Globalization, national innovation systems and response of public policy

Singh, Lakhwinder

01. November 2006

Globalization, national innovation systems and response of public policy

Lakhwinder Singh
Department of Economics
Punjabi University, Patiala 147002
Punjab, India.

Keywords

globalization of technology

role of state

knowledge gaps

global public good

innovative strategy

developing countries

international institutions

intellectual property rights

innovation policy

Abstract

This paper attempts to set the significance of public innovation policies in contemporary developing countries in the context of the fast pace of globalization. It is fairly well established both in theory and practice that investment expenditure on innovation projects is likely to be low if left in the hands of private economic agents as they have a tendency to under-invest due to the 'public good' nature of the outcomes of R&D. However, policy in developing economies seldom takes seriously the importance of investment in innovation projects. This has not been without far-reaching implications for the growth and development performance of developing countries in general. The paper explores the role of international institutions and national governments in the task of strengthening national innovation systems through innovative interventions at national and international levels.

Introduction

Development is a long-term process and involves both quantitative and qualitative changes. In the now-developed countries, this took the form of phased transformation from predominantly agrarian to industrial and then knowledge-based economies. Whether contemporary developing countries have to go through the same process is a debatable question. What is not debatable, however, is the need for policy in these countries to address the issue of technological progress underlying the process of transformation. Technological progress stems from the build-up of innovative activities; innovation itself is the product of a complex set of interactions conditioned by institutional, organizational and cultural systems. Restrictive systems limit the scope for innovation and technological progress. Dynamic systems, on the other hand, create opportunities for innovation and technological progress and hence for long-term growth and development. Why then are some countries or societies more inclined to innovation than others? In particular, why is the incidence of innovation low in developing countries?

There is nothing in the nature of developing countries that makes them less prone to or inherently incapable of innovation. The propensity to innovate is essentially a function of factors relating to the roles of the state and the market, and particularly the extent to which policy is disposed to take the lead in enabling individual and corporate market 'players' to seize emerging opportunities through the provision of appropriate institutional mechanisms. The nature of these mechanisms varies from country to country. In many developing countries, technology policy has taken the form of a 'top-down' linear structure, very much in line with the traditional practice of planning from the centre. There is now growing awareness that prospects for innovation and technological progress are least enhanced by a top-down approach to technology policy, and that the cause for sustainable development would rather be best served through the adoption of what has recently come to be known as national innovation systems (NISs) as a policy framework. This, however, poses a challenge for policy as it involves a multitude of agents of production and consumption engaged in a complex network of interactions. For most developing countries, characterized by institutional and

organizational fragmentation, the task of setting the NIS in place calls for 'capacity-building' initiatives as a priority policy concern. Not much has been achieved yet in this respect, however, so that the potential benefits of technology globalization are likely to be unevenly distributed across the spectrum of countries. Thus, the newly industrializing countries are, by virtue of their economic status, more favourably placed than the low-income developing countries to address the issue of innovation through the institution of the NIS.

Policy in developing countries is also under the pressure of having to respond to the challenges of the global intellectual property rights regime enacted by the World Trade Organization (WTO) and brought forth by the rapid pace of globalization. Globalization has not produced a level playing field for 'players' in the innovation field in both developed and developing countries. Empirical evidence on R&D location shows that firms still prefer to establish strategic innovation activities in their home countries, despite globalization of investment in innovative activities.[1] Cross-border R&D, however small, is taking place largely among the advanced countries, while newly industrializing countries (NICs) are also seeking to increase their respective shares of global R&D.

This paper seeks to examine the various instruments and institutional arrangements that successful, newly industrializing countries have adopted to encourage local technology development and attract cross-border innovation investments. The paper is organized in five sections. The second section, following this introduction, analyses sources and trends of technology across the world. The third section addresses the changing role of national innovation systems in the context of the renewed debate on the role of the state under the pressure of globalization. The fourth section maps out the technology development experience of the newly industrializing countries and draws lessons for developing countries in general. The fifth section analyses the role of public innovation policies both in developed and developing countries in the light of the changing context forced on international institutions by the globalization trend. Concluding remarks are given in the sixth section.

[1] Recent estimates for the US economy, for instance, show that nearly 90 per cent of goods and services consumed by its residents continue to be produced at home (Eichengreen 2002).

Globalization of technology

In terms of principle, globalization of technology is technology diffusion by another name. There are three strands of economic theory that explain long-run economic growth and directly address the question how knowledge diffusion takes place. First, although neoclassical growth theory seeks to assign a central role to knowledge as a factor explaining long-run growth, it considers knowledge as exogenously determined and therefore focuses solely on the public good aspect of technology (Solow 1956, 1957). Diffusion is assumed to be automatic and costless. However, the prediction and claim of the neoclassical theory of growth is that in the long-run, income across economies will converge as a result of the free interplay of market forces. Neoclassical theory is particularly conspicuous for its reticence regarding the dynamic process of innovation, which is far from smooth, automatic and even predictable for its outcomes.

