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Chapter 1

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Building Technological Capabilities through International Market Linkages

Chapter 1

A. Introduction

Technological catch-up for least developed countries requires access to the international knowledge pool and the ability to learn, master and adapt foreign technologies and thereby benefit from international technology diffusion. This process includes transfer of technology, which takes place through several channels. These can be formal (e.g. licensing, foreign direct investment) or informal (e.g. movement of people) and/or market (e.g. interaction with upstream suppliers or downstream customers) or non-market (e.g. technical assistance programmes of official development agencies or NGOs).

Technological catch-up for least developed countries requires access to the international knowledge pool and the ability to learn, master and adapt foreign technologies and thereby benefit from international technology diffusion.

The importance of those different channels cannot be established precisely and it varies according to different stages of development, as do developing countries' ability to take advantage of them. Nevertheless, the channels that involve continuous interaction between the acquirer and the supplier of technology are the most likely to be effective channels for knowledge diffusion. The main reason for this is that tacit knowledge is a component of virtually all technologies, but at the same time it is the most difficult to transmit between different agents. Therefore, it is mainly through continuous interaction between agents that tacit knowledge is transmitted. It can thus be assumed that the channels of technology diffusion that involve constant interaction and exchange are more important for LDCs than the others.

The most widespread international market mechanisms that involve continuous interaction between agents leading to knowledge flows are trade and foreign direct investment (FDI). From this, the major channels for international technology diffusion to LDCs can be derived from:

1. Imports of technology embodied in machinery and other capital goods;
2. Interaction with international customers (i.e. exports), particularly through the integration of LDC firms into global value chains;
3. Foreign direct investment;
4. Imports of disembodied technology (i.e. licensing).

The major channels for international technology diffusion to LDCs are imports of capital goods, integration into global value chains, foreign direct investment and licensing.

The working of those four market mechanisms as channels for diffusion of technology to LDCs is analysed successively in sections to B to E of this chapter.[1]

The critical issue is how effective these channels are in an LDC context. LDCs have over the past 20 years actively integrated into the global economy through trade and investment. Nevertheless, those countries are still at the initial levels of technological development. Their low income levels and the prevalence of poverty entail low levels of physical and human capital. Their national knowledge systems are not well articulated or efficient (UNCTAD, 2006b). Those countries are far away from the world technological frontier. Most domestic firms and farms

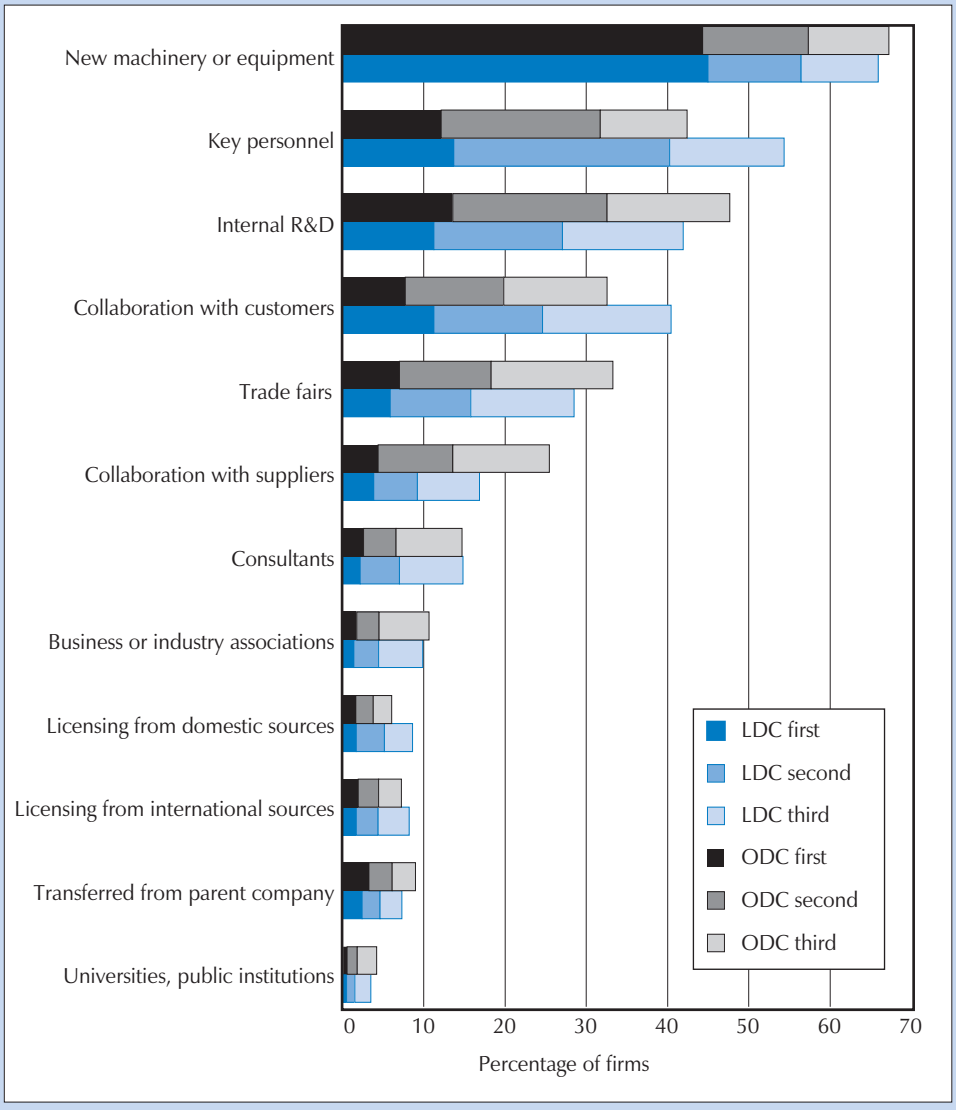
operate with rudimentary technologies and carry out little, if any, autonomous research and development (R&D). In these circumstances the working of international market linkages as channels of international technology diffusion may be severely constrained. The evidence presented in this chapter shows the extent of it. Section F summarizes and concludes.

Most LDC firms and farms operate with rudimentary technologies and carry out little, if any, autonomous research and development.

B. Imports of capital goods

By far the most important source of technological innovation in LDCs, as perceived by firms, is new machinery or equipment, according to a large-scale survey of firms in developing countries (chart 3). This is true of domestically owned firms and of foreign affiliates operating in LDCs (Knell, 2006).[2] Machinery and equipment were also found to be the major source of innovation by firms from other developing countries (ODCs).[3]

Chart 3. Three most important sources of technological innovation in LDCs and ODCs, 2000–2005



Source: Knell (2006), based on World Bank, Investment Climate Surveys, 2000–2005.

Note: Percentage of replies to the question asking firms to identify the first, second and third most important sources of technological innovation for them. The question was part of a survey questionnaire given to firms located in LDCs and other developing countries, as part of the World Bank's Investment Climate Surveys. In the case of the LDCs, interviews with 2,500 firms were carried out between 2000 and 2005 in Bangladesh, Cambodia, Ethiopia, Madagascar, Mali, Senegal, Uganda, United Republic of Tanzania and Zambia.

It is likely that most of the machinery and equipment operated in LDCs is imported, since those countries have very little capital goods manufacturing capacity. Hence, imports of capital goods are the main source of innovation for firms in LDCs and are a major feature of their technological effort. The presence of a national capital goods industry would reduce the dependence of LDCs on imports. However, the development of domestic capital goods manufacturing capacity typically takes place only at a much later stage of technological catch-up (Justman and Teubal, 1991). Therefore, at the present stage of technological development of LDCs imports remain the main source of capital goods.

Imports of capital goods are the main source of innovation for firms in LDCs and are a major feature of their technological effort.

This section analyses the development in LDCs imports of technology embodied in machinery, equipment and other capital goods between 1980 and 2005. It compares them with those of other developing countries in order to put LDCs in perspective. An analysis is made of different types of capital goods, according to their general characteristics and main end-use (whenever possible), so as to study which types of embodied technologies LDCs have been acquiring internationally over the last 25 years.[4] The trading partners of origin for capital goods are both developed countries and the group of the 20 most technologically advanced developing countries.[5]

Imports of capital goods by LDCs expanded only moderately during the 1980s and 1990s, but since 2003 they increased sharply.

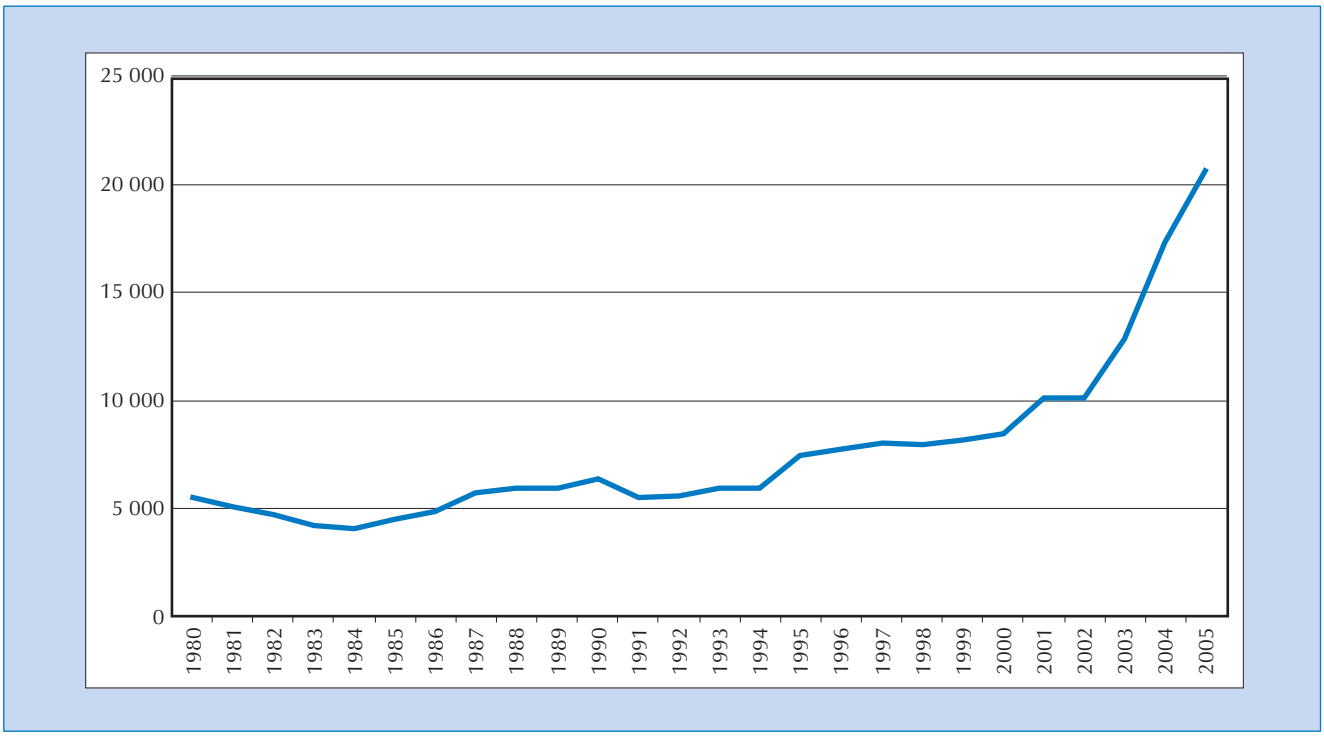
1. Trends and origin

Imports of capital goods (in nominal terms) by LDCs expanded only moderately during the 1980s and 1990s. Since 2003, however, they increased sharply to reach more than $20 billion in 2005 (chart 4). The strong increase in the more recent years was highly concentrated on oil-exporting countries and Bangladesh, the largest LDC economy.

A significant part of the capital goods imported by LDCs consists of second-hand equipment. Although trade data do not show the extent of this practice,

Chart 4. LDC imports of capital goods, 1980–2005

(Current $, millions)



Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Note: LDCs exclude Lesotho, Liberia and Timor-Leste. For the definition of capital goods and methodological notes, see the annex.

cursory evidence attests it. In the textile and garment industry, foreign investors often transfer used capital goods from other countries to LDCs when establishing themselves in the new host country (see subsection D.4 of this chapter). It is likely that junior mining companies do the same to some extent.

While in the 1980s 92 per cent of LDCs' capital goods imports originated in developed countries, during 2000–2005 this proportion fell to 59 per cent, this reflecting the rise of technologically advanced developing countries as exporters of capital goods.

The sourcing of LDCs' capital goods imports has changed markedly over the last 25 years. While in the 1980s most of them (92 per cent) originated in developed countries, during 2000–2005 this proportion fell to 59 per cent, this reflecting the rise of technologically advanced developing countries as exporters of capital goods. The shift towards this type of South–South trade was driven by the Asian LDCs, which sourced more than half of their capital goods imports from other developing countries in 2000–2005 (table 2). This is mostly explained by the growing regional integration of Asian LDCs not only in terms of international trade, but also in terms of foreign direct investment.

2. Intensity of capital goods imports

In order to assess the intensity of capital goods imports in LDCs and its development over time, a series of indicators are presented in table 3. They consist of capital goods imports as a share of GDP, gross fixed capital formation (GFCF), total merchandise imports and total merchandise exports. Lastly, per capita capital goods imports are also shown.

Relative to GDP, capital goods imports in the LDCs were lower than in other developing countries and the gap widened considerably during the last 25 years.

Capital goods imports as a share of GDP and GFCF remained approximately constant during the 1980s and 1990s in the LDCs, but rose marginally in 2000–2005 thanks to higher import values in 2003–2005.[6] Nevertheless, the levels were substantially lower than in other developing countries and the gap widened considerably during the last 25 years (table 3). The share of GDP of capital goods imports was similar in LDCs and ODCs during the 1980s, but it more than doubled to 12 per cent by 2000–2005 in ODCs, while in LDCs it rose to just half that level. On a per capita basis, capital goods imports of LDCs less than doubled to $18 between the 1980s and 2000–2005, while in the ODCs the ratio rose fivefold to $207, a level 11 times higher than in LDCs.

The part of national fixed investment that was dedicated to imported machinery and equipment in the 1980s was higher in the LDCs (27 per cent)

Table 2. Imports of capital goods, by origin, in LDCs and ODCs, 1980–2005

(Percentage ot total capital goods imports)

	1980–1989		1990–1999		2000–2005	
	Developed countries	*Developing countries*	*Developed countries*	*Developing countries*	*Developed countries*	*Developing countries*
LDCs	**91.5**	**8.5**	**75.4**	**24.6**	**59.0**	**41.0**
Africa and Haiti	95.0	5.0	88.6	11.4	66.3	33.7
Asia	81.7	18.3	51.2	48.8	43.4	56.6
Islands	92.0	8.0	84.4	15.6	73.8	26.2
Other developing countries (ODCs)	**89.4**	**10.6**	**72.3**	**27.7**	**57.5**	**42.5**
Africa	97.4	2.6	90.8	9.2	83.5	16.5
America	94.4	5.6	85.8	14.2	82.9	17.1
Asia	85.9	14.1	67.2	32.8	51.1	48.9

Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Note: LDCs and the regional subgroupings exclude Lesotho, Liberia and Timor-Leste. For the definition of capital goods, capital good groups and country groups, and methodological notes, see the annex.

Table 3. Indicators of the importance of capital goods imports in LDCs and ODCs, 1980–2005

(Percentage, unless otherwise indicated)

	Capital goods imports/ GDP			Capital goods imports/ Gross fixed capital formation			Capital goods imports/ Total merchandise imports			Capital goods imports/ Total merchandise exports			Capital goods imports per capita (Current $)		
	1980–1989	*1990–1999*	*2000–2005*	*1980–1989*	*1990–1999*	*2000–2005*	*1980–1989*	*1990–1999*	*2000–2005*	*1980–1989*	*1990–1999*	*2000–2005*	*1980–1989*	*1990–1999*	*2000–2005*
LDCs	**4.5**	**4.5**	**5.9**	**27.0**	**26.0**	**29.5**	**23.6**	**22.1**	**22.4**	**37.4**	**32.9**	**26.5**	**11**	**12**	**18**
Africa and Haiti	5.0	4.7	6.8	32.1	29.0	35.6	25.8	22.6	24.6	34.0	29.7	27.1	14	12	19
Asia	3.3	3.7	4.5	18.0	20.3	21.4	18.7	19.5	18.6	47.8	36.1	23.9	7	10	15
Islands	15.2	19.4	15.2	51.8	70.9	65.2	33.3	41.0	31.7	84.3	134.1	141.9	88	168	159
Other developing countries (ODCs)	**5.3**	**8.5**	**11.9**	**22.5**	**34.4**	**48.6**	**28.1**	**34.6**	**39.2**	**26.3**	**34.6**	**35.9**	**46**	**115**	**207**
Africa	5.5	6.2	7.3	25.6	35.3	43.7	29.1	30.0	30.9	28.7	28.7	27.4	87	74	97
America	3.8	5.4	7.1	17.8	27.3	38.0	33.1	37.6	35.5	28.9	40.2	34.6	81	187	270
Asia	6.2	10.7	14.6	24.9	37.6	52.4	27.3	35.1	41.1	25.8	34.5	37.2	37	110	213

Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Notes: As for table 2.

than in ODCs (23 per cent). In 2000–2005, by contrast, this was completely reversed. ODCs devoted almost half of their GFCF to imported capital goods, but LDCs less than one third (table 3). It is likely that this is an indirect indicator of the changing composition of fixed investment, with an increasing share of machinery and equipment in total GFCF of ODCs. This, in turn, possibly points to the increasing technological content of fixed investment in those countries and to their firms' strengthening technological effort. By contrast, comparable technological upgrading of GFCF does not seem to have taken place in LDCs.

