Discussion Papers

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Discussion Paper # 229

RIS
Research and Information System
for Developing Countries
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July 2018

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Innovation Regimes and Multilateralism: A Reflection on the Scope of New MDBs

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Abstract: We revisit technology transfer issues in climate change, trade, development and sustainability frameworks under select multilateral processes and highlight the possibilities ushered by new technological innovations in defining resource efficiency, sustainability, and inclusiveness. The scope of mainstreaming policy frameworks embedded in access, equity and inclusion principles for technology driven solutions would be an important consideration in this regard. It is observed, that despite efforts being made at multilateral platforms to overcome impediments to technology transfer and localization, existing regimes are far from being responsive. Challenges and complexities are expected to multiply with fast moving frontiers of technology under Industry 4.0. In this paper, we emphasize on the criticality of technology driven solutions for a sustainable future; and focus on the centrality of innovation debates at multilateral institutions. We propose a new lead in making progress through new actors like the new MDBs that have placed innovation and sustainability at the core of their funding principles. The MDBs can collectively influence markets and global regimes to minimise bottlenecks in technology transfer. The new MDBs are uniquely placed to adequately voice such concerns on behalf of their clientele (i.e. developing and emerging economies) and improvise on institutional approaches to promote local innovations.

Keywords: Technology transfer, Sustainable Development, Multilateral Development Banks, AIIB, NDB

Introduction

Embedding innovations in institutions, technology and modalities has emerged as an overarching paradigm in public policy and governance to mitigate challenges of the 21st century in the areas of development and sustainability. New technologies like Internet-of-Things (IoT) may be used

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The author is grateful to Prof. Sachin Chaturvedi, Director General, RIS for guidance and comments. Inputs received from Dr. K. Ravi Srinivas, Visiting Fellow, RIS and Ms. Nimita Pandey, Research Associate, RIS is acknowledged.

to connect a wide range of devices such as vehicles, mobile devices, sensors, industrial equipments, power generation and manufacturing machines, etc. to develop varied smart systems including smart city and smart home, smart grid, smart industry, smart vehicle and also smart health-care, smart agriculture and smart environmental monitoring. For example, the smart grid connects energy source, flow meter, and appliance. The smart grid optimizes energy use (cheaper and greener energy) of businesses, public transport and individuals and rationalises production and distribution of energy.

Resource-intensive economic growth has led to environmental degradation, climate change, pollution and depletion of natural resources. Sustainable practices are being mainstreamed to mitigate these challenges. Physical infrastructure is central to economic growth. Therefore, the infrastructure sector is a key focus for achieving sustainable development. In future, infrastructure would have to be less resource-intensive, energy-saving (and running on renewable energy), resilient and sustainable in facing new environmental challenges. It is imperative that infrastructure caters to all and it should be inclusive. New innovations are believed to be the only way forward for resilient and sustainable infrastructure; and in promoting innovation-driven infrastructure would be crucial in this regard. While governments play a major role across countries in creating physical infrastructure, demand for sustainable infrastructure along the lines described above is huge; and governments alone cannot meet these needs. Scope of funding of infrastructure in digital, transport, housing, renewable energy, etc. by private players remains underutilized. For example, in the case of telecom infrastructure for mobile connectivity, most investments were largely financed through private funds raised from a variety of players in the market (Mukhopadhyay, 2018). While, the governments use tax and budgetary transfers for infrastructure financing, private sector might have to rely on capitalization of user fees to cover infrastructure costs and borrowings. Much of this lending comes from multilateral development banks (MDBs), foreign and domestic financial institutions and private equity firms. It also, importantly, includes insurance

and pension funds in the case of relatively mature domestic economies. Such funds offer particular advantage of longer term lending.