Second, the 'technology gap' theory of long-run economic growth emphasizes the advantages of technological backwardness and the scope for catching up by the developing countries (Fagerberg 1987; Gerschenkron 1962). The mechanism of knowledge diffusion in this case involves the mastery of developed-country technologies by developing countries. Abramovitz (1979) argued that the existence of domestic capability is a precondition to assimilate spillovers from activities originating elsewhere. The process of imitation of technology from advanced countries entails cost and this cost varies positively with the increase in the complexity of knowledge. Thus, without a sufficient level of domestic capabilities, which requires massive investment, a country is unlikely to benefit from the technological knowledge conveyed through a variety of technology transfer mechanisms. Such a country is consequently doomed to lag behind, far from forging ahead and catching up on the technology leaders (Verspagen 1991).

Third, the new growth theory, also known as 'endogenous growth theory', stresses the role of innovative investment, human capital accumulation and externalities as the dominant factors that determine long-run economic growth. The theory acknowledges that although it is factor accumulation that accounts for growth, for factor accumulation to grow, the returns to capital stock should not diminish. The new

knowledge, which prevents diminishing returns on capital stock, is produced by investment in research and development. Moreover, the increase in knowledge will not be appropriated solely by those who undertake the investment. This implies that the investment effort gives rise to appropriable and non-appropriable knowledge categories. The latter is alternatively referred to as externalities or knowledge spillovers (Aghion and Howitt 1992; Grossman and Helpman 1991; Romer 1986). Central to the new growth theory is the role of investment in innovation projects. While latecomers in the development process may, in theory, have the advantage of not having to 'reinvent the wheel', in practice, their access to the spillover benefits is likely to be constrained as technological knowledge becomes increasingly complex and tacit in the face of the fast pace of globalization (Fagerberg and Verspagen 2002).

The new growth theory invigorated interest in the empirical study of the interdependence between economic growth and the international diffusion of technology across countries. International trade has been identified as the single most important channel for the diffusion of technological knowledge across countries (Coe and Helpman 1995; Coe et al. 1997; Evenson and Singh 1997). Over time, the composition of trade has undergone substantial changes with the weight of science-based high-technology products, largely originating from developed countries, constantly increasing. The United States accounts for more than one-fifth of the science-based manufactured exports of the global economy. Other important countries, which produce and export science-based manufactured products, are Japan (10.7 per cent), Germany (8.7 per cent), the United Kingdom (7.2 per cent), France (6.2 per cent), the Netherlands (5.6 per cent), Canada (3.2 per cent), Italy (1.9 per cent), and Sweden and Switzerland (1.4 per cent each). However, the developing economies only accounted for 11.7 per cent of the global science-based manufactured exports (Table 1).

Multinational corporations predominantly control international trade in the global market. Moreover, a substantial proportion of international trade is either inter-industry or intra-industry trade (Jones 2001; Kumar and Siddharthan 1997), which means that a good part, if not all, of the science-based exports originating from the developing economies derives from the operation of multinational corporations operating in these

economies. This concentration of the source of science-based manufactured commodities traded in the global market has reduced the importance of international trade as a true carrier of international diffusion of technology.

Table 1

Distribution of sources of technology across countries and regions

Country/ regions	**R&D expenditure (billion PPP$) 1997**	**R&D researchers '000' 1997**	**FDI outflows (billion $) 2000**	**High-technology exports (billion $) 2000**	**Technology fees received (billion $) 2000**	**Registered patents in US '000' 1977–2000**
United States of America	212.8 (40.8)	980.5 (18.9)	139.9 (12.1)	206.3 (20.7)	33.8 (42.2)	1337 (57.0)
Japan	90.1 (17.3)	617.4 (11.9)	32.9 (2.9)	106.5 (10.7)	6.9 (8.6)	429.4 (18.0)
Germany	42.0 (8.0)	236 (4.5)	48.6 (4.2)	87.1 (8.7)	11.9 (14.9)	173.8 (7.0)
France	28.1 (5.4)	156 (3.0)	172.5 (15.0)	62.1 (6.2)	2.2 (2.7)	68.2 (3.0)
United Kingdom	22.6 (4.3)	147 (2.8)	249.8 (21.7)	71.8 (7.2)	5.8 (7.2)	67.4 (3.0)
Italy	12.1 (2.3)	76 (1.5)	12.1 (1.1)	19.1 (1.9)	1.6 (2.0)	29 (1.0)
Canada	11.4 (2.2)	93 (1.8)	44.0 (3.8)	31.9 (3.2)	1.3 (1.6)	48.4 (2.0)
Netherlands	7.5 (1.4)	39 (0.7)	73.1 (6.4)	56.3 (5.6)	6.2 (7.7)	22 (1.0)
Sweden	7.1 (1.4)	37 (0.7)	39.5 (3.4)	14.1 (1.4)	0.4 (0.5)	22.9 (1.0)
Switzerland	4.8 (0.9)	23 (0.4)	39.6 (3.4)	14.2 (1.4)	2.8 (3.5)	31 (1.0)
Developed Countries	438.5 (84.0)	3713.3 (71.6)	851.3 (86.6)	881 (88.3)	72.9 (91.0)	2229.1 (94.3)