Data point to the increasing technological content of fixed investment in ODCs and to their firms' strengthening technological effort. By contrast, comparable technological upgrading of fixed investment does not seem to have taken place in LDCs.

Other indicators of the effort to acquire foreign technology embodied in capital goods are provided by their ratios to total merchandise imports and exports. The first ratio points to the priority given to capital goods, as opposed to other imports, such as consumer goods or food. This indicator has been approximately constant at about around 23 per cent in LDCs since 1980, as has the structure of imports of this group of countries. ODCs, by contrast, have strongly redirected their imports towards embodied technology since then, so that the share rose from 28 per cent in the 1980s to almost 40 per cent in 2000–2005 (table 3). Capital goods imports as a share of total exports indicates one possible use of foreign exchange earnings obtained through merchandise trade. It is competing with other uses, such as imports of other goods and payment of foreign debt. Thus, a rising share indicates foreign exchange earned through merchandise exports is increasingly being earmarked for building the productive capacity of the importing country. This indicator has taken opposite (and almost symmetrical) paths in LDCs and ODCs during the last 25 years. In the LDCs capital goods imports declined from 37 per cent of total exports to 27 per cent between the 1980s and 2000–2005. In the other developing countries they rose from 26 per cent to 36 per cent over the same period. Their foreign exchange earnings have been progressively used for building domestic technological capabilities. In LDCs, by contrast, the considerable increase in export earnings in 2000–2005 was not used to finance additional imports of capital goods to a comparable extent (except for oil-exporting economies), because of the only marginal rise in their investment rate.

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Country data reveal that the value of capital goods imports is related to the economic weight of national economies and/or to the fact of being a petroleum exporter. Thus, the largest importers are Angola, Bangladesh, Sudan, Myanmar and Yemen (table 4). This reflects a size effect and large capital goods imports associated with the sharp increase in FDI inflows in the oil extractive industry

Table 4. Indicators of the importance of capital goods imports for LDCs, by country, 2000–2005

(Period averages)

	Value	Capital goods imports/ GDP	Capital goods imports/GFCF	Capital goods imports per capita
	(Current $ millions)	*(%)*	*(%)*	*($)*
Angola	2101	13.2	112.0	136.8
Bangladesh	1792	3.2	13.5	12.2
Sudan	1026	5.7	30.0	28.7
Myanmar	730	7.9	70.7	15.5
Yemen	720	5.9	31.7	36.3
Ethiopia	617	8.3	39.3	8.2
United Rep. of Tanzania	521	4.8	24.8	14.3
Senegal	451	7.6	34.9	40.6
Zambia	383	8.5	40.4	34.7
Mozambique	369	7.7	33.4	18.9
Cambodia	352	7.9	38.5	26.2
Equatorial Guinea	326	10.9	25.2	702.6
Afghanistan	283	5.8	35.4	12.0
Madagascar	233	5.1	27.9	13.3
Benin	229	7.2	38.3	29.1
Nepal	225	3.8	19.6	8.8
Uganda	213	3.1	14.6	7.9
Mauritania	209	17.4	132.2	74.8
Mali	204	5.4	26.7	18.8
Dem. Rep. of the Congo	188	3.1	27.3	3.4
Guinea	173	5.3	34.7	20.0
Lao PDR	161	7.3	43.6	29.3
Chad	149	6.0	15.0	15.9
Malawi	133	7.1	69.2	10.7
Burkina Faso	133	3.6	14.6	10.2
Haiti	126	3.8	29.4	14.1
Togo	126	7.3	36.1	21.3
Djibouti	122	19.6	154.3	158.5
Sierra Leone	119	11.7	100.1	23.0
Maldives	100	14.2	50.1	348.0
Niger	92	3.9	26.2	7.5
Cape Verde	80	10.8	39.2	165.6
Vanuatu	79	28.8	140.4	387.2
Eritrea	75	9.6	37.8	18.0
Samoa	60	21.6	170.9	331.0
Rwanda	56	3.1	16.2	6.3
Bhutan	52	7.8	12.1	84.6
Gambia	49	11.9	58.0	32.4
Comoros	38	15.3	157.3	51.8
Burundi	33	4.6	37.9	4.5
Central African Republic	27	2.5	40.5	6.8
Solomon Islands	23	7.7	41.0	50.6
Lesotho	20	2.0	4.6	10.3
Sao Tome and Principe	15	27.1	80.5	103.6
Guinea-Bissau	15	6.3	34.5	10.0
Timor-Leste	12	3.6	11.2	12.9
Kiribati	12	21.3	49.4	135.0
Somalia	10	0.5	2.3	1.3
Tuvalu	6	31.7	56.7	587.3

Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Note: For the definition of capital goods and methodological notes, see the Annex. Countries are ranked according to import values. Data for Liberia not shown due to due to lack of reliable data.

since the 1990s (see section D of this chapter). Relative indicators reveal that the economies importing incorporated technology most intensively are islands, small economies and, again, oil producers (table 4). This reflects opposite size effects (since the impact of capital goods imports on small economies is greater) and the importance of petroleum extraction. By contrast, the countries with the lowest capital goods import intensity are not only those that have recently experienced armed conflict and therefore have a low investment rate. More surprisingly, some of the major LDC exporters of manufactures (e.g. Bangladesh, Nepal, Haiti and Madagascar) also have very low imports of embodied technology, a fact that indicates their firms' weak technological efforts, which could be expected to be stronger in view of their export structure.

Some of the major LDC exporters of manufactures have very low imports of embodied technology, a fact that indicates their firms' weak technological efforts.

3. Types of capital goods imported

For the purpose of our analysis capital goods have been classified in two different ways.[7] The first classification groups them mainly into two broad categories: machinery and equipment, and transport equipment.[8] The remaining capital goods consist of scientific and measuring instruments, which have always accounted for less than 6 per cent of capital goods imports of both LDCs and ODCs.

The large majority of LDC's capital goods imports over the last 25 years have consisted of machinery and equipment, and their share has increased over time. In 2000–2005 they accounted for over two thirds of LDCs' total capital goods imports, while transport equipment amounted to slightly more than one fourth (table 5). Regionally, the Asian LDCs import machinery and equipment most intensively, as those goods account for more than three fourths of their total capital goods imports. The share is much lower for African and island LDCs.[9] The stronger weight of this type of capital goods in imports of Asian LDCs reflects their higher level of industrialization as compared with other LDCs.

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Asian LDCs import machinery and equipment most intensively, reflecting their higher level of industrialization as compared with other LDCs.

Likewise, in other developing countries capital goods imports are dominated by machinery and equipment and their importance has grown over time. The most important difference between the two groups of developing countries, however, is that the share of imports of transport equipment in ODCs is much lower than in LDCs. This is due, on the one hand, to the higher level of industrialization of the former and, on the other hand, to the presence of domestic industry that produces transport equipment in most of the technologically more advanced developing countries. This means that part of the domestic demand for transport capital goods is met domestically rather than by imports.

The second classification of capital goods focuses on machinery and equipment and scientific and measuring instruments (i.e. excluding transport equipment) and endeavours to identify the type of industry that uses them. This is possible for specialized machinery, but not for general-purpose technologies or for the residual category "other industrial machinery".[10]

Among specialized machinery, the most important category for LDCs is construction, mining and metal crushing. This category is relatively more important for African LDCs.

Among specialized machinery, the most important category for LDCs is construction, mining and metal crushing, which in 2000–2005 accounted for 13 per cent of their total capital good imports (table 6). This category is relatively more important for African LDCs.[11] Here the share of this type of equipment increased over the last 25 years, while it remained approximately constant in other LDCs and declined in all ODC subregions. At the same time, the share of industrial machinery[12] in African LDCs' capital goods imports declined from 26 per cent in the 1980s to 23 per cent in 2000–2005. The changing composition of African LDCs' capital goods imports reflects the changing patterns of specialization

Table 5. Imports of capital goods, by broad categories, in LDCs and ODCs, 1980–2005

(Percentage of total capital goods imports)

	1980–1989			1990–1999			2000–2005		
	Machinery & equipment	*Transport equipment*	*Scientific & measuring instruments*	*Machinery & equipment*	*Transport equipment*	*Scientific & measuring instruments*	*Machinery & equipment*	*Transport equipment*	*Scientific & measuring instruments*
LDCs	**62.2**	**34.0**	**3.8**	**66.6**	**28.8**	**4.5**	**68.5**	**26.9**	**4.5**
Africa and Haiti	60.9	35.4	3.7	65.6	29.6	4.8	65.0	30.5	4.6
Asia	67.8	27.9	4.3	70.8	24.9	4.3	76.8	18.8	4.4
Islands	45.3	51.8	2.9	50.9	45.6	3.5	56.5	39.7	3.8
Other developing countries (ODCs)	**73.4**	**21.4**	**5.2**	**80.2**	**14.9**	**4.9**	**82.9**	**11.2**	**5.9**
Africa	69.3	25.9	4.8	70.5	23.9	5.6	69.6	24.9	5.5
America	64.2	30.9	4.9	67.9	27.1	5.0	71.0	23.7	5.4
Asia	75.4	19.4	5.2	83.1	12.2	4.7	85.5	8.5	6.0

Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Notes: As for table 2.

Table 6. Imports of capital goods, by type of end-use, in LDCs and ODCs, 1980–2005

(Percentage of total capital goods imports)

	Agricultural machinery			Construction, mining, metal-crushing			Power-generating machinery			Textile and leather machinery			Metalworking machinery			Food-processing machinery			Paper, pulp and publishing machinery			Other industrial machinery			ICT capital		
	1980–89	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*	*1980–89*	*1990–99*	*2000–05*
LDCs	**3.3**	**2.1**	**1.5**	**10.5**	**11.5**	**13.0**	**13.9**	**14.1**	**12.7**	**2.8**	**3.6**	**3.5**	**1.4**	**1.3**	**1.2**	**1.5**	**1.4**	**1.1**	**0.8**	**0.8**	**0.8**	**20.2**	**20.3**	**19.3**	**11.9**	**16.6**	**19.8**
Africa and Haiti	3.7	2.3	1.2	11.3	12.4	15.5	12.1	13.2	11.0	2.5	1.9	0.8	1.3	1.2	0.8	1.5	1.6	1.2	0.6	0.7	0.6	20.0	20.8	19.9	11.7	16.6	18.0
Asia	2.3	1.8	2.0	9.0	10.8	8.9	19.2	15.7	15.7	3.9	7.1	9.2	1.8	1.6	1.9	1.4	1.2	1.0	1.1	1.1	1.0	21.3	20.1	18.5	12.4	16.7	23.1
Islands	1.7	0.9	0.6	5.6	5.8	5.1	10.3	13.9	15.4	0.5	0.5	0.5	0.7	0.6	0.5	0.6	0.5	0.5	0.4	0.4	0.3	15.5	15.8	17.0	13.1	16.0	20.4
Other developing countries (ODCs)	**1.6**	**0.6**	**0.4**	**8.6**	**6.9**	**5.7**	**14.5**	**13.0**	**12.1**	**3.1**	**2.6**	**1.4**	**2.9**	**2.6**	**2.0**	**0.6**	**0.4**	**0.2**	**1.1**	**1.3**	**0.8**	**20.2**	**18.3**	**16.3**	**26.6**	**40.5**	**50.0**
Africa	2.9	1.8	1.3	10.1	9.6	9.0	14.6	13.2	14.0	3.0	2.9	1.7	2.6	2.0	1.5	1.1	1.1	1.0	1.3	1.5	1.3	23.4	22.8	20.6	15.9	21.4	24.8
America	2.0	1.1	0.9	7.7	6.6	5.2	13.9	13.3	14.8	2.6	1.9	1.1	3.2	2.1	1.6	0.7	0.6	0.4	1.3	1.4	0.9	17.4	17.9	17.6	20.9	28.2	33.9
Asia	1.1	0.4	0.2	8.3	6.6	5.5	14.2	12.6	11.3	3.2	2.7	1.5	2.9	2.7	2.0	0.4	0.3	0.2	1.0	1.2	0.7	19.8	17.7	15.6	30.0	44.6	54.3

Source: UNCTAD secretariat calculations, based on data from UNDESA Statistics Division.

Notes: As for table 2.

of those countries over the last 25 years, particularly the de-industrialization that followed trade liberalization and the re-specialization in natural resource extraction (UNCTAD, 2004, 2006b).

The share of ICTs in LDC imports was 30 percentage points lower than in ODCs. This reflects LDCs' slower adoption of the new ICT technologies and, more generally, those countries' lower technology intensity.

Asian LDCs, by contrast, import textile and leather machinery more intensively than any other developing region. This type of equipment accounted for 9 per cent of their total capital goods imports in 2000–2005, while in all other developing regions the corresponding share was below 2 per cent (table 6). In Asian LDCs the proportion of those capital goods has more than doubled over the last 25 years, a fact that reflects the expansion of the garment and textile industry (see subsection D.4 of this chapter).

The most striking difference between the composition of imports of capital goods of ODCs and LDCs is the importance of information and communication technology (ICT) capital. In the former that category accounted for one fourth of total capital goods imports already in the 1980s, and this share doubled to half in 2000–2005. In the LDCs, by contrast, in the early 21st century ICT amounted to just one fifth of total capital goods imports. Although the share of ICT in those imports doubled as compared with the 1980s, it was still 30 percentage points lower than in ODCs. This reflects LDCs' slower pace of adoption of the new ICT technologies and, more generally, those countries' lower technology intensity.

To a certain extent, the fact that ICT capital imports by LDCs are lower than those by ODCs is to be expected, given the lower level of technological development of the former group. Nevertheless, the low uptake of some of those technologies (particularly telecommunications) deprives many of those countries' firms and households of an important tool for economic integration and market efficiency. While the early enthusiasm about the potential contribution of ICTs to development has not been borne out by recent experience, it is widely recognized that those technologies can make a positive contribution to technological upgrading and associated benefits, even in an LDC context (Konde, 2007).

The low uptake of ICTs (particularly telecommunications) deprives many LDC firms and households of an important tool for economic integration and market efficiency.

The share of agricultural machinery in LDCs' total capital goods imports is low (1.5 per cent in 2000–2005) and less than half of its level during the 1980s (table 6). The relative contraction in those imports was driven by African LDCs, where the share declined by 2.5 percentage points, while there was less of a decline in the other LDCs. Those developments are apparently contrary to expectations. First, given the higher share of agriculture in total GDP in LDCs as compared with ODCs, it could have been expected that they would import agricultural machinery more intensively.[13] This is not the case, however, because the agriculture in LDCs is still largely carried on by smallholders on a non-commercial basis and with extremely low levels of automation. Second, it is likely that a Green Revolution (see chapter 2) would lead to greater imports of agricultural machinery in LDCs.

4. Implications

While the technological effort to acquire foreign embodied technology was comparable in LDCs and ODCs in the 1980s, the gap has widened considerably since that time.

Total capital goods imports by LDCs have lost momentum over the last 25 years. While expanding in nominal terms, they have either been stagnant or risen only marginally when compared with macroeconomic variables or the population. Moreover, they have dramatically fallen behind when compared with imports by other developing countries. The technological effort of ODC firms (in all the subregions) has decisively increased the resources devoted to the acquisition of foreign embodied technology in both absolute and relative terms. While the technological effort to acquire foreign embodied technology was comparable in LDCs and ODCs in the 1980s, the gap has widened considerably since that time. In the LDCs, imports of capital goods have been hampered by structural change, the slow progression of the investment rate and balance-of-payments restrictions.

