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Policies and programmes for technology development and mastery, including the role of FDI

Issues paper by the UNCTAD secretariat

The Commission on Enterprise, Business Facilitation and Development decided at its seventh session in Geneva (24–27 February 2003) to examine policies and programmes for technology development and mastery, including the role of FDI. This is the third Expert Meeting convened under the theme "Improving the competitiveness of SMEs through enhancing productive capacity". The previous Expert Meeting in October 2002 focused on policies and measures for technology financing, especially for small and medium-sized enterprises. This Expert Meeting will expand this analysis by examining a broader set of policy options to enhance technology development.

Technology development is a critical determinant of developing countries' ability to compete in integrated global markets. Technology is an essential part of doing business. It can create and transform working methods, as well as create and reshape demand for new products and services in developing countries.

This issues paper considers the main policy options that Governments can consider in order to move up the technology ladder and to improve competitiveness. It identifies six key drivers for technology development and examines the main policy changes conducive to moving up the technology ladder, including policies for technology transfer. It reviews financial and fiscal measures to promote collective action among institutions and agents such as home and host Governments, support agencies, large and small firms and networks for "linking, leveraging and learning". It concludes that different policy approaches are possible, but that Governments can play a key role in creating and adapting comparative advantage, particularly in value-added activities such as high-tech manufacturing and services.

Examples of these policy options and measures and how they actually work in practice are analysed in six case studies and the Background Report and Appendix of Policy Options, which are presented separately. This Background Report and Appendix compare and contrast the policies and experiences of three Asian countries that boosted their levels of technology development with the policies and experiences of three African countries that were less successful.

ACRONYMS

ASEAN	Association of South-East Asian Nations
CIP	Competitive Industrial Performance (CIP) Index
CSTD	Commission on Science and Technology for Development
FDI	foreign direct investment
FTZ	free trade zone
GNP	gross national product
HTE	high-technology exports
ICT(s)	information and communication technology (technologies)
IPR	Investment Policy Review (UNCTAD publication series)
LDCs	least developed countries
MHT	medium- and high-technology (products)
MVA	manufacturing value added
PRSP	Poverty Reduction Strategy Paper
R&D	research and development
R&L	royalty and licence (fees)
SMEs	small and medium-sized enterprises
TNC	transnational corporation
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization

CONTENTS

1. Introduction

1. The Commission on Enterprise, Business Facilitation and Development decided at its seventh session in Geneva (24–27 February 2003) that one of its Expert Meetings should examine policies for technology development and mastery, including the role of foreign direct investment (FDI). This issues paper presents an overview of the drivers of technology development and the main policy options that Governments could consider in order to improve competitiveness and to move up the technology ladder. It examines:

- Policy changes conducive to moving up the technology ladder, including for technology transfer;
- Technology development and mastery to meet international norms and certification;
- Financial and fiscal measures to promote collective action among institutions and agents (home and host Governments, support agencies, large and small firms, and networking among small firms) for "inking, leveraging and learning".

2. A separate Background Report[1] for the Expert Meeting compares the experiences of six economies to illustrate how these policies may actually work in practice. Three Asian economies (Malaysia, Singapore and Taiwan Province of China) that boosted their levels of technology development from 1985 to 1998 are contrasted with three African economies (Ghana, Senegal and Uganda) that were less successful. The Background Report summarizes key conclusions and possible policy options in the Appendix of Policy Options.

2. The technology ladder: the UNIDO Competitive Industrial Performance Index

2.1 Components

3. Given the different dimensions to technology development, there are different ways of defining and measuring technological development (CSTD, 2002). How do we define the technology ladder? The United Nations Industrial Development Organization (UNIDO) has developed a framework benchmarking national abilities to produce manufactures competitively and to provide the structural inputs for sustained industrial growth. The Competitive Industrial Performance (CIP) Index measures competitive industrial performance in four components:

1. Manufacturing value added (MVA) per capita;
2. Manufactured exports per capita;
3. Share of medium- and high-tech (MHT) activities in MVA – measuring the technological structure of MVA;
4. Share of medium- and high-tech products in manufactured exports – measuring the technological structure of manufactured exports.

4. CIP focuses on manufacturing industry and export performance and their technological structure. This focus on export performance is justified since “it is now widely accepted that growth prospects for developing countries are greatly enhanced through an outer-oriented trade regime and fairly uniform incentives” (Krueger, 1997). Export promotion strategies have largely replaced import substitution policies as a means of overcoming the challenge posed by

[1] The Background Report will be distributed at the Expert Meeting

small domestic markets[2] and exploiting economies of scale in production through access to larger global markets. Manufacturing and exporting are activities that are increasingly essential for participation in an ever more closely integrated world economy.

