GLOBALIZATION OF TECHNOCAL INNOVATION: CHALLENGES AND OPPORTUNITIES*

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Globalisation of science and technology may be reexamined on the basis of several criteria, each being unique and with varied implications. It is a law of nature and is a consequence of the natural course of history. Although the term ‘globalisation’ was coined in 1980, the concept itself is a very old one. Historically, the spirit of globalisation among mankind arose from the personal interest of human beings. And that may have happened first due to exposure, and subsequently by experience through life. Under the circumstances, the genesis of innovation was confined within an individual, community or within a narrow spectrum of population. Critics may argue this is an over-stretched definition of globalisation, and is better suited to describe the idea of exploration.

No doubt, exploration is at the very root of globalisation. Survival, to have a better life, and experiencing new horizon were the major driving forces for exploration. Migration of resources, ideas, and culture has been taking place since time immemorial. History teaches us that the pre-Harappan civilisation at Mehargarh was connected through trade routes with the sea-coast site of Balakot (near Karachi) in the south, and with the site of Mundigak (Afghanistan) in the north-west, providing access to Iran as well as Central Asia⁴. More recently (time-scale being relative!), the Venetian Republic was an early force of globalisation in the 11th century. The age of the Portuguese, Spanish and Dutch voyages of discovery helped immensely towards global integration through rapid advances in maritime technology⁵. Till 1200 AD, the East and the West were more or less at par in technological terms¹. As a matter of fact, the West was inferior, learning science as a compendium of earlier Indian and Greek accumulation of knowledge with some additions made by the Arabs. The Mongol invasion of the 13th century helped in the transmission of Chinese knowledge of science and technology in the form of gun powder, firearm, silk, paper, printing etc. to the West. The discovery of electricity, the expansion of the railway system and operation of new industries in the period from mid-19th century to 1914 led to an enormous increase in trade and financial integration.

However, it is important to remember that this great wave of economic integration was interrupted in the first half of the 20th century by a phase of aggressive nationalism and protectionism in the aftermath of World War I, leading to the Great Depression of the 1930s and the catastrophe of another World War². Time and space was a great factor in harvesting the migration of knowledge and exposure, and relevant to serving human interest during those periods. Even if there are some similarities in terms of trade and capital movements, major technological innovations that have led to a globalised world economy today are entirely different from the international economy of the last century.

Technologies play a fundamental role in making globalisation possible. The innovation of aeroplanes, telephones, computers, mobiles, satellites, internet, worldwide web and other superior technologies made the transfer and diffusion of technology possible, ideas and knowledge proliferated at an unprecedented rate and intensity making the world smaller and flatter, and creating a buzz around the word ‘globalisation’. The concept of...
globalisation has been shaped by technological invention and innovation. With the rapid advancement of technology the concept of ‘space and time’ continues shrinking. However, technology directed to solve a specific problem has not always transferred smoothly from one country to another, or from one culture to another—even though transmission of technical knowledge among people has historically received less resistance than that occurred in cases of cultural, religious, social and political habits. The transfer of technological innovations from one community to another, one society to another, one nation to another is possible only when their adaptive forces are very receptive, and comprises a common interest in social, economic, humane and geo-political terms. Some believed unprecedented improvement of new technologies in recent years would allow the emergence of a ‘globalised village’. Ideally globalised villages should be open, integrated and borderless space where ‘villagers’ can share equal opportunities, equal distribution of economy and benefits, and exchange ideas and thoughts freely. However, in reality that will never happen because inequality is another law of nature. In this paper we discuss the opportunities of globalisation in terms of technological innovation as well as the challenges associated with this.

