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TECHNOLOGY AND INNOVATION REPORT 2012

Innovation, Technology and South-South Collaboration

OVERVIEW

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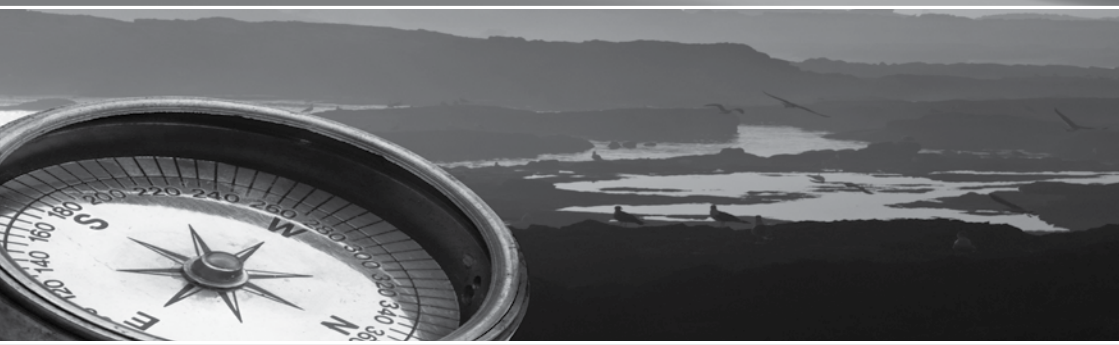

UNITED NATIONS
New York and Geneva, 2012

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UNCTAD/TIR/2012 (Overview)

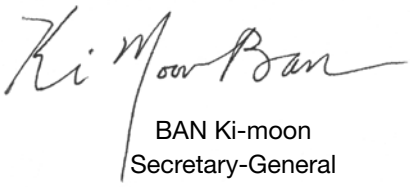
PREFACE

There is no doubt about the potential of rapid technological progress to help the world meet the defining challenges of our time. Yet for many individuals in the developing world, access is still a major challenge, hindering their ability to learn how to use technologies that would improve their lives and promote enterprise development. That challenge is multiplied many times over for national policy makers seeking to use technologies to address energy poverty, food insecurity, environmental threats and job creation.

Bridging the technological divide has become a core concern of the United Nations. If we are to build on and expand the progress that has been made toward the Millennium Development Goals, the international community will need to find innovative ways of closing this gap.

The increasing capacity of a growing number of countries in the South is a promising dynamic that signals the beginning of a new era in global development. As more and more developing countries embark on the process of industrial catch-up, South–South cooperation can help to address the technological divide.

UNCTAD's *Technology and Innovation Report 2012* focuses on how South-South collaboration can help address key capacity questions faced by developing countries. The information and analysis contained in this report mark a welcome contribution to the efforts now getting under way to establish a set of Sustainable Development Goals and to outline a post-2015 development agenda. I encourage governments and development partners to carefully consider the report's recommendations as we consider how best to promote equitable, sustainable and inclusive development for all.



BAN Ki-moon
Secretary-General
United Nations

ACKNOWLEDGEMENTS

This Technology and Innovation Report was prepared by a team led by Padmashree Gehl Sampath (Main author and Chief, Taskforce on the Technology and Innovation Report Series), Abiy Solomon and Bertha Vallejo. It was prepared under the overall guidance and direction of Anne Miroux, Director of UNCTAD's Division on Technology and Logistics.

Inputs were provided by Biswajit Dhar (Director General, Research and Information Allied Systems, New Delhi), Dic Lo (School of Oriental and African Studies, University of London) and Professor Nicholas Vonortas (Georgetown University). The contribution of Mongi Hamdi, Former Head of Science, Technology and ICT branch, UNCTAD is acknowledged.

An ad hoc expert group meeting was organized in Geneva to peer review the initial draft of the Report. The comments and suggestions provided by the following experts at the meeting are gratefully acknowledged: Carlos Eduardo Fernandez da Silveira (Director of Studies on Innovation and Sectoral Policies, Regulation and Infrastructure Department IPEA, Brazil), Dic Lo (Senior lecturer in Economics at the School of Oriental and African Studies, University of London), Emmanuel Nnadozie (Director, United Nations Economic Commission for Africa, Addis Ababa), J.R. Bangera (President, Federation of Karnataka Chambers of Commerce and Industry), Kevin McCarthy (Policy Coordinator, DG Development and Cooperation – Europe-Aid, European Commission), Banji Oyeyinka (Director, UN-HABITAT), Ken Shadlen (Political Scientist, Department of International Development, London School of Economics), Alfredo Saad-Filho (UNCTAD) and Kiyoshi Adachi (UNCTAD). Comments were also received from Carlos Correa (Director, Centre for Law and Economics, University of Buenos Aires, and Advisor, South Centre), Richard Kozul-Wright (UNCTAD) and Torbjorn Fredriksson (UNCTAD).

Research assistance was provided by João Paulo Cavalcante. Sophie Combette was responsible for the layout. The report was edited by Praveen Bhalla.

CONTENTS

OVERVIEW

I. SOUTH-SOUTH COOPERATION IS BECOMING INCREASINGLY IMPORTANT

As more and more developing countries embark on the process of industrial catch-up, it is expected that the new growth poles will increasingly contribute to a changing dynamics in international relations. A process that began with the rapid industrialization of the first- and the second-tier East Asian economies in the 1960s and 1970s[1] has been followed by accelerated industrial growth in a newer set of what are often referred to as emerging countries – India, China, Brazil and South Africa. This ongoing but punctuated process is expected to continue, with additional countries (such as Nigeria and Egypt) experiencing similar growth in the future.

Economic expansion and growth in these countries is attributable to several important and interrelated factors: their growing capabilities in manufacturing and services, greater investments in technologies and efficient use of opportunities arising from globalization. In addition, rising per capita incomes and concomitant growth of domestic demand have further boosted their growth performance. The steady economic growth of these countries has translated into an increase in South-South cooperation in trade, investment and technology over the past two decades, enabling them to become significant global trading partners with other developing countries in the 2000s (table 1).