In this paper, we emphasize on the criticality of technology driven solutions for a sustainable future and focus on the centrality of innovation debates at multilateral institutions to suggest the need for newer avenues of making progress through new actors like the new MDBs that have placed innovation and sustainability at the core of their funding principles. We divide the discussions under the following sections. Section I focuses on the framework of technology transfer under the climate change negotiations and highlights the achievements and impediments. In Section II, we highlight the emerging concerns of sustainable and resilient infrastructure development for urbanization and mobility where technology would play a crucial role. New innovations, particularly under the vintage of Fourth Industrial Revolution would redefine the scope of infrastructure development through transformative designs, resource efficiency and rationalized use. Section III discusses the scope of mainstreaming policy frameworks embedded in access, equity and inclusion principles for technology driven solutions. This section also caters to the enormous possibilities of digital revolution and its implications for connecting all citizens for deeper inclusiveness in the development process. Section IV is exclusively devoted to the question of localistion and how existing multilateral regimes on trade and technology have proven to be major hurdles for technology transfer and local capabilities towards innovation systems and industrialization. Section V highlights the UN initiatives on technology transfer framework for the Sustainable Development Goals (SDG), particularly in the ambit of the new Technology Facilitation Mechanism (TFM) which acknowledges the impediments to technology transfer and envisions a collective effort at knowledge sharing. Following our elaboration pertaining to technology transfer issues under climate change, trade, development and sustainability frameworks under selected multilateral processes, the final Section VI concludes with the scope of the new MDBs, particularly the Asian Infrastructure Investment Bank (AIIB) and the New Development

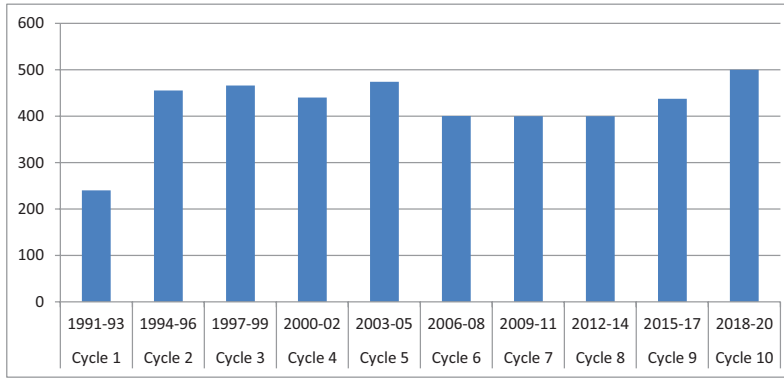
Bank (NDB) in influencing technology regimes and in mainstreaming innovations for sustainability.

I. Mitigating climate change: role of technology

The international climate change regime by and large is defined by the norms and procedures of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, among others. The international technology oriented agreements to address climate change may fall in the following four categories: 1) knowledge sharing and coordination; 2) research, development and demonstration; 3) technology transfer; and 4) technology deployment mandates, standards, and incentives. The most prominent initiatives in the area of technology transfer are: i) the Multilateral Fund under the Montreal Protocol ; and ii) Global Environment Facility (GEF). The provisions for technology transfer are driven primarily by a need to help developing countries in following a less GHG-intensive development path through access to climate-friendly technologies and through funding support to cover additional cost (Coninck *et al*. 2008). The multilateral technology transfer agreements addresses issues of technology adoption and capacity-building, apart from filling resource gaps in developing countries. Evidence suggests that most technology requirements of developing countries towards climate change mitigation are either in sustainable energy or sustainable agriculture.

The environmental effectiveness of the Montreal Protocol Fund has been substantial in achieving desired level of technological diffusion.[1] Asia, in general (including countries like China and India), and South East Asia and Asia-Pacific in particular have significantly benefitted from the projects under this fund. Since 1991, the Fund has approved activities including industrial conversion, technical assistance, training and capacity building worth over US $3.6 billion. The Fund has been replenished ten times (Figure 1).