Developing Countries	83.5 (16.0)	1476.2 (28.4)	298.6 (13.4)	117 (11.7)	7.2 (9.0)	135.8 (5.7)
TOTAL	522 (100.0)	5189.4 (100.0)	1149.9 (100.0)	998 (100.0)	80.1 (100.0)	2364.9 (100.0)

Notes: 1.Figures in parentheses are percentages. 2. PPP stands for purchasing power parity.
Source: UNESCO (2001); World Bank (2003); Kumar (2003)

On the other hand, foreign direct investment (FDI) has gained significance from the point of view of its capacity to transmit technological knowledge and novel management techniques. Multinational corporations (MNCs) are considered as leaders in producing innovations of commercial significance, including new technologies, new products and new organizational forms. This makes MNCs a potent vehicle of international technology diffusion (Carr, Markusen and Maskus 2001). Empirical studies conducted to examine the impact of foreign investment on international technology diffusion, however, report mixed results. Aitken and Harrison (1999) show a negative relationship between FDI and total factor productivity of the domestic plants. However, Xu (2000) found a positive relationship between productivity growth and FDI in an aggregative study covering 40 countries. The impact of foreign direct investment on productivity is stronger and more robust for advanced countries than it is for less developed ones. The dismantling of control systems by the developing countries through liberalization policies to attract FDI has not, however, helped much in promoting innovation efforts. The mere presence of FDI does not, of course, significantly change the situation of technological knowledge and the gains to be derived from it until developing countries step up efforts to absorb, adapt, master and improve technology. Indeed, in the absence of innovative capabilities in most of the developing economies, the gains arising from FDI initiatives has remained concentrated in the developed countries.

Trans-border scientific and technological cooperation has become an increasingly important channel for international transfer of technological knowledge. There has been a substantial increase in the number of strategic technological partnerships among governments and firms. During the period 1980–2000, technological alliances have

increased from 212 to 574 (NSF 2002). However, studies which have examined the incidence of strategic alliances during the period 1987–94 show that more than 93 per cent of the recorded strategic technology partnering involved countries based in the developed world (Narula and Sadowski 2002).

Table 2

Distribution of research and development expenditure financed from abroad 1993–98

.

Country/Year	**Percentage of the total 1993**	**Percentage of the total 1998**	**Percentage point change 1993–98**
Canada	10.1	13.6	+3.5
Denmark	7.3	6.4*	-0.9
Germany	1.6	2.4	+0.8
Finland	1.8	5.1	+3.3
France	8.1	7.9*	-0.2
Italy	4.4	5.0	+0.6
Japan	0.1	0.3	+0.2
Netherlands	5.3	12.8*	+7.5
New Zealand	2.4	5.2*	+2.8
Norway	5.4	6.5*	+1.1
Sweden	2.9	3.4*	+0.5
Switzerland	-	3.1*	-
United Kingdom	11.9	16.8	+4.9
United States	-	-	-
European Union	5.9	7.0*	+1.1

Source: OECD (2000)

Note: * implies figure belongs to the year 1997

Both output and input indicators of innovation, presented in Table 1, clearly show a high degree of concentration of innovative activities in developed countries. The United States, Japan, Germany and France together accounted for 71.5 per cent of the global R&D expenditure. The high share of developed countries in total R&D expenditure (84 per cent) and in the global population of scientists and engineers (77.6 per cent) reflects their control on the global trend of innovation and technological progress.

The high degree of concentration in the share of developed countries has, however, diminished to some extent during the last decade of the twentieth century (Savvides and

Zachariadis 2003). There are two fundamental reasons for the decrease in the concentration in R&D expenditure. First, the newly industrializing countries in South East Asia have stepped up substantially their innovative effort and emerged as important players in the development of new technologies. Second, there is a growing trend of internationalization of R&D expenditure through the growth in the activities of multinational corporations. The growing trend of internationalization of R&D in the 1990s can be seen from Table 2.

A larger proportion of the commercially-oriented R&D expenditure in the advanced countries is undertaken by the multinational corporations of the respective countries. The growing trend of internationalization of innovative activities of the advanced countries is spearheaded by a small number of the multinational corporations. The overseas R&D expenditure of US corporations increased from 6.4 per cent in 1982 to 11.72 per cent in 1994. The overseas R&D expenditure of Japanese multinational corporations increased from 1.44 per cent in 1989–90 to 2.3 per cent in 1996–97 (Kumar 2002). Wide differentials have been noticed in the location of R&D expenditure of multinational corporations of different developed countries. A larger proportion of the outward location of innovative activities is due to multinational corporations originating from the Netherlands and the United Kingdom. More than 90 per cent of the total overseas R&D expenditure incurred by US multinational corporations is located in the advanced industrialized countries. The meagre amount of overseas R&D, which goes to less-developed countries, basically focuses on adapting products to the needs of local users (Evenson and Westphal 1995; Archibugi and Pietrobelli 2002). Thus, despite globalization, distribution in the generation of knowledge has been concentrated in regions/hubs where competencies agglomerate (Cantwell and Iammarino 2002; Kumar 2002; Guerrieri et al. 2001). A handful of multinational corporations owning and controlling commercially-oriented innovative activities draw on the domestic innovative activities, but market their products globally.

