I. Introduction

The importance of scientific and technological advance in driving long-term growth has become increasingly salient to economists and policymakers in the years since World War II (Bush, 1945; Solow, 1956; Abramovitz, 1956; Romer, 1990). While “new-to-the-world” technical innovation has been concentrated historically in a small number of countries, a striking feature of the post-war era is the emergence of a select few countries as leading innovators. For example, Germany and Japan vastly increased their innovative output per capita in the thirty years after World War II, while England experienced relative stagnation in its overall innovative capacity (Pavitt, 1980). In recent decades, a number of countries, including Sweden and Denmark, have joined group of leading innovator nations, while a set of former laggard countries, including South Korea, Singapore, and Taiwan, have met with enormous success in improving their innovative capacities.

The fact that some countries have risen to become leading innovator nations while relatively similar countries have seen their innovative productivity languish presents a puzzle for the study of national systems of innovation (Dosi, et al., 1988; Lundvall, 1992; Nelson, 1993). This paper investigates the country-level investments, institutional
configurations, and national policy decisions that shape the success of “follower” nations in catching up to the world’s leading innovator countries in terms of per capita innovative output. In so doing, it responds to Patel and Pavitt’s (1994) call for quantitative analysis clarifying the properties of national innovation systems.

This paper will also extend the scope of previous investigations of country-level innovation (e.g., Keller, 1997; Kortum, 1997; Cimoli, 1998) to consider the factors that affect inputs into the production of “new-to-the-world” innovations. For example, national innovative output per capita may rise because gross expenditures on R&D increase substantially. A portion of these spending increases may arise because of relatively exogenous national decisions (such as additional R&D tax credits) while remaining portions may increase as a result of these exogenous decisions (i.e., private R&D spending may rise in response to the taxation incentives).

The core of the analysis involves the estimation of a production function for economically significant technological innovations. Using simultaneous equation modeling, we aim to disentangle the factors that affect the level of national inputs devoted to innovation from those that affect the productivity achieved by country-level investments in innovation. We anticipate that the results will be relevant both for the academic study of technical change as well as for policymakers efforts to influence national innovative abilities.

II. Historical Background

The “economic miracles” of post-war Germany and Japan involved vast improvements in physical and human capital and culminated in the 1970s and 1980s with remarkable increases in innovative productivity. It is curious that that Germany and Japan accomplished such leaps in national innovative productivity while countries such as England and France did not. This result repeats in the latter half of the 20th century, as a set of countries join the group of elite “innovator” countries, although their economic and political circumstances at the start of the 1980s are quite similar to a number of countries whose innovative productivity does not increase.
The empirical analysis in this paper focuses on the time period, 1980-2000, for which international data enables statistical analysis on the country-level determinants of innovative output. This proves to be an empirically interesting time frame, during which a set of nations, including Scandinavian and Asian countries, among others, vastly increased their innovative productivity while other countries with similar initial conditions, including Latin American and southern European countries, did not substantially to improve their capacities for innovation. For example, in the early 1980s a sub-sample of Latin American countries achieved greater innovative output per person than a comparison group of emerging Asian economies; in sharp contrast, by the second half of the 1990, patenting in the Asian economies dwarfs the Latin American output, despite few changes in the countries’ demographic characteristics. (For examples of country-specific studies of innovative development, see Amsden, 1989; Kim, 1997; O’Sullivan, 2000; and Trajtenberg, 2001.)

III. Method & Data

We base our model of national innovative productivity on the “ideas” production function described by Romer (1990), Jones (1995), and Stern and Porter (2000) and our framework for thinking about national innovative productivity on that described by Furman, Porter, and Stern (2002). Specifically, we describe a production function for economically significant technological innovations, choosing a specification in which innovations are produced as a function of the factors underlying national innovative productivity. In turn, endogenous factors driving innovative output, such as overall R&D expenditure, are modeled as a function of factors more exogenous to the process of national innovation, such as national policies regarding international trade. (This model must be constructed with care, recognizing that while some policies are relatively exogenous to country-level innovation over the near term, national policies are broadly endogenous over the medium- to long-term.)

To perform the analysis, we assemble a novel panel dataset of industrialized countries from 1980 to 2000, using data drawn primarily from the OECD, World Bank, and Penn World Tables, as well as commonly used indicators of country-level policies. We
organize our empirical analysis around the observed number of “international patents,” the number of patents filed by foreign country inventors at the United States Patent and Trademark Office. Although no measure of innovation at the national level is ideal, the advantages and disadvantages of patents as an indicator of innovation are well understood (Pavitt, 1982, 1988; Griliches, 1984; Trajtenberg, 1990) and their limitations as a measure can be somewhat mitigated by the use of international patents (Soete and Wyatt, 1983; Evenson, 1984; Dosi, Pavitt and Soete, 1990; Eaton and Kortum, 1996).

IV. Discussion

This paper examines the country-level investments, institutional configurations, and national policy decisions that have distinguished “emerging innovator” countries, such as Korea and Ireland, from follower countries, such as Italy and Spain, whose innovative productivities increased at a substantially lower rate over the past two decades. In so doing, the paper aims to disentangle the factors that determine the level of inputs into national innovation from those that affect the productivity of that process. We will discuss the implications of our analysis for the study of national innovation systems and national technology policy.

V. References