Table 1: Evolution of trade relationships between developed and developing countries and regions, 1995 and 2010 [a] (Percentage of total trade)

	Importers					
	Developing countries	Developed countries	Others	Developing countries	Developed countries	Others
	1995			2010		
Developing countries	41.58	57.64	0.78	55.82	41.88	2.31
Latin America and the Caribbean	28.91	70.10	1.00	40.42	58.45	1.13
Southern Africa	59.21	40.64	0.15	52.93	46.60	0.48
South Asia	41.22	56.37	2.41	64.74	32.53	2.73
South-East Asia	44.91	54.64	0.45	64.63	34.42	0.95
East Asia	46.04	52.90	1.06	56.33	41.23	2.44
West Asia	38.20	59.69	2.11	55.48	41.29	3.24

Source: UNCTADstat.

a The figures presented in the table add up to 100 per cent horizontally for each of the years, 1995 and 2010.

b. Note: Southern Africa comprises: Botswana, Lesotho, Namibia, South Africa, Swaziland. South Asia comprises: Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka. East Asia comprises: China, Democratic People's Republic of Korea, Hong Kong (SAR of China), Macao (SAR of China), Mongolia, Republic of Korea, Taiwan Province of China. South-East Asia comprises: Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Singapore, Thailand, Lao People's Dem. Republic, Philippines, Timor-Leste, Vietnam. West Asia comprises: Bahrain, Iraq, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Turkey, Yemen. Latin America and the Caribbean comprises: Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guyana, Haiti, Honduras, Jamaica, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela

Ongoing South-South cooperation is not restricted to economic factors alone. Some developing countries, along with their strengthening economic clout, are contributing towards reshaping global trade, aid and economic relations. This is partly reflected in their increasing contributions to development cooperation and assistance. Recent studies estimate that development assistance by developing countries has been growing steadily, amounting to $7.3 billion in 2010 (OECD, 2010).[2]

These developments point towards the emergence of a new paradigm for international development, which could extend the existing boundaries of engagement to include those developing countries – particularly least developed countries (LDCs) – that are currently marginalized in the global economic system.

1. Greater South-South cooperation could benefit all developing countries

Rising South-South trade and investment trends have been viewed positively as a signal that some developing countries could provide a significant impetus to growth in developing countries. The literature identifies two main aspects of cooperation among developing countries. First, such cooperation would help the South to decouple from the global cyclical trends of growth, thereby promoting a new form of stability in the global economic system. Second, since the emerging countries are still in their development phase, they are better placed to understand the problems of development, particularly in the current global context, and could provide a new model of cooperation and technical assistance in relation for developing countries.

Moreover, growing South-South cooperation carries with it the promise that it could be channelled into addressing specific development goals. Realising the full potential of South-South cooperation will require significant changes in the way the global economy is governed, to make it more development-oriented. Ways and means to achieve this will also need to be fully explored through policies and practices at the national and regional levels.

Against this background, this *Technology and Innovation Report – TIR 2012* – argues that the time is ripe to move beyond analysing current trends in South-South trade and investment. Specifically, it is important to consider how and to what extent South-South cooperation could help developing countries overcome certain obstacles to economic expansion and growth in order to achieve specific development goals. One such goal, which continues to elude the global community, is to bridge the technological divide so as to promote industrialization and inclusive growth across the developing world.

2. The South can complement the North in promoting technological learning and innovation capacity

Technology and innovation are both difficult to assess within economic transactions, and there is no single indicator that measures them holistically. A long history of empirical research has uncovered a number of international factors shaping the

process of technological change and productivity growth. One factor that is a significant contributor to technological learning and capacity-building is the import of capital goods. Participation in global production networks (GPNs) – and in customer-supplier-retailer relationships in these networks – along with foreign direct investment (FDI) are other factors that can promote learning and the building of capabilities through technological spillovers to local firms, either directly through licensing and technology transfer, or indirectly through tacit know-how accumulation by local personnel. These are often supported by other means such as copying, interacting with foreign clients on design, standards and quality requirements, and collaboration in joint ventures.

The impact of these channels on the building of capabilities depends on the presence of some level of absorptive capacity within countries. But since institutions in many developing countries, particularly LDCs, tend to be weak, they are likely to be challenged in their quest to use South-South trade and investment to build their technological capabilities and promote activities leading to structural change and diversification of their economies.

In order to overcome these limitations proactive policies are needed at various levels of South-South exchange. Emerging countries have used a variety of measures to overcome barriers to trade and intellectual property rights (IPR) protection in their own economic development, which can provide important lessons for other developing countries. Their successful experiences show not only how technological capabilities can be built, but also what policy measures could potentially be used to promote national development in the context of the existing multilateral trade regime. The similarity of their developmental experiences is important, deriving from their past path-dependent constraints on promoting sustainable development.

Sharing of experiences amongst developing countries and strengthening their collaboration remains essential and relevant for countries that are still grappling with ways to create harmonious and coherent local innovation and industrial policy environments. Recognizing this, both policy and scholarly analyses have begun to give greater attention to what lessons can be drawn from experiences of emerging countries for development in general, and the process of capabilities building, in particular.

A second and perhaps more appropriate advantage of developing countries for fostering technological learning in the South is that most of them have followed similar pathways in building their capabilities: from reverse engineering to

incrementally innovating in products and processes, to increased research and development (R&D) and operating at the technological frontier itself. Even in the developing countries that can be termed as emerging, while there are a number of industries that are at the technological frontier globally, many other industries or firms face routine constraints on innovation similar to those prevailing in other developing countries, including LDCs. This implies that, to varying extents, these countries are still confronted with some basic issues relating to promoting the technological absorptive capacities of their systems as a whole.

The similarity of many of these challenges to innovation lends support to the view that the technologies produced by developing countries may often be much more accessible – and contextually appropriate – to other developing countries and firms, thus highlighting the importance of promoting greater South-South collaboration in this area. Collaboration on technology and innovation is perhaps one of the most critical components of South-South solidarity, offering a real promise of sustainable development throughout the developing world. However, because such collaboration still takes place between developing countries at very different levels of development, it necessarily involves some pressures as well as opportunities for many developing countries. Pressures include conforming with certain requirements imposed by various agreements on international trade and IPR regimes, among others (such as obligations relating to climate change mitigation and adaptation, the transition towards a green economy, and IPRs protection), while ensuring inclusive and sustainable industrial development.

