Ceylon Journal of Science 45(1) 2016: 1-2
DOI: http://dx.doi.org/10.4038/cjs.v45i1.7368

EDITORIAL

Basic and applied scientific research, innovation and economic development

Basic scientific research can be defined as fundamental, investigative research, theoretical or experimental, to advance knowledge without a specifically envisaged practical applications. It is the quest for new knowledge and the exploration of the unknown. Basic research is driven purely by curiosity and a desire to expand our knowledge. On the contrary, applied research is used to answer specific questions that have direct applications to the society. Basic and applied research is a continuum and they are inter-dependent. The demarcation between basic research and applied research is not at all clear cut. Most scientific research, whether in the academic world or in industry, is a hybrid leading to new knowledge generation and subsequent exploitation. The integration of basic and applied research is crucial to problem-solving, innovation and development of products and processes.

Major innovations are rarely possible without prior generation of new knowledge founded on basic research. Strong scientific disciplines and strong collaboration between them are necessary both for the generation of new knowledge and its applications. New scientific knowledge is essential not only for fostering innovation and promoting economic development, but also for formulating good national development policies and policies for education and training. Even a successful transfer of scientific knowledge cannot be achieved without having well-trained scientists. However, excessive dependency on scientific progress in other countries is rarely likely to lead to the resolution of local problems. Countries need to be able to generate their own scientific knowledge through research and adapt this to their own local needs.

As the move towards a global knowledge economy accelerates, the necessity of having a thriving scientific community to generate new knowledge and to exploit it, both in the academic world and industry, becomes irrefutable. Adequate public investment in science education and research is a critical factor under-pinning socio-economic development in any country. Therefore, every country needs to develop long term and sustainable strategies for investment in scientific research.

Research scientists and funding agencies are often pressed by governments to quantify the economic value of scientific research. Any attempt to quantify basic scientific research in terms of expected short term economic benefits is extremely short-sighted and will have an adverse effect on true innovation. However, a majority of economists agree that scientific research plays a substantial role in fostering innovation leading to new technologies, products, processes and services. The problem is that innovation is not a simple, linear system in which one finds that research leads direct to advanced technology, and technology leads to innovation. Innovation is a complex, highly nonlinear ecosystem, full of interdependencies and feedback loops that aren't even completely mapped yet, never mind ripe for quantification.

While it may be difficult to assign a universal "return on investment" for broad scientific research, it has been shown that in many countries, there is a direct correlation between scientific research, research publications and economic development. Specifically, investment in scientific research is the starting point for long term and sustainable economic development. After studying several different growth models by economists, a single conclusion has emerged: research publications

have positive and significant effects on economic growth. Some examples are the newly industrialized countries like South Korea, Taiwan and Singapore.

It is worth mentioning just two of the modern technologies which had a dramatic impact on today's economy. These are the information technology (IT) and the bio technology (BT) which are built on scientific advancements through research. Microprocessors have emerged from basic materials research to provide smaller and faster components for computers, cell phones, and numerous other electronics devices contributing to the IT revolution. The basic scientific discovery in 1953 of the double helix structure of DNA by James Watson and Francis Crick marked a milestone in the history of science and gave rise to modern molecular biology. Their discovery yielded ground-breaking insights into the genetic code and protein synthesis which later helped to produce new and powerful scientific techniques, specifically recombinant DNA research, genetic engineering, rapid gene sequencing, and monoclonal antibodies, techniques on which today's multi-billion dollar biotechnology industry is founded.

Today the relationship between research and innovation is far more complex. Science based technologies such as microelectronics and biotechnology could not have developed without scientific understanding gained from basic scientific research.

Investment in science, technology and innovation (STI) is essential for economic development and social progress. One should also keep in mind that funding R&D activity is only a part of what the government can do to foster innovation. Ensuring a sufficient supply of individuals with science and engineering skills is equally important for promoting innovation. The relation between publicly funded R&D and science education is a key issue in this context. Many studies of the economic benefits of publicly funded research identify trained and skilled graduates and postgraduates as the primary benefit. Moreover, results from analyses indicate that employees in the private sector with a higher level of education contribute twice as much to the economy than with a lower level of education.

A publishing record of a research scientist is an entry ticket to the academic and research network making these academics useful as guides to form a broader research base. The main contribution of universities in this process is to educate scientifically trained people. Their training enables them to have enough understanding to make sound decisions about where to seek solutions to problems arising in the development process. In addition to the training of younger generation of researchers, senior academic researchers can also serve as consultants and discussion partners to an industry in its search for knowledge. This uses the researchers' overall expertise and network of contacts making an overall contribution to the industry without limiting to their specific research findings.

As evident from developed countries in the west and newly industrialized countries in Asia, the productivity in scientific research correlates with economic growth, but does not directly cause it. Investing in scientific research leading to technology and innovation appears to be the best way a middle-income country can foment fast economic growth, although it is difficult to find a direct cause and effect relationship between scientific research and economic development. Also, the technology without science is unlikely to be sustainable.

M.A.K. Lakshman Dissanayake