Short Communications

ECONOMIES OF SCALE IN SCIENCE & TECHNOLOGY AGENCIES

A. POURIS

FRD, P.O.Box 2600, Pretoria (South Africa)

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This study is the first to provide estimates of the economies of scale in science and technology agencies. As such, it sheds new light on issues of interest to policy-makers. The study identifies that there are strong economies of scale to be captured in organisations with budgets less than $200 million. The least efficient agency in the study requires 136 times more input per unit of output than the most efficient one. The study was unable to identify diseconomies of scale up to the range of $3 billion. The policy implications for countries which are small in science in particular, are discussed.

Introduction

The unit cost of science agency activities is of importance to policy makers internationally. Most policy analysts believe that efficiency is, and ought to be, an important element of policy change.¹-³ Political ideology aside, governments accept that enhanced efficiency is almost always going to be a useful instrument for achieving their objectives.

Shrinking science budgets, public concern about overheads and efforts to reduce the extent of government involvement in economies all add to the importance of identifying whether there is an optimal size for organisations charged with the responsibility of promoting research through their funding activities. The issue is of particular importance in countries small in science, countries where not only funding, but also managerial and scientific skills are limited or are in short supply.

The estimation of unit cost as a function of the size of operations is usually examined under the term economies of scale. A production process is said to exhibit economies of scale over a particular range of output in the long run, when average production costs over this range fall while output rises. Spencer⁴ defined economies of scale as the curvilinear relationship between average cost and the number of units produced.
Economies of scale have been examined in the context of various industries, primary education, technical education and so on, but not in the context of science agencies.

Science agencies use two main approaches to distribute funds allocated towards supporting research:

1. By awarding grants of for research to be carried out at universities, technikons and other institutions.
2. By maintaining their own research establishments.

This investigation concentrates on economies of scale in the former institutions (i.e. institutions awarding grants). These institutions can be considered as one homogeneous industry on the basis of their similar *modus operandi*, (i.e. peer review, evaluation committees, awards of grants), in contrast with organisations operating through intramural research whose *modus operandi* may vary depending on the supported disciplines, sectors, etc.

The questions we set about answering are whether there are economies of scale; what the minimum optimal size of such organisations is and whether there are diseconomies of scale beyond a certain size. The resulting answers could have implications for the amalgamation of subcritical science agencies, or the breaking up of super-large ones – questions that are currently tackled at the political corporate level only.

**Method and data**

Economic theory suggests that economies of scale are associated on the one hand with a reduction in the physical quantity of raw materials for input, various types of labour and management, as well as various types of capital and on the other hand, with pecuniary economies which are achieved by paying lower prices for the factors of production and distribution of the product, for example, bulk buying by the firm as its size increases. While all kinds of economies of scale may be present in science and technology agencies we are concentrating on the labour and managerial economies of scale. Labour and managerial economies are achieved as the scale of output increases because of specialisation and division of labour and automation of the production process which becomes appropriate above a certain volume of output.

Labour and managerial-related expenditures constitute the major component of the total cost in agency activities. On average, they constitute 60% of the total costs (defined as the amount spent internally in the organisation), e.g. at the Medical...