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by Ishaq M. Nadiri

upon
Sectoral and Macroeconomic Impacts of Research and Development on Employment
by Jürgen Blaizeczak, Georg Erber and Gustav A. Horn

Introduction

The chapter by Blaizeczak, Erber and Horn addresses an important subject reaches some interesting results. The determinants of R&D investment and its e on the structure of production at different levels of aggregation in various econo have been a fertile but relatively new area of economic research. The literature presented a considerable amount of evidence suggesting that R&D investment sig cantly affects the demand for output and factors of production such as employees ment in plant and equipment, and energy. There is also supporting evidence R&D investment has positive and important effects on the export competitivene industries.

In discussing the results reported by the authors, I confine my remarks to two of comments. First, I outline the major findings presented in their chapter. I then sent some corroborating and contrasting evidence from other studies in the field make suggestions as to how the authors could strengthen their investigation. Sir have not had access to the technical description of their study, I can only guess a type of relationships incorporated in their model. As I shall argue below, the rea for and consequences of R&D investment can differ substantially, depending on structure of the underlying model.
The basic findings

The authors focus on the employment effects of R&D expenditure in a number of West German industries. Their basic question is whether growth of demand in sectoral, economy wide and export industries can serve to compensate for the decline in employment due to productivity growth induced by an increase in R&D investment. The sectors chosen are chemicals, automotive manufacturing, electronics, and food and beverages - which account for 75 per cent of West Germany's private R&D investment. The authors gather time-series data on the stock of R&D in their industries and suggest that by using an interindustry-sales matrix of investment in plant and equipment, one can distinguish an industry's 'own' R&D knowledge and that which it has purchased.

They simulate a factor-demand model and assume that R&D spending increases by 10 per cent for five years. Their production model is linked to a model of wage formation and demand for final output. The results reported are that R&D investment increased labour productivity significantly, particularly in electronics, machine-building, textiles and steel, a change that led to significant reductions in employment ranging from 3.5 to 8.2 per cent. These reductions can be offset by the demand-induced effect of R&D investment. That is, an increase in R&D investment may increase demand for capital goods and may thereby offset the employment-reducing effect of increased R&D investment. Increased R&D investment also enhances the export competitiveness of West German export industries. According to the authors, the simulation results suggest that (1) West German trade volume increased by about DM 15.4 billion (exports by DM 12 billion and induced imports by over DM 3.4 billion) and (2) net West German export significantly increased in real terms in vehicle-equipment, chemicals and electrical sectors, but only marginally in machine-building. On the whole, increased demand induced by higher R&D expenditure is not great enough to compensate for its employment-reducing effect due to productivity growth. For the four export industries studied, the level of employment declined by 11,000 people in the simulated period. The adverse employment effect is particularly severe in the machine-building and electrical equipment industries.

Productivity growth due to R&D investment will lead to increases in wages and profits that may, in turn, increase demand for investment and consumption. To take account of the macro-effects of wage and profit increases, Blazejczak, Erber and Horn use a macroeconometric model of the West German economy. They focus on three sets of issues: productivity acceleration due to technical change, improved competitiveness due to higher export and lower import elasticities induced by technical change, and additional investment due to increased demand. The authors' conclusion is that only fairly favourable overall economic growth may compensate for the employment decline due to R&D investment and that decline in R&D investment can induce a fairly significant retardation in economic growth. The authors correctly emphasize that the adverse effect on employment should not be the litmus test for R&D expenditures; rather, investment in R&D is essential for generating technological opportunities that ensure economic growth and productivity increase and for increasing the export petiteness of West German industries.

Evidence from other studies and some modelling issues

A number of studies, such as Evans (1976), have confirmed that R&D investment growth in output and productivity. The magnitude of this contribution varies one industry and economy to the next. Evans's study, which is similar to that by B. jczak, Erber and Horn, presents some striking simulation results. Holding total government expenditures constant, Evans increased NASA's 1975 R&D investment $1 billion. The result was a 2 per cent increase in the GNP (approximately $23 bil in 1984. The rate of increase in consumer prices was a full 2 per cent lower than baseline projection, unemployment decreased by 0.4 per cent, and the increase productivity in the private non-farm sector was 2 per cent higher than that of the baseline projection. There was also a significant shift in industrial output and employment because of the change in composition of government expenditures in favour of R&D investment. What is important is that the economy would have gained about 1 per cent total employment over time. The reason for the contrast between the results reported by Evans (1976) and those reported by Blazejczak et al. in this volume may be that the full intersectoral effects of an increase in R&D investment might not have been taken into account in the Blazejczak model or that the underlying sectoral and employment elasticity in the West German and U.S. economies are quite different.