3. Technology and innovation-based collaboration may not be automatic

Given the potential of South-South cooperation to promote technological learning, there is clearly a renewed interest in this area. Key policy considerations include how ongoing South-South cooperation could be oriented to foster technological and innovation capacity, and how the technology needs of all developing countries and LDCs could be integrated into a balanced agenda of cooperation and exchange.

In the classical development economics discourse, economic growth is considered to be a process of mobilizing and combining complementary factors to shift the production structure of economies and extend the production frontier. Those factors are capital accumulation, technological change and economic diversification. In the context of developing countries, however, economic growth, on the one hand, and technology and innovation capacity on the other have a mutually reinforcing relationship. Technology and innovation capacity play an important role in boosting

economic growth of the kind that results from changes in the structure of production. Economic growth often enables technological learning and greater sophistication, and at the same time, technological capabilities are critical for ensuring that growth is of a productive nature and can be steadily maintained.

However, these mutually supportive linkages do not emerge spontaneously. Particularly, in the context of South-South exchanges, while there is potential for continued growth of trade and investment that can result in technological learning, much still needs to be done to harness that potential. Firms seeking to expand through a search for newer markets and economies of scope and scale may have only limited incentives to engage in collaborations/ joint ventures with host-country firms. These incentives are usually market-based, depending on the specific attributes of the host country firms that make them attractive partners. This could include their extensive marketing and distribution networks in the host countries, or their specific R&D capabilities or technological expertise, or their ability to produce particular products competitively. However, such market-related incentives only entice firms to enter into alliances with firms in host countries that have some level of expertise, as demonstrated by the value addition they create in return. Relying on such incentives for technological learning is misleading, since they are not sufficient to entice firms on their own to enter into technological learning alliances with partners who have little or low levels of technological expertise.

Moreover, despite the significance of these issues, the literature on South-South technological cooperation is quite scarce, and generally focuses on how pressing international challenges, such as public health and climate change, can be addressed through cooperation amongst developing countries. The analysis tends to be rather general, and data on issues of technological change and innovation capacity are scarce or not easily available. This Report seeks to fill this gap and aims to contribute new policy insights in this complex area.

The Report argues that the similarity of development experiences of the countries of the South (particularly in promoting innovation capacity), and the contextual appropriateness of their technologies, makes them essential complements to existing North-South interactions. The central message of *TIR 2012* is that developing countries, particularly emerging countries, can be important partners for promoting technological capabilities in the South, and therefore analysing how South-South collaboration for technology and innovation can be promoted in a systematic way to promote inclusive sustainable development should be a priority.

Hence, the Report focuses on whether South-South exchanges could lead to building technological capabilities, and under what circumstances. From an analysis of the current patterns of South-South exchanges on technology and innovation issues, the Report seeks to identify key issues in this area, and derive best practices for moving forward in fostering South-South collaboration on technology and innovation.

II. A RICH LANDSCAPE OF SOUTH-SOUTH EXCHANGE IS EMERGING

The growing economic and commercial interests of some developing countries have been fuelling market expansion and some level of technological collaboration with other developing countries. Within these transactions, imports of capital goods and growing participation in GPNs may help local firms accumulate knowledge, not only relating to technical aspects of production, but also to managerial, business and quality-related aspects. FDI and licensing can also have important implications for technology acquisition and learning in some contexts. However, to what extent this holds, and whether economic growth in the South and the resulting rise in South-South trade and investment do indeed contribute to greater technological learning and development of innovation capacity remain pertinent questions from both theoretical and policy-making perspectives.

1. Developing countries are increasingly importing capital goods from the South

Developing countries have surpassed developed countries as major partners of other developing countries for trade in capital goods. Capital goods imports are not only inputs for the expanding economic activities and consumption patterns in these countries, they also show that developing countries, particularly emerging countries, are increasingly offering competitive products in a variety of industries involving a range of technologies.

Available data show that there has been a marked increase in trade in capital goods among developing countries since the mid-1990s. Indeed, overall trends show a clear shift away from developed countries as sources of such goods for developing countries during the period 2005–2010, especially after the economic slowdown in 2008. As part of rising South-South trade, the share of developing countries' imports from other developing countries has increased steadily, from 35 per cent in 1995 to 54 per cent in 2010 (table 2), which indicates that developing countries have become the main sources of capital goods for other developing countries.

Table 2: Regional share of imports of capital goods in total imports from developing and developed countries, 1995 and 2010 (Per cent)

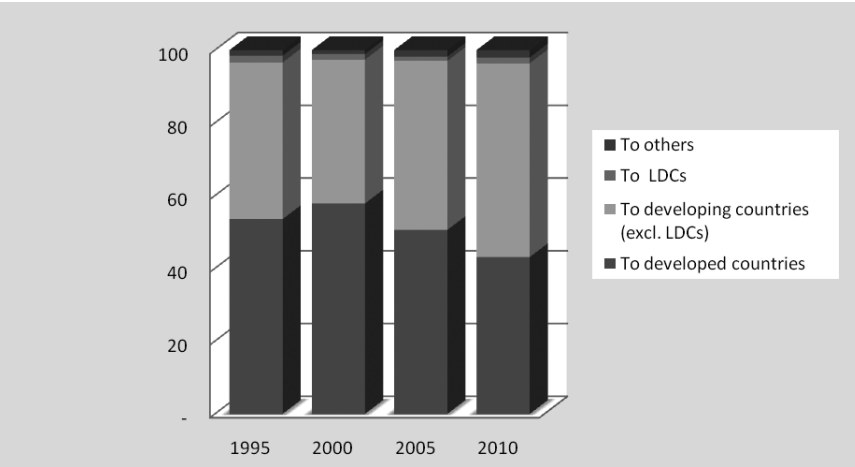
	Importers					
	Developing countries	Developed countries	Others	Developing countries	Developed countries	Others
	1995			2010		
Developing countries	35.36	62.21	2.43	53.99	43.78	2.23
Latin America and the Caribbean	30.42	68.80	0.79	39.27	60.02	0.71
Southern Africa	..	..	..	57.90	41.46	0.64
South Asia	32.45	65.00	2.56	56.06	42.36	1.57
South-East Asia	44.13	55.43	0.44	62.57	36.67	0.76
East Asia	45.52	53.73	0.75	50.21	47.03	2.76

Source: UNCTADstat.

