Science, Technology and Economy – Overview of the Sessions

By

N S Siddharthan

Forum for Global Knowledge Sharing and Madras School of Economics

nssiddharthan@gmail.com

I Introduction

Our earlier conference themes were focussed on specific issues. The theme for this year is broad and wide ranging. Consequently the papers have been somewhat heterogeneous covering several issues related to the general theme. During our last general body and governing council meetings it was felt that having conducted three conferences on specific themes, the forum should discuss the interface between science, technology and economy. Such a discussion would be appropriate as this is one of the few forums that deal with the interface between disciplines. In retrospect this has been a good decision as this conference has attracted more participation by technologists. The papers have been classified into four sub-themes and in addition we also have two panel discussions – one, on the general theme of the conference and the other, concentrating on employment. Some of the panellists have also submitted papers.

II Multinational Enterprises

There are three papers under this theme covering three important aspects. The first paper by V.N.Balasubramanyam and Nocolas Forsans analyses the emerging trend of Indian investments abroad in the overall context of science, technology and economy. India, despite being a low-income country, ranks alongside the world's leading multinationals in skill and technology

intensive industries like pharmaceuticals, software, transport equipment and machinery. Unlike other developing countries the bulk of Indian investments abroad are in manufacturing and services. Furthermore, most of them are to developed countries and in high-tech and skill intensive industries. The paper examines this apparent paradox and comes out with interesting explanations. The paper argues that the main ownership advantage of the Indian multinational enterprises (MNEs) has been skill and technology specific employees of the enterprises. They attribute the availability of skilled personnel to historical factors including the establishment of the technology institutes and Indian Institute of Science during the Nehruvian era soon after independence. Furthermore, output per unit of wages increased enormously in India compared to other countries. The growth of productive efficiency coupled with managerial skills is mainly attributed by them to the growth of outward foreign direct investment by Indian MNEs.

When foreign enterprises spend on technological activity in the host country they result in technology spillovers and the domestic enterprises benefit from them. Most empirical research concentrates on the impact of MNE technological activities. However, the paper by Filip De Beule and Ilke Van Beveren, perhaps for the first time discusses the impact of the host countries technological environment and R&D activities of the local enterprises on the foreign enterprises technological status and activity. Foreign subsidiaries also network with the host country technology and R&D institutions. In addition, some of them also network with the R&D units of local firms. The study found that MNE subsidiaries that networked with local institutions in fact increased their own R&D budget. Hence they conclude that subsidiaries that are better embedded in the host country environment demonstrate higher research intensity. However, to achieve full benefits the subsidiaries should enjoy higher levels of autonomy. The results have implications for host government policy and for the MNEs themselves. The host government should

encourage local technology institutions as they attract FDI in R&D which in-turn enriches the host country technological environment. To participate effectively the MNEs should also grant higher levels of autonomy to their subsidiaries.

Local innovation systems as seen from research institutes and other R&D units also play a significant part in facilitating spillovers and exports. The study by Chiara Franco and Subash Sasidharan shows that Indian firms that were well connected with the local technology institutions and R&D establishments (those firms that paid royalty and technical fees to these institutions) were the main beneficiaries of the export spillovers from MNEs. They argue that the linkages with the innovation systems provide the necessary skills to enter the export market. In addition R&D intensity of the Indian firms also promoted exports. Furthermore, heterogeneity of the MNEs also influenced the export spillovers.

III Information and Communications Technology

This session also has three papers dealing with three different aspect of IT. The emergence of India as a global software power is now recognised. However, what is not sufficiently recognised is the crucial role played by the government and in particular the role played by the Software Technology Parks (STP). The paper by Aradhna Aggarwal fills this gap. She shows that STP is a unique system, which integrates the characteristics of other two important institutions created by the government, namely, Special Economic Zones and Export Oriented Unit schemes. This is the main reason for most of the software units opting for STP and not for the other two schemes. Therefore, she argues that STPs should be strengthened and not disbanded. Furthermore, using the concepts of revealed comparative advantages and incremental comparative advantages, she

shows that India's main competitors have started bridging the gap and India could lose its advantage soon. Under these conditions India cannot take its international position for granted and in her view, the main way of maintaining the preeminent position is through strengthening the STPs scheme. The paper is of methodological interest (estimating the revealed comparative costs and incremental costs) and has policy implications.

It is, by and large, agreed that unless IT firms undertake research and development they will not be able to climb the value addition ladder and improve their future prospects. Nollen's paper deals with the determinants of R&D of the Indian and Chinese IT firms. His sample shows that the majority of Indian and Chinese firms undertake R&D. However, the Chinese firms patent more than the Indian firms. But the Chinese patent mostly in China, while the Indian patent abroad. His results showed that the decision to invest in R&D depended mainly on the entrepreneurial orientation. Furthermore, units that had a higher proportion of professional workers tended to have R&D units. With regard to the introduction of new products and services that are introduced by the units also entrepreneurial orientation emerged as the main determinant. In addition foreign alliances also contributed to the introduction of new products. However, the presence of the units in IT clusters did not contribute to the decision to have an R&D unit and in the introduction of new products.

The impact of IT is not confined to the IT sector and its exports. Its impact cuts across sectors and influences all sectors and all sections of population. The IT sector is unique as it has greatest forward and backward linkages. In this context the paper by Narayanan examines the impact of IT education on the poor and deprived sections. It enhances the poor people's opportunities and is a major source of their empowerment. The study analyses the socioeconomic impact of subsidised IT education programme among the socially and economically

underprivileged. Narayanan found the programme enhanced the poor people's opportunities by improving their market access.