The technology ladder

5. The technology ladder is defined by the CIP Index as export and manufacturing performance, with added recognition for medium- and high-tech activities. At the very least, the development of manufacturing capability represents economic diversification for developing economies specialized mainly in the production of primary commodities. High-tech activities are activities closely associated with strategic competitive advantage, in allowing economies to get on to the technology ladder and to improve their technological development. Specialization in high-tech activities offers opportunities of participation in higher-margin value-added activities, greater technological development and learning and entry into the fastest-growing segment of world trade[3] (various analyses by Lall; UNCTAD, 2003a).

6. However, these benefits are far from easy to realize and far from automatic, especially for developing countries that lack resources and institutional capabilities to capitalize upon such opportunities. High-tech activities are subject to rapid technological change and obsolescence and often require large, high-risk investments. Even where technologies become obsolete, the learning, experience and skills gained may leave the country better positioned to benefit from and adapt newer technologies. The "survival of the fittest" in competitive global markets means that the standards achieved by the best-performing countries set the criteria by which other countries must compete. Developing countries seeking to compete on world markets must not manufacture only to the standards of (or compete with) an average firm in an average country, but also to the standards of transnational corporations (TNCs). Such challenges are not insurmountable, as South-East Asia has shown. However, they may prove difficult to meet for many developing countries without policy changes that focus on the "micro" environment.

7. It is important to note several value judgements implicit in adopting the CIP Index as our definition of the technology ladder. Developing countries specialized in the production and export of primary commodities will not score highly in an index based on manufacturing and manufactured products. Irrespective of resource endowments, manufacturing is the preferred area of specialization to engage in. Furthermore, technologies used in production (e.g. tractors and harvesters) do not count: it is the technological structure of outputs that is important. For many least developed countries (LDCs), this definition of the technology ladder contains an inherent normative value and may focus more on what they **"ought"** to be doing than on what they in fact **are** doing, irrespective of their resource endowments or comparative advantage. (This point is discussed again in section 3). The question for many LDCs thus becomes: to what extent can they adapt and create comparative advantage in areas where they may previously have had little or no advantage? Also, to what extent can LDCs acquire a competitive edge by going up the value-added chain via the technology ladder?

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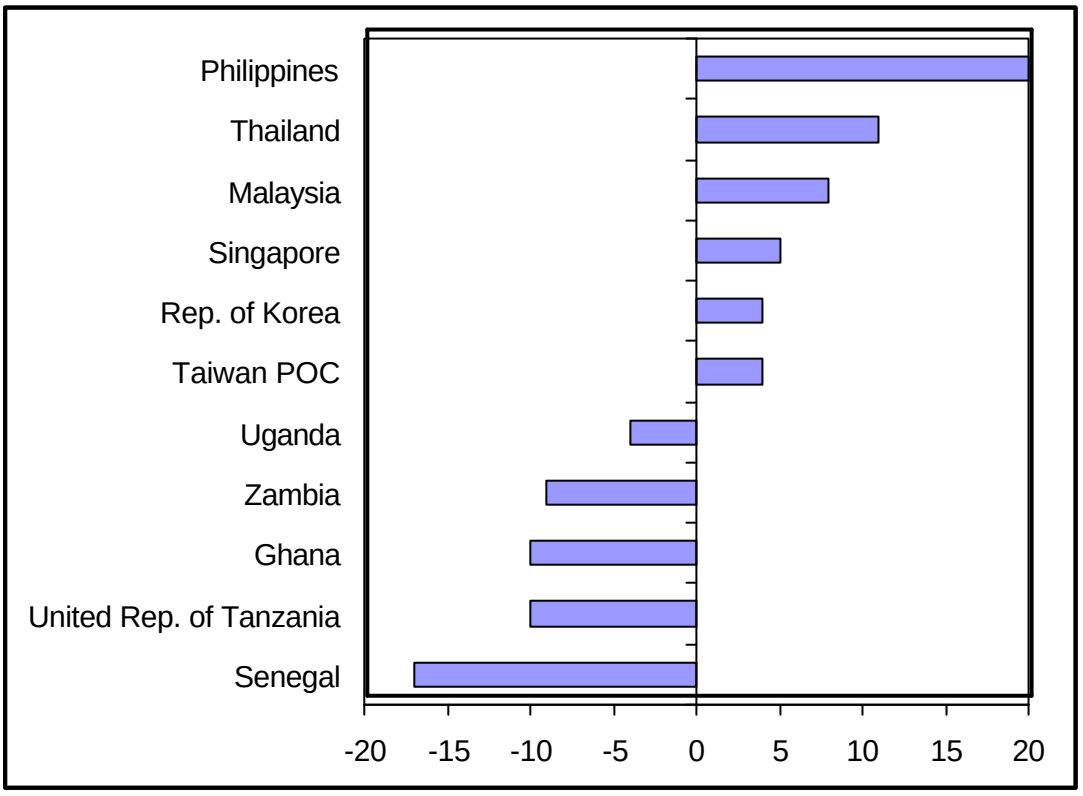
[2] Identified as a problem for some developing countries, for example in UNCTAD's Investment Policy Review of Uganda.