The definition of ‘globalisation’ is varied and its meaning is growing with time. If we run a Google search with the word ‘globalisation’, the number of hits is more than 44 million (about a two-fold increase from 2006 as reported by Roy). According to Horst Kohler, Managing Director of the IMF, from the point of view of an economist, “globalisation means a process of increasing international division of labour and the accompanying integration of national economies through trade in goods and services, cross border corporate investments and financial flows”. In our present understanding and in the current context of this conference, we are inclined to use a wider definition as has given by Giddens: “the intensification of world-wide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa”. The phrase ‘social relations’ used in the definition includes all kinds of forces like economics and culture to influence the relationship. The term globalisation produces a varying reaction and interpretation amongst people—some see globalisation as a driving force in advancing the world economy while some see it as a threat to the world economic, social and cultural systems.

There is no doubt that economics is the major driving force of globalisation. To many, the concept of globalisation has been introduced as a new concept by developed nations as a means of securing economic benefits through investments and capturing the international markets where labour and resources are cheap. This face of capitalism is not new, but has existed historically in the muted form of money-lending and small trade. Globalisation of technological innovation plays a dominant role in the economic, political, environmental, technological, medical, social, cultural and security-related aspects between different countries.

There is much more to innovation than invention. Invention is the creation of a new idea and its application to practice is technology. Technology is a replicable artefact with practical application produced using the knowledge available. Technology is manifested in new products, processes and systems including the knowledge and capabilities needed to deliver functionality that is reproducible. But innovation requires all the activities required in the commercialisation of new technologies. Essentially, innovation is the successful commercial exploitation of the scientific, technological, organisational, financial, and business activities leading to the commercial introduction of a new (or improved) product or service.

One of the major significant impacts of globalisation is the agreement of ideologies globally with a convergent agreement on open market economy and free trading system. The process started with China’s 1978 reforms in political and economic policies, followed by a series of revolutions in Eastern and Central Europe, and ending with the dissolution of the Soviet Union in 1991. Gradually the division between market economies in the West and socialist economies in the East is disappearing. In a sense, globalisation is spreading a homogeneous culture through media, dress and language (English being the lingua franca of international business) for global communication. Some see these developments as a new form of colonialism, others see it as capitalism in the age of improved technology.

Any society based on knowledge has been found to progress with the process of exchange of people, goods, capital, and more importantly, ideas and knowledge. Globalisation of technological innovation falls under three main categories: 1) international exploitation of technology produced on a national basis, 2) the global generation of innovations, and 3) global technological collaborations.

The first category, international exploitation, includes an innovator’s attempts to gain economic advantage by exploiting their technological assets in foreign markets. Enterprises which were mainly focused on local markets have extended their range in terms of markets and
production facilities to a national, multinational, international or even global reach. Multinational corporations maintain their national identity, even when their technologies are sold in more than one country. They exploit their technological assets in overseas markets by selling their innovative products, selling their technological knowledge (through licenses and patents), and establishing local production facilities (through foreign direct investment). In this case, both the exporting and the receiving country have an interest in the exchange of products and work on the basis of comparative advantage within similar technological intensity. More than a third of global international trade occurs through these multinational enterprises. With this change in the structure of the world economy, international conflicts are no longer limited to territorial wars between nations, but have also shifted to battles between these enterprises connecting profits.

The second category, global generation of innovation, refers to the production of technologies by single proprietors (largely multinational corporations) on a global scale. Multinational corporations use international but intra-firm networks of R&D laboratories and technical centres as one of three main approaches. In the centre-for-global approach, the core strategic resources—top management, planning, and technological expertise—are located at a company’s headquarters. In the local-for-local approach, the firm’s subsidiaries develop their own technological knowledge and know-how to serve local demand and preferences. The interactions among subsidiaries are limited in terms of the development of technological innovations. In the local-for-global approach, multinational corporations conduct their R&D activities in multiple locations.

The third category, global technological collaborations, has grown in importance in recent years. Technological collaborations occur when two companies establish joint ventures or formally agree to develop technical knowledge and products, while maintaining their respective ownership. Main actors of technological collaborations may be universities and public research centres, or national and multinational firms. Universities and research institutes share knowledge through joint scientific projects, through exchanges of scientific scholars and international flow of students. By contrast, national and multinational firms work through joint ventures for specific innovative projects and through productive agreements for exchange of technical information or equipment. In fact, a substantial portion of technical collaboration relates to sharing of know-how and/or generation of new products and processes.