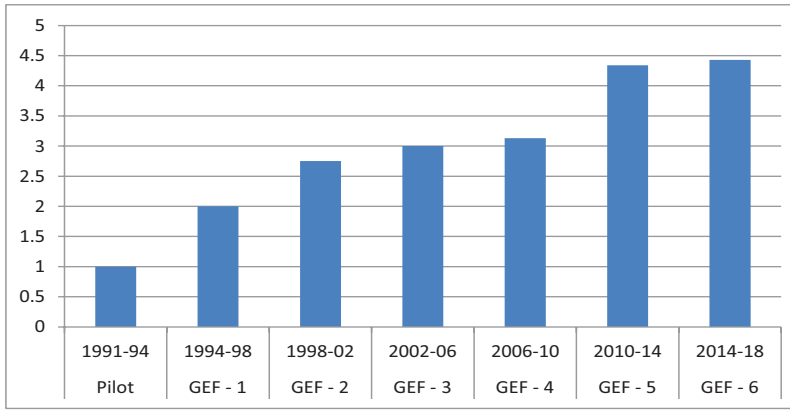
Figure 1: Montreal Protocol Fund Replenishment Cycles (in US$ Million)



Source: Multilateral Fund under the Montreal Protocol official website.

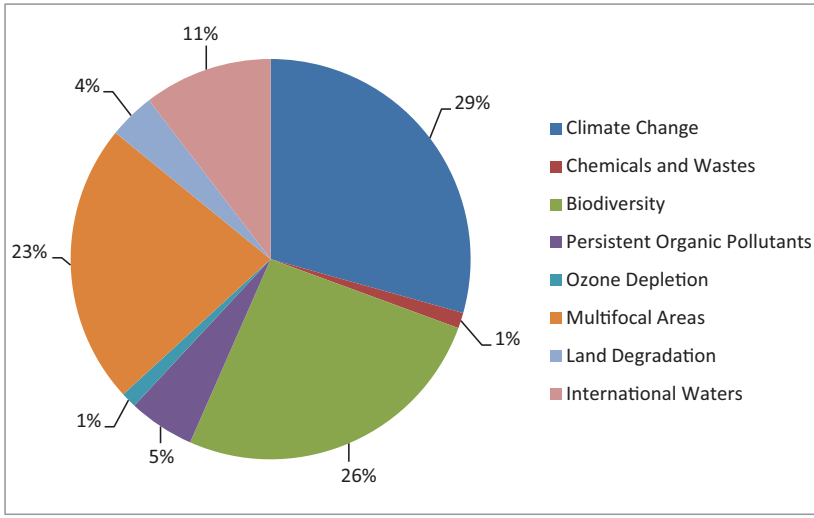
Also, the performance of the GEF (a joint initiative of the UNDP, UNEP and the World Bank), has been satisfactory. The GEF has facilitated developing countries' access to new technologies and project financing at a low cost. The GEF is generally financed from the Official Development Assistance (ODA) flows. The GEF Replenishment Cycles and funding composition till date are presented in Figures 2 and 3.

Figure 2: GEF Replenishment Cycles (in US$ Billion)



Source: GEF official website.

Figure 3: GEF Funding by Area



Source: GEF and IBRD, World Bank (2017)

It has been suggested that low carbon technology transfer is at the forefront of international climate negotiations. The promise of access to new technologies is widely recognized as a major incentive for developing nations coming on board in the UNFCCC.[2] , However, many countries are not satisfied with the progress in achieving technology transfer so far (Ockwell, 2008). A particular area of concern and disagreement between the developed and the developing countries is on the issue of Intellectual Property Rights (IPRs).[3] , While developed countries stress on strong IPR protection of new technologies in developing countries, developing countries squarely focus on the question of access. Some experts have identified that with low levels of IPR protection in developing countries, transfer of technologies could be difficult.