The composition of capital goods imports by LDCs to a large extent mirrors changes in their productive structure and trade specialization and their overall level of technological development. That explains the relatively high and growing share of imports of machinery and equipment destined for the extractive industry in African LDCs (construction, mining and metal-crushing equipment) or for low-value-added manufacturing in Asian LDCs (textile and leather machinery).

Capital goods imports are associated with the type of FDI that LDCs have been attracting in recent years.

Developments in capital goods imports are, moreover, partly associated with the type of FDI that those countries have been attracting in recent years. Therefore, the impact of such imports on the technological capability-building of LDCs depends also on the technology-diffusing effects of the associated FDI projects and on the patterns of TNC insertion in host LDC economies (see section D of this chapter). Imports of capital goods and equipment for mineral resource extraction by African LDCs, for example, have since 2000 been boosted by the surge in investment in this sector (driven mainly by FDI) and by the changes in mining policy. Policy reforms have facilitated access to foreign finance and reduced the cost of importing the equipment and spare parts needed to rehabilitate and expand existing mines and develop new ones (Campbell, 2004).

In summary, imports of capital goods could be expected to play a major role in LDCs' learning of foreign technology and in the domestic accumulation of their firms' technological capabilities. However, this potential is being fulfilled to only a very limited degree for two main reasons. First, the growth in capital goods imports by those countries has been sluggish, in sharp contrast to their dynamic expansion in other developing countries. Second, the types of equipment and machinery imports that have increased most have accentuated the specialization in natural resource extraction and low-value-added manufacturing into which LDCs are locked. By contrast, greater imports of other types of capital goods could have been expected in view of the early stage of technological catch-up of most LDCs (as a Green Revolution would require more agricultural machinery imports) or if a broader diffusion of telecommunication technology were taking place (leading to higher ICT capital goods imports).

Importing relatively few capital goods implies that LDC firms are foregoing the possibility of technological learning and adaptive innovation potentially associated with greater imports of technology embodied in those goods.

Importing relatively few capital goods implies that LDC firms are forgoing the possibility of technological learning and adaptive innovation potentially associated with greater imports of technology embodied in those goods. Moreover, beyond the quantities imported, the crucial issue is whether these firms can make efficient use of these embodied technology imports. However, this is constrained by their low absorptive capacities (see section F of this chapter).

C. Exports and the role of global value chains

The global value chain approach emphasizes the importance of international linkages and the increasing varieties of inter-firm arrangements.

The possibilities available to LDC firms for developing their technological capabilities through exports depend on the linkages they develop with their downstream foreign customers and on the technological effort that they make to learn through those linkages. This is especially true given the changes in international production systems, distribution channels and financial markets, accelerated by the globalization of product markets and the spread of information technologies. The global value chain (GVC) approach emphasizes the importance of international linkages and the increasing varieties of inter-firm arrangements. It helps to explain the strategic role of relationships with key external actors. Thus, it sheds light on how LDC firms can enhance their technological capabilities by exporting (learning-by-exporting) or, alternatively, they can become marginalized from GVCs (Pietrobelli, 2007).

Global value chains often represent one of the very few options for local firms and suppliers to secure access to larger (international) markets and to innovative technologies.

Global value chains are increasingly present in developing countries, also as a result of changes in national and international regulatory frameworks. They often represent one of the very few options — or perhaps the only one — for local firms and suppliers to secure access to larger (international) markets and to innovative technologies. Participation in GVCs may be associated to the upgrading of firms. In this perspective, four types of upgrading have been distinguished for enterprises (Humphrey and Schmitz, 2000):

- *Process upgrading* is transforming inputs into outputs more efficiently by reorganizing the production system or introducing superior technology.
- *Product upgrading* is moving into more sophisticated product lines in terms of increased unit values.
- *Functional upgrading* is acquiring new, superior functions in the chain, such as design or marketing, or abandoning existing lower-value-added functions, so as to focus on higher-value-added activities.
- *Intersectoral upgrading* is applying the competence acquired in a particular function to move into a new sector.

However, whether LDCs' firms and farms will benefit from the relationships with foreign buyers depends on a number of circumstances that may or may not arise. The upgrading process is fraught with difficulties and obstacles, which are particularly great for LDC firms. The following two subsections explain how that process can in principle take place and its applicability to LDCs. An analysis of those exports countries' then highlights how LDC firms have been able to position themselves in GVCs.

Whether LDCs' firms and farms will benefit from the relationships with foreign buyers depends on a number of circumstances that may or may not arise. The upgrading process is fraught with difficulties and obstacles.

1. The changing nature of global value chains

The value chain describes the full range of activities that firms and workers carry out to bring a product from its conception to its end-use and beyond. That includes activities such as design, production, marketing, distribution and support to the final consumer. Chart 5 provides the example of the textile and garments value chain (whose presence in Asian LDCs is analysed in subsection D.4 of this chapter). Rarely do individual companies alone undertake the full range of activities required in order to bring a product from conception to market. The design, production, and marketing of products involve a chain of activities that are often divided among different enterprises, often located in different places and sometimes even in different countries. All activities contribute to total value, but it is crucial to identify those activities providing higher returns (i.e. "premia") along the value chain in order to understand the global distribution of value added. "Rents" often emerge in GVCs, whenever non-competitive structures emerge and the balance of power is unevenly distributed among actors.

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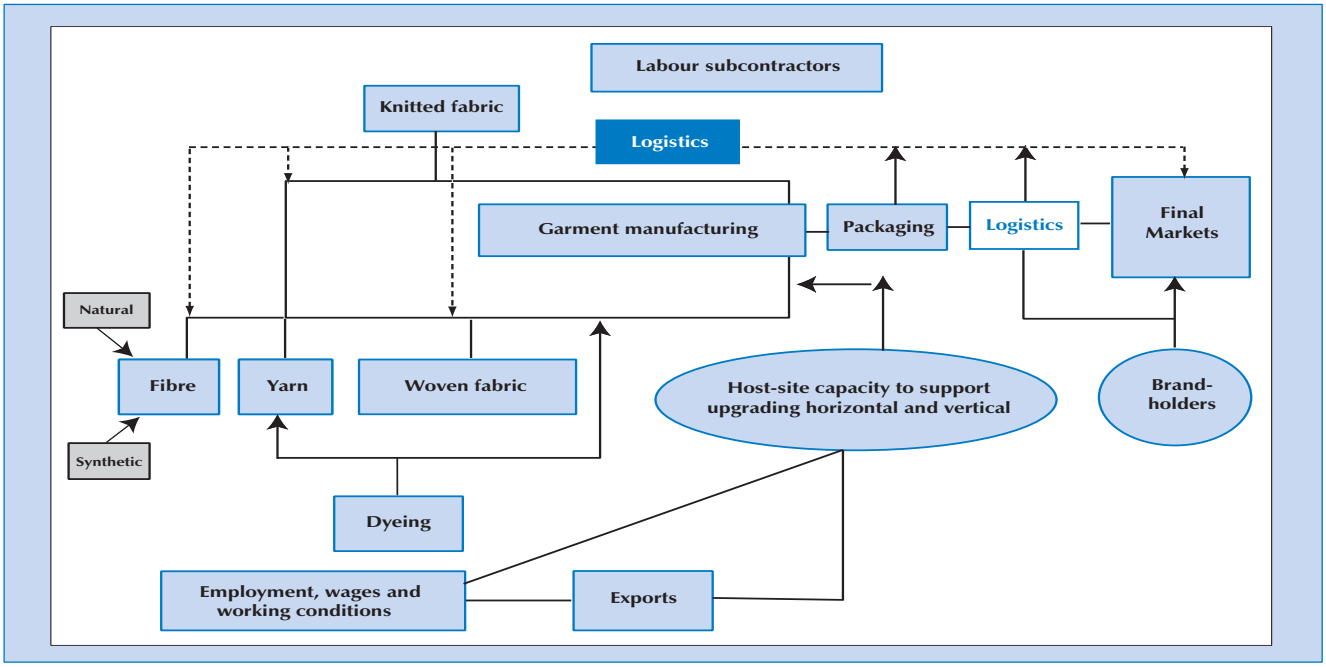
"Rents" often emerge in GVCs, whenever non-competitive structures emerge and the balance of power is unevenly distributed among actors.

At any point in the chain, some degree of governance and coordination is required. This governance may occur through arm's-length market relations or through non-market relationships with different hierarchies: network (implying cooperation among firms of more or less equal power that share their competencies within the chain), quasi-hierarchy and hierarchy (Humphrey and Schmitz, 2000; Pietrobelli and Rabellotti, 2004, 2006a).[14]

The GVC literature also stresses the role played by the GVC leaders, particularly the buyers, in transferring knowledge along the chains. Buyers and retailers

Chart 5. The textile and garments value chain



Source: Rasiah (2006a).

increasingly play a role in product development, branding, supplier selection and distribution, and that is especially true for agricultural and fresh produce (Dolan and Humphrey, 2001, 2004; Humphrey, 2005). The increasing "buyer-drivenness" of value chains allows leaders to transfer the so-called low-profit functions to firms in other functional positions along the chain in order to obtain enhanced organizational flexibility (Gibbon and Ponte, 2005). In fact, today the overall process of driving appears to be related to the relations between lead firms and first-tier suppliers, and between first- and second-tier suppliers, and to the allocation of control over the definition of the functions that first-tier suppliers should play. The rise of buyer-driven chains has been facilitated by developments in the national and international regulatory frameworks, trade liberalization, increasingly stringent food (and sanitary) safety regulation, increased currency convertibility, transport market liberalization and improvements, and reduced costs of international communications and transport.

The rise of buyer-driven chains has been facilitated by trade liberalization, increasingly stringent food (and sanitary) safety regulation, increased currency convertibility and reduced costs of international communications and transport.

Those changes open up opportunities for firms in developing country firms (Humphrey, 2005), such as the following:

- Increased processing, much of it close to growing sites.[15] Retailers are often willing to outsource value chain functions to suppliers, providing new opportunities along the chain;
- Increasing product differentiation and investment in innovation;
- Improved systems within supplying countries to respond to the demand for greater emphasis on freshness and agility within the logistics system;
- Emphasis on parts of the supply relationships such as reliable delivery, trust, flexibility in supply and ability to innovate that increase the switching costs for buyers, and may increase the length of contractual relationships for sellers.

Insertion in a quasi-hierarchical chain may offer favourable conditions for process and product upgrading but hinder functional upgrading.

For small firms in less developed countries, participation in value chains is moreover a means of obtaining information about the needs of global markets and gaining access to those markets. Although this information has high value for local small and medium-sized enterprises (SMEs), it is less clear what role the leaders of the GVCs play in fostering and supporting SMEs' upgrading process. Although the lead firm may be the driver for change, it is not necessarily the agent that implements change or provides support to deal with change. It may set the target and the rules to win an order (e.g. by setting a standard or a performance that needs to be achieved) and, insofar as the cost of switching to source from another supplier is not excessive, it may well source elsewhere. Evidence suggests that insertion in a quasi-hierarchical chain may offer favourable conditions for process and product upgrading but hinder functional upgrading (Humphrey and Schmitz, 2000; Pietrobelli and Rabellotti, 2006a; Giuliani, Pietrobelli and Rabellotti, 2005); networks offer ideal conditions for all forms of upgrading, but they are the least likely to occur among producers in developing countries.

In some sectors vertical relations with suppliers of inputs may be particularly important sources of product and process upgrading, as in the case of textiles and most traditional manufacturing.

As innovation studies have shown, in some sectors vertical relations with suppliers of inputs may be particularly important sources of product and process upgrading, as in the case of textiles and most traditional manufacturing. However, in other sectors the major stimuli for technical change may be provided by technology users, organizations such as universities or the firms themselves, as, for example, with software or agro-industrial products (Pavitt, 1984). Table 7 provides relevant information for two types of sectors prevalent in LDCs: resource-based activities and low-tech manufacturing.

2. Participation of LDCs in global value chains

Access to the fastest-growing market segments depends upon satisfying the demands of retailers and competing with other suppliers. Large retailers become gatekeepers to markets, hindering and/or fostering access. These difficult changes represent opportunities but may also threaten exclusion for those suppliers that are unable to respond to the challenge.

Since the mid-1980s lead firms have required more functional capacities (i.e. the range of activities, and the related conditions and skills, that suppliers are required to carry out) from first-tier suppliers in all cases, and sometimes also from second- and third-tier suppliers. At the same time, lead firms require higher performance levels from second-tier suppliers (i.e. compliance with standards for carrying out those activities). These increasing demands by buyers differ by sector and by specific value chain.

Buyers and chain leaders are becoming more and more demanding, but they do not necessarily provide support or transfer knowledge and capabilities.

Buyers and chain leaders are becoming more and more demanding, but they do not necessarily provide support or transfer knowledge and capabilities. The key agents for knowledge transfer and organization vary from chain to chain. The "lead" firm may not be responsible for ensuring technical competence along the supply chain. In fact, much of the work of value chain organization and management is being outsourced by lead firms, which establish a first tier of suppliers and push responsibility towards them to an increasing extent. First-tier suppliers in turn increasingly rely on a series of second- and third-tier suppliers. Firms from LDCs rarely qualify — that is, they do not have the capacity, skills and volumes — to become first-tier suppliers, and in the best case may become second- or third- tier suppliers.

For the LDCs, the risks involved in increasing demands of buyers in GVCs have been described as the risks of marginalization and exclusion.

According to most recent empirical evidence, by far the most demanding entry barrier increases have been for first-tier suppliers (Gibbon and Ponte, 2005). This is perhaps less worrying for LDCs, as no firms from those countries play the role of leader, and very few that of first-tier (or often even second-tier) supplier.

What are the consequences of those increasing demands by buyers for second-tier suppliers in LDCs? The risks involved have been described as the risks of marginalization and exclusion (Gibbon and Ponte, 2005). The former refers to the possibility of downgrading within the same GVC and being relegated to less remunerative and more vulnerable segments of activity, while the latter refers to the eventual inability to enter, and being utterly excluded from global chains.

The processes of exclusion and marginalization differ in different value chains and countries, but the risks have become a standard typical characteristic. However, those risks do not necessarily imply marginalization and exclusion:

Table 7. Patterns of learning and innovation in selected sectoral groups

Groups	Industries	Learning patterns	Description
Traditional manufacturing	Textiles and apparel, footwear, furniture, tiles	Mainly supplier-driven	• Most new techniques originate from machinery and chemical industries • Opportunities for technological accumulation are focused on improvements and modifications in production methods and associated inputs, and on product design • Most technology is transferred internationally, embodied in capital goods • Low appropriability, low entry barriers
Resource-based activities	Sugar, tobacco, wine, fruit, milk, mining industry	Supplier-driven, science-based	• Importance of basic and applied research led by public research institutes due to low appropriability of knowledge • Innovation is also spurred by suppliers (machinery, seeds, chemicals etc.) • Increasing importance of international sanitary and quality standards, and of patents • Low appropriability of knowledge, but high for input suppliers

Source: Giuliani, Pietrobelli and Robellotti (2005); Pietrobelli and Rabellotti (2006a).

the evidence reveals that it is not easy to escape from marginalization, but it is indeed possible, and domestic firms' efforts to build technological capabilities are essential. In some cases, clever strategic alliances with the lead firms may help, as there are specific circumstances where the private sector has direct business motives for investing resources in transferring knowledge and upgrading suppliers. These tend to be time-limited, and are usually directed towards strengthening the ability of suppliers to meet buyers' requirements. However, in some instances public policies explicitly directed to favouring SME inclusion may help (Gomes, 2006).

It is not easy to escape from marginalization, but it is possible, and domestic firms' efforts to build technological capabilities are essential.

Analyses on a chain-by-chain basis are necessary in order to identify the consequences for LDC enterprises of the increasing demands made by buyers. To that end, it may be useful to examine the specific opportunities to get a "reward" (i.e. an advantage or a return) and the concrete roles that suppliers may play in getting those rewards (Gibbon and Ponte, 2005). That also helps explore the extent to which LDC producers have attempted to perform those roles, and the opportunities they may have had in that respect. Table 8 presents the structures of rewards in selected GVCs in sub-Saharan Africa, and the roles that local suppliers may play in capturing them.

In sub-Saharan Africa, there have been relatively few examples of clearly successful upgrading.

One of the few cases of detailed studies of specific GVCs in sub-Saharan Africa analyses cotton, clothing, citrus, coffee, cocoa, and fresh vegetables GVCs, concluding that there have been relatively few examples of clearly successful upgrading (Gibbon and Ponte, 2005). Acquiring larger volumes — and economies of scale — appears central in most cases, and this sometimes suggests an interesting scope for regionalization (large regionally integrated markets) and for SMEs growing to medium-sized status.