National innovation systems (NISs) and the role of the state

Knowledge accumulation is very much rooted in the evolution of human civilization. Governments have pursued science and technology policies to improve the innovative performances of agents of production (Mowery 1995). They have also created a network of institutions to promote interactions between agents of production and enhance their competitiveness in the international market. The accumulation of knowledge and provision of the infrastructure to enhance the generation of knowledge and the implementation of technology policy have been brought together in the formulation of the concept of national innovation systems (NISs). The NIS is a new approach for the study of innovation (Freeman 1987; Lundvall 1988, 1992; McKelvey 1991; Nelson 1993). Innovations are viewed in the NISs approach as part of a larger process of development of knowledge of economic relevance and also as an important determinant of economic growth. Due to the complexity of the innovation processes, economic agents of production do not innovate in isolation, but through interactions with other organizations to gain, develop and exchange knowledge, information and other resources.

There are three important factors which influence the innovation behaviour of economic agents of production: the infrastructure and skill base which determines the development of science and technological outcomes; the interactions between firms and between firms and other organizations which have learning effects; and the role governments play in support of advances in science and technology. Historically, the state has played a fundamental role in the evolution of the NISs and thus, in the pace and direction of technological progress. After World War II, the federal government of the United States stepped up its research and development expenditure which peaked at around 67 per cent of total R&D expenditure in the mid-1960s. The federal government's R&D expenditure remained much higher than private R&D expenditure until 1980. Thereafter, the share of federal R&D expenditure started declining, dropping to 49.8 per cent in 1989 (Goodacre and Tonks 1995; Mowery and Rosenberg 1993). By the last decade of the twentieth century, the share of the federal R&D expenditure had declined to 33 per cent of the total R&D expenditure in the United States (Ruttan 2001). Even so, it is worth noting that the competitive edge of the US industries has mainly resulted from

the strategic support extended by the federal government. In the words of Ruttan (2001: 602):

> Government has played an important role in technology development in almost every US industry that has become competitive on a global scale. The government has supported agricultural technology through research, the automobile industry through design and construction of the highway infrastructure, the development of the computer through military procurement, and the growth of the biotechnology industries through support for basic biological research.

Contrary to the US experience, public R&D expenditure incurred by the Japanese government remained quite low at 19.9 per cent of the total R&D expenditure in the year 1988 (Goodacre and Tonks 1995), and declined substantially during the 1990s. However, state intervention through the MITI remained all-pervasive in terms of providing leadership and setting goals for innovative activities in the private sector. Among the developed European countries also, state intervention was active in terms of providing innovative resources during the last half of the twentieth century. During this period, national innovation systems progressed and matured to a level that would enhance the competitiveness of agents of production in both domestic and international markets. In countries such as France, Germany and the United Kingdom, R&D expenditure by the public sector dwindled during the last decade of the twentieth century (UNESCO 2001).

Table 3

Share of business R&D expenditure in GDP across countries

Name of country	**1971**	**1981**	**1991**	**1998**
Belgium	0.71	0.96	1.16	1.28
Canada	0.38	0.49	0.59	1.01
Denmark	0.41	0.46	0.85	1.34
Finland	0.44	0.62	1.07	2.07
France	0.67	0.79	0.99	1.34
Germany (West)	1.13	1.40	1.57	1.40

Ireland	0.30	0.26	0.58	0.98
Italy	0.44	0.43	0.61	0.74
Japan	1.09	1.38	2.13	2.37
Netherlands	1.02	0.83	0.91	1.08
Norway	0.41	0.50	0.77	0.95
Portugal	0.09	0.10	0.14	N/A
Spain	0.11	0.18	0.38	0.41
Sweden	0.80	1.24	1.71	2.65
Switzerland	1.67	1.68	2.07	N/A
United States	0.81	0.91	0.94	1.78
United Kingdom	0.97	1.17	1.36	1.13
Mean	0.67	0.79	1.05	1.37
Standard deviation	0.42	0.47	0.56	0.61

Source: OECD (2000); Patel and Pavitt (2000)

Significantly, business-funded R&D expenditure has emerged as the most important and widely accepted indicator of innovation in recent years. Table 3 shows the increasing importance of the business-funded innovative activities. Countries vary in terms of experience with respect to private sector expenditure on R&D; but in most countries, business-funded R&D has received substantial government support through incentives and tax concessions (Ruttan 2001). The nature of state intervention has, however, undergone a substantial transformation from direct participation to indirect participation via supporting commercially-oriented research through public–private participation and also through the provision of subsidies and tax incentives.

The experience of East Asia and lessons for less-developed countries

East Asian economies sustained high rates of economic growth and transformation since the 1970s. Technological progress and international trade are the two fundamental factors behind this structural transformation. The share of science-based (high-tech) exports in the total manufactured exports of East Asia and Pacific countries was on average 30 per cent in 2000. This compares favourably with the corresponding figure for high-income

countries, which was 23 per cent for the same year. However, not all East Asian countries have performed equally in terms of high-tech exports, as can be seen from Table 4. Notice, for example, the difference between Singapore (with 63 per cent of total manufacturing exports based on high-tech exports) and Indonesia (where high-tech exports account for only 16 per cent of the total manufactured exports).

