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Mark-ups, economies of scale and the role of knowledge spillovers in OECD industries

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Abstract

Using R&D-based models of economic growth as a foundation, this paper argues that market-driven knowledge creation is necessarily linked as an engine of productivity growth to economies of scale and market-power. A cost function and factor demand model is applied to a cross-country industry data set to study market-power, economies of scale and the role of knowledge in an integrated approach. Empirical results reveal the presence of market-power and economies of scale in all of the industries investigated. R&D and spillovers explain some of the productivity growth observed. Spillovers are identified as an external source of economies of scale.

JEL classification: C31; C33; O32; O47

Keywords: Economic growth; Technological change; Market power; Knowledge spillovers; OECD industries; Error correction models

1. Introduction

Most empirical researchers choose a Hall/Solow residual approach to study the impact of knowledge and spillovers on productivity growth (Coe and Helpman, 1995; Keller, 2002). This framework, however, relies on the assumptions of constant returns to scale and perfect competition, while increasing returns and market power are essential features of R&D-based models of economic growth (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992). As emphasized by Romer (1990), recognizing the non-rivalrous

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nature of knowledge necessarily links it with economies of scale and imperfect competition. The cost function and factor demand system employed in this study encompasses all of these interrelated features of R&D-based growth models. It thus provides a framework in which they may be studied in an integrated approach, while avoiding biases inherent in the Solow residual.

A few researchers "correct" the Solow residual to account at least for the presence of imperfect competition (Keller, 2002). Beyond concerns regarding biases of the Solow residual, however, theory suggests that it may be very revealing to study the role of knowledge and the presence of market-power and economies of scale explicitly in an integrated approach.

The factor demand system in the error correction form used in this study accounts for varying capacity utilization allowing for very general deviations from equilibrium in the short run. It thus addresses a problem that is often thought to bias measures of productivity growth (Paquet and Roubidoux, 2001) and economies of scale (Basu, 1996; Burnside, 1996; Burnside et al., 1993) which are derived from a simple Hall/Solow residual framework.

The OECD Stan data set including industry data from Canada, France, Germany, Italy, Japan and the US is employed to investigate economies of scale, market-power, the role of knowledge creation and spillovers for productivity growth, as well as links between these features.

The study is organized as follows: Section 2 describes the empirical framework, while Section 3 provides a data description. Estimation results are discussed in Section 4. The conclusions are given in Section 5.

2. Empirical framework

2.1. Modelling knowledge and spillovers as factors of production

R&D-based models of economic growth use different images to illustrate technological change, $\dot{A}$, or the evolution of the stock of knowledge, A, used in production. In Romer's (1990) and Rivera-Batiz and Romer's (1991) models, A is the number of varieties of intermediate inputs, while in Aghion and Howitt's (1998) model version A represents the average quality of intermediate inputs. What these models have in common is that the increase in knowledge is proportional to R&D spending, $\dot{A} = \phi I^R$, and the stock of knowledge A is proportional to the sum of all R&D spending in the past, $A = \phi R$. R, the economy's R&D capital stock at time t, thus becomes an additional factor of production. In each of the two model versions, intermediate goods producers incur fixed costs associated with the invention of their new or improved variety of the intermediate input, before they can start production. Once they have invented a new good, or purchased a patent from the R&D sector, they act as monopolists in this market, charging a mark-up of price over marginal costs. Market-power is necessary to cover the costs of inventing a new or improved product.

For the empirical purposes of this paper, a gross output production function is used

$$Y_i = F_i(K_i, L_i, M_i, R_1, \ldots, R_i, \ldots, R_j, t). \tag{1}$$

Industry i produces its output, Y_i, using labor, L_i, material inputs, M_i, and its physical capital stock, K_i. Technological progress due to innovations developed in industry i are