On the sectoral level, some U.S. studies conducted in the United States indicated that R&D contributes substantially to growth in output (see Nadiri, 1980, for references). The output elasticity of the stock of R&D is often over 10 per cent for manufacturing and total durables and about 20 per cent for total non-durables. Studies comparing the production structure of the manufacturing sector in Japan, the Federal Republic of Germany and the United States, Mohnen, Nadiri and Pr (1986) report short-term output elasticities of about 30 per cent for each country. Studies can be cited as well, but the important point is that these results, while firming the general findings presented by Blazejczak, Erber and Horn, suggest their measurement of the productivity effect of R&D investment is probably an underestimate. As noted earlier, they may also have underestimated the expansionary effect that R&D investment has on aggregate output and employment. There may be much of an adverse effect on employment.

R&D investment in the authors' model is taken to be exogenous. But if I spending is an investment in the capacity of an industry to increase the quality or quantity of its output or improve its production process, then that investment ought to be incorporated explicitly as a factor of production in the model of production that Pr and I propose. In such a situation it is not only that the stock of R&D affects derived demand for other inputs as well as output demand; that stock itself affects the factors in turn, by changes in the process of other inputs and by the growth of demand (N
the doubtfully negative effect on employment, it certainly pays for the Federal Republic of Germany or other countries with advanced economies to invest much larger shares of their GDP in various types of R&D as soon as possible. Again, the answer depends on the way R&D investment is modelled. If the stock of R&D, like that of the physical plant and equipment, is regarded as a quasi-fixed input with adjustment costs, then it can be shown that it is the presence of high adjustment costs that requires the rate of return on R&D investment to be very high in the short run. And bearing in mind the substantial risks of failure associated with R&D projects and the difficulties in appropriating the benefits of successful R&D projects, one might understand why R&D investment is not as high as conventional static models seem to suggest.

In conclusion, Blazejczak, Erber and Horn address a very important set of issues and report interesting results. Their results are in general similar to those for the United States. The specific estimates on how R&D investment affects productivity growth, employment, and the structure of production will depend on how the R&D investment process is modelled. Further work is needed to distinguish R&D investment from other types of investment before it is possible to advocate any policy measures.

References


5.3 Impact of selected technologies on employment and its occupational composition: an input-output-approach

DIETMAR EDLER

The impact of new technologies on economic development especially on employment has a long research tradition in economic thought despite the fact that it did not play a prominent role when neoclassical theory predominated (see Hagemann and Kalmback 1983). With the onset of persistent high unemployment and a wide range of emerging new technologies, however, it once again became the centre of theoretical and political interest. Therefore, the German Federal Ministry of Research and Technology (BMFT) funded a broad study of the impact of new technologies on employment. The nine participating research institutions were expected to collaborate closely so that their research teams could profit from each other’s results. An important research goal for the German Institute for Economic Research (DIW) was to further develop its different economic models in a direction that would allow it to incorporate the results of the other research teams, which are more microeconomically oriented for the most part. This approach should eventually result in the first steps towards a methodological ‘micro-to-macro’ bridge, which, if ever completely feasible, would mean significant progress for this type of empirical research.

This chapter discusses how the input-output approach is employed to analyze the impact of selected new technologies on employment and its occupational composition. The input-output technique was used to investigate welding robots and CNC machine tools as part of new computer-based production and automation processes. In addition to the more traditional static input-output model, a newly implemented dynamic input-output model for the Federal Republic of Germany was developed. This chapter aims to show how that model may be used for this type of investigation and to demonstrate the results it may yield. The results should be interpreted as the outcome of empirical