II. Innovation for Resilient and Sustainable Infrastructure: Roads, Urbanization and Mobility

Roads are most important of all connectivity infrastructures, connecting ports, urban centres, regions, and remote areas in difficult terrains. Existing roads have to be widened to accommodate traffic, quality of all roads new and old has to be improved even in remote areas to make them durable; and green codes have to be implemented in construction, maintenance, lighting and traffic mobility. New innovations are effective in this regard. The Prime Minister of India recently inaugurated the Eastern Peripheral Expressway (EPE) connecting highways from the eastern side of Delhi. This is the first Expressway in the country to use solar power on the entire length of 135 km. There are eight solar power plants on this Expressway with a capacity of 4000 KW (4 megawatt) for lighting underpasses and running solar pumps for watering plants. Rainwater harvesting has been installed, and plants are drip irrigated all along the expressway. Rapid urbanization exerts pressure on housing, rehabilitation of slums, fresh water supply, sewage, living environment and public health. Cities are the centres of economic activity with maximum contribution towards national income. Cities that support large populations within limited geographical areas are prone to greater damage due to disasters. Therefore, high quality, resilient and sustainable urban infrastructure, covering public transport systems, waste management, housing, renewable energy, smart technologies for efficient management of cities are proposed as tools of urban management. Efficient management of cities with the use of new-age technologies form the template for 'Smart Cities'. Smart Cities is a promising concept as it places robust integration and efficient distribution as the defining principle.

In the context of urbanisation, it is important to note that along with agglomeration benefits like economies of scale, there could be serious negative externalities in the form of congestion. Technology has enormous scope to guide agglomeration and at the same time minimise congestion to lower social and economic costs. This would be possible through coordinated use of smart devices and big data analytics with precision

acumen on demand and supply. Such predictive capacities of advanced computing and interconnected devices and systems would be hugely effective for water supply systems, solid and liquid waste management, transportation and traffic. Application of such technologies are giving visible results. Overall, with the efficient allocation of natural and physical resources in urban spaces, it is likely that resource and carbon footprints of cities would be reduced. Additionally, technology driven early warning and evacuation systems can help cities enhance their disaster management capabilities.

Urban transportation is undergoing rapid transformation across the globe to meet challenges of environmental sustainability and the need for greater connectivity. Transportation is one of the key areas of innovation that has a bearing on a low carbon future and increased well-being of citizens. Multi-modal Mass Rapid Transportation Systems (MRTS) appears to be a promising solution to ever-increasing traffic in major cities of the world. Besides roads, metro rail system, mono rail, rapid metro, high-speed railway (HSR), waterways, amphibious mobility have emerged as new modes of public transportation in many countries of the world. The IoT and host of other digital technologies would be leveraged fully for integrating various modes of transportation and by introducing technology-led solutions like smart cards for seamless movement between different modes of transportation. New technologies like IoT and Artificial Intelligence are expected to provide necessary backbone for integrated transport through autonomous operations and adjustments to peak- traffic requirements.

Inclusive innovation and opportunities in digitalization

In urban infrastructure, it is important that investments and innovations do not contribute to furthering inequities in accessing basic services and goods. Urban development often leaves out the marginalized sections of society and their needs are either not addressed or addressed through mechanisms that are market-based. Studies show that access to water, energy and housing on the one hand, and access to services like education, health-care on the other hand have an impact on standard of living and

well-being. Access is one component, and it is essential that access is equitable and inclusive. Inclusion here means that facilities and services are made available to different categories of users, including physically challenged, the poor and women. Although innovations may appear to be neutral and accessible, they may not be so in reality. On account of factors like high cost, scale and adaptability, certain sections may be excluded from using innovations or accessing them.

In case of infrastructure, there are a number of studies that indicate multiple inequities contributing to unequal access and utilization. Infrastructure needs of poor neighborhood and areas where poor and immigrants are concentrated may not get priority in planning or in adopting innovations. The lack of access to energy can also result in lack of access to energy-efficient lights, etc. Similarly in case of health services and education, adoption of innovations may be delayed or simply denied.