IV Economics

The first two papers that are included in this session deal with technological change. The paper by Lal and Paul deals with the role of entrepreneurs in initiating technological change. In this context it is important to note that the entrepreneur did not create new technology or invent new goods but took the risk of commercialising a technology or introducing a new good that had been designed by technologists. Thus the entrepreneur plays a crucial role, namely, introduction of new goods and technologies. However, as argued by Lal and Paul, technological change introduced by ICT is different from changes introduced by earlier technologies. Adoption of ICT requires in-depth knowledge of the tools and hence entrepreneurship alone might not be sufficient for its successful adoption. The study shows that the profiles of the chief executives of Malaysian firms that have adopted ICT are different from other firms that have not adopted. Furthermore, profiles of workforce between the two groups of firms are also different. ICT using firms had more workers who had undergone formal training and not merely training on the job. The paper shows that heavy investment in human resources would facilitate the use of IT in units.

Saon Ray argues that policies to promote innovations should focus on the whole economy rather than specific to low-tech and high-tech industries as there are several interconnection and relationships between the sectors. This is despite the evidence that the determinants of technological change and productivity of the low-tech and high-tech sectors are

different. This does not mean that she is against specific policies targeted toward low and high tech industries. But they should recognise the importance of interdependence of the various sectors. Furthermore, the index of market power also plays an important role in innovative activities especially in the medium tech industries. Even in low-tech industries, in-house R&D plays a notable role in absorbing technologies and improving productivities. Thus mere import of technologies unaccompanied by in-house R&D efforts might not succeed.

The third paper in this session by Krishna and Paul examines knowledge production as seen from publications in six leading Indian economic journals. Though there are a large number of economists in India, all are not equal in producing knowledge. There is a core group of authors who are visible and the collaboration seekers also prefer to network with the core group of authors. They suspect that citation probabilities are higher if author's network with the core group and that partly explains the high demand for working with the core group. In my view one of the solutions to this problem could be the introduction of double blinded refereeing. Most Indian journals have only single blinded refereeing.

V Science and Technology

There are four papers included in this session and they cover four different topics. The first paper deals with the role of science and technology in promoting economic growth. In recent times emerging economies like Brazil, South Africa, China and India have been attracting considerable attention from scholars and policy makers. These countries have been growing fast for more than a decade and together with Russia they are likely to emerge the main growth centres of the world. It is important to investigate the role science and technology played in their impressive

growth. The paper by Kathuria and Mukundan analyses this important link. They use data on economic growth, publications in scientific forum, and patents for the period 1976 – 2007 to examine the relationship between growth of the economy and science and technology development. They found the drivers of growth for the four countries are different. In particular, they found the performance of Brazil and South Africa different from that of India and China. They argue that the Latin American countries focussed only on R&D investment and emphasised less on innovations. The Asian countries emphasised both. They showed that for China and India the interactive model between growth, science and technology that worked. Mere expenditure on R&D is not sufficient for sustained growth.

Developing countries need to produce lot more technologists in order to promote technology and skill intensive industries. To do so it is vital to start more institutions of technology. However, most developing countries lack qualified technologist to teach and impart training to students. The lack of sufficient qualified teachers is a major constraint in starting new colleges. The way out of the problem could be in using the tools of distant education. In this context, IIT Bombay has been transmitting live through EDUSAT and webcast about 1000 hours of its own class room teaching free of cost. Transmitting class room teaching live was pioneered by MIT in the US and to the best of my knowledge IIT Bombay is the first in India to do so at a massive scale. The paper by Kannan Moudgalya discusses in detail the technological and organisational aspects of the programme and its impact on engineering students all over India. IIT B programme made available recorded lectures also so that student who missed the class could also benefit. Furthermore, weak students could play it several times to understand better. Thus the programme in addition to benefiting all the engineering students in India also benefited the IIT B students. The model also uses interactive sessions and students asking questions from

remote centres. For the model to succeed, in addition to technology, there should also be coordination among staff, huge amount of back room work involving an army of teaching assistants and computer assistants.

Currently the world is facing the twin problems of energy shortage and environmental degradation. With regard to electric energy, heating, refrigeration and air-conditioning requirements account for about 40-70 per cent of electric power demand. And this demand is likely to increase in the coming years. Given this scenario, we need to introduce technological change to meet the demand and also avoid environmental degradation and high socio-economic costs. The paper by Milind V Rane argues that by co-generating electricity, cold and hot utilities will reduce energy consumption and associated costs. The paper presents some opportunities for co-and tri- generating various cold and hot utilities developed by IIT Bombay. It also discusses techno-economic benefits and commercial applications. Furthermore, the paper discusses the energy and ecological benefits of the product.

The last paper of the session deals with an important but a controversial issue, namely, intellectual property rights of publically funded research and inventions. In particular, it deals with patenting and sharing of royalties. The paper by Jayaraman mainly evaluates the proposed "The Protection and Utilization of Publicly Funded Intellectual Property Bill, 2008". With regard to university-industry linkages, it mentions the dissimilarities between the US institutions and Indian institutions. He is particularly against the proposed clause in the bill, which states that failure to patent would attract penalties. In the authors view the institutional mechanism proposed in the bill will further bureaucratise research and delay publications. The paper also discusses the desirability of strengthening intellectual property regimes.

Thus, the last session covers four important aspects of science and technology development, namely, its impact on economic growth, strategies to overcome constraints in terms of shortage of qualified technologists to train engineers, innovations to tackle the twin problem of energy shortage and ecological and environmental degradation, and the policy issues relating to intellectual property rights.