[3] UNCTAD (2003[a]) argues that specialization in MHT activities is desirable, given high growth rates in manufacturing and high-tech goods and services in particular in world trade. However, this is partly attributable to their lower trade base or share (giving larger percentage growth rates), as the paper acknowledges.

8. On the basis of the results of the CIP Index, UNIDO (2002) concludes that "industrial performance and its drivers are diverging rather than converging, with success confined to a few developing countries". Furthermore, "to achieve long-term, sustainable industrial development, countries and firms need a concerted strategy for industrial restructuring and upgrading – for moving from simple to more advanced technologies" (p. 27). The purpose of this issues paper is to explore those strategies and policies that countries have followed in order to improve their technology development, and to contrast the experiences of some of the successful countries with some of the less successful. The objective is to compile a set of short-term policy options that will prevent developing countries from falling farther behind.

Figure 1. Change in the CIP ranking for selected countries between 1985 and 1998



Source: CIP Index.

9. East Asia is the best industrial performer in most respects, with a more technologically advanced export structure and rapidly improving drivers of industrial performance. By contrast, sub-Saharan Africa (excluding South Africa) is regressing in its technological structure of industrial production and exports. According to the CIP definition of the technology ladder, the four highest-achieving developing countries are in South-East Asia, while nine of the ten lowest-achieving countries are in sub-Saharan Africa. Figure 1 illustrates changes in rankings for selected countries in the CIP Index. For example, Senegal's ranking fell by 17 places between 1985 and 1998.

2.2 Drivers

10. The CIP Index identifies five broad "drivers" or determinants of industrial performance, which are summarized in table 1. These are the policy domains where policy changes can help countries move up the technology ladder, and are examined in section 3. Although drivers are analysed separately here, it is important to emphasize synergies arising from the combination of these drivers. It may be better for countries to develop complementary capabilities across drivers in a balanced way, than to focus on one or two drivers to the exclusion of others.

Table 1. CIP drivers of industrial performance

Driver	Rationale and measure
Skills	Skills are a fundamental determinant of a country's ability to compete and its attractiveness to FDI. The CIP Index uses formal secondary and tertiary education enrolment rates.
Technological effort	Intensity of R&D indicates general abilities to master and use new technologies. The CIP Index uses R&D by productive enterprises.
"Internalized" technology transfer	FDI is an important means of technology transfer. The CIP Index uses inward FDI flows *within* the firm, from parents to affiliates of TNCs.
"Externalized" technology transfer	R&L fees are a further important means of technology transfer. The CIP Index uses R&L payments abroad as measures of arm's length technology transfer *between* firms internationally.
Infrastructure	Infrastructure is a fundamental determinant of countries' industrial capabilities and their attractiveness to FDI. The CIP Index distinguishes between traditional and modern infrastructure and uses mainline rates.

11. There are determinants of technology development that are omitted from the CIP Index. There is no separate measurement of government policy or what constitutes a successful policy, although Governments that encourage FDI and expand secondary and higher education implicitly receive more credit. Important factors such as the importance of small and medium-sized enterprises (SMEs) in developing domestic supply capacity and the fundamental role of financing in accessing technology are less readily measurable and are not taken into account in the CIP Index. These have been covered at previous Expert Meetings (Expert Meeting on Improving the Competitiveness of SMEs through Enhancing Productive Capacity: Financing Technology October 2002) and Commission sessions (seventh session of the Commission on Enterprise, Business Facilitation and Development, February 2003). See also the reports by UNCTAD (2002a, 2002b, 2002c).

2.3 Conclusions

12. Given the different dimensions to technology, there are many different ways of defining and measuring technology development and its underlying drivers. This section has described the issues and rationale underlying the CIP Index and had adopted this as a reasonable working definition of the technology ladder. The CIP Index's drivers of industrial performance (table 1) represent the policy domains where policy changes can help countries to move up the technology ladder. These policy domains are examined in section 3. The Background Report analyses three African case studies (Ghana, Senegal and Uganda) and three Asian case studies (Malaysia, Singapore and Taiwan Province of China).