Growing imports of capital goods by developing countries implies the expanding capacity in the South to produce goods, at least in some countries. It also shows that imports of these goods by other developing countries are on the rise as part of their increasing efforts to promote productive capacity. As noted earlier, such imports are important for building productive capacity, since they can result in the transfer of technology to the extent that the imported goods are studied for design characteristics and reverse engineering. They can also directly improve productivity when they are employed in production processes. The impact of imports of capital goods in terms of enhancing productivity in developing countries is reflected in part by the increasing share of manufacturing exports from developing countries as a whole, a large part of which is also sourced to other developing countries (figure 1).

Within these broad trends, there has been a consistent increase in imports of high-technology-intensive goods by developing countries. A closer look at the growing technological intensity of South-South imports shows that, on average, over 53 per cent of all high-technology products imported by developing countries as a group was sourced from other developing countries in 2010 (table 3). Comparing the level of technological intensity (low, medium and high) of developing-country imports, there was a larger share of manufactured imports of high skill and technology intensity than those of medium skill and technology intensity. These trends strengthen the notion that developing countries are increasingly able to export technology-intensive goods globally, and particularly to the South.

Figure 1: Distribution of manufacturing exports of developing countries, 1995–2010 (Per cent)



Source: UNCTADstat.

Table 3: Imports of capital goods with high technology intensity sourced from developing countries as a percentage of total imports, by regional groups, 1995 and 2010

	Importers					
	Developing countries	Developed countries	Others	Developing countries	Developed countries	Others
	1995			2010		
Developing countries	24.85	74.07	1.08	53.04	46.23	0.73
Latin America and the Caribbean	26.62	73.31	0.07	34.14	65.35	0.51
Southern Africa	..	..	..	58.60	40.74	0.66
South Asia	52.13	37.76	10.11	47.60	45.06	7.34
South-East Asia	42.93	56.64	0.43	54.61	44.82	0.56
East Asia	42.14	57.19	0.67	64.67	33.89	1.44

Source: UNCTADstat.

2. Developing countries are increasingly participating in global production networks

A predominant factor explaining the rising trend in technology imports is the growth of GPNs, driven by some of the more technologically advanced developing countries. Another factor is the increasing domestic demand in some of the emerging countries – particularly China and India – due to their large populations and the growing purchasing power of their growing middle classes, which is leading to a surge in imports of technological products from other countries in the South into these economies. Many of these imports, as data trends show, serve to meet growing demand driven by the expanding economic activities and consumption patterns in these countries. Moreover, some emerging countries are able to manufacture several high-technology products at competitive prices, resulting in a shift in developing-country imports from developed countries to developing countries.

However, these trends are uneven across regions, and are largely explained by the existence of production networks in countries in East Asia, and more recently in South-East Asia and South Asia. These countries have progressed in technological sophistication as illustrated by their ability to produce high- and medium-technology-intensive products using advanced processes. This further facilitates their ability to absorb newer products that also embody high skills and technology intensity much better than some of the other regions shown in table 3, such as Southern Africa. Similar trends can be observed with respect to medium-technology-intensive imports.

Generally, a country can import capital goods so long as it can pay for them. However, what remains important for productivity growth is how these imports are channelled effectively into generating future income. This relates to how firms and sectors are able to adapt and use technologies embodied in these imports to generate productivity growth. So long as this is possible and evident, it would lead to the conclusion that such imports of capital goods are contributing to building technological capabilities in developing countries. On this aspect, two trends stand out.

First, developing countries that already have a minimum level of technological capabilities are engaging in extensive trade in capital goods with other countries of the South. This points to the importance of some level of technological capabilities to participate in capital goods trade, underscoring the fact that while any country

can import capital goods, those that consistently participate in trade in such goods use many of these imports to enhance their production capacities.[3] The second trend, which to some extent supports the first, is that there is a significant overlap between countries that import capital goods and those that export technology-intensive goods. Hence, a sub-set of developing countries that already possess some level of technological capabilities are able to leverage ongoing trade and investment to further boost their technological capabilities and innovation capacities.

This does not completely exclude the presence and importance of technological transactions in other countries of the South. But it points to an important result that many are limited by the smaller size of their markets, lower ability to pay and the lower technological intensity of their overall economic activity.

Trends in imports of machinery and transport equipment show a widening gap among developing countries, confirming the overall trends presented here regarding the technological capacity of countries. Developing countries as a group increased their imports of machinery and transport equipment as a share of global imports of this category from 27 per cent in 1995 to 53 per cent in 2010. However, countries with lower technological capacities, such as a large number of LDCs, increased the share of their imports of this category from only 0.04 per cent in 1995 to 0.08 per cent in 2010, which is much lower than that of other developing countries.[4] Among the LDCs, there are further variations, with the oil-exporting LDCs largely accounting for the increase in these imports, showing that such imports are biased towards the commodity sectors in the oil exporting LDCs.[5]

3. South-South FDI has been rising

FDI by developing countries has been rising in recent years, increasing the possibilities for it to be leveraged for technological learning in various other developing countries. The importance of developing countries as sources of FDI has increased quite significantly and steadily over the past four decades,[6] although it declined somewhat in 2008, following the eruption of the financial and economic crisis. The share of developing countries in total outward FDI rose from 15 per cent in 2005 (from $132 billion) to 27 per cent in 2010 ($400 billion), but preliminary estimates for 2011 indicate that it may have declined to 21.4 per cent for the year.[7] The analysis of South-South FDI leads to the following main observations:

– Although there has been a substantial rise in South-South FDI, there are significant regional variations in outward FDI which have an impact on the

share of gross fixed capital formation in countries. East Asia accounts for most of the FDI outflows from the South, followed closely by South-East Asia and Latin America.[8]

– Over the past two decades, the sectoral composition of outward FDI from developing countries has changed significantly to be comprised of investments in manufacturing and services. Of this, large shares are directed at other developing countries. Estimates indicate that in the early 1990s almost three fourths of developing-country investments abroad went to the manufacturing sector, which accounted for 27 per cent of such FDI. Apart from manufacturing, services account for a large share of the FDI outflows from developing countries, much of which are directed at other developing countries. For instance, during the period 2008–2010, services accounted for nearly 70 per cent of such FDI, of which more than 55 per cent went to developing countries.