East Asian countries also differ from one another in terms of the sources of technological progress, as can be seen from Table 4. Taiwan is, for example, ranked second in the global economy just next to the United States, according to the international technology index. The Republic of Korea ranked ninth in 2001 and slipped to eighteenth position in 2002. Singapore and Malaysia are the two other East Asian countries that rank high in terms of technological achievement according to the international technology index. On the other hand, Thailand and Indonesia rank low.

Table 4

Indicators of technology across East Asian countries

Country	**Share of R&D expend. in GNP** (%)	**High-tech exports as % of manufactured exports (2000)**	**Patents registered in the US (2000)**	**Quality of secondary education ranking (1998) maths**	**Quality of secondary education ranking (1998) science**	**Patent protection index (1990)**	**Technology index rank (2002)**
Indonesia	0.07 (2000)	16	-	34	32	2.4 (72)	65
Korea, Rep. of	2.68 (2000)	35	3472 (7)	2	5	4.5 (29)	18
Malaysia	0.42 (2000)	59	47	16	22	4.4 (33)	26
Taiwan	2.08 (2000)	39	5806 (3)	3	1	4.6 (27)	2
Singapore	1.47 (1997)	63	242	1	2	5.7 (12)	17

Thailand	0.16 (2001)	32	30	27	24	4.0 (38)	41

Source: UNESCO (2001); Yusuf (2003), World Economic Forum (2003); World Bank (2003)

Notes: 1. Figures in parentheses in the column two are the years for which the latest data is available.

2. Figures in parentheses in column four are global ranks.

3. Ranks of mathematics and science are based on a test conducted for problem solving abilities of the students in 38 countries.

There are two distinctly discernible patterns of technological development, which can be observed from a careful analysis of the national innovation systems of the East Asian countries. First, the technological achievements in terms of high-tech exports and sustained high rates of economic growth have been dependent on foreign direct investment (FDI). The countries which followed this path of technological development are Malaysia, Thailand, Indonesia and the Philippines. However, as is apparent from both the input and output indicators of technological performance shown in Table 4, industrial enterprises in these countries have weak technological and competitive capability. This is because the national innovation systems in these countries have remained weak in the face of foreign capital that continued to play a dominant role in the supply of technology.

The second pattern emerging from the experience of East Asian countries relates to the path of technological development based on the national innovation system with little or no reliance on foreign direct investment, as in the case of Taiwan and the Republic of Korea (South Korea). Both these countries used the opportunity of import-substitution and export-promotion strategies and domestic innovative investment efforts to build technological capability at an enterprise level. These countries moved successfully on the technological ladder through an interactive approach to learning. First, they created high-quality educational institutions to train the manpower required for new opportunities in the industrial sector. In particular, they put strong emphasis on science- and engineering-based higher educational institutions. This provided the creative, imitative and adaptive learning capabilities for the reverse engineering of products and processes developed by the advanced industrialized countries. Governments in both Taiwan and South Korea created a web of science- and technology-based

institutions that helped them understand the complex process of technological innovations. They also took the lead in facilitating access to required technologies and in providing the incentives that private enterprises would need to underwrite the risk of innovation (Suh 2000; Kim 2000).

Thus, the proactive role of the state in terms of exposing enterprises to the competitive global environment helped to transform enterprises from being imitators to being innovators in a short span of time. In addition, the governments in Taiwan and Korea used a weak intellectual property rights regime to allow enterprises to absorb the technological knowledge derived from the developed countries, using reverse engineering ators of technological knowledge. Protection of intellectual property rights remained quite weak despite legislation aimed at appeasing the international community, particularly the US government (Kumar 2003; Wade 1990).

Success in technological experience which saw Taiwan and Korea evolve from being imitators to being innovators has important implications for other developing countries that are keen to draw lessons from the experience. First, the active role the government took in terms of the provision of supportive institutional arrangements as well as funding for R&D and skill development was crucial for stimulating and reinforcing the innovation effort of enterprises. Second, governments have the responsibility to enact and enforce the accountability of enterprises and public institutions engaged in innovative activities. Third, foreign direct investment does not fill the gap of technological knowledge unless and until a minimum level of technological knowledge is acquired by the domestic enterprises (Siddharthan 2004). Finally, intellectual property rights (IPR) are now a major constraint on innovation because of their enforcement by the WTO. This would make it difficult for less-developed countries to copy the experience of East Asian countries that thrived on the prevalence of weak IPR regimes. However, less-developed countries have the option to negotiate longer time frames for the implementation of IPR. They can also negotiate for compensation from the loss incurred due to strong IPR regimes and use this fund for initiating a strong innovative base within the country to enhance their competitive advantage.

What should governments in developing countries do?