3. Policy domains: The drivers of industrial performance

3.1 Skills

13. Skills are an essential prerequisite for national competitiveness and technological mastery. According to Lall (2000), skills are "perhaps the most important single determinant" of competitiveness. According to classical trade theory, the comparative advantage of developing countries lies in their natural resource endowments and low-cost labour. There is widespread evidence of investors choosing investment destinations for low-cost labour advantages, among others. Lall (2000) notes that it is possible to enhance competitiveness for short periods by relying on unskilled labour. However, this is not a long-term strategy and countries "have to raise skill levels to grow in open, competitive markets. There is no other way to keep – and improve – competitiveness. LDCs have to improve their human capital base if they are to grow and prosper" (p. 129). The question for developing countries is how, and to what extent, can they modify their traditional comparative advantage of low-cost labour towards more skilled and flexible labour and working methods. Their ability to do this can determine their ability to climb the technology ladder and to compete in the emerging global economy.

14. The mastery, use and adaptation of new technologies call for more skills, higher levels of skills and different kinds of skills. However, in many developing countries where basic education and literacy levels are low, it is difficult to match coverage and technical content to investors' requirements. There is critical policy choice between establishing specialist institutions offering technical training and extending the coverage of basic education to more of the population. Knight and Sabot (1991) contrast the United Republic of Tanzania, which devoted resources to expanding primary education, with Kenya, which established a system of privately funded schools. They find contrasting outcomes in completion rates, educational attainment and income inequality. There may be unexpected social outcomes to technical training, in the creation of well-paid elites with advanced technical skills and the "brain drain" or loss of trained labour abroad (Lowell and Findlay, 2002). Some developing countries may choose to devote resources to basic educational and literacy requirements and rely on on-the-job training and apprenticeships to develop more advanced skills in the labour force. This requires close cooperation and partnership with the private sector, which can provide the guidance and inputs to develop the skills needed to climb the technology ladder.

3.2 Technological effort: Research and development

15. According to the "technological gap" theory, innovation is essential to trade and competitiveness, as countries that innovate gain an advantage and export to countries which are lagging technologically in certain products and technologies. This trade is eliminated as laggards catch up, but new innovations create new trade possibilities (Posner, 1961). The importance of innovation in general, and research and development (R&D) in particular, for developing, promoting and deepening local technological capabilities has been emphasized repeatedly (UNCTAD 2003a, Lall, 2000, CSTD, 2002). R&D confers important advantages in enabling reverse engineering, learning-by-doing and more specialized technological know-how, as well as technologies adapted to local consumption tastes and conditions. R&D is important because even industrial "latecomers" have to undertake R&D to assimilate, adapt and improve imported technologies to suit local conditions. Absence of R&D and the lack of

R&D capability can constrain upgrading in developing countries seeking to enter into complex technologies; this suggests an important "permissive" or facilitating role for R&D.

16. R&D expenditure is one of the key factors that differentiates industrialized countries from developing countries. Most developing countries spend only negligible amounts on formal R&D. Furthermore, developing countries do not generally attract the research activities of transnational corporations (World Investment Report, 2001). It is easy to see why: when resources are limited, R&D represents a long-term, potentially risky investment with long-term, uncertain and partially hidden returns.

17. Furthermore, it is not just total R&D expenditure that counts: the agent undertaking the research is important. R&D can be carried out by local or foreign firms, government and scientific educational institutions. There are different outcomes to R&D, depending on the agent undertaking the research. Where it is carried out by TNCs, UNCTAD (2003a) notes a tendency for the latter to "transfer the results of R&D rather than the process itself". This was one reason why Japan and Taiwan Province of China adopted indigenous innovation policies to develop local innovative abilities. Incentives were provided to domestic firms to license or copy foreign technologies and invest in domestic research capabilities. UNCTAD (2003a) concludes that the sustained technological growth of developing countries calls for increasing local innovation by domestic agents. Table 2 provides a comparison of the source of R&D funding for selected countries.

Table 2. Source of R&D funding in selected countries, 1995

Country	R&D spending as % of GNP	Source of funds					
		Business enterprises	Government	University	Priv. non-profit	Funds from abroad	Not distr.
Tunisia (1)	0.30	55.5	32.3			4.0	8.2
Mexico	0.33	17.6	66.2	8.4	1.1	6.7	
China	0.61	2.8	91.0	5.7		0.5	
Chile	0.67	20.2	68.5			11.3	
India (2)	0.73	24.0	75.0	1.0			
Brazil	0.84	20.8	43.9				35.3
Italy (2)	1.03	43.7	50.2			6.1	
Germany (3)	2.31	61.4	36.7	0.3		1.6	
Finland	2.46	57.7	37.4	0.4		4.5	
United States	2.61	59.4	35.5	5.1			
Republic of Korea (2)	2.71	84.0	15.9				
Japan (4)	2.96	81.7	18.2			0.1	

Source: UNESCO.
1) 1997; 2) 1993; 3) 1994; 4) 1991.

