CHAPTER

3

Measuring productive capacities: LDCs' progress towards sustainable development

The number of LDCs with low productive capacities has increased over time

The number of LDCs with high productive capacities has decreased over time

LDCs outperform ODCs
in the natural resources component

CHAPTER 3

Measuring productive capacities: LDCs' progress towards sustainable development

A. Introduction

The structural economic problems of least developed countries (LDCs) have received considerable attention in the development discourse. Over the past 15 years or so, UNCTAD has consistently highlighted the need to develop the productive capacities of LDCs and support these countries with concrete measures to reduce their vulnerabilities. Among the measures it has proposed are diversifying and building the resilience of LDC economies, as well as increasing social development returns and boosting the poverty elasticity of growth. The productive capacities needed to transform LDC economies are broadly described in Chapter 1 and referenced throughout the report. This chapter demonstrates that efforts to monitor the progress made by LDCs in attaining internationally agreed objectives, notably the Istanbul Programme of Action for the Least Developed Countries (IPoA) and the Sustainable Development Goals, could be enhanced by measuring the productive capacities of the countries across all possible dimensions.

With less than a decade left to implement the 2030 Agenda for Sustainable Development, building the productive capacities of the LDCs could help the countries to ramp up progress on several Sustainable Development Goals. A steady rise in productive capacities is necessary to boost economic development impacts, including reducing extreme poverty (Sustainable Development Goal 1). The comparative advantages of LDCs in natural resources and abundant labour have not been efficiently exploited to enhance productive activities that could help these countries achieve higher levels of economic development. With the labour force in LDCs increasing by 2.7 per cent per annum in 2011–2019, these countries have a unique opportunity to bolster agricultural productivity (Sustainable Development Goal 2) and industrial growth (Sustainable Development Goal 8), particularly if improvements to labour productivity are contemporaneously implemented with surges in other productive capacities, such as energy (Sustainable Development Goal 7), structural change, information technology, infrastructure, transport linkages and private sector (Sustainable Development Goals 8 and 9).

This chapter builds on the concept of productive capacities outlined in chapter 2 and will demonstrate its policy relevance. An overview the UNCTAD productive capacities index (PCI) is presented and applied to assess the progress that LDCs have achieved over time. Since graduation from the LDC status is a fundamental goal of all international support measures (ISMs) specific to LDCs, the analysis appraises the performance of individual countries as they progress towards graduation, and the overall objective of the IPoA to enable half of the LDCs to meet the graduation criteria by 2020.

A steady rise in the productive capacities of the LDCs is necessary to achieve the SDGs

The chapter further highlights areas in which LDCs have made notable progress and where they could have done better. The multidimensionality of the productive capacity categories implies that improvements, or lack of traction, in some productive capacity categories may affect progress in other categories. The analysis advances the view that building productive capacities is a viable framework for operationalizing development policy; however, to be effective the different capacities in the economy must complement one another as a system; linkages among countries also play a critical role for diversification and building export capacities.

The literature on measuring productive capacities proposes a large choice of indices; however, most of them measure productivity at the sectoral or aggregate economic level and are used to explain dynamic effects of growth on the structure of economies over time (Kalirajan and Salim, 1997; Nordhaus, 2002; Gagnon, 2007). In this approach, growth performance is explained by decomposing the marginal contributions of various inputs, particularly of labour (Scarpetta et al., 2000). The UNCTAD PCI is an aggregate measure which incorporates not just the endowments of a country but also how it transforms its resources and benefits from interlinkages with other countries. Although the methodology and indicators for measuring productive capacities may improve in the future, the UNCTAD PCI is the most extensive in scope, content and technical effort.

The rest of the chapter is organized as follows. A brief description of the methodology for constructing the UNCTAD PCI is provided in section B, which includes an illustration of how the PCI is used to benchmark the progress made by LDCs in relation to other country groups. Section C provides an assessment of the progress achieved by individual LDCs towards the IPoA targets. The assessment is based on targets explicitly identified in the IPoA and includes a dimension of how productive capacities boost or impede the chances of countries achieving the

targets. Section D concludes the chapter with some policy recommendations.