Internationalization of economies is taking place under the rules of the game enacted by international institutions such as the IMF, the World Bank and the World Trade Organization (WTO). These institutions are striving to restructure the role of the state and have been successful in providing a dominant space to international capital as well as to market forces. Reduction of fiscal deficit and the universal applicability of a strict IPR regime weaken the boundaries of national innovation systems and diminish the effectiveness of the effort of governments to support and promote innovation-related activities. The globally applicable strict IPR regime has been devised by the WTO keeping in view the rise in the commercially-oriented innovative activities in the advanced countries, on the one hand, and the rise in imitative/reverse engineering activities in the newly industrializing countries, on the other.[2] But is there reason to believe that the WTO is essentially driven by the commercial interest of enterprises in the developed countries? At the heart of this question is the conflict between the innovative and 'rent-seeking' behaviour of enterprises. What is not clear, though, is the boundary beyond which IPR ceases to serve as an appropriate reward to the risk borne by innovators and becomes a factor that constrains innovation.

For reasons of externalities associated with innovation, there is divergence between the social and private returns from investment in innovative activities, the former being higher than the latter. This is the principal reason for the reluctance of private sector agents to engage in innovative activities (Arrow 1962; Stiglitz 1999; Mani 1999). A consensus has not yet emerged, however, on the reduction of spillover gaps from a uniform framework for IPR and the achievement of equitable gains to both developed and developing economies. The economic theory of public goods and historical evidence regarding development of the innovative capabilities of nations, however, clearly provide enough support for the state to enable domestic agents of production to innovate with the view to enhancing their long-term competitive advantage.

---

[2] For US enterprises alone, the loss of profits due to free technology copying is estimated to range between $60 billion and $2.3 billion per annum (US International Trade Commission 1988). The magnitude of the loss becomes smaller, however, when refinements are introduced to the analysis (Maskus and Konan 1991).

The IPR regime enforced by the WTO is based on the official public policy stance taken during the discussions and negotiations of R&D subsidies contained in the original Dunkel draft of the GATT subsidies code. The original Dunkel draft provided for government contribution not to exceed 50 per cent for basic research or 25 per cent for applied research. This was revised raising government support from 50 per cent to 75 per cent (Gibbons 1994). The UK government introduced tax credits for R&D towards the late 1990s. This initiative shows the growing awareness about the importance of public innovation policies. Most developing countries, on the other hand, continued to adopt patent laws to protect intellectual property rights, but dramatically reduced public R&D expenditure as well as public support to institutions on the lines suggested by the WTO.

The crisis that afflicted the East Asian economies in 1997 led to the renewal of the role of the state in terms of provision of good governance, including, *inter alia*, support to innovation efforts. It also helped the international community to rethink as to how the market and the state can be made to work together. According to the World Bank (1999), a major role of the government in developing countries is to develop capabilities for creating knowledge at home and to provide support to domestic agents of production to take advantage of the large global stock of knowledge. The UNDP has taken the lead in identifying knowledge gaps between developed and developing countries and articulating arguments against the strict IPR regime enacted and implemented by the WTO. The UNDP has also identified knowledge as a global public good and the role of international community in reducing the knowledge gap (UNDP 2001; Stiglitz 1999). Thus, a major role of the state in developing countries is to provide a policy framework that will enable domestic agents of production to capture the spillover benefits created by the globalization of capital and technology.

Conclusion

This paper has explored the significance of innovation policies in developing countries for strengthening the national innovation systems and enabling domestic agents of production to achieve technological development and competitiveness in the global

market. Developing countries, however, seem to ignore the importance of national innovation systems, preferring instead to adhere to the intellectual property rights regime put in place by the WTO. There are two possible reasons for this. First, developing countries appear to perceive, if naïvely, that because technological globalization has become pervasive, domestic agents of production will have no problem in drawing on the global pool of knowledge. The focus is thus on liberalization policies, the global knowledge market and its accessibility to developing countries. But this position assumed by developing countries smacks of the naïve neoclassical view that innovation is an automatic and costless process. Nothing, however, can be further from the truth. Moreover, the WTO's strict IPR regime is generally criticized for being disposed in favour of the interests of enterprises in developed countries and against innovation and capability development initiatives in developing countries.

The second reason for the apparent neglect of the active role of the state in promoting national innovation systems relates to the budgetary implications of structural adjustment policy. The pursuit of stringent control over fiscal deficit has the effect of reducing the capacity of governments in developing countries to allocate resources for the strengthening of national innovation systems. The fast pace of globalization has thus made intervention by the state rather difficult. It has not, however, diminished the importance of state intervention; rather it has heightened the case for capability development so that developing countries could maximize the benefits to be derived from the spillover effects of the global technology market. The articulated response of the state in the newly industrialized economies such as Taiwan and South Korea to the challenges of technology globalization by strengthening the national innovation systems provides a lesson of experience for other developing countries, where globalization is considered to be more of a threat than an opportunity.

Acknowledgements

This is the revised version of the paper presented in the International Conference on Globalization and Development organized by the Development Studies Association, UK

and hosted by the University of Strathclyde, Glasgow from 10–12 September 2003. The author is grateful to Mozammel Huq, Arlindo Villaschi and Girma Zawdie for helpful comments and enlightening discussions during the conference. Many thanks go to the anonymous referee of the journal for helpful suggestions and editor's painstaking efforts and assistance. Financial assistance extended by the Asian Scholarship Foundation (ASF), Bangkok, which enabled the author to attend the conference, is gratefully acknowledged. The author is solely responsible for errors and omissions.