Several Kenyan exporters consolidated their supply of fresh vegetables to United Kingdom supermarkets in the late 1990s by expanding their scale

Table 8. Structures of rewards in selected global value chains in sub-Saharan Africa

Sector	Reward	Means of obtaining these rewards
Clothing	Security of contracts, ability to compensate for secularly falling prices through larger volumes	• Sales ordered in advance by trading houses and direct sales to retailers • Become a recognized producer of a product type • Meet special delivery conditions (delivery on call-off)
Coffee	Achieve reference prices Medium- and long-term purchasing commitments Considerable premia (direct sales, long-term purchase commitments, multi-season prices)	• Become a non-anonymous seller (typically from large exporter — in Latin America) • Specialize in specialty coffees within the Arabica market • In general, limited opportunities to upgrade in tropical countries (it depends on coffee's physical properties, and most coffee roasters use blends of various origins)
Fresh vegetable citrus	No premium for quality but for producing specific varieties (changing over time) Security of contracts, stability of prices (3–9 months). This in turn allows longer-term planning, planning of larger volumes, economies of scale and cross-subsidization of new product development	• Essentially available to suppliers serving large supermarket chains (mostly in the United Kingdom)
Cocoa	Traditional reward structures for primary producers have disappeared	• Second-tier suppliers (smallholders and cooperatives) can upgrade only by taking on first-tier supplier roles, i.e. engaging in international trading and/or grinding, but this is difficult
Cotton	GVC is less buyer-driven, and rewards reflect global supply/demand balance, including subsidies Premia attached to form of sale (forward, tender) and timing of sale (early market window)	• International cotton trade as a single non-anonymous market bifurcated between coarser and finer cottons — defined in terms of quality and national origins. • Reputational dimensions of national origins matter (difficult to measure and prove quality otherwise) • Upgrading requires improvements in reputation

Source: Gibbon and Ponte (2005), and the cases therein.

(including through investments in the United Republic of Tanzania), improving quality assurance, and diversifying into snow/snap peas and cut flowers. Regarding cotton, the experiences from the United Republic of Tanzania and Zimbabwe are the opposite. While the former experienced downgrading in the 1990s, the Zimbabwean company Cottco consolidated its minor first-tier supplier status by vertically integrating into spinning of cotton knitting yarn, acquired a cotton concession in Mozambique and gained economies of scale in the regional market.

In the coffee value chains the general trend has been one of downgrading of local export companies, now working for foreign-owned exporters (Ponte, 2002a, 2002b). Nevertheless, the few examples of upgrading among second- and third-tier suppliers relate to the following specific instances:

- Participation by mainly private and foreign-owned estates in specialty coffee sales;
- Smallholder cooperatives selling new quality content through fair trade and organic channels;
- In the United Republic of Tanzania, smallholder farm groups selling directly at auction;
- Few local traders establishing wet processing plants, and improving the quality profile of their coffee.

In the clothing sector in Mauritius, many producers upgraded in processes and products (diversification) by increasing their operational scale through investments in Madagascar.[16]

The examples above show how some LDCs have integrated into selected GVCs through FDI from other developing countries, by occupying an upstream position in the chain. In those cases LDCs produce low-value-added goods and occupy the position of third-tier suppliers or further away from final markets.

Some LDCs have integrated into selected GVCs through FDI from other developing countries, by occupying an upstream position in the chain. In those cases LDCs produce low-value-added goods and occupy the position of third-tier suppliers or further away from final markets.

In some instances, however, foreign buyers have offered interesting potential for upgrading through product differentiation (Lewin, Giovannucci and Varangis, 2004; Linton, 2005), and some lessons may be drawn:

- Finding the right buyer can be an important part of promoting agricultural exports, because of the marketing outlet and support for farmers that buyers may provide.
- Value can be added to products in a variety of ways (e.g. for coffee through organic production, environmental sustainability, origin and characteristics of the produce).
- The buyer may in some cases provide technical assistance (directly or through third parties) to ensure that the quality and consistency of the coffee meet the premium market targeted.
- The link to a specific buyer remained important for achieving certification (e.g. organic and bird-friendly) and identifying the product as a premium product.

The benefits to the producers of a relationship with the buyer are, however, not to be taken for granted, and depend on a host of conditions. Clearly, one of the major risks is suppliers' dependence on a single buyer, which often ends increasing the fragility and vulnerability of suppliers to buyer decisions (IFAD, 2003).

One of the major risks is suppliers' dependence on a single buyer, which often ends increasing the fragility and vulnerability of suppliers to buyer decisions.

The uncertain support provided by global buyers and their variable engagement with local suppliers lead some authors to argue that LDCs-based firms should aim at "trading down" (Gibbon and Ponte, 2005). This means consolidating their suppliers' role, focusing on economies of scale, high specialization, and simple and labour-intensive technologies, and aiming at mass markets via large-scale retailers. However, if trading down implies withdrawing from the attempts to develop, strengthen and deepen technological capabilities, it should clearly not be the strategy for LDC suppliers. The search for specific market niches to exploit advanced capabilities always offers potential benefits. However, if technological capability development comes together with "trading down" — that is, a focus on high specialization, economies of scale and firm-size expansion — this may be an option to choose on the basis of a very pragmatic and ongoing assessment. The following subsection examines how LDC firms have fared collectively in terms of trading up/down in international markets.

If trading down implies withdrawing from the attempts to develop, strengthen and deepen technological capabilities, it should clearly not be the strategy for LDC suppliers.

3. Upgrading and downgrading in LDC exports

Hereafter countries' changing integration into global value chains has been approximated through changes in their world export market shares. An expansion of countries' share in world exports of a product that is associated with the upper end of a value chain (e.g. refined petroleum) means that they have upgraded their specialization within that value chain. Conversely, an expansion of their share in world exports of a product at the lower end of the value chain (e.g. crude petroleum) implies that they have downgraded their specialization in GVCs.

An analysis has been made of LDCs' participation in 24 value chains that cover two thirds of the total merchandise exports of LDCs in 2000–2005. The changing integration into those chains thus has substantial implications for those countries. The value chains analysed are characterized by a relatively high resource intensity, as they refer either to primary products (unprocessed and processed) and/or resource-intensive manufactures. Table 9 shows the integration of LDCs and ODCs into the value chains that were most important for LDC exports during that period.[17]

With the exception of petroleum, LDCs tend to have a low level of specialization and a relatively small expansion of their specialization in more lucrative value chains. At the same time they continue to have a relatively high level of specialization and a rather small expansion in the more traditional value chains.

A focus on all products regardless of processing stage shows whether country groups have increased or decreased their specialization in a particular value chain. Between 1995–1999 and 2000–2005 the specialization of LDCs increased only in petroleum, sugar and a few tropical primary commodities (tobacco and cocoa), given their growing world market shares in those product groups. The specialization of other developing countries, by contrast, grew in 19 of the value chains analysed. With the exception of petroleum, LDCs tend to have a low level of specialization and a relatively small expansion of their specialization in more lucrative value chains (e.g. horticultural products and fish), and at the same time they continue to have a relatively high level of specialization and a rather small expansion in the more traditional value chains (e.g. tobacco, cocoa and sugar).

But it is not just important in which type of value chains countries specialize; it is also important which products within value chains they produce; whether they specialize in products at low processing stages, which are associated with relatively low value added; or whether they specialize in products at higher processing stages, which generally imply higher value added.

LDCs achieved an upgrading of exports between 1995–1999 and 2000–2005 in only seven out of the 24 value chains analysed. In 12 they experienced downgrading, while in three others (plastic, pulp and milk) there was no change. Upgrading in different value chains was achieved by different means:

- Aluminium, iron/iron products, artificial fibres and nickel: increased specialization at the upper end of value chain and decreasing specialization at the lower end;
- Fruit: increasing specialization at the upper stages of the value chain and unchanged specialization at the lower end;
- Cotton and wheat: relatively large increase in specialization at the upper end of the value chain and a relatively weak increase in specialization at the lower end.

In the case of two other value chains (livestock/food and cork) the "apparent upgrading" was reached as a result of the decreasing specialization in products at a lower processing stage.

LDCs rapidly increased their specialization in only a few value chains and they did not manage to significantly upgrade their specialization within value chains.

At the same time LDCs experienced downgrading of their exports in 12 value chains:

- Fish, copper and vegetables/fats: increasing specialization at the lower end of the value chain and decreasing specialization at the higher stages;
- Petroleum, vegetables/food, sugar, cocoa, rubber and fur skin: increasing specialization at the lower stages of the value chain and unchanged specialization at the upper end;
- Wood, livestock/leather and tobacco: relatively strong increase in specialization at the lower end of the value chain and a relatively weak increase in specialization at the upper end.

In sum, LDCs rapidly increased their specialization in only a few value chains and they did not manage to significantly upgrade their specialization within value chains. Exports of products in which upgrading occurred amounted to 18 per cent of the total merchandise exports of LDCs in 2000–2005 (including the two cases of "apparent upgrading"). By contrast, the value chains in which downgrading took place accounted for a much higher 52 per cent of those countries' total exports. Hence, those countries' economies have been significantly more affected by downgrading than by upgrading. The increasing consolidation at the lower end of value chains is also reflected by the fact that many LDCs have experienced a collapse of processed primary commodity exports since the 1980s (measured as a share of total merchandise exports) (UNCTAD, 2002), and that many LDCs have experienced a premature de-industrialization since the early 1980s (UNCTAD, 2006b). While the increasing specialization of LDC economies at the lower end of value chains is in line with theories of comparative advantage, it may be considered problematic from the viewpoint of more development-oriented theories, which stress that technological progress and upgrading are preconditions for catching up.

Exports of products in which upgrading occurred amounted to 18 per cent of the total merchandise exports of LDCs in 2000–2005. By contrast, the value chains in which downgrading took place accounted for a much higher 52 per cent of those countries' total exports.

The changing specialization of the group of LDCs sometimes hides considerable differences for geographical subgroups. Between 1995–1999 and 2000–2005 African LDCs upgraded only in cotton, aluminium, wheat and nickel (in the two last products they have only a very weak specialization). Over the same period, Asian LDCs upgraded in cotton, copper, iron/iron products and artificial fibres (in the latter products they have a very limited specialization).

The changing nature of global value chains has led to higher entry barriers for LDC firms that aim at integrating into those chains.

4. Implications

The changing nature of global value chains has led to higher entry barriers for LDC firms that aim at integrating into those chains. The increased power of downstream lead firms and buyers allows them to set the standards (technical,

Table 9. Integration of LDCs and ODCs into selected global value chains, 1995–2005

(Shares in world exports[a], period averages)

Value chains			LDCs			ODCs			World exports
Value chain/ Processing stages	***Product***	*SITC code*	***1995–1999***	***2000–2005***	***Change***	***1995–1999***	***2000–2005***	***Change***	***($ billion) 2000–2005***
			(A)	*(B)*	*(B) – (A)*	*(C)*	*(D)*	*(D) – (C)*	
Petroleum (40.13)[b]									
All products			2.1	3.0	0.9	62.6	57.2	-5.4	690.6
Stage I	Petroleum oils, oils from bitumen. materials, crude	333	2.8	4.1	1.3	70.3	62.8	-7.6	478.7
Stage II	All		0.4	0.5	0.0	46.2	44.7	-1.5	211.9
	Petroleum oils or bituminous minerals > 70 % oil	334	0.5	0.5	0.0	47.6	45.6	-2.0	198.1
	Residual petroleum products, n.e.s., related materials	335	0.1	0.2	0.1	27.2	30.6	3.4	13.8
Cotton (14.06)[b]									
All products			2.6	3.7	1.1	54.8	60.2	5.4	195.8
Stage I	Cotton	263	10.8	10.9	0.1	23.9	22.8	-1.1	9.1
Stage II	Textile yarn	651	0.5	0.6	0.1	43.3	50.7	7.4	35.5
Stage III	Cotton fabrics, woven	652	0.2	0.3	0.1	50.0	51.8	1.9	22.1
Stage IV	All		2.8	4.6	1.8	62.6	67.0	4.4	129.1
	Men's clothing of textile fabrics, not knitted	841	4.2	6.0	1.8	61.2	64.0	2.8	43.6
	Women's clothing, of textile fabrics	842	2.0	3.7	1.8	61.4	67.1	5.7	54.8
	Men's or boy's clothing, of textile, knitted or crocheted	843	2.9	5.3	2.4	70.7	72.9	2.1	10.9
	Women's clothing, of textile, knitted or crocheted	844	1.7	3.7	2.0	64.3	70.0	5.7	19.7
Aluminium (2.54)[b]									
All products			0.8	1.4	0.5	17.5	22.0	4.5	94.8
Stage I	Aluminium ores and concentrates (including alumina)	285	8.9	7.5	-1.5	29.5	31.5	2.0	8.3
Stage II	Aluminium	684	0.0	1.2	1.2	17.7	21.1	3.4	58.8
Stage III	Flat-rolled products of alloy steel	675	0.0	0.0	0.0	12.8	21.1	8.3	27.7
Wood (2.30)[b]									
All products			0.9	0.9	0.0	27.6	35.9	8.3	139.0
Stage I	Wood in the rough or roughly squared	247	5.8	7.5	1.7	30.2	23.2	-7.1	10.8
Stage II	All		0.6	0.7	0.1	24.1	27.4	3.3	47.8
	Wood simply worked, and railway sleepers of wood	248	0.8	1.0	0.1	20.3	22.4	2.1	31.4
	Wood manufacture, n.e.s.	635	0.1	0.1	0.0	33.3	36.8	3.5	16.5
Stage III	Furniture & parts; bedding & similar stuffed furniture	821	0.0	0.1	0.0	29.9	42.6	12.7	80.4
Fish (2.19)[b]									
All products			2.5	2.5	0.1	39.7	43.2	3.5	44.5
Stage I	Fish, fresh (live or dead), chilled or frozen	34	2.9	3.1	0.2	34.6	38.1	3.5	30.0
Stage II	All		1.6	1.3	-0.3	49.7	53.9	4.2	14.5
	Fish, dried, salted or in brine; smoked fish	35	2.3	2.2	-0.2	17.3	22.6	5.3	3.0
	Fish, aqua. invertebrates, prepared, preserved, n.e.s.	37	1.4	1.1	-0.3	59.3	62.1	2.8	11.5
Vegetables (1.70)[b]									
Vegetables/ food									
Base product									
Stage I	Vegetables; roots & other edible vegetable products	54	1.5	1.8	0.3	31.0	32.5	1.5	27.2
Food products									
Stage II	All		0.5	0.3	-0.1	45.7	47.9	2.3	37.3
	Margarine and shortening	91	0.1	0.3	0.3	20.9	27.1	6.1	1.7
	Fixed vegetable fats & oils, crude, refined or fractionated	421	0.8	0.6	-0.2	34.9	37.1	2.1	12.6
	Fixed vegetable fats & oils, crude, refined or fractionated	422	0.5	0.3	-0.2	86.1	86.7	0.6	10.7
	Vegetables, roots, tubers, prepared, preserved, n.e.s.	56	0.1	0.1	0.0	28.0	28.4	0.5	12.3

Table 9 (contd.)