B. The UNCTAD productive capacities index

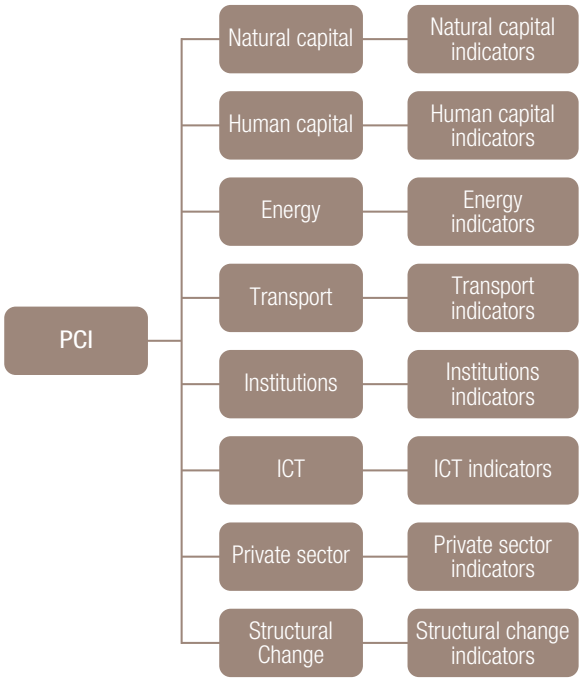
1. Overview

The UNCTAD PCI is the first comprehensive attempt to measure productive capacities in all economies. The index is multidimensional, country-specific and allows for a comparison of progress made over periods and across countries or regions (UNCTAD, forthcoming). It builds on a conceptual framework discussed in Chapter 2 that posits productive capacities on three pillars, namely productive resources, entrepreneurial capabilities and production linkages; together, these productive capacities determine the capacity of a country to produce goods and services and enable it to grow and develop (UNCTAD, 2006).

Guided by these imperatives, the UNCTAD PCI incorporates eight categories (subindices) containing indicators addressing various aspects of productive capacity. The subindices represent the main channels through which the productive capacities of a country develop (Figure 3.1), and include an active accumulation of factors of production, which form dynamic processes through which factor accumulation occurs, as well as the exogenous effects of the immersion of the LDCs into the global economy (UNCTAD, 2006). The technical details on how the PCI and its subindices are constructed, as well as the indicators that were used are described in the Annex to this chapter. It is important to note that the definitions of the subindices are quite broad, and their aggregation procedure is quite rigorous. The two aspects that must be borne in mind are that: (i) for the panel data, the indicators used to construct the index are treated as random variables; and (ii) the correlation structure between the domain for each subindex are maintained, hence the final index consistently represents all domains.

Figure 3.1

The PCI thematic structure



Source: UNCTAD, forthcoming. The UNCTAD Productive Capacities Index: The Methodological Approach and Results.

Unleashing the power of productive capacities for structural transformation and economic development can be achieved through better utilization of existing capacities and building new ones, as well as an active reassessment of capacity gaps. Adopting a productive capacities methodology allows LDCs to reframe the development discourse to better balance social and industrial priorities (UNCTAD, 2020d). When countries are compared through the lens of the UNCTAD PCI, the link between social development and other development priorities (e.g. infrastructure, private sector and trade) become apparent. This distinction and the synergies in the index's productive capacities categories are critical to the economic development process and to the policies supporting it.

As a data intensive composite measure, one of the unavoidable steps in the construction of the PCI is the data imputation of missing values. As explained in the Annex, there are several options for imputing missing values, including by using neighbouring countries as proxies. The process is not without controversy as it assumes that observations in one country are correlated with those of its neighbours, and that the measurement scale of the imputed variables is adjustable to an arbitrary choice of weights. In severe cases, imputed data can introduce bias and uncertainty about the true statistical properties of variables, resulting in misleading predictions and inferences (John et al., 2019). For the PCI, data imputation is unavoidable because of the number of indicators and countries involved. Also, the optional step of forecasting new values and the principal components analysis deals with any data entropy issues that arise due to induced imputation or other measurement errors. It has been shown that the method behind the PCI is robust, with the only limitation being the need to re-estimate the entire dataset when one or more data points change.

Re-estimation of the data points ensures consistency and a high correlation of alternative forecasts within entropy limits. However, the computation complexity and costs of iterations are not negligible in large datasets (Kim et al., 2019).

The other steps, also explained in the Annex, involve forecasting new observations and constructing the index using principal component analysis to reduce the dimensions represented by the original indicators. The principal component analysis explores the correlation structure and the variance of the observed data through a few linear combinations of the original data. The resulting linear combination is a latent factor that captures the information common to individual indicators in the cluster of variables forming a subindex. The final step applies the geometric mean to the subindices representing each category to reduce the level of substitutability between dimensions and control outliers and skewness in the distributions of the data. The resulting data contains a panel of 193 countries which make up the PCI and its components for the years 2000–2018.