References

Abramovitz, M.A. (1979), 'Rapid Growth Potential and its Realisation: The Experience of Capitalist Economies in the Postwar Period', in E. Malivaund (ed.), *Economic Growth and Resources: The Major Issues***,** vol. 1, London: Macmillan.

Aghion, P. and Howitt, P. (1992), 'A Model of Growth through Creative Destruction', *Econometrica*, 60: 2, pp. 323–51.

Aitken, B. and Harrison, A. (1999), 'Do Domestic Firms Benefit From Foreign Direct Investment? Evidence from Venezuela', *American Economic Review*, 89: 3, pp. 605–18.

Archibugi, D. and Pietrobelli, C. (2002), 'The Globalisation of Technology and its Implications for Developing Countries: Windows of Opportunity or Further Burden?', mimeo, University of Rome III.

Arrow, Kenneth J. (1962), 'Economic Welfare and the Allocation of Resources of Invention', in Richard Nelson (ed.), *The Rate and Direction of Inventive Activity: Economic and Social Factors***,** Princeton, NJ: Princeton University Press.

Cantwell, J. and Iammarino, S. (2002), *Multinational Enterprises and Regional Systems of Innovation in Europe*, London: Routledge.

Carr, D., Markusen, J. and Maskus, K. (2001), 'Estimating the Knowledge-Driven Model of the Multinational Enterprises', *American Economic Review*, 19: 3, pp. 693–708.

Coe, D.T. and Helpman, E. (1995), 'International R&D Spillovers', *European Economic Review*, 39: 5, pp. 859–87.

Coe, D.T., Helpman, E. and Hoffmaister, A. (1997), 'North-South R&D Spillovers', *Economic Journal*, 107: 440, pp. 134–49.

Eichengreen, B. (2002), 'Capitalizing on Globalization', *Asian Development Review*, 19: 1, pp. 14–66.

Evenson, R.E. and Westphal, L. (1995), 'Technological Change and Technological Strategy', in J. Behrman and T.N. Srinivasan (eds), *Handbook of Development Economics*, vol. 3, Amsterdam: Elsevier Science.

Evenson, R.E. and Singh, Lakhwinder (1997), *Economic Growth, International Technological Spillovers and Public Policy: Theory and Empirical Evidence from Asia*, Economic Growth Center, Yale University, Discussion Paper 777.

Fagerberg, J. (1987), 'A Technology Gap Approach to Why Growth Rates Differ', *Research Policy*, 16: 2–4, pp. 87–99.

Fagerberg, J. and Verspagen, Bart (2002), 'Technology-Gaps, Innovation-Diffusion and Transformation: An Evolutionary Interpretation', *Research Policy*, 31: 7, pp. 1141–61.

Freeman, C. (1987), *Technology Policy and Economic Performance: Lessons from Japan*, London: Pinter.

Gibbons, John H. (1994), 'Statement of the Honorable John H. Gibbons', Director, Office of Science and Technology Policy before the Subcommittee on Technology,

Environment, and Aviation, Committee on Science, Space and Technology, United States House of Representatives.

Gerschenkron, A. (1962), *Economic Backwardness in Historical Perspective*, Cambridge, MA: Belknap Press.

Goodacre, A. and Tonks, Ian (1995), 'Finance and Technological Change', in Paul Stoneman (ed.), *Handbook of the Economics of Innovation and Technological Change*, Oxford: Blackwell.

Grossman, G. and Helpman, E. (1991), *Innovation and Growth in the Global Economy*, Cambridge, MA: The MIT Press.

Guerrieri, P., Iammarino, S. and Pietrobelli, C. (eds) (2001), *The Global Challenge to Industrial Districts: SMEs in Italy and Taiwan*, Cheltenham: Edward Elgar.

Jones, Ronald W. (2001), 'Globalization and the Fragmentation of Production', *Seoul Journal of Economics*, 14: 1, pp. 1–13.

Kim, L. (2000), 'Korea's National Innovation System in Transition', in Linsu Kim and Richard R. Nelson, (eds), *Technology, Learning, and Innovation: Experience of Newly Industrializing Economies*, Cambridge: Cambridge University Press.

Kumar, N. (2002), *Globalization and the Quality of Foreign Direct Investment*, New Delhi: Oxford University Press.

Kumar, N. (2003), 'Intellectual Property Rights, Technology and Economic Development: Experiences of Asian Countries', *Economic and Political Weekly*, 38: 3, (18 January), pp. 209–26.

Kumar, N. and Siddharthan, N.S. (1997), *Technology, Market Structure and Internationalization: Issues and Policies for Developing Countries*, London: Routledge and UNU/INTECH.

Lundvall, B-A. (1988), 'Innovation as an Interactive Process: From User-Producer Interaction to the National Systems of Innovation', in G. Dosi et al. (eds), *Technical Change and Economic Theory*, London: Pinter.

Lundvall, B-A. (ed.) (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter.

Mani, S. (1999), 'Public Innovation Policies and Developing Countries in a Phase of Economic Liberalisation', DP, no. 9902, Maastricht, The Netherlands: UNU-INTECH.