Value chains			LDCs			ODCs			World exports
Value chain/ Processing stages	***Product***	*SITC code*	***1995–1999***	***2000–2005***	***Change***	***1995–1999***	***2000–2005***	***Change***	***($ billion) 2000–2005***
			(A)	*(B)*	*(B) – (A)*	*(C)*	*(D)*	*(D) – (C)*	
Vegetables/ textile fibres									
Base product									
Stage I	Vegetables; roots & other edible vegetable products	54	1.5	1.8	0.3	31.0	32.5	1.5	27.2
Textile fibres									
Stage II	Vegetable textile fibres, not spun; waste of them	265	3.1	2.3	-0.8	29.5	22.5	-7.0	0.7
Copper (1.61)[b]									
All products			1.8	1.7	-0.1	40.1	49.1	9.0	48.8
Stage I	Copper ores and concentrates; copper mattes, cement	283	0.2	1.5	1.2	73.8	78.8	5.1	9.2
Stage II	Copper	682	2.1	1.8	-0.4	34.0	42.2	8.3	39.6
Livestock (1.37)[b]									
Livestock/ food									
Base products									
Stage I	Live animals other than animals of division 03	1	2.3	2.1	-0.3	16.4	17.6	1.1	10.1
Food products									
Stage II	All		0.1	0.1	0.0	15.3	16.4	1.1	45.7
	Meat of bovine animals, fresh, chilled or frozen	11	0.1	0.0	-0.1	12.5	18.3	5.9	16.1
	Other meat and edible meat offal	12	0.1	0.1	0.0	17.0	15.4	-1.7	29.7
Stage III	All		0.0	0.0	0.0	19.4	26.2	6.8	9.6
	Meat, edible meat offal, salted, dried; flours, meals	16	0.0	0.0	0.0	4.0	11.6	7.5	2.3
	Meat, edible meat offal, prepared, preserved, n.e.s.	17	0.0	0.0	0.0	24.2	30.8	6.6	7.3
Livestock/ leather									
Base products									
Stage I	Live animals other than animals of division 03	1	2.3	2.1	-0.3	16.4	17.6	1.1	10.1
Leather products									
Stage II	Hides and skins (except furskins), raw	211	1.6	1.9	0.3	8.3	8.5	0.3	5.5
Stage III	Leather	611	1.8	1.9	0.1	43.7	46.5	2.8	17.6
Stage IV	Manufactures of leather, n.e.s.; saddlery & harness	612	0.1	0.1	0.0	40.8	41.4	0.6	1.8

Source: UNCTAD secretariat calculations, based on UNCTAD, GlobStat database.
Notes: The value chains have been identified on the basis of SITC 3-digit level data. The identification of value chains and processing stages involves some judgement. All calculations are based on trade data in current values.
a The numbers in the table have been estimated by calculating the total imports of the world from either LDCs or ODCs as a share of total world imports. *b* The numbers indicate the value of all products in the value chain as a share of total LDC exports (2000–2005).

quality, environmental) that must be met in order to participate in the chain. Chain leaders, however, rarely help producers to upgrade their technological capabilities so as to become able to fulfil those requirements.

Although LDCs have increased their specialization in some value chains since the mid-1990s, they did not manage to significantly upgrade their specialization within those chains. In quantitative terms, downgrading has been more prevalent than upgrading. In almost all cases LDCs have increased their specialization in relatively basic products at a low stage of processing. This also reflects processes of structural changes and re-specialization that these countries have been undergoing since the 1980s.

Export patterns indicate that little technological upgrading has taken place recently among LDC firms, irrespective of their participation in GVCs.

These export patterns indicate that little technological upgrading has taken place recently among LDC firms, irrespective of their participation in GVCs. They seem to have responded to growing worldwide demand for raw materials by exporting larger quantities of unprocessed goods whose production entails little value added and limited technological learning. Policies to foster further processing of raw materials have been mainly absent, with some exceptions, as in the case of fisheries exports in Uganda (Kiggundu, 2006).

D. Foreign direct investment

The present section examines the contribution of FDI to technological capability-building in the LDCs. It first describes the mechanisms through which the former can in principle contribute to the latter. According to the composition of FDI, it can have different impacts on technological accumulation in host countries. Therefore, the second subsection examines general trends of FDI in LDCs alongside its sectoral composition.[18] Following the same reasoning, the third and fourth subsections analyse the contribution of FDI to LDC knowledge accumulation in two major industries of destination: mining of minerals and garment manufacturing. The final subsection concludes.

It is argued that the arrival of TNCs leads to technological upgrading of domestic firms through technological spillovers via imitation, competition, labour mobility and exports.

1. FDI and technology diffusion

It is generally contended that FDI in developing countries contributes to the latter's capital accumulation[19] and to their productivity, as transnational corporations (TNCs) have specific advantages (e.g. production methods, marketing, management) that are generally superior to those of domestic firms. It is moreover argued that the arrival of TNCs leads to technological upgrading of domestic firms through technological spillovers[20] via imitation, competition, labour mobility and exports (which entail exposure to the technology frontier). These spillover effects have the potential to increase the productivity of other firms.

Backward linkages are the most likely channel through which spillovers are transmitted.

Kokko (1994) identifies at least four ways in which technology might be diffused from TNCs to domestic firms in the host economy: (i) demonstration-imitation; (ii) competition; (iii) foreign linkage; and (iv) training. Javorcik (2004) suggests that backward linkages are the most likely channel through which spillovers are transmitted — through (i) direct knowledge transfer from foreign customers to local suppliers; (ii) superior requirements for product quality and on-time delivery introduced by TNCs, which provide incentives to domestic suppliers to upgrade their production management or technology; and (iii) TNC entry into the domestic economy, which increases demand for intermediate inputs, allowing local suppliers to reap the benefits of scale economies.[21] Damijan et al. (2003) argue that the presence of TNCs in the host economy can increase the rate of technical change and technological learning in the economy through knowledge spillovers, which occur as a consequence of introducing new technologies and organizational skills that are typically superior to those in domestic firms. To the extent that domestic firms and TNCs operating in the same sector compete with one another, the latter have an incentive to prevent technology leakage and spillovers from taking place; this can be done using patents, trade secrecy and/or paying higher wages. Görg and Greenaway (2003) argue that TNCs usually do not hand over the source of their advantages voluntarily. On the other hand, they may benefit from improved performance from inputs provided by domestic suppliers, and so they can foster the upgrading of the production of local firms.

The materialization of the potential positive impacts of FDI on knowledge accumulation in host countries hinges on a number of conditions, including structural characteristics of host economies and the type of insertion of TNCs in those economies.

However, the materialization of the potential positive impacts of FDI on knowledge accumulation in host countries hinges on a number of conditions, including structural characteristics of host economies, the type of insertion of TNCs in those economies and the job-generating impact of TNCs. First, the structural characteristics of host countries are associated with their absorptive capacity, which in turn depends on the stock of human capital, the dynamism of entrepreneurship, the quality of institutions and the desire for progress (Abramovitz, 1986), as well as infrastructure development. Second, the more TNCs are integrated into host economies, particularly through backward and

forward linkages, the more spillover effects are likely to happen. *Mutatis mutandis*, TNCs are not expected to impact positively on microeconomic efficiency and productivity if they operate in enclaves, having minimal contact with domestic firms (Görg and Strobl, 2005; Lall and Narula, 2004; Moss, Ramachandran and Shah, 2005).[22] Third, circulation of knowledge is more likely if the number of jobs generated by TNCs is high, if they are skill-intensive and if there is high labour turnover between foreign affiliates and domestic firms. Fourth, if TNCs simply displace pre-existing domestic firms, the upgrading through competition cannot take place.

TNCs are not expected to impact positively on microeconomic efficiency and productivity if they operate in enclaves, having minimal contact with domestic firms.

Two opposing arguments on technological distance and spillovers have appeared in the literature on FDI and technology transfer. One argument contends that the wider the technology gap between foreign and domestic firms, the more the scope for spillovers (Findlay, 1978). The other argument states that the narrower the technology gap, the easier the technology transfer is (Glass and Saggi, 1998). Görg and Greenaway (2003) and Kokko (1994) suggest that the latter argument is more plausible than the former.

2. Trends and sectoral composition of FDI

FDI inflows into LDCs have increased markedly since the early 1990s (chart 6). Between 2000 and 2005 annual inflows were three times higher than during the preceding 10 years (table 10). On average, 39 of the 50 LDCs received higher annual inflows during the early years of the new century than in 1990–1999. LDCs still account for a marginal part of total FDI flows towards developing countries, but their share rose to 3.5 per cent in 2000–2005, as compared with 2.1 per cent in 1990–1999 and 1.6 per cent in 1980–1989. In the same vein, LDCs accounted for 2.7 per cent of the total FDI stock of developing countries in 2005, up from 1.7 per cent in 1990. On a global scale, FDI inflows in LDCs accounted for 1 per cent of world inflows in 2000–2005 and 0.7 per cent of the world stock in 2005.

FDI inflows into LDCs have increased markedly since the early 1990s, but LDCs accounted for 1 per cent of world inflows in 2000–2005 and 0.7 per cent of the world stock in 2005.

In order to put value figures in perspective, indicators of FDI flows and stocks relative to GDP, gross fixed capital formation (GFCF) and population are presented in table 10. They invariably show a continuous deepening of FDI in the LDCs since the 1980s, a trend that has accelerated sharply since 2000. This was more marked than in other developing countries, which also experienced some FDI deepening. FDI inflows as a share of both GDP and GFCF in the LDCs doubled between the 1990s and 2000–2005. While those indicators had been lower than or close to the corresponding ones for other developing countries in the 1980s and 1990s, during the early years of the 21st century LDCs largely surpassed other developing countries on these accounts.

FDI inflows as a share of both GDP and GFCF in the LDCs doubled between the 1990s and 2000–2005 when LDCs largely surpassed other developing countries on these accounts.

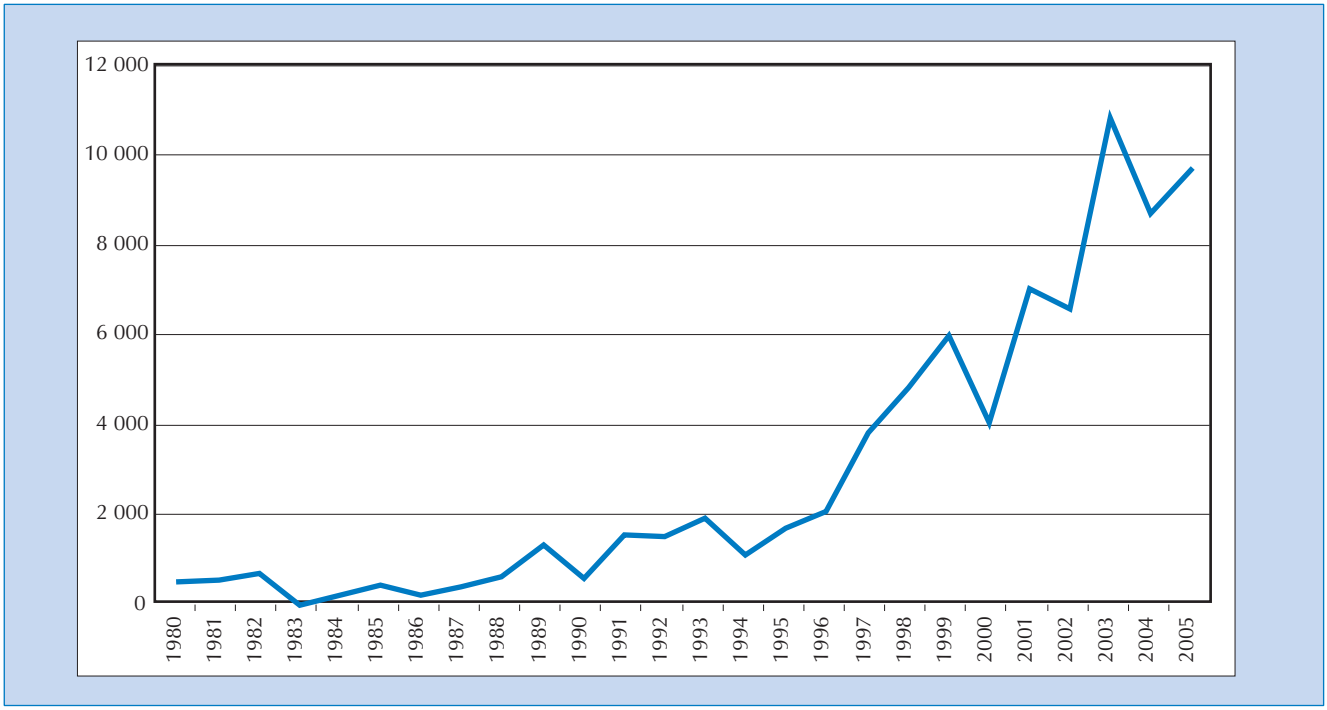
Per capita FDI inflows are lower in LDCs than in other developing countries (table 10). Moreover, the difference between the former and the latter has increased since the 1980s. The reason is that although the rise in FDI flows to LDCs was greater than the rise in flows to other developing countries, this was partly offset by the former's more rapid demographic growth.

The FDI stock as a share of GDP in LDCs rose continuously since 1990 and reached 26 per cent in 2005. This level is similar to that of other developing countries (table 10). These indicators reveal that the surge in FDI into LDCs is a more recent development, as compared with ODCs.

FDI inflows in LDCs are highly concentrated geographically. While African LDCs accounted for 66 per cent of total inflows in the 1990s, this share rose to

Chart 6. FDI inflows in LDCs, 1980–2005

(Current $ millions)



Source: UNCTAD secretariat calculations, based on UNCTAD, FDI/TNC database.

Table 10. Indicators of the importance of FDI in LDCs and ODCs, 1980–2005

	FDI inflows												FDI stock							
	Value ($ millions)			*FDI / GDP (%)*			*FDI / GFCF (%)*			*FDI per capita ($)*			*Value ($ millions)*				*FDI stock / GDP (%)*			
	1980-1989	*1990-1999*	*2000-2005*	*1980-1989*	*1990-1999*	*2000-2005*	*1980-1989*	*1990-1999*	*2000-2005*	*1980-1989*	*1990-1999*	*2000-2005*	*1980*	*1990*	*2000*	*2005*	*1980*	*1990*	*2000*	*2005*
LDCs	**507**	**2 517**	**7 830**	**0.4**	**1.6**	**3.5**	**2.6**	**8.8**	**17.6**	**1**	**4**	**11**	**4 318**	**9 426**	**38 029**	**76 669**	**4.1**	**6.3**	**21.6**	**26.4**
Africa	468	1 669	6 839	0.6	1.8	5.5	3.9	11.0	28.98	2	4	16	3 692	8 329	27 473	62 739	0.0	0.0	0.0	0.0
Asia	25	780	926	0.1	1.2	1.0	0.3	6.6	4.7	0	3	3	557	861	9 600	12 660	1.6	1.7	12.0	11.1
Islands	13	68	65	1.3	3.5	2.4	4.5	13.0	10.4	8	31	25	69	235	956	1 269	8.5	16.4	41.8	37.4
Other developing countries (ODCs)	**19 912**	**111 415**	**210 022**	**0.7**	**2.1**	**2.8**	**3.1**	**8.3**	**11.6**	6	**29**	**49**	**134 388**	**377 570**	**1 684 327**	**2 632 623**	**5.4**	**10.4**	**26.1**	**27.3**
Africa	1 739	4 915	11 292	0.5	1.1	1.9	2.3	6.2	11.4	6	13	26	43 389	84 151	209 688	373 263	9.7	20.4	41.3	48.0
America	6 401	38 061	62 531	0.8	2.2	3.1	3.6	11.0	16.7	17	79	119	32 986	101 178	420 740	720 652	4.3	9.1	21.1	29.2
Asia	11 772	68 439	136 199	0.8	2.1	2.8	3.1	7.5	10.1	5	23	41	58 014	192 241	1 053 898	1 538 708	4.5	9.1	26.6	24.1

Source: UNCTAD secretariat calculations, based on data from UNCTAD, FDI/TNC database; and UNDESA Statistics Division.

Note: Indicators of FDI inflows are period averages. All values are in current dollars. LDCs and Islands exclude Timor-Leste.

FDI inflows in LDCs are highly concentrated. Just four petroleum-producing countries received 56 per cent of the LDC total in 2000–2005.

87 per cent in 2000–2005. During this period Asian LDCs received 12 per cent and island LDCs just 1 per cent. The increase in the African share in 2000–2005 was brought about by a small number of recipients of additional FDI flows in that period. Just four petroleum-producing countries — Angola, Sudan, Equatorial Guinea and Chad — received 56 per cent of all FDI inflows during that period. The top 10 FDI recipients accounted for 81 per cent of total inflows, while the other 40 LDCs received the remaining 19 per cent. In other words, the surge in FDI in LDCs in recent years has been led by foreign investment in oil extraction, although most countries have received higher inflows in recent years.

The values and relative indicators of FDI flows and stocks for individual LDCs are presented in table 11. They show that the economies that have attracted FDI most intensively are the four petroleum exporters mentioned above, some island States (Kiribati, Tuvalu and Vanuatu) and Liberia. At the other extreme, with very

low FDI intensity, are some other island States (Samoa and Solomon Islands) and some Asian LDCs (Afghanistan, Bhutan and Nepal).

Data on the sectoral destination of FDI in LDCs are fragmentary. Table 12 presents the sectors targeted by foreign investors in selected countries in given years for which data are available. They give the impression that the tertiary sector is the major recipient of FDI inflows in LDCs, as is the case worldwide. Nevertheless, fragmentary evidence indicates that over many years services dominate FDI inflows mainly in island LDCs. In other LDCs FDI is relatively more directed towards the primary sector in the African LDCs and towards industry in the Asian LDCs.