18. R&D becomes more significant as a country's industrial structure develops and firms use more advanced technologies. This suggests a growing role for R&D as an economy industrializes. The CIP Index uses R&D as a measure of technological effort to master new technologies, although it notes that much of this effort cannot be quantified since it occurs across all parts of an enterprise and is often informal. However, R&D makes an essential contribution to building technological capabilities and enabling technology mastery. It thus forms a useful, representative measure of technological effort for our purposes.

3.3 "Internalised" technology transfer

19. FDI is an efficient way of transferring technology (UNCTAD, 2003a). There is evidence to suggest that TNCs are important investment agents. Two thirds of world trade was handled by TNCs in the late 1990s (World Investment Report 1999), while one third of world trade is intra-firm trade within one corporate system.

20. FDI can directly increase technology stocks by providing machinery and equipment, as well as technical assistance and know-how. It is an efficient way of transferring technology since it often carries commitments by the investor of skills, information and brand name technologies, in addition to capital (UNCTAD, 2003a). For many new technologies, internalized transfers are the only means of transfer, since innovators resist their transfer to unrelated parties. It is possible to develop wide-ranging competencies and establish, build and deepen local industrial capabilities and skills through being part of a TNC system. Such competencies and skills include technical skills of production, distribution and control, as well as management and subsidiary service skills such as marketing and financial services. UNCTAD finds direct and multiplier effects of FDI on employment and the quality and skills of the labour force (see UNCTAD's Investment Policy Review of Ghana, 2002). FDI can also promote the development of non-traditional exports, thereby enabling economic diversification. In addition, it may introduce and promote competition in an economy, stimulating efforts to improve efficiency among local competitors in the host country.

21. However, these benefits do not always materialize. The objectives of TNCs and developing countries often diverge, with bargaining necessary in order to reach a compromise acceptable to the TNC, and host and home Governments. Some TNCs may focus more on short-term profits and quarterly earnings than on long-term competitive strategies. Host countries, on the other hand, have multiple development objectives that will be achieved only in the long term. TNCs may often invest in developing countries for the advantages of low-cost physical and human resources, more permissive legislation and fiscal and financial incentives, among other factors. They may not necessarily invest heavily in developing the technological capabilities of their subsidiaries, which become outsource centres for simpler and more labour-intensive work. Indeed, UNCTAD (2003a) finds that in the later stages of industrial development, internalized technology transfer and local capability development can become **competitive rather than complementary**, reflecting these conflicts of interest (p. 14). Specific efforts are necessary in order to encourage the transfer of technology from foreign to local enterprises through business linkages, mentoring and coaching, as well as training and apprenticeship programmes.

22. At the international level, developing countries may find themselves in a "race to the bottom" with other countries, whereby they negotiate away some of their advantages and accept reduced returns in order to attract investment at any cost. Offering more advantageous terms may result in host Governments receiving a reduced proportion of investments that they may not otherwise have attracted. However, the long-term implications of offering ever more advantageous terms may prove costly and are only just becoming apparent.

23. Measures to promote FDI may include liberalization of the FDI and investment framework, regulatory and institutional reform, investment promotion agencies and incentives for investors. Best practices for investment promotion agencies include provision of information, marketing and support services, active investigation of investment opportunities

and targeting of investors, and "one-stop" liaison services. Financial incentives for investors include tax holidays, capital allowances, customs duty exemptions and other inducements, such as free trade zones (FTZs).

3.4 "Externalized" technology transfer

24. Another key channel for technology transfer is licensing and arm's length purchases of know-how, patents, licences and blueprints. Licensing is an agreement to transfer the exclusive rights to use technology from the innovator to the licensee in exchange for payments of royalty and licence fees. R&L fees include industrial technology and also service sector purchases of know-how, brand names and franchises. The growth of the service sector is likely to boost an economy's technological development since service activities are typically information-intensive and often require use of information and communication technologies (ICTs). La Rovere (1996) studied banking in Brazil and observes that service industries are "particularly suited to benefit from IT diffusion, since [they are] organized around the storage and transfer of information" and lend themselves to automation and computerization owing to the high volume of repeat transactions involved.

25. Licensing also typically includes non-arm's length transactions between the affiliates and parents of TNCs, a fact which explains the reasonable positive correlation observed between R&L fees and FDI in UNIDO's (2002) analysis. The report concludes "East Asia pays far more royalty fees than any other region, and spends the most on R&D and receives the most FDI. [This] suggests that these different modes of acquiring and developing technology complement each other" (p. 38). Indeed, acquisition of technological blueprints through licensing is unlikely to prove successful unless local technological capabilities to master and adapt abstract technological blueprints obtained through licensing are in place.