In sum, total FDI outflows from the South has increased, with a clear emphasis on the services and manufacturing sectors. Such a sectoral focus would normally imply a potential for technological learning. However, estimates indicate that FDI in sectors such as services and manufacturing originates mainly from emerging countries, particularly East Asian and South-East Asian countries, and is largely directed to those developing countries that possess strong production networks in these sectors or have the capacity to source such investments by virtue of their technological capabilities. This is true of a large share of the services FDI directed towards developing countries. FDI outflows targeting electronics and automobile industries are also directed towards East and South-East Asia, which have globally competitive production hubs. The FDI thus helps to cement and enhance the already existing technological capacity of these developing countries as part of existing production networks.

A large proportion of FDI outflows to developing countries that do not have significant technological capabilities such as the resource-rich developing countries (including African countries), go to their mining and natural resources industries. This form of FDI usually does not have direct technological impacts.[9]

III. THE POTENTIAL OF SOUTH-SOUTH COOPERATION FOR TECHNOLOGICAL LEARNING STILL NEEDS TO BE HARNESSED

Technological change and economic growth have a mutually reinforcing relationship in developing countries. Sustainable economic growth that is built on

productivity increases in these countries does not fully rely on frontier innovations, as in industrialized countries, but rather, on the possibility to learn and build upon already existing technologies. This requires investment not only in manufacturing, but also across a range of activities that support overall industrial development, including in marketing, managerial and financial services, as well as in infrastructure and learning activities. This in turn increases absorptive capacity and the ability to adapt and apply existing technologies (in the form of products and processes) by means of local innovations, and thus leads to a gradual increase in productivity in all sectors. Such growth is intrinsically tied to how production structures evolve and what kinds of factors, policies and institutions enable the diffusion of technological knowledge to domestic sectors and firms.

However, much still needs to be done in order to harness this critical relationship in developing countries. For instance, an argument that has often been advanced is that the ongoing growth and shift in production patterns in some of the emerging countries, from low-end manufacturing to more knowledge-based domains, has opened up opportunities for other developing countries, particularly LDCs, to engage in low-end manufacturing. However attractive this might be, it does not occur automatically. To develop industrialization processes that could lead to a significant proportion of the total population being engaged in value-added production requires investments in building absorptive capacity. This necessitates a fundamental shift in the underlying conditions of many developing countries, with a particular focus on factors that promote technological learning and innovation capabilities in those countries. Such a shift should be consistent with their comparative advantages and local demand. This challenge in leveraging technological learning through ongoing economic growth processes is demonstrated by the analysis of data and case study evidence in *TIR 2012*. The conclusions that lend strength to this observation are as follows:

– The empirical evidence on ongoing South-South technological exchange shows that the surge of economic growth in developing countries, particularly emerging countries, has been made possible in large part by their growing technological capabilities. This is reflected in the increase in their capital goods imports in recent times. Although capital goods imports by developing countries are growing, and are considered to be an indication of technological learning, the trends show that a large share of the capital goods exported and imported is concentrated in a sub-set of developing countries. These

are countries that have some level of technological capabilities to integrate into GPNs, and their level of economic growth enables them to import capital goods. On the other hand, a large number of developing countries, particularly LDCs, are not major importers or exporters of capital goods.

– The growing manufacturing capabilities of a number of developing countries, particularly Brazil, China, India and South Africa, has enabled them to increase their exports of manufactured goods. It has also enabled them to participate in GPNs in both low-cost manufacturing and high-technology, value-added production. Moreover, globalization, as well as newer technologies and the move towards the knowledge economy, especially information and communication technologies (ICTs), have provided opportunities for these countries to use their existing skilled workforce to accumulate further knowledge and promote technological learning.

– FDI trends are similar to technological empowerment trends of the South, which tends to be concentrated in some countries, mainly East Asian countries as well as countries such as Brazil, China and India. Emerging countries account for the largest share of FDI outflows from developing countries, including through mergers and acquisitions (M&As) in the South. While South-South FDI outflows are directed to a variety of sectors, including services and health, they tend to be concentrated in specific activities involving exchanges among some countries in those sectors. This shows that a few developing countries are increasingly involved in mutually beneficial technological exchange.

– A review of case study evidence on South-South technological collaborations conducted in the Report[10] shows that South-South inter-firm technology-related initiatives seem to be motivated mainly by economic considerations or proactive government incentives, or both. In contrast, South-South public sector and government-driven collaborations are more wide-ranging in nature, but at the same time they focus more on scientific and technical aspects rather than on technological collaboration or firm-level learning. There are also a variety of government initiatives for promoting technology exchange and learning, both regional and in the context of South-South relations, including the annual summits of the BRICS (Brazil, the Russian Federation, India, China South Africa) and the India, Brazil, South Africa (IBSA) forum. However, such initiatives could better serve the needs of developing countries if they specified ways and means of collaboration for technological capacity-

building. Also, they should be more closely coordinated with government policy and projects within individual countries. Currently, the scientific and technical assistance programmes conducted by national agencies are often isolated from technological collaborations involving public and private sector organisations (that conduct joint R&D and training activities in specific scientific disciplines). In order to benefit the recipient countries, these need to be properly coordinated.

– While some South-South technological collaboration is evident, most countries are limited by the lack of intrinsic technological capabilities required to benefit more from ongoing South-South exchanges. Additionally, the South is contributing to an increasing commodity dependence of LDCs, which reduces their ability to structurally diversify their economies.[11] While this is clearly an incidental effect of the economic boom in the emerging countries, there is a need to closely align the interests of all developing countries towards bridging the technological divide.