The bulk of foreign investment in African LDCs is of the resource-seeking type, while FDI directed towards Asian LDCs is mostly efficiency-seeking and quota-seeking.

The motivation for FDI in LDCs differs therefore among different regional groupings. The bulk of foreign investment in African LDCs is of the resource-seeking type, while FDI directed towards Asian LDCs is mostly efficiency-seeking and quota-seeking. Market-seeking FDI in LDCs is marginal (given the small size of those countries' markets) as compared with total FDI inflows. It drives mainly FDI in the tertiary sector (e.g. telecom).

Given that mineral extractive industries and garments have accounted for most of FDI inflows into LDCs over the last 15 years, the following subsections analyse the contribution of FDI to domestic technological capability accumulation through TNC activities in those two industries.

Since the late 1990s a few developing countries have emerged as a significant source of outward investment in the mineral industry of LDCs, particularly South Africa and China.

3. FDI in mineral extractive industries

The strong increase in FDI in mineral extraction in LDCs (as well as in other developing countries) since the turn of the century was spurred by the sustained and strong rise in the prices of commodities, particularly mineral ones. The upward phase of the price cycle in turn was caused by the imbalance in the commodities market. Starting in the late 1990s, world demand for raw materials rose at a significantly greater pace than previously (mainly owing to the steep rise in consumption in some Asian developing countries, including China), but the supply response was slow. In order to react to the higher pace of demand expansion and take advantage of strong prices, international mining companies actively sought new locations for mineral exploration and extraction. Africa was a major destination for those investments.[23]

Most foreign companies investing in mining in LDCs have traditionally originated in developed countries (mainly Europe, North America and Australia) and they remain the main host countries of mining TNCs operating in LDCs. Since the late 1990s, however, a few developing countries have emerged as a significant source of outward investment in the mineral industry of LDCs, particularly South Africa and China.

On the recipient side mineral-rich countries, particularly in Africa, have striven to attract higher FDI inflows by radically changing their policies and regulations for the mineral sector since the 1980s.

Apart from petroleum extraction, since 2000 international companies have also targeted African LDCs for natural resource exploration and extraction in hard rock mining (mainly metals). They have established operations in many countries, including Burkina Faso, the Democratic Republic of the Congo, Ethiopia, Guinea, Mali, Mauritania, Mozambique, Niger, Sierra Leone, the United Republic of Tanzania and Zambia.

On the recipient side mineral-rich countries, particularly in Africa, have striven to attract higher FDI inflows by radically changing their policies and regulations for the mineral sector since the 1980s. Frequently adopted in the context of structural adjustment programmes, most of those reforms have resulted in privatizing State-

Table 11. Indicators of the importance of FDI in LDCs, by country, 2000–2005

Country	FDI inflows, 2000–2005 (period averages)				Country	FDI stock, 2005	
	Value ($ millions)	*FDI/ GDP (%)*	*FDI/ GFCF (%)*	*FDI per capita ($)*		*Value ($ millions)*	*FDI stock/ GDP (%)*
Angola	1 604	13.6	106.2	109.0	Angola	13 413	46.5
Sudan	1 141	6.4	33.6	32.5	Sudan	7 850	31.8
Equatorial Guinea	1 055	32.4	73.4	2172.2	Equatorial Guinea	7 351	130.1
Chad	566	22.2	52.3	62.3	United Rep. of Tanzania	6 029	46.6
Bangladesh	461	0.8	3.5	3.4	Myanmar	4 862	44.5
United Rep. of Tanzania	442	4.1	21.9	12.0	Liberia	4 031	719.0
Ethiopia	326	4.6	22.6	4.4	Chad	3 857	78.0
Dem. Rep. of the Congo	290	4.3	39.1	5.1	Bangladesh	3 508	5.5
Myanmar	239	2.6	22.9	4.8	Zambia	3 183	43.5
Mozambique	239	5.3	23.3	12.7	Ethiopia	2 752	29.6
Uganda	200	2.9	14.2	7.5	Cambodia	2 471	45.8
Cambodia	173	3.9	19.1	12.8	Mozambique	2 386	35.7
Zambia	158	3.3	15.2	13.9	Dem. Rep. of the Congo	2 333	32.4
Mali	140	3.8	19.0	11.1	Uganda	1 830	20.1
Liberia	134	28.0	295.6	40.2	Senegal	1 126	13.6
Mauritania	97	8.5	64.7	34.0	Yemen	983	6.3
Madagascar	63	1.4	7.9	3.7	Mali	915	17.7
Senegal	59	1.0	4.8	5.4	Togo	686	31.4
Guinea	54	1.6	11.4	5.9	Mauritania	684	40.9
Togo	50	3.1	15.5	8.7	Lao People's Dem. Rep.	669	23.3
Benin	41	1.3	7.2	5.3	Madagascar	651	13.2
Lesotho	38	3.8	8.9	19.6	Guinea	578	18.9
Lao People's Dem. Rep.	24	1.2	7.7	4.4	Lesotho	527	39.5
Gambia	24	5.9	30.7	17.7	Malawi	503	23.5
Yemen	21	0.3	1.4	1.3	Vanuatu	430	130.6
Burkina Faso	18	0.5	2.1	1.5	Eritrea	395	36.7
Cape Verde	18	2.6	9.1	37.5	Benin	290	6.6
Sierra Leone	18	2.1	23.0	3.6	Gambia	289	60.2
Kiribati	17	29.9	69.3	175.4	Rwanda	279	13.2
Timor-Leste	16	4.3	10.9	18.4	Cape Verde	247	23.8
Djibouti	14	2.2	14.0	18.4	Maldives	184	24.0
Eritrea	14	2.1	7.6	3.7	Timor-Leste	167	42.4
Vanuatu	14	4.9	23.8	67.1	Kiribati	151	210.6
Niger	13	0.6	3.9	1.0	Solomon Islands	135	45.3
Maldives	13	1.9	6.9	42.5	Nepal	129	1.7
Malawi	12	0.7	5.7	1.0	Haiti	128	3.3
Haiti	9	0.3	2.0	1.1	Niger	127	3.9
Somalia	7	0.3	1.7	0.9	Central African Republic	112	8.4
Rwanda	6	0.3	1.7	0.7	Djibouti	108	15.3
Nepal	6	0.1	0.5	0.2	Sierra Leone	108	9.3
Tuvalu	6	33.3	59.3	533.0	Burkina Faso	68	1.3
Guinea-Bissau	3	1.3	6.6	2.2	Guinea-Bissau	58	19.4
Sao Tome and Principe	3	5.0	14.4	18.8	Somalia	48	2.2
Burundi	2	0.2	2.3	0.2	Burundi	45	5.3
Central African Republic	1	0.2	0.9	0.4	Samoa	40	9.8
Afghanistan	1	0.0	0.1	0.0	Tuvalu	33	127.2
Comoros	1	0.2	2.2	0.8	Sao Tome and Principe	24	33.4
Bhutan	1	0.1	0.1	0.3	Comoros	24	6.3
Solomon Islands	-2	-0.7	-3.9	-5.2	Afghanistan	22	0.3
Samoa	-3	-0.7	-6.0	-13.7	Bhutan	16	1.7

Source: UNCTAD secretariat calculations, based on data from UNCTAD, FDI/TNC database; and UNDESA Statistics Division.

Note: All values in current dollars. Countries are ranked according to FDI inflows and FDI stock values.

Table 12. Inward FDI inflows in selected LDCs, by sector, 1995–2005

Country	Year	$ millions				Percentage		
		Primary	*Secondary*	*Tertiary*	*Total*	*Primary*	*Secondary*	*Tertiary*
Bangladesh	2002	17.1	69.5	188.5	275.1	6.2	25.3	68.5
Cape Verde	1995	..	4.6	23.3	27.9	..	16.5	83.5
Cambodia	2002	..	68.9	86.2	155.1	..	44.4	55.6
Ethiopia	2000	40.5	83.7	10.4	134.6	30.1	62.2	7.7
Lao PDR	2001	3.0	13.9	7.0	23.9	12.6	58.2	29.3
Mozambique	2005	45.8	16.5	94.9	157.2	29.1	10.5	60.4
Myanmar	2004	127.9	13.1	4.2	145.2	88.1	9.0	2.9
Nepal	1997/98	5.4	1.7	20.5	27.6	19.6	6.2	74.3
Solomon Islands	1996	130.3	0.6	75.9	206.8	63.0	0.3	36.7
Vanuatu	2002	..	..	6.3	6.3	..	..	100.0

Source: UNCTAD (2006a).

owned companies, enhancing geological data, lowering taxes and royalties, granting temporary tax exemptions, eliminating restrictions on the entry of TNCs, introducing import-tax exemptions for equipment, eliminating national content and employment provisions, establishing liberal immigration laws for expatriates, scrapping restrictions on profit and dividend remittances, granting other incentives (e.g. land allocation) and so forth. Examples of this type of policy reform among the LDCs are the mining codes adopted by Guinea (1995), the United Republic of Tanzania (1998), and Mali and Madagascar (1999) (Campbell, 2005).

The sweeping changes in African LDCs' mining policy in the 1980s and 1990s were aimed at attracting FDI and increasing exports, in which they have been successful.

The sweeping changes in African LDCs' mining policy in the 1980s and 1990s were aimed at attracting FDI and increasing exports, in which they have been successful. Total FDI inflows into African LDCs rose fourfold from an annual average of $1.7 billion in the 1990s to $6.8 billion in 2000–2005 (table 10), the bulk of which was directed to mineral extractive industries (including petroleum). Those countries' mineral exports (including ores, metals, petroleum and related products) increased almost fivefold from $8 billion in 1995 to $38 billion in 2005. The share of those exports in total merchandise exports of African LDCs rose from one quarter in 1995 to almost half 10 years later.[24] This accentuated the re-specialization of those countries in primary extraction.

Typically, TNCs' mineral extraction activities in LDCs are strongly integrated internationally, but weakly embedded into domestic economies.

The dominance of the mineral industry's FDI inflows into LDCs since the 1990s has consequences for the impacts that they can have on domestic technological capability accumulation. Typically, TNCs' mineral extraction activities in those countries are capital-intensive, have little impact on employment, are highly concentrated geographically, have high import content and result in exports of their output as unprocessed raw materials.[25] Most of those operations are totally owned by foreign investors (rather than joint ventures) and a large share of their foreign exchange earnings is retained abroad. Those operations are strongly integrated internationally, but weakly embedded into domestic economies, as they have few forward and backward linkages in host economies (UNCTAD, 2005). In other words, they tend to operate as enclaves.

This type of insertion of FDI projects in domestic economies means that some of the main channels of potential knowledge circulation between TNCs and domestic firms are largely absent: linkages, joint ventures and labour turnover.

This type of insertion of FDI projects in domestic economies means that some of the main channels of potential knowledge circulation between TNCs and domestic firms are largely absent: linkages, joint ventures and labour turnover.[26] The arrival of foreign companies tends to displace small- and medium-scale local miners to marginal areas, rather than establish links with them. This is especially the effect of the entry of medium-sized TNCs, which tend to target older abandoned properties, waste dumps or already known deposits, which are

frequently being worked by artisanal miners or by local companies using semi-mechanized methods.

There is little evidence that the entry of TNCs into mining in LDCs is leading to the technological upgrading of domestic firms.

The potential of those FDI inflows to contribute to domestic technological capability-building in host countries is, therefore, very limited. In fact, there is little evidence that the entry of TNCs into mining in those countries is leading to the technological upgrading of domestic firms in the same industry. Where some intermediate technology potentially useful for small- and medium-scale miners has been developed for secondary processing purposes, its distribution and assimilation within the mining community have been limited (Abugre and Akabzaa, 1998).

The changes in mining policy adopted by African LDCs have neglected wider objectives such as articulating the mining sector into broader developmental objectives, for example through backward and forward linkages or domestic value-added processing of minerals. Additionally, they have resulted in weakening State capacity to influence the development process and the developmental impact of mining (Campbell, 2005).

Enhancing the contribution of the mining industry and its TNCs to knowledge accumulation in host countries has not been among the objectives of host countries.

Enhancing the contribution of the mining industry and its TNCs to knowledge accumulation in host countries has not been among the objectives of host countries, owing to the narrow sectoral focus adopted (as opposed to a broader developmental perspective). The goal of generating technology spillovers has generally not been actively pursued, nor has it been an unintended consequence of increased TNC activity. There are few indications that increasing FDI inflows into the oil and hard rock mining industry of African LDCs have been accompanied by greater knowledge flows to those countries beyond the activities of the TNCs themselves.

4. FDI in garment manufacturing

Foreign direct investment has played an important role in several Asian LDCs in recent years. Bangladesh has since the mid-1990s been the main destination of FDI among those countries. Cambodia and the Lao People's Democratic Republic have been very successful since the 1990s in attracting larger foreign investment inflows. Myanmar received relatively high levels of FDI inflows in 1996–1998, but they fell thereafter, because of political uncertainty and foreign economic sanctions.[27] Poor infrastructure, political instability, being landlocked and/or lack of cross-border synergies have restricted FDI inflows into Afghanistan, Nepal and Bhutan (Rasiah, 2007a).

Most Asian LDCs have relied extensively on FDI to drive investment, employment and exports in the garment industry.

Garment manufacturing remains the most promising sector for attracting FDI in a wider range of economies — a consequence of both the industry's flexibility in adjusting to unskilled labour,[28] low precision standards and long delivery times, and the preferential access that has emerged from post-MFA developments.[29] The Multifibre Arrangement (MFA) was phased out from 1995 to 2004, but this coincided with the granting of preferential access agreements to LDCs: bilateral trading arrangements between the United States and some Asian LDCs were introduced in 1999 and the Everything But Arms initiative was adopted by the European Union in 2001.[30] This attracted foreign investors seeking export quotas and stimulated local subcontractors to enter garment manufacturing.

FDI has brought scarce capital with superior access to export markets and links with buyers driving value chains. Most Asian LDCs have relied extensively on FDI to drive investment, employment and exports in the garment industry, particularly through foreign firms located in export processing zones (EPZs).

Where local firms are important, as in Bangladesh, they participate only in low-value-added subcontracted activities.[31]

The introduction of preferential access to LDCs has influenced FDI inflows of Chinese capital to those countries, as happened in Cambodia. Chinese investment in garment manufacturing in Cambodia amounted to 40 per cent of total FDI in that industry in 2000–2005, with Taiwan Province of China and Hong Kong (China) accounting for 21 per cent. Exports of garments under the Generalized System of Preferences (GSP) accounted for 64 per cent of GSP-related exports from Cambodia in 2004, a sharp rise from 3 per cent in 1995. The impact of garment FDI and exports on Cambodia has been dramatic, with the industry accounting for 72 per cent of manufacturing value added and 15 per cent of GDP in 2004 (Rasiah, 2006b).

Preferential market access conditions offered to LDCs have ensured that their garment exports grew after 2000.

As the MFA was phased out, China's exports grew by an average annual rate of 15.5 per cent in 2000–2005, which led to its attaining a world market share of 27 per cent in 2005 (table 13). China's penetration into global garment markets seems to have accounted for a contraction in production in several economies, with export growth slowing down or exports falling in several Asian economies. Preferential market access conditions offered to LDCs have, however, ensured that their garment exports grew after 2000. Those of Cambodia expanded by 17.8 per cent annually and those of Bangladesh by 10.4 per cent. Exports from the Lao People's Democratic Republic only grew by only 1.8 per cent per annum, while those of Myanmar contracted by 16.2 per cent over the same period (table 13).

The rapid expansion of garment exports from Bangladesh and Cambodia augurs well, suggesting that the industry could act as a good platform to generate jobs, foreign exchange and technological learning to support development. Garments accounted for over 70 per cent of those countries' total exports in 2005. The slow growth in the Lao People's Democratic Republic reflects additional costs involved in carrying out operations in a landlocked country as well as its small labour force. The severe contraction in Myanmar following foreign sanctions is likely to continue unless political circumstances change significantly.

Unless the embedding environment for higher technology activities is strong, firms will participate little in learning and innovation activities, which are pivotal for upgrading and long-term sustainability of garment operations in the LDCs.

However, unless the embedding environment for higher technology activities is strong, firms will participate little in learning and innovation activities, which are pivotal for upgrading and long-term sustainability of garment operations in the LDCs. The analysis below focuses mainly on the impact of FDI inflows on technological learning in garments in Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar. A comparison is drawn with other Asian developing economies.[32] The analysis reviews the insertion of those countries' firms in international value chains, upgrading and their technological effort and achievements.