Responsible Research and Innovation (RRI) framework, which finds its genesis in the policy debates of the European Union (EU), in relation to science and society interface primarily in the developed world emphasizes on ethics, social relevance, access to scientific information and public engagement. In the Indian context, Access, Equity and Inclusion (AEI) framework has been pursued to evaluate Science and Technology (S&T) policy and outcomes. The significance of these perspectives lie in incorporating and improving discourses on technology-led exclusion, discrimination and socio-economic disparities. The AEI framework should help in understanding how access is linked to innovation and infrastructure and also help in mapping inequities in access, equity and inclusion in the urban areas. More importantly it can be used to sensitize on the need to be aware of factors that exacerbate current inequities.[4],

Digital technologies offer enormous opportunities towards achieving economic inclusion within a shorter time span (RIS and MoF, 2018). The scale of AADHAAR-based intervention in India is much larger than similar efforts elsewhere. The Aadhaar programme has already achieved number of milestones, and is by far the largest

biometric based identification system in the world. Aadhaar is used as a unique identification number, and facilitates financial inclusion of the underprivileged and weaker sections of the society, and is therefore a tool of distributive justice and equality. Aadhaar identity platform with its inherent features of Uniqueness, Authentication, Financial Address and e-KYC, enables Government of India to directly reach citizens in delivery of subsidies, benefits and services by using resident's Aadhaar number only. Some of the other key initiatives include India BPO Promotion Scheme, Software Procurement Policy for faster delivery and effective monitoring of services, Tele-law through Common Services Centers (CSCs) to mainstream legal aid in rural India, among others. The CSCs have been effectively used to reach out to the last mile and bridge the gaps between the urban sector and rural sector.

Innovation for Localization – Implication of Technology Regimes

Generation of knowledge in developing countries happens largely through technological learning and often these countries are neither in a position to purchase proprietary knowledge nor appropriate indigenous knowledge resources. Hence, knowledge is vehemently looked upon as a public good by them and universal access to knowledge resources is of critical importance. Early industrialization created technological leaders in the west. The large constituency of developing countries elsewhere only had the option of maturing through technological learning. Technological change implies technological learning, improvements in cognitive abilities of the workforce and firm-level adoption and adaptation of technologies leading to productivity gains. Immediate effects in terms of technical change may be in the form of minor innovations which are equally important as the source of productivity improvement as major jumps in the frontier. The IPR regimes greatly facilitate and influence extent of technological learning that a country achieves. For developing countries, appropriate IPR regime would encourage spontaneous technological

learning and catch-up. In many of the developed nations, in the initial stages of development a not-so-strong IPR environment helped rampant industrialization.

Evidence indicates that stronger IPR in the South accelerates the rate at which multinational production is transferred to Southern countries (Branstetter *et al*. 2006). However, this may not be uniformly true for all products/sectors of production (Bilir, 2014). Multinationals are more likely to respond to changes in the IPR regime when products have longer life cycles (e.g. in automobiles) suggesting lagged imitation risks in the South that get further minimized due to stronger intellectual property protection. In segments, where life-cycle of products is short (computers and electronics), imitation risks are low and hence there may not be any perceptible change in the behavior of multinationals in response to changes in the provisions of the IPR laws. This is likely to be to be true for most of the new technologies in the class of Industry 4.0.

The optimum level of patent protection remains a puzzle. It is generally accepted that although patents create incentives for innovations, it could potentially limit chances of innovation through extended monopoly. The patent system needs to be vigilant towards IPRs posing a hindrance to innovation and it should not suppress innovation potential of developing countries. Jeopardizing local innovation capabilities could come at a cost for the developing world and may hamper local supply of knowledge. Hence, a private rights driven model would end up supplying sub-optimal level of knowledge globally. While Trade Related Intellectual Property Rights (TRIPs) secured an overwhelming mandate for itself, the balance between IP rights, innovation and developmental priorities appear nonetheless elusive.