3.5 Infrastructure

26. Infrastructure is an essential prerequisite for both individual firms' and national competitiveness. Our definition of the technology ladder — the CIP framework — explores a narrow definition of technological infrastructure in telephone mainlines, personal computers, mobile phones and Internet hosts, before selecting telephone mainlines as a representative measure of infrastructure, on the ground that these variables are all highly correlated. The UNCTAD Investment Review series repeatedly notes the importance of a broader range of infrastructure (including electricity, transport and clean water) to businesses and to the economy as a whole. For example, the Investment Policy Review of Ghana notes that an estimated 4 per cent of national output lost in Ghana in 1998 was due to power shortages. This is consistent with the "permissive" rather than "causal" nature of infrastructure, with a certain minimum infrastructure being necessary to ensure the smooth functioning of an economy.

27. Given the monopolistic nature of many infrastructural services, regulatory functions are important for ensuring that public monopolies are not replaced by private foreign monopolies (e.g. Deutsche Telecom's investment in Matav in Hungary) and for ensuring incentives and sustained pressure to invest in infrastructure. Efficient and effective regulation may be difficult to achieve, however, where there is a history of institutional weakness.

28. It is worth highlighting that under the Poverty Reduction Strategy Paper (PRSP) programme, many developing country Governments are required by the World Bank and the International Monetary Fund (IMF) to specify expenditure plans for infrastructure to prioritize and facilitate the allocation of available resources. Many of these plans concentrate on development of rural infrastructure, consistent with goals of broad poverty reduction, rather than infrastructure provision for business districts or FTZs, which is important for national competitiveness and job creation (and ultimately, but more indirectly, for poverty reduction).

3.6 Financial and fiscal measures for collective action

29. The case studies also explore examples of financial and fiscal measures to promote collective action among institutions and agents (home and host Governments, support agencies, large and small firms, and networking) for "linking, leveraging and learning". These are essential to both enterprises and countries to enable their technological development and upgrading. They are defined for the purpose of the CIP Index as:

- Linking: connecting with outsiders to acquire needed technologies and skills;
- Leveraging: going beyond arms, length transactions to derive as much as possible from the new relationships with those outsiders;
- Learning: making efforts to master processes and product technologies, consciously building the foundation for improving current technologies and creating new ones.

30. The UNCTAD Investment Policy Review series uses a broader definition of linkages as formal or informal associations between enterprises, different sectors of industry and/or domestic and foreign firms, with no exclusive emphasis on "outsiders". Formal associations may include contractual arrangements or trade organizations, while informal associations can comprise contacts, business acquaintances and transmission of information. This series also examines the role of clusters and networks in industrial development and technological upgrading. "Cluster" implies an association with a specific structure, with a centre and satellite members who may differ in status, nationality or capabilities, for example a TNC and its domestic subcontractual suppliers. ("Clusters" may also be used more generally to refer to spatial groupings.) "Network" implies multiple linkages between members of equal or unequal status for the exchange of information, contacts and resources. A network may or may not include collective action as part of its functions.

Box 1. Penang, Malaysia

In Penang, Malaysia, the Government decided in the early 1960s to implement a comprehensive set of locational policies thanks to a long-term development vision and commitment. Initially, public interventions concentrated on making locally available efficient communication and transportation facilities, as well as highly qualified human resources and engineering skills. Subsequently, fiscal and financial incentives were put in place, including EPZ-type export promotion measures, in order to attract foreign investors and large transnational corporations. Through the Global Supplier Development Programme, TNCs such as Bosch, Motorola and Intel developed local supply capacity through coaching and mentoring programmes, under which TNCs and large enterprises agree to guide their small suppliers for continuous upgrading of leadership skills and technology.
Source: UNCTAD (2003b).

31. In summary, various measures can promote linking, leveraging and learning. Government ministries, trade associations, and investment and export promotion agencies can facilitate linkages to acquire needed technologies and skills, including with outsiders.

Financial and fiscal measures are then necessary to stimulate those linkages and to "leverage" or capitalize upon such transactions in order to derive as many benefits as possible from these relationships. These include targeted grants and subsidies, collective funds and insurance arrangements, fiscal incentives, and preferential and advantageous tax rates for investors, suppliers, vendors and distributors. Policy measures to facilitate cluster establishment may include free trade zones, multi-facility economic zones, partnership schemes between SMEs and TNCs, and incubator and microenterprise development programmes. These are categorical definitions, and much depends upon how these policies are implemented in practice. The case studies examine country examples of how these measures were used to encourage transfer and mastery of technologies, skills and learning.