No LDC firm can be expected to have integrated activities in all processing stages of the textile/garment value chain.

Global value chains and upgrading. When the textile and garment industry in Asian LDCs is analysed from the point of view of global value chains and upgrading, it is seen that none of their firms can be expected to have integrated activities in all processing stages shown in chart 5. In the upstream stages of processing among the Asian LDCs examined only Bangladesh has textile firms, including spinning, weaving, dying, printing and finishing firms. By contrast, firms in Cambodia, the Lao People's Democratic Republic and Myanmar are engaged only in garment manufacturing (Rasiah, 2007b forthcoming; Myint, 2007; Yviengsay and Rasiah, 2007, forthcoming). Their fabric inputs are mainly imported and constitute between 60 and 70 per cent of their production costs. These four economies are net importers of textiles and net exporters of garments, and they reap a trade surplus from the combined textile and garment trade.

Table 13. Garment exports of selected LDCs and other countries, 1990–2005

	Value ($ millions)					Share in domestic exports (%)		Average annual growth (%)
	1990	*2000*	*2003*	*2004*	*2005*	*2000*	*2005*[a]	*2000–2005*
LDCs:								
Bangladesh	643	3 907	4 912	5 686	6 418	77.6	74.2	10.4
Cambodia[b]	0	970	1 600	1 981	2 199	69.8	70.9	17.8
Haiti	63	245	275	303	335	76.9	71.2	6.5
Lao People's Dem. Rep.	0	98	87	99	108			1.8
Lesotho[b]	..	261	290	235	..	77.7	32.4	..
Madagascar[b]	7	309	360	552	530	37.4	69.7	11.4
Myanmar	12	800	692	568	331	48.6	11.3	-16.2
Nepal	50	209	226	..	..	26	34.1	..
Other countries:								
China[c]	9 669	36 071	52 061	61 856	74 163	14.5	9.7	15.5
European Union (25)	-	53 273	68 447	76 887	80 354	2.2	2	8.6
Hong Kong	15 406	24 214	23 158	25 097	27 292	11.9	9.3	2.4
India[b]	2 530	6 178	6 625	6 632	8 290	13.7	8.2	6.1
Indonesia	1 646	4 734	4 105	4 454	5 106	7.6	6	1.5
Mexico[c]	587	8 631	7 343	7 490	7 271	5.2	3.4	-3.4
Pakistan	1 014	2 144	2 710	3 026	3 604	23.8	22.6	10.9
Philippines[c]	1 733	2 536	2 250	2 157	2 276	6.4	5.5	-2.1
Sri Lanka[b]	638	2 812	2 513	2 776	2 877	51.8	45.3	0.5
Thailand	2 817	3 757	3 615	3 985	4 085	5.4	3.7	1.7
Tunisia[b]	1 126	2 227	2 722	3 289	3 332	38.1	31.8	8.4
Turkey	3 331	6 533	9 962	11 193	11 818	23.5	16.1	12.6
United States	2 565	8 629	5 537	5 059	4 998	1.1	0.6	-10.3
Vietnam[b]	..	1 821	3 467	4 441	4 805	12.6	15.2	21.4
World	**108 129**	**197 782**	**232 557**	**259 147**	**275 639**	**3.2**	**2.7**	**6.9**
Memo item: Chinese share in world (%)	8.9	18.2	22.4	23.9	26.9			

Source: UNCTAD secretariat calculations based on WTO (2006: IV. 83).
a Nearest year; *b* Includes WTO secretariat estimates; *c* Includes significant exports from export processing zones.

Nazneen (2007, forthcoming) and Myint (2007), suggest that even Bangladesh and Myanmar are not ready to participate in higher-value-added activities. Foreign firms in Myanmar showed positive signs of upgrading, but this was interrupted by the imposition of sanctions in 2001 (Myint, 2007).

In the downstream stages, Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar have no domestic brand names sold in major markets.

In the downstream stages, Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar have no domestic brand names sold in major markets. Local brands are sold in Bangladesh, but the huge barriers to entry into world garment markets obviously discourage the extension of those brands into larger markets. The country's garment firms could sell own brands in developing economies, but those from Cambodia and the Lao People's Democratic Republic are certainly not ready to invest in building brand recognition.

Lead times — the time taken between the placement of orders by essentially brand-holding buyers and the delivery of orders by contract producers — provide an indicator of competitiveness. It is a combination of throughput time and logistics coordination time, which depends on both the technological capabilities

of firms and country infrastructure. Long lead times mean that producer–customer coordination of demand and supply is underdeveloped. Short lead times give producers the flexibility to absorb customization far more than long lead times. That is increasingly important in this industry owing to the quickening pace of fashion changes.

Poor logistics coordination and heavy dependence on imports are a major reason why delivery times are high in the four Asian LDCs.

Table 14 indicates the lead times for garments in selected Asian LDCs and ODCs. The former have the longest lead times among the countries shown. Firms from the Lao People's Democratic Republic and Myanmar were the most disadvantaged, taking 90 to 130 days. Cambodia and especially Bangladesh perform better (60–120 days), but lag significantly behind firms from ODCs. Poor logistics coordination and heavy dependence on imports are a major reason why delivery times are high in the four Asian LDCs. The long lead times mean that circular knit garments produced particularly in Cambodia, the Lao People's Democratic Republic and Myanmar are confined to very low margins where fashion changes are not so critical for driving competitiveness. By contrast, firms in China are able to deliver garments faster (40–60 days) than the other economies shown in table 14.

Skills utilization. The skill intensity in Myanmar is the highest among the LDCs examined. It exceeds levels in Indonesia and Thailand and is close to that of China (table 15). Myanmar has invested substantially in education, but now faces demand constraints where labour and human capital supply tends to exceed demand. Hence the skilled labour shares are high, but wages have been lower than those in Cambodia, Indonesia and China. The skill intensity level in Cambodia and the Lao People's Democratic Republic, by contrast, is extremely low. Despite their low skill intensities, those countries' wages are not that much lower than those of China.

The skill intensity in Myanmar is the highest among the LDCs examined.

Training. Among the sample of garment firms of the Asian countries surveyed, those located in LDCs have the lowest spending on training: around 0.2 per cent of their payroll. That level is considerably lower than that of the other developing countries mentioned in table 15. Garment firms in the Philippines, Indonesia and China reported similar mean training expenditure, amounting to 0.4 per cent of the payroll.

Among the sample of garment firms of the Asian countries surveyed, those located in LDCs have the lowest spending on training.

Table 14. Garment lead times in selected Asian LDCs and ODCs, 2004

(Days)

	Woven	Circular knit
LDCs		
Bangladesh	90–120	60–80
Cambodia	90–120	90–120
Lao People's Dem. Republic	100–130	100–130
Myanmar	90–130	90–130
ODCs		
China	40–60	50–60
India	50–70	60–70
Indonesia	60–90	60–70
Malaysia	60–90	50–60
Sri Lanka	60–90	60–70
Thailand	60–90	50–60
Viet Nam	60–90	60–70

Source: Rasiah (2006a, 2007a).

Note: Lead time is the time taken between the placement of orders (essentially by brand-holding buyers) and the delivery of orders by contract producers.

Chinese firms in Cambodia — which account for the bulk of the garment firms in the country — hardly use any of the training institutions in the country to train employees. That suggests that the engagement of Chinese firms in the country would be seriously affected when the existing preferential access openings in the United States and EU were closed. In Myanmar the contraction in garment exports has discouraged the opening of training centres (Myint, 2007). In the absence of such centres, training in garment firms in the Lao People's Democratic Republic is carried out only in-house in firms. Training centres exist in Bangladesh, but they are focused on reducing injury and downtime rather than on driving upgrading. Other countries have successfully adopted policies to induce training in garment firms, for example Viet Nam, Malaysia and Singapore. But there have been no similar mandatory training policies in Bangladesh, Cambodia, the Lao People's Democratic Republic or Myanmar.

None of the LDCs examined seem to be equipping themselves effectively to sustain expansion in the garment industry when the preferential access instruments are removed.

Foreign machinery suppliers have also participated in training local firms engaged in knitting in Bangladesh and Cambodia. However, the lack of proactive promotion of such avenues of learning has restricted technology absorption in those countries.

The training evidence suggests none of the LDCs examined seem to be equipping themselves effectively to sustain expansion in the garment industry if the preferential access instruments are removed. This has been the case in other countries. In the Philippines and Thailand dwindling employment and exports since the removal of MFA quotas, together with low levels of training expenditure, suggest that garment manufacturing is hollowing out in those countries.[33]

Process technology. Process technology consists of machinery and equipment, layouts, inventory and control techniques, and firm organization, which are important indicators of technological intensity in firms. None of the four Asian LDCs examined is engaged in the manufacturing of machinery and equipment used in the garment industry, hence the role of machinery and equipment imports (section B of this chapter).

Equipment and machinery used in Asian LDCs economies have either been relocated after use in China, Malaysia and Thailand or imported second-hand by domestic producers.

The evidence from Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar shows that equipment and machinery used in those economies have either been relocated after use in China, Hong Kong (China), Taiwan Province of China, Malaysia and Thailand or imported second-hand by domestic producers. Only independent knitting machinery and equipment (weft

Table 15. Comparative technological intensity levels of garment firms of selected LDCs and ODCs, 2001–2005

(Percentage, unless otherwise indicated)

	LDCs			ODCs				
	Lao PDR	*Cambodia*	*Myanmar*	*China*	*Indonesia*	*Sri Lanka*	*Philippines*	*Thailand*
Skill intensity	8.7	12.1	29.7	30.2	25.2	36.3	35.3	29.1
Wage ($)	22.5	21.8	20	25.3	20.2	44.6	41.4	83.3
Training	0.21	0.26	0.2	0.4	0.35	0.29	0.4	0.4
Process technology	0.15	0.19	0.15	0.58	0.32	0.31	0.42	0.48
Adaptive engineering	0.001	0.005	0.001	0.022	0.012	0.017	0.019	0.022

Source: UNCTAD compilation based on UNU-MERIT (2004-2005); NERI (2006); Myint (2007); Rasiah (2007a).

Notes: Data for Cambodia, Myanmar and Lao PDR are for 2005, those for Sri Lanka are for 2002 and those for the other countries are for 2001.

Skills intensity: share of skilled, technical and professional personnel in total workforce (%); wages: mean monthly wage (dollars); training: share of training expenditure in payroll (%); process technology: share of expenditure on changes to organization, layout and processes in total sales (%); adaptive engineering: share of expenditure on product and equipment adaptation in total sales (%).

and warp knitting) from Germany and Taiwan Province of China were imported by some firms in Bangladesh and Cambodia. Importing depreciated machinery and equipment was also common earlier in Malaysia, Thailand, the Philippines and Indonesia. Therefore, the much lower process technology intensity in firms from the Lao People's Democratic Republic, Cambodia and Myanmar (table 15 should not be of concern at the moment. What is crucial is whether learning can be driven fast enough for firms in the latter countries to be able to import and use precision equipment and machinery to manufacture higher-value-added garments, as well as support more reliable and quicker logistics coordination with final markets.

Adaptive engineering. Interviews suggest that in Bangladesh and Cambodia firms only invest in automation, machinery and equipment modification and plant layouts to reduce defects and increase yield rates. This type of investment in the LDC garment firms is invariably lower than in the ODCs (table 15), particularly in the Lao People's Democratic Republic and Myanmar. While foreign sanctions have been reported as the prime cause of the decline in investment in upgrading in Myanmar, the structural features of the Lao People's Democratic Republic are seen as the prime deterrent to embedding in the domestic economy.

Anchoring. Evidence suggests that the rapid growth in garment-related FDI inflows, employment and exports has not been accompanied by a corresponding development of the technological capabilities of firms in Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar. The Governments of those countries have not devised and implemented an effective policy to develop garment manufacturing and foster its anchoring in the domestic economy, although the industry plays a major role in those economies. Their policy actions have been limited to liberalizing foreign investment regulations, promoting private enterprise, and coordinating investment approvals, customs and basic infrastructure to stimulate the growth of the different segments of activities in the value chains. None of those economies has even imposed training levies on firms to stimulate upgrading.

Governments in Asian LDCs must formulate strategies that will lead to the proactive embedding and diversification of the textile and garment manufacturing activities. Bangladesh has massive labour reserves and hence has the largest garment industry among the LDCs, but unless the infrastructure is improved the size of the industry is unlikely to expand that much more. The political environment in Myanmar has constrained access to the United States market, and thus its higher skills intensities have failed to revive a once promising industry. Cambodia must strengthen governance mechanisms to stimulate learning, which is critical if the garment industry is to follow the direction of Viet Nam. The small labour force and being landlocked have imposed limits on further expansion of the garment industry in the Lao People's Democratic Republic.

5. Implications

There is little evidence of a significant contribution by FDI to technological capability accumulation in LDCs. This is not due to those countries' insufficient "opening" to foreign investors, given the policy changes that they have made since the 1980s and the sharp growth of FDI penetration since the 1990s, which in some respects has become greater than in other developing countries. Rather, its limited contribution is due to the type of integration of TNCs into host countries' economies, the sectoral composition of FDI, the priorities of policies enacted by LDCs and the low absorptive capacity of these countries.

The rapid growth in garment-related FDI inflows, employment and exports has not been accompanied by a corresponding development of the technological capabilities of firms in Bangladesh, Cambodia, the Lao People's Democratic Republic and Myanmar.

Governments in Asian LDCs must formulate strategies that will lead to the proactive embedding and diversification of the textile and garment manufacturing activities.

There is little evidence of a significant contribution by FDI to technological capability accumulation in LDCs.

LDC Governments have liberalized FDI policy regimes and have thus been successful in attracting higher FDI inflows and achieving increases in exports. National Governments have not, however, tried to enhance the impact of higher FDI inflows on domestic technological capability-building or on domestic enterprise development. Consequently, recent inflows into LDCs have led to enclave-type development, with few linkages to the domestic economy. This is true of both natural resource investment — predominant in FDI in African LDCs – – and of light manufacturing, which is more prevalent in Asian LDCs. Although the latter has a higher employment impact, it does not entail technological diffusion through the training and movement of labour, since the type of manufacturing in LDCs is labour-intensive, but involves few skills. Additionally, the establishment of foreign subsidiaries is not accompanied by active training measures that could create knowledge spillovers.

LDC Governments have not tried to enhance the impact of higher FDI inflows on domestic technological capability-building or on domestic enterprise development.

For LDCs to reap some of the technological spillovers usually attributed to the presence of TNCs in host economies, active policy initiatives to that end must be implemented. In addition to attracting FDI, LDCs should introduce policies aimed at maximizing the development and technological learning impacts of foreign investment (see chapter 2 of this Report).

E. Licensing

The use of licensing as a channel for accessing the international knowledge pool (through imports of disembodied technology) is usually considered to be directly related to the income level and technological sophistication of economies. The reason for this is that using this technology diffusion channel effectively requires engineering skills and R&D programmes for adaptation and learning, to a much higher degree than other channels such as capital goods imports (Hoekman, Maskus and Saggi, 2005).

The use of licensing as a channel for accessing the international knowledge pool is inversely related to the income level and technological sophistication of economies.

Licensing should therefore be less relevant to LDCs than to other developing countries as a channel for foreign technology diffusion. The data on imports of disembodied technology in table 16 confirm that expectation. Royalty and licence fee payments in these countries are extremely low. Between 2000 and 2005 foreign disbursements amounted to 0.02 per cent of the GDP of the 24 LDCs for which data were available, as compared with 0.36 per cent in other developing countries. On a per capita basis, spending on imports of disembodied technology by LDCs amounted to $0.07 per inhabitant, while in ODCs it was 90 times higher. Imports of disembodied technology by LDCs have grown only moderately since the late 1990s. In 2000–2005 they were on average 14 per cent higher than during the period 1996–1999, but the relative indicators remained stagnant. In other developing countries, by contrast, licence fee payments almost doubled between those two periods, and there was a similar development with regard to the relative indicators (table 16).

On a per capita basis, spending on imports of disembodied technology by LDCs amounted to $0.07, while in ODCs it was 90 times higher.

Licence fee payments are also associated with TNC presence in the country, since most transfer of disembodied technology occurs within multinational corporations (Mendi, 2007). However, it is particularly TNCs in knowledge-intensive sectors that generate that type of intra-firm payments, for example, the information technology and pharmaceutical industries. Since that is not the type of FDI that arrives in LDCs, the strong presence of foreign investment in LDCs (as analysed in section D above) has not entailed a corresponding strengthening of licensing activity in those countries.