The fundamental issues around Industry 4.0 going ahead will be capability to produce; ability to connect; and capacity to use. Policy framework ignoring any one of these would result in sub-optimum and even adverse outcomes. It is noted that the trade policy regime in the form of Information Technology Agreement (ITA) might have generated unequal gains across countries and led to reduced production of ICT

goods in many countries, including India. China has benefitted most among developing countries.[5], The dynamism in changing pattern of trade in information technology goods as presented in Table 1 shows unequal distribution of production capacities across countries, and the divergence in performance between China and India. On the other hand, most knowledge underlying Industry 4.0 would eventually be proprietary and would potentially be owned by a few companies based in selected countries.[6] , Integration into new age supply chains, information networks, data repository would be critically linked with access to relevant knowledge in other countries and societies. Innovation systems fostering widespread innovation under Industry 4.0, technology pooling and open source models across countries are highly desirable.

Table 1: Trade in Information Technology Products of Selected Countries (USD Billion)

Selected Countries	X= Exports M= Imports	1996	2000	2005	2010	2015	2016
China	X	14.46	40.29	213.64	450.86	639.63	585.14
	M	20.43	52.65	199.01	355.46	479.28	461.32
Germany	X	50.80	67.02	115.02	116.09	118.50	121.10
	M	50.68	70.70	107.53	114.18	114.10	115.81
India	X	0.76	0.88	1.97	6.52	4.68	4.89
	M	1.67	3.50	12.99	26.03	39.29	39.44
Japan	X	104.50	141.68	144.76	145.51	105.12	112.10
	M	49.13	70.76	79.80	88.32	96.70	94.63
Republic of Korea	X	28.37	55.14	87.95	113.48	141.10	134.95
	M	27.39	43.65	59.22	79.51	89.38	88.24
United Kingdom	X	42.94	59.15	60.53	32.57	30.57	29.06
	M	47.66	76.04	69.98	57.96	58.71	54.16
United States	X	134.20	201.41	170.12	184.42	200.99	198.78
	M	148.94	234.86	237.43	278.18	351.63	351.69

Source: Chaturvedi *et al* . (2016)

SDGs and UN Mechanisms on Technology Transfer

The year 2015 was a milestone in global partnership for development and sustainability. Following the adoption of the much hailed global compact in the form of the Agenda 2030 for Sustainable Development and the underlying Sustainable Development Goals (SDGs), world leaders also agreed on the Paris Climate Agreement. Implementation of the SDGs, which comprise interconnected goals practically covering all aspects of economic and social development , is slated to be hugely challenging. This essentially suggests that the developed world has to embark on a path of sustainable production and consumption, and the developing countries would have to balance their unmet developmental needs against environmentally sustainable pathways. No doubt, the advanced countries have easier access to resources and technology, the dual means of implementation identified by the Agenda 2030.

Technology holds the key in defining and designing sustainable pathways.[7] , To ease difficulties faced by developing countries in this regard, some countries (led by India, Brazil and France) while negotiating the Agenda 2030 came up with a novel idea, which was finally adopted, known as the Technology Facilitation Mechanism (TFM). This new initiative under the auspices of the UN is being developed as a nodal centre that can consolidate similar efforts by other UN agencies, serve as an informational hub of innovations and create a platform of stakeholder engagements. The work on operationalising this facility is in progress and careful audit of conceptual, systemic and institutional challenges are being carried out. Regional assessments, initiatives, models and templates may be used in shaping global technology transfer regimes. The institutional barriers impeding technology transfer has to be overcome through appropriate negotiations and partnerships between countries and stakeholders. New models based on mutual benefit have to be developed. In this context, existing international technology transfer frameworks and the new TFM under the UN are expected to facilitate implementation of the SDGs. The scope of cooperation in strengthening this architecture as well as to devise means to benefit from it is significant.