– The analysis further shows that in the countries that have been collaborating the most on technology and innovation, supportive national innovation environments have been contributing to building their technological capabilities. Within emerging countries, positive developments in factors such as R&D investments, education, patenting and licensing trends, the number of researchers per million people, infrastructure and ICTs are further strengthening their innovation capabilities.

These results point to two fundamental issues. First, ongoing South-South collaboration could potentially provide more opportunities for developing countries, including LDCs, to benefit technologically by leveraging the ongoing process of economic growth explicitly to promote technological change. For example, the analysis on FDI shows that despite its current regional concentration, South-South FDI could become more versatile in terms of its ability to be combined with capability-building approaches since it is largely concentrated in manufacturing and services. The rising share of FDI from developing countries into sectors such as services also creates opportunities for technological collaboration in these sectors, which is now currently not being fully harnessed.[12] A review of ongoing initiatives in this area shows that there are some interesting cases of scientific and technical collaboration, both public-sector-based and private-sector-led. But these too do not seem to demonstrate the full potential of South-South collaboration for technological learning and innovation.

While it could be argued that South-South technological collaboration is still in its initial phases, and therefore lacks coordinated efforts, it still seems appropriate to address the key challenge of fostering such collaboration systematically. This automatically leads to the second issue, namely, how to ensure that an appropriate level of emphasis is given to this by developing-country governmental initiatives and that the various platforms on South-South collaboration do in fact result in greater technological learning. This calls for measures that promote closer linkages between government agenda-setting and ongoing scientific and technological collaboration initiatives as well as inter-firm technological alliances within a broader framework of South-South collaboration.

IV. A FRAMEWORK TO PROMOTE SOUTH-SOUTH COLLABORATION ON TECHNOLOGY AND INNOVATION IS NEEDED

In order to effectively address these issues, *TIR 2012* proposes a set of principles around which a framework of South-South collaboration for technology and innovation can be structured. Such a framework must be able to address the challenges identified in this Report. To begin with, short-term objectives of trade openness and the imports of inputs for industrialization processes should be consistent with longer-term technological development goals of the developing world as a whole. A framework on South-South collaboration could therefore help to align the interests of all developing countries in this highly relevant area. Moreover, although technology and knowledge are key inputs to catching up (and convergence) processes through which developing countries absorb ideas and concepts from the industrial frontier, the accumulation of technological capabilities will not be possible without express policy and institutional support by the international community and by the developing countries themselves. Therefore, as part of such a framework, *TIR 2012* proposes that developing countries strengthen their cooperation with a particular focus on *collaboration for technology and innovation*. A framework that promotes interaction at three different levels is suggested:

– Exchange of experiences in policy-making and in devising policy frameworks for technology and innovation;

– Technology exchange and flows aimed at increasing the technology absorptive capacity of the private and public sectors; and

– Transfer of technologies in key sectors of importance to public well-being, such as agriculture, health, climate change and renewable energy.

Such a framework for South-South collaboration on technology and innovation needs to move beyond priority setting and political declarations; it should propose a clear road map for action. The Report articulates a set of principles that could form the basis for such an international framework. These principles are derived from some important issues prevailing in the context of technology and innovation exchange globally and among developing countries. These are discussed briefly here.

1. The technological needs of all developing countries should be better integrated into ongoing South-South exchange (principle 1)

Closing the gap between formal and informal production structures in a large number of developing countries, particularly LDCs, and promoting domestic capabilities calls for more proactive engagement in addressing their technological needs in a coherent and dynamic way. This form of engagement not only necessitates greater investments in tertiary education, skills training and competence-building within countries; it also needs to be reinforced by enabling greater access to knowledge and technological capacity-building through, for example, inter-firm cooperation, joint ventures and licensing agreements. Support for knowledge-based activities in developing countries is therefore essential for transforming their economies towards activities that focus on greater value addition and higher returns on investment.

2. The experiences of developing countries in building innovation capabilities should be shared more proactively (principle 2)

Emerging countries have pursued a variety of industrial and development policies and strategies to promote technological catch-up. Innovation policies are essential components of such strategies. Innovation policy frameworks can be understood as purposive actions and incentives provided by governments to promote interactive learning and collaboration among all economic and non-economic actors in the system. Such policies have been instrumental in overcoming market imperfections that obstruct technological change, and which are pervasive and widespread, particularly in developing countries. Sharing these policy experiences is relevant for two main reasons. To begin with, they are useful in order to glean general

lessons and derive best practices on how developing countries can best promote economic catch-up. Secondly, they can also be highly instructive in deriving policy options for promoting linkages between various aspects of innovation frameworks. Whereas all measures will not be applicable in all countries universally, sharing these experiences would provide an array of policy options for developing countries that could be pursued for investment promotion, linking IPR protection to innovation policy, linking enterprise development with innovation policy, and coordinating research between universities and industry, among others.

3. Learning needs to be promoted through South-South alliances and technology transfer (principle 3)

A critical shift in South-South collaboration on technology and innovation is needed, with a focus on promoting technological learning based on the South's own rich and diverse experiences, as highlighted in the Report. Some of the means of such learning, such as technology transfer, have been demanded by developing countries in the international discourse for decades. Technological development implies more than just promoting the import of technologies through FDI or trade in capital goods. As mentioned above, what is more crucial is the building of capabilities through skills development and the transfer of operation and maintenance know-how which promotes technological progress.

Mechanisms for technological collaboration have traditionally focused on a North-South dimension, but there are also opportunities to develop South-South mechanisms for the sharing of experiences on technological capacity-building and transfer. Indeed, these could be particularly appropriate in the developing-country context, given that these countries share common development challenges. Such mechanisms could complement ongoing efforts to foster North-South technology transfer by placing an explicit emphasis on technological learning and building local capacities for innovation. One such mechanism is the creation of strategic technological alliances between some developing countries, particularly the emerging countries on the one hand, and other developing countries, on the other, to promote learning in sectors that already have some level of domestic technological capabilities. Technology transfer and the sharing of tacit know-how is another instrument that the South could use to pioneer different solutions by leading by example.

