Carnegie-Rochester Conference Series on Public Policy 38 (1993) 275-278
North-Holland

Quality ladders, growth, and R&D: an assessment from U.S. industry A comment

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Enhancing our understanding of the linkages between research and development (R&D), technological change, market structure, and economic growth is crucial to gaining a clearer view of how human welfare improves and which public policies foster advances in living standards. Kerk Phillips provides a helpful glimpse into the vast literature on these topics, presents some suggestive empirical work, and outlines useful research strategies.

Theory of technological progress, growth, and market structure

An attractive feature of Kerk Phillips' paper is that it uses a model that treats technological progress as the result of calculated investments undertaken by agents responding to market incentives. This is crucial. As economists we want to use economic analysis to examine that part of technological progress that responds to basic economic incentives rather than treating technology as an exogenous process. "Endogenizing" technological progress should help us uncover the essential incentives underlying growth and may improve our policy recommendations.

The basic story from the quickly emerging endogenous technological change and quality ladders literature is that profit-seeking agents devote resources to produce a new good, a higher quality good, or a cheaper process for producing goods. A successful innovation provides the profit-seeker with a monopolistic niche in the market and therefore with monopolistic profits for some period of time. Furthermore, many models have the feature that innovation increases the total stock of society's knowledge. This increased stock of knowledge increases the ability of society to successfully innovate in the future. These spillovers from innovation may not only increase the probability of success within the innovating industry, they may increase the likelihood of successful innovation in other areas of activity.

From Phillips' model, the prediction arises that monopoly power — or more accurately the expectation of the ability to extract monopoly profits if one successfully innovates — stimulates innovation: the greater the potential monopolistic position of the firm, the greater the resources devoted to R&D. Yet, we know this is not completely true. A firm with an uncontested monopoly would probably have less incentive to devote resources to R&D than a firm facing competition. Thus, some competition — or perceived market contestability — is crucial if firms are to engage in R&D activities that generate technological progress. To extract more useful predictions regarding the relationship between market structure and technological change, therefore, future research might focus on questions such as what market structure best stimulates innovative activities and what public policies help generate such a structure. While pursuing these subtle issues in theoretical models should improve our approach to the link between competition and innovation, finding plausible empirical measures of market structures to examine the predictions of these models will be difficult and require important, innovative, and rewarding contributions.

In addition, the Phillips paper shunts aside potentially important differences between product and process development. For example, if General Motors invents a new engine, every car manufacturer can "see" it, "touch" it, examine it – basically, there will be an immediate spillover to the innovative processes of the other car manufacturers even though the new engine has a patent. However, if General Motors improves its production process, such that it can lower the price of its cars, other manufacturers will not be able to examine this innovation as quickly and precisely. The engine will have a patent, the production process will not, but the production process may be more excludable while the patented engine may yield more spillovers. Thus, in a competitive market with poorly enforced patent rights, there may be more emphasis on different types of technological innovation than in a competitive market with well-enforced property rights.

Finally, it has become common practice to view the recent endogenous technological change literature as "Schumpeterian." This is not completely accurate. In his 1911 book *The Theory of Economic Development*, Schumpeter puts great weight on financial intermediaries in the process of economic development. Specifically, if entrepreneurs are Schumpeter's engine of development because they create new and better goods, then financial intermediaries are the fuel that drive this engine because they provide the capital that allows entrepreneurs to implement their ideas. King and Levine (1993) integrate financial intermediaries into a model of endogenous technological change.

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Empirical work

As in most empirical work, the data are often not as closely associated with the ideas present within our theoretical models as we would like. The term "technological" is perhaps even more difficult to measure empirically than it is to define conceptually. Empirically, "technology" is defined as the "Solow" growth residuals. Hopefully, the residuals from our growth accounting exercises are related to our concept of technology. Similarly, in the model, R&D represents the expenditure of any effort or resource toward product or process improvement. Empirically, R&D is reported measures of R&D expenditures by firms, not by individual production units. Since firms may span more than one production process and may not accurately report all resources devoted to product and process development, these data often do not correspond to our conception of R&D. These and other measurement problems are discussed by Griliches (1991).

The most disappointing part of Phillips' paper is that it does not place its empirical contributions within the context of an admittedly unwieldy literature. Existing investigations range from detailed studies of particular innovations within firms to aggregate industry studies. The industry studies frequently focus on spillovers and involve complex methods of computing how "close" one firm is to another in testing for spillovers. These procedures involve identifying R&D expenditure by economic activity, by company, by 4-digit SIC level data, by closeness to other firms in terms of sales/demand space, through cross-referencing of patents, through geographic proximity, through proximity to universities issuing patents, etc. The evidence from an assortment of different types of studies generally supports the spillover hypothesis.

Using fairly aggregated industry data, Phillips' main finding is that lagged R&D expenditures tend to predict growth in the Solow residuals. This finding is important. Establishing an empirical link between expenditures on innovative behavior with future productivity enhancements confirms our intuition and the predictions of an assortment of models. Of course, there are numerous caveats. These regressions do not control for any other factors that may explain technological progress, and Phillips lists many other problems with interpreting this result too strongly. One of the best parts of the paper is where Phillips outlines future research ideas. Unlike most papers, however, many of the research endeavors suggested by Phillips can be done, and I look forward to learning the results.

References

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Carnegie-Rochester Conference
North-Holland

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