India entered the yellow brick road of globalisation only after the liberalisation of India’s science policy which is a relatively recent phenomenon. After independence, Jawaharlal Nehru was focused on building science and technology institutions to create a scientific spirit within the country which would ultimately, not immediately, help overall development. Indira Gandhi believed that self-reliance in technology would help India take an independent position in the world. It was during her time that an attempt to link S&T with economic planning was made for the first time, but never repeated. Her tight control over the import of equipment and foreign technology impeded the development of science and technology. In India liberalisation started in the eighties, although its actual implementation occurred in the nineties with the reorientation of its trade policies being necessitated by decelerating exports, worsening balance of payments and stagnating industrial growth, all of which paved her path for globalisation.

The first criterion needed for the transfer of innovative technology from one place to another is mutual interest, be it economic or political, with varying degree of usefulness. There is no denying the fact that the major driving force in today’s technology transfer between countries is the market economy. The next important thing to make this transfer possible is the preparedness of the two in terms of technical capability, culture, human resources, language and political acceptance. For example, among many countries with similar technological capabilities, India is often acceptable to many foreign investments due to its skill in the English language. However, in an increasingly globalised and knowledge-based world economy, markets are becoming more and more competitive. In order to maintain sustainable relationship, it is important to have a good technology policy so as to be capable of regular technology upgrades. The total R&D investment in developing countries is about one-sixth of that spent by developed nations. This mismatch of spending in R&D affects the rate of periodic technology upgrade required for sustainable technological relationship.

Countries which are advanced in scientific culture prove to be more capable of doing frontline activities in research, development and application of technology. To retain their advancement, they obviously require human resources as well as material resources. This leads to a paradox. Exponential expansion of growth and diversified activities of scientific and technological feats demand adequate manpower to handle intricate activities in science and technology and routine activities as well. Incidentally, capable human resources are available cheap from developing and underdeveloped countries and are available to advanced countries at low cost. Here the driving force
is the interest in human resources. Low salaried labours are being imported from less prosperous countries to the advanced countries. In such transactions how parity can be maintained is a big question.

Technological innovation when dispersed in other countries generally produces beneficial effects through competition, and opens up possibilities to explore the potential for global cooperation which may even help combat environmental and other threats. However, cutthroat struggles may ensue as soon as two countries begin producing similar products with competitive prices, particularly if these products are in the areas of strategic importance like nuclear reactors, semiconductors, etc. leading to international rivalry. Can the knowledge of research and development in science and technology and other innovative factors be distributed freely over nations at large disregarding the geo-political barrier?

Innovative firms sometimes accrue benefit by selling off intellectual property to a foreign firm by way of licensing, particularly when the originating firm faces obstacles for international trade in the form of high transportation cost, high wage rate for workers, etc.

Usually the transfer of technological innovation from one country to the other depends not only on the mutual interest but also on the preparedness and acceptability of the technology in the importing country. Many developing countries are not receptive to advanced scientific and technological activities due to a lack of proper education and training. There are nations with bountiful resources but under-equipped with knowledge—advanced nations may explore those countries for diffusion of technological innovation by providing education and training to the rich human resources. Although this is an expensive proposition (and enough to dissuade advanced nations from shouldering this liability), it could succeed in reducing the gap between poor and rich nations.

One major problem is the distribution of potential benefits leading to conflicts of various types at the regional, national and international level. For instance, some feel that the unequal distribution of gains from globalisation creates greater inequalities between rich and poor nations. Others fear that the faster growth poorer nations may lead to some kind of convergence of incomes globally. The benefits of globalisation are generally measured by the economic well-being of the people, defined by the Gross Domestic Product. It is necessary to scrutinise the reform policy to check the negative social effect on health, security and environment.