4. FDI needs to be more technology-oriented in order to support the building of technological capabilities (principle 4)

Many countries have leveraged FDI to promote the absorption of technologies and building of innovation capacity. The Republic of Korea is an example of a country that has sought to use FDI as a source of technology within its overall industrial development strategy. There are instances where South-South FDI has had positive results in terms of building national technological capabilities. Interesting examples of how governments have promoted the transfer of tacit know-how by the foreign investing firm to a local partner are those of Uganda and Ethiopia.[13] These cases show that FDI can be combined with a variety of other policy measures. However, on a general scale, there is often a disjunction between innovation policies and FDI policies in countries. This disjunction needs to be addressed through an innovation policy framework that allows recipient countries to realize the potential of FDI for technological learning.

5. Developing countries should pool technological resources to address common challenges (principle 5)

There are a range of development challenges that confront all countries of the South to varying degrees. They need technological innovations and platforms that promote a smoother transition towards a green economy, help address climate change mitigation and adaptation, encourage the use of sustainable energy and renewable energy technologies, as well as help improve public health and food security. For all these technological challenges, common responses could be forged.

In all these areas, the level of domestic firms' capabilities in many developing countries is insufficient to support the creation of conventional forms of technological alliances. Therefore, there is a need for new alliances that enable the development of particular kinds of technologies that are of critical importance to the developing world. Developing countries could also help the sharing of already existing knowledge in important sectors and industries, which until now has not been systematic. Instead, there is a continued reliance on North-South exchanges in finding technological solutions.

Not only are developing countries' experiences in building innovation capacity particularly relevant for bridging the technological divide, their technologies are also often more locally adaptable in other developing countries, including LDCs, owing to similar contexts, and hence they are more appropriate for those countries.

V. EXPLICIT POLICIES ARE REQUIRED TO SUPPORT THE EMERGENCE OF SUCH A COLLABORATIVE FRAMEWORK

Current discussions on technology and innovation in the international context often revolve around how international commitments for technology dissemination and transfer can be fostered.[14] Within several of these discussions, such as those related to Article 66(2) of the Agreement on Trade Related Aspects of Intellectual Property Rights (the TRIPS Agreement), consensus still needs to be reached on defining and measuring technology transfer. While these discussions remain important from an overall global perspective, this Report articulates a number of policy measures that could be implemented at the national, regional and international levels in order to operationalize the principles outlined above.

The policy measures identified by this Report are not exhaustive, but help to show the way forward. Moreover, they should not be construed as binding developing countries, particularly emerging countries, to exacting technological commitments. The policy measures suggested here are meant to facilitate South-South technological collaboration through long-term-oriented institutions in all developing countries, whether they act as suppliers or recipients of technological knowledge in collaborative ventures.

1. Closely link national innovation policies to South-South initiatives

National innovation policy frameworks could be accompanied by the following policy measures specially aimed at encouraging South-South collaboration for technology and innovation.

a. Coordinate local and regional innovation policies with South-South initiatives

There is often a disconnect between national and regional policies on technology and innovation. Furthermore, since some developing countries have only recently emerged as significant sources of technological learning, many existing policy instruments do not expressly refer to South-South collaboration in this area. This needs to be revised in policy setting exercises, both at the national and regional levels, to reflect the new reality, recognizing developing countries as long-term partners in technological capacity-building.

As part of this, innovation policy frameworks at the national and regional levels need to be revised to incorporate certain key innovation priorities in South-South

transactions. A range of policy measures could be implemented to expressly promote South-South technological collaboration, including, but not necessarily restricted to:

- Linking developing-country FDI with clearly articulated technology and tacit know-how requirements;
- Providing/using existing government funding to promote scientific and technical collaborations for priority sectors between developing countries (in their region or even outside the region);
- Granting special incentives and tax reductions to local firms in return for entering into joint ventures or joint production arrangements with firms from developing countries, with a particular emphasis on acquiring technologies;
- Offering incentives to foreign firms from developing countries, particularly emerging countries, such as special tax cuts or government procurement assurances, in return for setting up production facilities and transferring know-how to local firms;
- Providing technology incubation facilities to support new technology applications in local industry with help from firms in developing countries, particularly emerging countries.

b. Provide incentives for shifting towards higher value-added activities

In order to minimize the risk of local firms remaining at lower ends of GPNs with few or no chances of moving up the value-added stages of production, there is a need for explicit policy measures that support engagement in higher value-added activities. Higher value-added activities in this context are closely associated with, but not identical to, manufacturing although this sector is certainly essential for driving structural transformation. The notion of higher value-added should also encompass greater social value added through innovation activities, which essentially relate to ensuring that innovation activities respond to local needs and also foster equitable and inclusive development and are pro-poor. Innovation funds, both at the national and sectoral levels, could help to induce such a shift towards increased value added, particularly in countries rich in natural resources.

c. Focus on technological learning in policies of emerging countries

In order to ensure that technological learning is an essential component of South-South interactions, emerging countries could introduce policy measures that help

to increase the focus on collaborations in mutually beneficial technologies and innovation. These could take the following forms:

- Adopting policies that promote technological engagement with other developing countries from a long-term perspective; and
- Providing additional incentives to national firms to engage in technological exchange and the building of tacit know-how in firms in other developing countries.

2. Adopt policies that promote a long-term technological orientation

The overall technological development of the South is a common good that will have positive network effects for all developing countries and their policy strategies need to reflect this. Their long-term vision and strategy should contain clear targets and milestones to be achieved in terms of technological collaboration.

a. Adopt policies that link technical and scientific cooperation with technological collaboration

As the Report shows, although many developing countries are actively engaged in expanding their technical and development assistance activities, there is a lack of coordination between scientific and technical collaboration provided by their agencies and the ongoing technological collaborations between firms. In order to ensure the best results, these activities should be better coordinated by means of a clear policy on South-South technological collaboration set out by the governments. Emerging countries, in particular, need to articulate long-term strategic objectives as suggested in the aforementioned section.

b. Provide incentives to firms for technological collaboration and technology transfer

Emerging countries could provide greater incentives for technological collaboration and transfer of technology within their policy frameworks. These incentives could take the following forms:

- Tax concessions to emerging-country firms in return for entering into or attracting joint ventures or joint production arrangements with firms in developing countries, particularly LDCs;
- Grant local firms special “development-friendly” certificates as a goodwill gesture. These can add to the corporate image of the firms and help them to develop a customer base across the South.