32. Some concerns have been expressed about fiscal measures interfering with free market forces and distorting incentives (UNCTAD, 2002a). Governments should encourage the development of sound and viable national financial institutions to provide the finance needed for technology transfer. For an overview of the Commission's earlier work on the financing of technology and financial incentives, see the papers presented to the Expert Meeting on financing technology for SMEs in October 2002.
(http://r0.unctad.org/en/subsites/dite/enterprise_dev/c3em281002.htm).

4. Country case studies

33. This issues paper adopts the CIP Index as a reasonable working definition of the technology ladder. Using this definition, three Asian economies that improved their technology development from 1985 to 1998 were selected, namely Malaysia, Singapore and Taiwan Province of China. Three African economies that were less successful were chosen, namely Ghana, Senegal and Uganda. The Background Report analyses and compares the experiences of these countries to examine how policies for technological development may actually work in practice, and summarizes key conclusions and possible policy options.

34. TNCs play an undoubtedly important and growing role in technology development. Two thirds of visible world trade was handled by TNCs in the latter half of the 1990s (World Investment Report 1999), while one third of world trade is intra-firm trade within a single corporate system. The role of TNCs in R&D and FDI is equally prominent. TNCs are important channels for technology transfer and mastery. However, TNCs may not necessarily invest heavily in developing the technological capabilities of their subsidiaries. There is growing recognition of the important partnership role of local firms and SMEs in providing domestic supply capacity and in the development of local technological capabilities. Local private sector development is essential for attracting and benefiting from FDI in the long term. There is a need to promote business start-ups and SMEs, to encourage the formation of linkages between local and foreign firms, and to build enterprise capabilities generally, including the promotion of education and science and technology policies responsive to the needs of the private sector (UNCTAD, 2003b). Host governments and local firms must make specific efforts to encourage the transfer of technology from foreign to local enterprises through supplier development programmes, including coaching and mentoring, training and apprenticeships, job mobility and subcontracting arrangements. Subcontracting arrangements are the main channel for technology transfer as job mobility is often low.

35. Within the case studies, there is considerable diversity in the policy paths followed by different countries. Singapore (and to a lesser extent, Malaysia) followed FDI-dependent strategies for technological mastery, driven by FDI and exports under the aegis of TNC global networks. In Singapore, there were strategic interventions to attract, direct and upgrade TNC activity and investment according to strategic priorities, including R&D and the development of technology institutions. In contrast, Taiwan Province of China followed an autonomous strategy based on the development of capabilities within domestic firms. This strategy used extensive industrial policy interventions within a strongly export-oriented regime, with incentives based on good export performance.

Box 2. The case of Singapore

Singapore, located on a 602 sq. km sandbar without natural resources, had a multi-ethnic population (Chinese, 75 per cent; Malay, 14 per cent; and Indian, 11 per cent) of 2 million in the late 1950s. For Lee Kuan Yew, former prime minister of Singapore, education, discipline and the ingenuity of the people would substitute for resources. He established zero tolerance for corruption in government and invested in infrastructure. Singapore established world-class standards in public and personal security, health, education, telecommunications and services so that it became a base camp for TNC and entrepreneurs who had business in the region. These were paid for by taxes levied on consumption versus production. The Economic Development Board and the Development Bank financed entrepreneurs who needed venture capital because established banks were reluctant to lend to would-be entrepreneurs. The Government attracted FDI through industrial estates, equity participation, fiscal incentives and export promotion. Yew chose one word to explain why Singapore had succeeded in attracting FDI, "confidence". A virtuous cycle of low expenditures, high savings, low welfare costs and high investments was established. Singapore ranks number one in terms of the CIP Index and income per capita has risen from $1,000 (1965) to over $30,000 (2000). (Yew, 2000).

36. The African countries are seeking to diversify from their traditional economic base and specialization in natural resources in different ways. Often, the FDI they receive relates to their natural resource endowments through, for example, investments in mining and extraction activities. The UNCTAD Investment Policy Review series investigates opportunities for investment and private participation in infrastructure projects. Ghana is pursuing a "Gateway" strategy to position itself as a West African hub for import, export, storage, assembly, distribution, manufacturing and trans-shipment of goods and services. It is doing this through legislative, regulatory and incentives reform and capacity-building and trade agreements. Uganda is undertaking similar legislative and regulatory reforms and seeking to build its export capabilities to overcome the small size of its domestic markets. Such strategies should ultimately contribute to improving technological development of those countries.