One of the most significant developments in the globalisation of technological innovations is the network involving technological collaboration, in which the main actors are universities, research institutes and a wide range of enterprises. This has been practiced in the form of joint research projects, exchange of scientists through exchange programmes or sabbatical leaves. Collaborations are usually in the emerging areas of science and technology, such as biotechnology, nanotechnology etc. The major driving force for these types of activities is to reduce cost, as well as to lessen the risk associated with the development of new products. Besides reducing risks, this type of activity also plays a key role in the development of technological capabilities in institutions of developing countries. Such arrangements are particularly important in areas with limited access to other forms of financing, such as venture capital. (Even where venture capital is available, these arrangements still serve an important risk-reducing function.) Technological capabilities gained by this type of joint programmes are very specialised and would also be useful in the management of industrial production. Forward-looking economic policies undertaken by India through the liberalisation of its economy and developing strong protection of intellectual property rights encouraged foreign direct investment in the country.

As mentioned before, in this type of collaborative programmes, economy is not the major driving force—rather it is based more on an academic principle of exchange of knowledge and technical capabilities, cooperation that can be between developing countries only. For example, science ministers from Brazil, India and South Africa have been working together to identify areas for trilateral cooperation over nanotechnology and HIV/AIDS. This was the first major effort of developing countries to promote cooperation with a focus on emerging technologies. On the positive side, this may inspire other nations (including developed nations) to join this programme in tune with the spirit of globalisation. However, it is also true that the scale, intensity and nature of exchange of ideas, knowledge and technological innovation between two developed nations and between developed and developing nations are different. It may be due to objective realities like inadequate infrastructural capacity and human resource capability; but whether developed nations will transfer all innovations freely and without any kind of barrier is also an open question.

Creating incentives for private enterprise without simultaneous growth in human capital is not enough for private sector growth. Critical factors for the growth of private enterprises in developing countries include the lack
of financial resources, lack of human capital, lack of market-oriented research culture, and lack of interface to transfer research findings obtained in academic institutions to commercial enterprises. Strengthening the interface between research activities and commercial enterprises will stimulate scientists engaged in academic research.

Initiatives have been started in many developing nations including India to attract expatriate scientists to return to their home countries, or to contribute in strengthening the research and business activities in the country of their origin. Diaspora communities have started contributing by taking advantage of the present technological feat of rapid connectivity, mobility and interdependence. India is introducing a number of policy measures to bring back capable expatriates such as the granting of dual citizenship, as well as offering attractive positions (with good compensation packages) in academic institutions and R&D centres to strengthen their activities.

A more recent effect of globalisation is on higher education. Higher education and research has traditionally been always more open compared to other areas because the driving force is to acquire knowledge with no or insignificant interest in economy. However with the development of technological advances particularly the information technology the structure of the university is changing. Universities, which have traditionally been the knowledge provider through teaching and research, now function under the influence of market economy, consumerism and global interconnectedness through the internet. Modern universities no longer operate within a given physical boundary. Because of the depressing economic conditions and decreasing demand for higher education, foreign universities are shifting their education base to developing nations where the demand for a degree awarded by a foreign university has always been appreciated. Policymakers almost everywhere believe that to succeed like US universities it is necessary be like US universities, but operating within the national constraint, resources and infrastructure cannot deliver American outcomes. Stricter policies on cost, nature of the course, mode of teaching need to be in place to determine whether it is helping in the intellectual development of students.

The process of technological innovation has become intricately linked to the globalisation of the world economic system. The recent trend of moving from largely domestic activities to more complex international relationships demands a fresh look at policies that integrate science, technology, and innovation into socially acceptable economic strategies. In spite of the increasing globalisation of technology, the involvement of developing countries in producing new technologies and innovations is almost negligible, and the production of technological knowledge is concentrated in industrial countries. The challenge facing the global community is to create conditions that will enable developing countries to make full use of the global fund of knowledge to address developmental challenges. Globalization is not merely interconnectedness nor internationalization, the goal of globalization is to go beyond that, globalization means integration.

References