Maskus, K.E. and Konan, D.E. (1991), 'Trade Related Intellectual Property Rights: Issues and Exploratory Results', mimeo, University of Colorado.

McKelvey, M. (1991), 'How do National Systems of Innovation Differ? A Critical Analysis of Porter, Freeman, Lundvall and Nelson', in G.M. Hodgson and E. Screpanti (eds), *Rethinking Economics: Markets Technology and Economic Evolution*, Aldershot: Edward Elgar.

Mowery, D. (1995), 'The Practice of Technology Policy', in Paul Stoneman (ed.), *Handbook of the Economics of Innovation and Technological Change*, Oxford: Blackwell.

Mowery, D. and Rosenberg, N. (1993), 'The US National Innovation System', in R.R. Nelson (ed.), *National Systems of Innovation: A Comparative Study*, Oxford: Oxford University Press.

Narula, R. and Sadowski, B. (2002), 'Technological Catch-up and Strategic Technology Partnering in Developing Countries', *International Journal of Technology Management*, 23: 6, pp. 599–617.

Nelson, R.R. (ed.) (1993), *National Systems of Innovation: A Comparative Study*, Oxford: Oxford University Press.

NSF (2002), *Science and Engineering Indicators 2002*, National Science Board, Arlington, USA (http://www.nsf.govt./October/ 27/2002).

OECD (2000), *Main Science and Technology Indicators*, vol. 1, Paris: Directorate for Science, Technology and Industry, Organization for Economic Cooperation and Development.

Patel, P. and Pavitt, K. (2000), 'National Innovation Systems: Why They are Important, and How They Might be Measured and Compared', in Charles Edquist and Maureen McKelvey (eds), *Systems of Innovation: Growth, Competitiveness and Employment***,** vol. 1, Cheltenham: Edward Elgar.

Romer, P.M. (1986), 'Increasing Returns and Long Run Growth', *Journal of Political Economy*, 94: 5, pp. 1002–37.

Ruttan, V.W. (2001), *Technology, Growth, and Development: An Induced Innovation Perspective*, New York: Oxford University Press.

Siddharthan, N.S. (2004), 'Globalisation: Productivity, Efficiency and Growth – An Overview', *Economic and Political Weekly*, 39: 5 (31 January), pp. 420–22.

Savvides, A. and Zachariadis, Marious (2003), 'International Technology Diffusion and the Growth of TFP in the Manufacturing Sector of Developing Economies', paper presented in the NEUDC, 17–19 October, Economic Growth Center, Yale University.

Solow, R.M. (1956), 'A Contribution to the Theory of Economic Growth', *Quarterly Journal of Economics*, 70: 1, pp. 65–94.

——— (1957), 'Technical Progress and the Aggregate Production Function', *Review of Economics and Statistics*, 39: 3, pp. 312–20.

Stiglitz, Joseph E. (1999), 'Knowledge as a Global Public Good', in Inge Kaul, Isabelle Grunberg and Marc A. Stern (eds), *Global Public Goods: International Cooperation in the 21st Century*, New York: Oxford University Press.

Suh, Joonghae (2000), *Korea's Innovation System: Challenges and New Policy Agenda*, Discussion Paper No. 2000-4, Institute for New Technologies, United Nations University, Maastricht, The Netherlands.

UNDP (2001), *Making New Technologies Work for Human Development: Human Development Report 2001*, New York: Oxford University Press.

UNESCO (2001), *The State of Science and Technology in the World 1996–1997*, UNESCO Institute for Statistics.

US International Trade Commission (1988), *Foreign Protection of Intellectual Property Rights and the Effects on US Industry and Trade*, Washington DC: Government Printing Office.

Verspagen, B. (1991), 'A New Empirical Approach to Catching Up or Falling Behind', *Structural Change and Economic Dynamics*, 2: 2, pp. 359–79.

Wade, Robert (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*, Princeton, NJ: Princeton University Press.

World Bank (1999), *World Development Report 1998/99: Knowledge for Development*, Oxford: Oxford University Press and the World Bank.

World Bank (2003), *World Development Report 2003: Sustainable Development in a Dynamic World – Transforming Institutions, Growth, and Quality of Life*, New York: Oxford University Press.

World Economic Forum (2003), *The Global Competitiveness Report 2002–2003*, New York: Oxford University Press.

Xu, B. (2000), 'Multinational Enterprises, Technology Diffusion and Host Country Productivity Growth', *Journal of Development Economics*, 62: 2, pp. 477–93.

Yusuf, Shahid (2003), *Innovative East Asia: The Future of Growth*, New York: Oxford University Press.

Contributor details

Lakhwinder Singh is Reader/Associate Professor of Economics in the Department of Economics at Punjabi University, Patiala-147002, India. His research interests cover areas including international knowledge spillovers, national innovation systems, globalization and public policy, and comparative economic development in Asia.

Contact details

Dr. Lakhwinder Singh
Department of Economics
Punjabi University, Patiala 147002
Punjab, India
Telephone (O):91+17+2282461-66 Ext.6103&6113
Fax:91+175+2283073
Telephone ®: 91+175+2282295
E-mail: lkhw2002@yahoo.com