3. Operationalize the South-South Innovation and Technology Pact (SITEP)

In order to facilitate a common, development response to these issues, this Report suggests the pooling of technological resources by developing countries through a comprehensive South-South Innovation and Technology Pact (SITEP). The proposed pact would be a mechanism that seeks to coordinate and promote a developing-country response to technology-related issues. The SITEP should provide institutional support at three levels. To begin with, it could promote technological learning at the firm level as an essential complement to ongoing South-South scientific cooperation and technical assistance programmes. At a second level, it could promote enterprise development and financing of specific innovation activities that are of particular importance to developing countries. Finally, it could act as a platform for sharing innovation experiences and promoting learning at the policy-making level (box 1).

Given the similarity of developing countries' innovation experiences and their technological strengths, the Report recognizes these countries as natural strategic partners with each other in efforts to bridge the technological divide. Furthering

Box 1: Institutional features of the proposed *South-South Innovation and Technology Pact* (SITEP)

The SITEP would support technological learning and innovation capacity across all developing countries by providing institutional support at three different levels through a variety of policy instruments. At each of the levels, institutional support could take the following forms.

(i) Promote technological learning at the firm level.

A number of developing countries, in particular emerging countries, are increasingly producing new, state-of-the-art technologies. Many of these efforts are being financed by public investment. Three instruments could particularly advance access to and production of such knowledge:

- Pooling public investment for basic R&D: Such a mechanism would pool together public investment for basic R&D across developing countries that seek to join hands as a means of promoting both the development of domestic learning capabilities as well as linkages and interactions among actors in innovation systems across themselves. This could be done at a regional level, or amongst countries that choose to partner across regions.
- South-South research and product development hubs: Regional R&D facilities to create and sustain R&D within firms or those which provide R&D services on a pay-as-

you-go basis could constitute an important short- and medium-term solution to some of the major problems faced by public and private sectors in developing countries.

- South-South pooling of supply and demand: A major impediment to many technological innovations is the limited or lack of local/regional market demand. This is particularly true in industries where technological innovations are investment-intensive and risky, such as in health technologies. This mechanism would fill that gap by pooling demand regionally or across like-minded countries that have similar needs within the South.

(ii) Promote enterprise development and financing of specific innovation activities that are of particular importance to developing countries as a whole.

The proposed SITEP would have a second set of policy instruments and activities that are directly geared to alleviating many of the constraints faced at the enterprise level, including financing that could take various forms as discussed below:

- Venture capital funding at the regional level: Emerging enterprises in LDCs that show promise in key sectors of regional importance, such as pharmaceuticals, agro-processing and ICTs, could be provided with venture capital funding. Such funding programmes could offer awards through contests for participating regional firms.
- Co-investment with private investors in innovative enterprises: A number of schemes could be launched at the regional level for the development of early-stage innovative technologies by local firms. Acquisition of technological know-how could be supported through public-private/private-private partnerships between various developing countries.
- Financing for collaboration between private and public enterprises: Such an instrument could expressly address the lack of incentives at the national/sectoral levels in developing countries so as to enable collaborative linkages.

(iii) Act as a platform for sharing innovation experiences and promoting policy learning.

Developing countries could benefit enormously from building a common forum for exchange of information about their national technology and innovation policies. Such a forum would enable the sharing of experiences on how countries could promote industrial development within the parameters of the international trade and IPR regimes. The forum would provide a venue for discussions on the options and flexibilities that are still currently available under the existing international rules which, overall, can often be restrictive.
The SITEP could be augmented by regional initiatives directly aimed at building innovation capacity at the regional level.

Source: UNCTAD.

this role requires creating the right basis for accessing science, technology and innovation resources within the developing world. The technology and innovation resources of the South will be critical for linking firms and organizations across developing countries, particularly LDCs, with the global knowledge economy to accelerate their development processes. This needs to be based on an

understanding that: (a) innovation is a multidirectional, highly interactive process that integrates or "articulates" science, technology and production, and (b) new policy thinking is needed to help establish virtuous circles of rising productivity, technological progress and structural transformation across the entire developing world.

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There are many outstanding issues concerning technological learning and innovation capacity in the context of developing countries, including those related to technology transfer, which need to be addressed at the international level. Developing countries can lead the way by working together and providing constructive solutions to these unresolved policy challenges in the coming years.

NOTES

1 Referred to as the "East Asian miracle", the first-tier newly industrializing economies (NIEs) that followed Japan's industrialization comprised Hong Kong, the Republic of Korea, Taiwan Province of China and Singapore, and the second-tier comprised Indonesia, Malaysia and Thailand.

2 See box 3.2 in chapter III. Some other studies such as UN-ECOSOC (2008) quote higher figures. This reflects the considerable variation in the quality and availability of data from the four major contributors from the South – the Bolivarian Republic of Venezuela, China, India and the Republic of Korea. Furthermore, this figure may underestimate total development assistance by the South, since several smaller bilateral and multilateral contributions were not included in the study due the paucity of data and differences in definitions of what constitutes development cooperation.

3 See annex table A.II.6 of the Report.

4 Annex table A.II.11.

5 These trends are captured in figure 2.8, chapter II, which shows a large gap in the imports of machinery and transport equipment between oil-exporting LDCs, non-oil exporting LDCs and other developing countries.

6 Table 2.7 and figures 2.9 and 2.10, chapter II.

7 Table 2.7, chapter II.

8 Table 2.8, chapter II.

9 Table 2.9, chapter II.

10 Chapter III.

11 Trends in exports of primary commodities show that while LDCs exported their primary commodities mainly to developed countries, this pattern has shifted significantly towards developing countries since 2003 (figure 1.5, chapter I).

12 Table 2.9 and figure 2.12 in chapter II show that the services sector accounts for over 50 per cent of all FDI from developing countries.

13 These examples are discussed in chapter III of the Report.

14 See box 4.8 in chapter IV for a discussion.

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