Box 3. The metal cluster in Kumasi, Ghana

The Suame Magazine cluster in Kumasi (Ghana) is one example of a cluster which became dynamic thanks to the proliferation of linkages among users and suppliers and to networking with research institutions such as the Technology Consultancy Centre at the University of Science and Technology in Kumasi. The Intermediate Technology Training Unit of the Technology Consultancy Centre provided training to upgrade the skills of mechanics in informal workshops and to teach them basic accounting and management skills. The Government, after initial opposition to the mushrooming of informal workshops in Suame Magazine, moved to support their development through the provision of technology services, training and credit.

These linkages generated considerable technology capacity-building within the cluster, and this process was reinforced during Ghana's long period of economic crisis by the movement of educated people out of the public sector and into micro and small-scale enterprise. When, towards the end of the 1980s, the IMF structural adjustment programme liberalized imports, hundreds of businesses collapsed and thousands of workers lost their jobs. Businesses that had shifted to manufacturing fared better than others, and the lesson was learned that to survive and prosper, enterprises had to raise their level of technology and to change their role from that of repairers or assemblers to that of manufacturers. In this process, private learning efforts by firms were complemented by free or low-cost access to specialized facilities owned by the State, low-cost information on new products and processes, subsidized/decentralized materials and testing services.

Source: Powell (1995).

5. Conclusions

37. The comparative advantage of developing countries has traditionally been considered to lie in natural resource endowments and low-cost labour. However, arguments for economic diversification and for technological upgrading require that countries attain a competitive advantage. Some developing countries have also successfully developed research and innovatory capacity and niches as trading and communication hubs through regional and preferential trade agreements. The question for other LDCs thus becomes: to what extent can they adapt and create competitive advantages in areas where they may have little or no previous advantage?

38. The technological development of an economy partly reflects its sectoral structure in the status and technology requirements of its manufacturing and service sectors. A vibrant manufacturing sector is often automated and R&D-intensive and creates domestic demand for manufactured and high-tech products. The growth of the services sector boosts an economy's technological development through information-intensive service activities that often require the use of ICTs. Sectoral strategies to support and expand the manufacturing and service sectors promote general technological development.

39. However, further specific strategies are needed to promote technological development and the transfer and mastery of technology in strategic industries. These include skills development policies and targeted training programmes to develop technological and research capabilities. Given the important role of FDI in technology transfer, liberalization of investment framework should prove beneficial.

40. The Expert Meeting on financing technology concluded that government interventions in the form of subsidies and incentives are needed to finance technology in developing countries. Private sources of finance for technology are very limited in developing countries. Venture capital plays a useful role in some countries, but the conditions for establishing a viable venture capital industry are too stringent for most developing countries to fulfil in the short term. What options do developing countries have in choosing between [PC1]financial and fiscal incentives? In many countries government policy is biased against SMEs and favours the large enterprises particularly in the area of subsidies and incentives. Therefore, targeted interventions and safeguards should be adopted to ensure that public mechanisms are cost-effective and do not lead to further market distortions, moral hazard, or outright corruption. A further issue to consider is the compatibility of these measures with WTO rules and other international commitments (IMF, Bank for International Settlements).

41. This issues paper has provided a broad overview of the underlying issues surrounding technology development and the drivers that determine technology outcomes. The Background Report to be circulated at the Expert Meeting compares the experiences of three countries that improved their technology development with three countries that were less successful, for the purpose of examining which policies for technological development proved successful, which were less successful, and why. The Background Report summarizes key conclusions and policy options emerging from this comparison of country experiences.

6. List of points for discussion at the Expert Meeting

The experts may wish to consider the following issues for discussion:

General issues

- Methods of measuring competitiveness

Policy responses to improve competitiveness

- Broad education versus skills training, or both ;
- Effective methods to promote R&D by different agents;
- Facilitating licensing (including compulsory licensing);
- Financing basic infrastructure (power generation, communication, roads, water);
- FDI targeting and incentives to promote linking, leveraging and learning;
- Financial and fiscal measures for promoting collective action.

Policy coherence

42. The policy directions indicated so far for achieving competitiveness at the micro level need to be evaluated in terms of international and regional policies. For example, Governments may be constrained in their ability to promote micro improvements by macro policies such as structural adjustment policies, the Basle II Capital Accord, the European Union's rules for establishing a single financial market and the World Trade Organization's Agreement on Subsidies and Countervailing Measures, among others.

43. UNCTAD recommended in the World Investment Report 2002 that certain incentives offered to foreign or domestic firms that have a development impact should be allowed in the context of international processes. Such development impacts would involve the creation of

more and deeper linkages, the provision of technology and the training of local suppliers and their personnel. The distortive effects of such measures could be reduced by open and transparent processes, with regular reporting and accounting of the costs of incentives used and with an assessment of their effectiveness.

Issues for discussion

- International commitments (WTO, IMF, BIS) and support measures for competitiveness;
- International negotiations and support measures for competitiveness.

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