Table 16. Indicators of the importance of licensing in LDCs and ODCs, 1996–2005

(Royalty and licence payments, period averages)

	Value ($ thousands)		Licence payments/ GDP (%)		Licence payments per capita ($)	
	1996–1999	*2000–2005*	*1996–1999*	*2000–2005*	*1996–1999*	*2000–2005*
LDCs	**29 044**	**33 250**	**0.02**	**0.02**	**0.07**	**0.07**
Africa	20 231	23 308	0.03	0.03	0.07	0.07
Asia	8 605	9 779	0.02	0.02	0.06	0.07
Islands	207	163	0.03	0.01	0.34	0.24
Other developing countries (ODCs)	**11 771 543**	**22 543 234**	**0.23**	**0.36**	**3.55**	**6.36**
Africa	785 767	1 020 422	0.24	0.27	3.72	4.43
America	2 698 636	3 253 528	0.15	0.17	5.82	6.53
Asia	8 287 140	18 269 284	0.28	0.47	3.14	6.49

Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators online and UNDESA, Statistics Division.

Note: LDCs and regional aggregates are composed of the following countries: Angola, Bangladesh, Benin, Burundi, Cambodia, Cape Verde, Eritrea, Ethiopia, Guinea, Lesotho, Madgascar, Malawi, Mali, Mozambique, Niger, Rwanda, Samoa, Senegal, Sierra Leone, Sudan, Togo, Uganda, United Republic of Tanzania and Zambia.

The diffusion of foreign technology to LDCs through market mechanisms is taking place to a very limited degree, there being very little technological development in those countries, despite the high exposure of LDCs to international trade and capital flows.

F. Conclusions

The diffusion of foreign technology to LDCs through market mechanisms is taking place to a very limited degree, there being very little technological development in those countries, despite the high exposure of LDCs to international trade and capital flows. The main reasons for this lie in the way in which those channels of knowledge diffusion are being accessed by LDCs. The latter are either using market channels too little or they are accessing them intensively, but not in a way that allows their potential for technological learning to develop. The former is true of capital goods imports and licensing, which have virtually stagnated at low levels (in relative terms) in LDCs over the last 25 years. The latter is the case with foreign direct investment and exports: LDCs are quite open to both, but are not capable of using them as effective channels for technology diffusion.

LDCs are either using market channels too little or they are accessing them intensively, but not in a way that allows their potential for technological learning to develop.

The only moderate growth of capital goods imports and licensing in LDCs is in sharp contrast with other developing countries, which have greatly intensified their use of those channels for access to the international knowledge pool. Little licensing activity can be expected in the early stage of technological catch-up, with this channel typically becoming more relevant only in the later stages. Low capital goods imports, by contrast, are a matter of concern, since they are expected to play a major role in diffusion of foreign technologies to LDCs. The sluggishness of those imports means that domestic firms are upgrading their processes and products only marginally. Their technological learning and innovative activity is therefore constrained. The main reasons for the low level of capital goods imports are the de-industrialization of the LDCs since the 1980s, the only moderate rise in the investment rate of those economies and the composition of their fixed capital formation (a relatively small share of which is devoted to machinery and equipment, including ICTs). Nevertheless, even the intensification of capital goods imports and licensing will not on its own guarantee that these international market linkages will work effectively as channels of knowledge diffusion. Policy action is required to make this happen.

The intensification of capital goods imports and licensing will not on its own guarantee that these international market linkages will work effectively as channels of knowledge diffusion. Policy action is required to make this happen.

The levels of FDI inflows and stock of LDCs, as well as their merchandise exports, relative to their economies are comparable to those of other developing countries. Nevertheless, the positive effects of technology spillovers, upgrading or learning-by-exporting that occur in some ODCs (particularly in the late phase of technological catch-up) are mostly absent from LDCs. In the case of FDI, the reasons for this are: (i) the type of foreign investment that those countries have attracted; (ii) the limited linkages of TNCs with domestic economies; and (iii) the lack of policy action aimed at anchoring those activities in the domestic economy or at enabling their potential as technology diffusion channels to unfold. Difficulties in using exports and downstream linkages with international customers as means of technological learning are linked to the changing nature of global value chains, the growing entry barriers and the scarcity of measures taken by chain leaders to help their suppliers to upgrade. Thus, the growing integration of LDCs into international trade and investment flows since the 1980s has not prevented their marginalization from technology flows, as evidenced by the widening knowledge gap and the low-level development of their firms' technological capabilities.

The positive effects of technology spillovers, upgrading or learning-by-exporting that occur in some ODCs are mostly absent from LDCs.

LDCs' limited and ineffective use of international market linkages to build domestic technological capabilities is worrying since it is precisely those mechanisms —particularly international trade and FDI — that are expected to play a major role in technology diffusion to LDCs in the early stage of catch-up. Despite the enhanced contribution that should be made by knowledge aid (see chapter 5 of this Report), market mechanisms will remain the main channels for the diffusion of knowledge to LDCs, provided their presence is accompanied by adequate policy action. Their technology diffusion effects will not occur merely because of the existence of — or even increase in — trade and investment flows, as shown by the experience of LDCs over the last 25 years. Therefore, the recommendations, commonly made, that developing countries (including LDCs) increase their opening to foreign trade and FDI are not pertinent or are at least insufficient. Apart from the questionable effectiveness of such policy lines for technology diffusion, they generally do not apply to most LDCs, since they have already opened up strongly to foreign trade and investment.

LDCs' limited and ineffective use of international market linkages to build domestic technological capabilities is worrying since it is precisely those mechanisms that are expected to play a major role in technology diffusion to LDCs in the early stage of catch-up.

For policy-makers in all developing countries, including in LDCs, it is important to realize that the learning associated with these international transactions does not occur automatically. There is, for example, no "fixed quotient" of learning that arrives in developing countries with every "unit" of, say, exports or FDI. Consequently, measures to increase the volume of exports or FDI inflows do not guarantee any increase in learning. Instead, the learning-intensity of such transactions is variable, and the key issue is to raise that learning intensity – to increase the magnitude of knowledge and skill that is acquired "per unit" of exports, imports or inward FDI.[34] In other words, the learning potential of these international transactions is something that can be exploited more or less fully. It is on that variability that policy should focus, and not just on the scale of the transactions (Bell, 2007).

Leveraging international market mechanisms to strengthen their role as channels for the diffusion of technology to LDCs requires active policy at the national level, as well as at the regional and international levels. This is particularly required in the early stage of technological catch-up, when policy action must actively pursue the goal of fostering technological capability-building. Although those interventions comprise S&T policy, they must be part of broader development strategies geared towards the development of productive capacities in all its dimensions, including strengthening domestic absorptive capacity. This issue will be discussed in chapter 2 of this Report.

Leveraging international market mechanisms to strengthen their role as channels for the diffusion of technology to LDCs requires active policy at the national level as part of broader development strategies geared towards the development of productive capacities.

Notes

1 Diffusion of technology through these four channels derives from interactions between different firms in the context of market transactions. Chapters 4 and 5 of this Report analyse other potentially effective channels for technology transfer to/from LDCs: migration of skilled persons (which usually does not result from market transactions between firms) and knowledge aid (which is a non-market mechanism), respectively.

2 The next major sources of innovation are key personnel, internal R&D and collaboration with customers (see chart 3 and UNCTAD, 2006b: table 35).

3 The crucial importance of capital goods as a source of innovation even in developed countries is confirmed by a survey of European enterprises, which shows that 50 per cent of total innovation expenditure is embodied in plant, machinery and equipment purchased by industrial firms, with own R&D accounting for just 20 per cent (Evangelista et al., 1998, quoted by UNIDO, 2002).

4 The working of trade as a channel for technology diffusion is gauged in different studies through trade openness or total imports (Edwards, 1998; Helliwell, 1992), but these are imprecise proxies for imports of embodied technology. This Report examines capital goods and their main categories in order to gain a better assessment of technology flows through merchandise imports.

5 The Annex provides the list of countries of origin of capital goods.

6 Trends in the intensity of LDCs' capital goods imports are driven by the African and Asian countries. The corresponding indices for island LDCs are substantially higher, due to the small size of these economies (table 3).

7 The precise definition of each category (including its trade classification) is provided in the Annex.

8 Automobiles are dual-use goods and can be either consumer goods or capital goods. Our category of capital goods includes only transport equipment used mostly for production purposes by firms and therefore excludes passenger cars.

9 "African LDCs" refers to most African LDCs plus Haiti. The Annex provides the list of countries included in this grouping, as well as the list of countries that make up the two other groupings: Asian LDCs and island LDCs.

10 The category "scientific and measuring instruments" is reclassified mostly as ICT capital in the second classification of capital goods. Hence the groups presented in table 6 are mainly a further specification of the broad "machinery and equipment" category shown in table 5.

11 Ideally, it would be desirable to separate mining and metal-crushing machinery from construction machinery, so as to highlight the role of natural resource extraction in total capital good imports. These two types of equipment fall, however, into the same category at the 5-digit SITC level (i.e. the most detailed in this trade classification). This is partly due to the fact that in some cases the same types of machinery can be used by both the mining and the construction industries (e.g. earth-moving equipment). Therefore, it was not possible to disentangle them in the trade data set used here.

12 Comprising the following capital good groups: textile and leather machinery; metalworking machinery; food-processing machinery; paper, pulp and publishing machinery; other industrial machinery.

13 In other developing countries, the share of agricultural machinery in total capital goods imports was lower than in LDCs and it has also declined since the 1980s. This, however, mirrors the much lower share of agriculture in GDP and the expansion of domestic supply capacity of agricultural machinery.

14 Gereffi, Humphrey and Sturgeon (2005) identify five different GVC governance patterns.

15 For example, transfer of post-harvest processing of fresh vegetables to producer countries has been observed in Kenya (Humphrey, McCulloch and Ota, 2004).

16 The relocation of activities to Madagascar has led to a strong increase in the country's exports of garments between 2000 and 2005 (table 13).

17 Apart from the value chains shown in table 9, the analysis considered the following: tobacco, iron, fruit, sugar, rubber, plastics, cocoa, pulp, wheat, artificial fibres, milk, fur skin, nickel and cork.

18 The approach is analogous to the one followed in section B of this chapter, which considers the sectoral breakdown of capital goods imports.

19 It is the greenfield part of FDI that brings additional capital to the host economy, but not brownfield investment.

20 Spillovers from FDI occur when the entry or presence of TNCs increases the productivity of domestic firms in a host country and the TNCs do not internalize the value of these benefits.

21 Horizontal spillovers refer to the technology transfer from TNCs to local firms in the same industry. Vertical spillovers take the form of positive externalities via value chains. Backward linkages are contacts between TNCs and their local suppliers. Forward linkages spillovers arise when domestic firms become more productive as a result of gaining access to new, improved or less costly inputs produced by TNCs in upstream sectors.

22 In LDCs natural resource extraction typically develops as enclaves, but this may also be the case of manufacturing and even service projects (e.g. in some cases of industry located in EPZs or tourist facilities) that have little backward or forward linkages with the domestic economy.

23 In this subsection mining refers to the extraction of minerals, including metals and fuels, as well as other minerals.

24 These developments in export values reflect both prices changes (given the cyclical rise in commodity prices just mentioned) and volume increases.

25 The first three features of mining activities are common to most modern mining operations throughout the world, while the two last ones are prevalent in developing countries (including LDCs), but usually not in developed countries (Eggert, 2001).

26 Abugre and Akabzaa (1998) claim that in Africa the "bulk of the investment in the mining sector goes to metallic and precious minerals. There is very limited investment in the non-metallic ores such as lime, phosphate, clay products and salt, all of which require relatively little capital to process but which have the greatest horizontal linkages to, and a higher multiplier effect on, the domestic industry".

27 The United States imposed sanctions on Myanmar in 2001 and by 2004 had terminated all direct imports from the country.

28 The garment industry can operate at both extremes of the skill-wage spectrum (at the low skill-low wage end and at the opposite high skill-high wage end), as well as at intermediate points.

29 Asian LDCs mostly lack the infrastructure and the skills endowments to attract a wide range of industries.

30 The United States and the European Union accounted for about 76 per cent of world garment imports in 2005, while Japan's imports totalled only 8 per cent. Therefore, preferential access to those two markets is very important for LDCs.

31 Although FDI also played a key role in Myanmar, the imposition of sanctions in 2001 led to a contraction in foreign investment and in exports. Domestic capital accounted for 79 per cent of the total number of firms in 2004–2005.

32 The analysis draws on the original findings on technological learning, domestic anchoring of industries and FDI that Rasiah (2007a) prepared for this Report on the basis of data from a series of surveys containing firm-level data on Asian LDCs and ODCs. That paper provides details on the different surveys that have been compiled.

33 The contraction of the garment industry in the Philippines and Thailand might lead to the relocation of firms to the Asian LDCs. Cambodia arguably remains the most appealing of the LDCs examined as regards attracting those firms, but only if further upgrading can be achieved, since the market in the really low-value-added niches is saturated.

34 The same reasoning applies to ODA flows, analysed in chapter 5 of this Report.

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Annex

The data set on imports of capital goods by developing countries

Definition of capital goods and groups. The definition of capital goods is mostly based on the BEC (Broad Economic Categories) Rev.3 classification of the United Nations. It comprises the following categories (with the respective BEC Rev.3 codes):

41 Capital goods (except transport equipment)

42 Parts and accessories *(of Capital goods under heading 41)*

521 Industrial *(Transport equipment)*

53 Parts and accessories *(of Industrial transport equipment under heading 521)*

Capital goods have been loosely classified in two ways. The first is a general classification that divides them into the following groups (with the respective SITC Rev.3 codes):

1. Machinery and equipment (612.1, 629.2, 657.7, 657.9, 692, 695, 711, 712, 713, 714, 716, 718, 721, 722, 723, 724, 725, 726, 727, 728, 731, 733, 735, 737, 741, 742, 743, 744, 745, 746, 747, 748, 749, 751, 752, 759, 761.2, 762.8, 763.8, 764, 771, 772, 773.2, 776, 778, 812.1, 821.3, 881.2, 881.3, 894.6, 895.1)
2. Scientific and measuring instruments (774, 871, 872, 873, 874, 897.4)
3. Transport equipment (625.2, 625.3, 782, 783, 784, 786, 791, 792, 793)

The second classification singles out (whenever possible) capital goods by their main end-users or by type of general-purpose technology. It divides them into the following groups (with the respective SITC Rev.3 codes):

1. Agricultural machinery (721, 722)
2. Construction, mining, metal crushing (723, 728)
3. Power-generating machinery (711, 712, 713, 714, 716, 718, 771, 772, 773.2, 812.1)
4. Textile and leather machinery (724)
5. Metalworking machinery (731, 733, 735, 737)
6. Food-processing machinery (727)
7. Paper, pulp and publishing machinery (725, 726)
8. Other industrial machinery (612.1, 629.2, 657.7, 657.9, 692, 695, 741, 742, 743, 744, 745, 746, 747, 748, 749, 778, 821.3, 871, 881.2, 894.6, 895.1, 897.4)
9. ICT capital (751, 752, 759, 761.2, 762.8, 763.8, 764, 774, 776, 872, 873, 874, 881.3)
10. Transport equipment (as above)

Definition of country/territories groups. The following country groups have been used:

1. ***Developed countries/territories:*** Andorra, Australia, Austria, Belgium, Canada, Channel Islands, Cyprus, Czech Republic, Denmark, Estonia, Faeroe Islands, Finland, France, Germany, Gibraltar, Greece, Holy See, Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

2. ***Technologically advanced developing countries/economies:*** the 20 developing countries/economies with the highest ranking in UNIDO's ITA (index of industrial and technological advancement): China, Hong Kong (China), India, Indonesia, Jordan, Republic of Korea, Malaysia, Pakistan, Philippines, Singapore, Taiwan Province of China, Thailand, Turkey, Argentina, Brazil, Costa Rica, El Salvador, Mexico, South Africa, Tunisia (source: UNIDO, 2005).

3. LDC subregional groupings:

3.1. Africa and Haiti: Angola, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Togo, Uganda, United Republic of Tanzania, Zambia.

3.2. Asia: Afghanistan, Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic, Myanmar, Nepal, Yemen.

3.3. Islands: Cape Verde, Comoros, Kiribati, Maldives, Samoa, Sao Tome and Principe, Solomon Islands, Timor-Leste, Tuvalu, Vanuatu.

Methodological notes. Mirror trade data have been used to estimate capital goods imports, with developed countries and technologically advanced developing countries (as defined above) as reporters and developing countries as partners. Raw data were downloaded from UNDESA Statistics Division, Comtrade database, in January 2007.