-encompassing definition of region, regional studies have used the full spectrum of geographic definitions of region as their unit of analysis. Such studies have used definitions of region ranging from large multi-state regions to the relatively smaller metropolitan areas. What is the appropriate spatial conceptualization for this study?

In a study similar to this one, but using states as the geographic unit of analysis, Feldman (1992) writes: “States are not an entirely satisfactory unit of observation to use in this analysis.... Ideally, we would like data at a sub-state level of aggregation” (Feldman, 1992, p.9). If the state is not an appropriate unit of analysis, it appears reasonable to argue that the larger multi-state region would also not be the most suitable. Furthermore, an even larger region - the nation - would appear to be even more inappropriate. As Porter states, “the importance of geographic concentration raises interesting questions about whether the nation is a relevant unit of analysis” (Porter, 1990,