The UN has undertaken several initiatives over the years to address the challenge of technology gap between developed and developing countries for environmentally sound technologies. Notable among these are the following: The Multilateral Fund under the Montreal Protocol; the Climate Technology Centre and Network of the UNFCCC; National Cleaner Production Centre Initiative; Green Industry Platform; GEF; and the Green Climate Fund (the GCF). The Green Climate Fund was started in 2011 under the UNFCCC to promote the shift towards low-emissions and climate-resilient development pathways. The GCF secretariat is hosted in South Korea.

As envisioned in the 2030 Agenda, the TFM should effectively contribute to the implementation of the agenda. To get the mechanism to deliver expected results, it has to be robust and larger in scale and scope than ongoing initiatives under the UN. The experience gained through ongoing initiatives should be key building block of this new institutional framework. However, the framework so developed should remain unique in its scope and modalities. The scale should solely be determined by the volume of global needs and the multitude of feasible solutions. The resource needs and the sophistication requirements for this new institution, therefore, would only be larger. To ensure that it achieves its full scale, effective partnership and collaboration has to be constituted within the UN System and deeper confidence building with national governments has to be pursued. The credibility and sustainability of this mechanism would depend on the extent to which it achieves its objectives.

Way Forward: Collective Role of MDBs in Futuristic Infrastructure and Innovation

Benefits of use of the Industry 4.0 vintage of technologies would be far reaching in terms of infrastructure development towards:

- public health monitoring and prevention;
- efficient management of water supply, irrigation, solid and liquid wastes;

- agriculture, soil health, land planning, cropping pattern, food security and reduction of food waste;
- housing, habitat and transport planning;
- monitored energy consumption and use
- entrepreneurship and innovation;

These point towards centrality of technology and innovation in achieving sustainable development and in fulfilling targets placed under the Agenda 2030 and the Sustainable Development Goals (SDGs).

Industry 4.0 is still in its early phase. There are apprehensions that massive use of technology would replace human labour with significant social impact. However, it is also suggested that immediate employment effects of Industry 4.0 may not be linear given long-term comparative advantages of demography and labour endowment in some countries and disadvantages of ageing population in others. While it is imperative that governments, institutional investors, MDBs and the private sector should strive towards promoting the flow of new technologies, much would depend on specific country contexts and associated technology choices. Therefore, it is also likely that operational feasibility, financial viability, and societal scope of infrastructure development spanning transportation, connectivity, urban amenities, etc. would be determined through big-data analytics.

The MDBs have played a very important role in providing concessional finance and technical assistance to developing countries. Yet, development gaps are widespread and economic growth is uneven. Performance of Emerging Economies is impressive but dangers of the 'middle income trap' are real. Infrastructure needs are not static given aspirations of higher economic growth. This is coupled with additional demands of retro-fitting and replacing older infrastructure, new age mobility and urbanization projects that are smart, sustainable and resilient, transition to renewable energy and clean and green

industrialisation. Innovation has widened technological options much faster in recent decades. However, access to innovations and capacity to innovate are not uniform across countries and regions.

The MDBs signify collective efforts at resource mobilisation and have sophisticated institutional apparatus to channelize resources to critical sectors which have strong multipliers and interconnections with economic growth, development and sustainability. However, global needs of development finance are much beyond the capacities of MDBs alone, and thus partnerships and collaborations would be important. Nevertheless, the MDBs have higher credit credentials and bigger clout than other institutions to influence resource and knowledge flow. To influence future trajectory of sustainable development, it is not only resources but also knowledge and innovation that would be critical. New innovations are expected to be 'cost-saving' either from a static or a dynamic perspective. Such costs include physical costs, environmental and social costs.

It is imperative, therefore, to encourage innovation and knowledge flow. It has been argued that commitments on the access to new technologies are central for developing nations to participate in climate negotiations. However, such commitments to technology transfer are not strictly followed by advanced countries. Perceptions on rights and access over knowledge are divergent between developed and developing countries. Therefore, older regimes and standard approaches need to be re-evaluated when it comes to knowledge-sharing in order to bring down transaction costs in knowledge. The MDBs can collectively influence markets and global regimes to minimise bottlenecks in technology transfer and support innovation ecosystems, which in turn, would thrive on technology flow, knowledge exchange, innovation networks and knowledge spill-over.

Endnotes

[1] Since the Montreal Protocol came into effect, the atmospheric concentrations of the most important chlorofluorocarbons and related chlorinated hydrocarbons have either leveled off or decreased.

[2] The Climate Technology Centre & Network (CTCN) is the operational arm of the UNFCCC technology mechanism. This mechanism hosted by the United Nations Environmental Programme (UNEP) and the United Nations Industrial Developmental Organization (UNIDO) and is supported by other institutions specialising climate technologies. The CTCN is expected to promote the transfer of climate technologies and promote development and deployment of climate technologies for energy-efficient, low carbon and climate-resilient growth trajectory of developing countries. This also serves as a knowledge sharing platform on climate change technologies and provides technical assistance to developing countries to help strengthen network, partnership and capacity building for climate technology transfer.

[3] Srinivas (2009) concludes that the dominance of developed countries in specific technologies is evident from patent statistics. The analysis on specific technologies indicates that IPRs is an important issue in development and transfer of technology and it is a barrier. Data indicates that although developing countries have made some progress, the dominance of developed countries in terms of patents, royalty and licensing income and expenditure on Research and Development remains as before. The historical experience is that stronger IPRs do not always result in more technology transfer and technology absorption. Hence the argument that developing countries should provide stronger protection of IPRs to encourage technology transfer has to be challenged. The technology transfer under UNFCCC and Kyoto Protocol has been minimal and insufficient to meet the needs of developing countries.

[4] Chaturvedi et al (2015) elaborates that Access and Equity are linked with inclusion. Access to benefits of advances in S&T and deriving the benefits of technological advances is important. While, access is an important value, equity is a contested term. Iniquitous distribution of benefits of advances of S&T and/or bearing the disadvantages from developments in S&T without deriving any benefits indicates that S&T policies can exacerbate persisting inequalities in the society and thereby contribute to widening disparities or worsening of the condition. The paper argues that AIE could be considered as ethical principles that would help in assessing impacts of S&T policies and their outcomes. This also means S&T policies should ensure that policy design or institutional frameworks do not reduce access, result in more exclusion and more iniquitous distribution of benefits.

[5] Chaturvedi et al (2016) highlights that China's export for IT products was way

behind developed countries like US, UK, Germany, Japan, and South Korea in 1996. However, China overtook the United States in 2004 to become the world's leading exporter of information and communications technology (ICT) goods such as mobile phones, laptop computers and digital cameras. China remains the world's top exporter of all main categories of ICT goods. China is also the top importer of ICT goods, accounting for 18 per cent of world imports and 34 per cent of all electronic component imports, including re-imports from Hong Kong (China) (UNCTAD, 2014).

[6] Post ITA, US Multinational Companies (MNCs) were increasingly investing in manufacturing in low cost countries like China. EU and Japan have been ahead in manufacturing and innovations of IT products and are aggressive players in ITA. The US has been one of the biggest beneficiaries of the ITA. Not only did US exports in particular product categories like semiconductor increase (US presently holds 50 percent market share in semiconductors globally) after ITA was adopted by the signatories, ITA also provided a big push to the expansion of Global Production Networks (GPNs) of US ICT companies (Ernst, 2014).

[7] According to Chaturvedi and Saha (2016) the importance of S&T and availability of innovation driven solutions, particularly to mitigate and address sustainability challenges globally has been a central theme in all important global platforms in the recent past including the Rio+20 process that led to the 2030 Agenda for Sustainable Development, the Third International Conference on Financing for Development (FfD3) leading to the Addis Ababa Action Agenda, the Climate Change negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) including COP 21 and the Istanbul Plan of Action (IPoA) for the Least Developed Countries (LDCs). The FfD3 prioritising S&T delivery perhaps signals collective willingness to address issues of resource availability and financing of a global mechanism to facilitate and support the process.

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