2. Measuring progress and benchmarking with PCI

The PCI scale, both for the aggregate index and its subindices, ranges from 0 to 100, with 100 being the best score. PCI scores for LDCs varied from 9 (Niger and Chad) to 36 (Tuvalu), and the simple average for the group was 17 in 2011–2018 (Table 3.1). The scores for the seven Island LDCs are equal to or higher than the average for the LDCs and should be treated as a special case.[1] This is because the deflators used in the underlying variables include per capita and other measurement scales that tend to overcompensate for smaller countries. With this qualification, the PCI scores for a few non-island LDCs, including Bhutan, Bangladesh, Cambodia, Lesotho and Djibouti, are just slightly above the 75th percentile (19); Bangladesh and Cambodia, however, eclipse the group when small states are excluded. For the group, the median productive capacity score climbed from 14.9 to 17.2 in 2011–2018, and rose from 27.3 to 28 for other developing countries (ODCs).

A close examination of the subindices reveals significant disparities among countries. As a group, LDCs showed considerable depth in private sector capacity, with a median score of 65.2 and a maximum

The rate of change in productive capacities is very slow

of 85.1 (out of a possible 100). These scores represent, among others, liquidity of domestic credit markets to private sector (as a per cent of GDP), the cost of exporting/importing a container and lead times to export/import goods. The countries with the relatively higher scores in the energy productive capacity category are Bhutan, Nepal, Lao People's Democratic Republic, Guinea-Bissau and Myanmar, while the lowest ranked are Mali, Kiribati, Haiti, Benin and Togo. Oil and mineral resources exporters feature prominently in the natural resource category; however, the inclusion of land and forest area and flow measures of extraction and material intensity imply that the subindex does not distinguish between agrarian and industrial economies relying on extractives. As a result, Lesotho, Guinea, Liberia, Guinea-Bissau and Zambia top the group with scores ranging from 57 to 60, followed by predominantly agrarian countries (Malawi, Rwanda, Uganda, South Sudan and Burkina Faso), scoring slightly above the LDC average range of 47 to 49.

To illustrate the use of PCI in benchmarking the progress of LDCs, three clusters of least, average and high productive capacity LDCs were iteratively created for the years 2001, 2011 and 2018, respectively.[2] Countries were assigned to groups with the closest median PCI. The resulting distribution shows that productive capacities have slightly improved in the least productive cluster over the years, with the subgroup median PCI score rising from 18 to 22 in 2000–2018. However, in all clusters, the rate of change in productive capacities is too slow, and individual country performances have been lacklustre. Of note is the shrinking of the high-productive group from 11 countries in 2001 to only six in 2018 (Figure 3.2). It is important to note that the median PCI among the high-productive group rose from 23 to 29. Meanwhile, the low productive group expanded from 18 countries to 25 over the same period, while the number of countries in the average group ranged between 16 and 18 in 2001–2018. In addition, the composition of countries in the two

[1] The seven Island LDCs are Comoros, Kiribati, Sao Tome and Principe, Solomon Islands, Timor-Leste, Tuvalu and Vanuatu.

[2] The number of clusters was chosen arbitrarily, based on observed trends in trade, GDP and other characters which often result in natural clustering according to export specializations. For the interested reader, STATA and other statistical packages can automatically determine the optimal number of clusters (Makles, 2012).

Table 3.1

Productive capacities index scores of individual least developed countries and other country groups, average, 2011–2018

Country/Region	PCI total	Energy	Human capital	ICT	Institutions	Natural resources	Private sector	Structural change	Transport
Tuvalu	36	33	31	33	57	42	85	35	12.35
Bhutan	27	49	38	10	61	42	70	34	2.13
Vanuatu	26	29	31	8	57	34	77	36	5.26
Timor-Leste	23	32	29	7	53	37	67	31	3.11
Solomon Islands	22	34	30	5	46	49	77	27	2.42
Kiribati	21	25	39	7	56	16	76	16	6.44
Lesotho	21	33	31	8	50	60	67	42	0.63
Bangladesh	20	37	35	6	34	41	65	34	1.00
Cambodia	20	35	35	9	36	42	74	29	0.88
Djibouti	20	27	34	5	35	39	72	42	1.70
Sao Tome and Principe	20	28	34	9	47	39	69	32	0.87
Lao People's Democratic Republic	19	41	30	9	35	50	70	38	0.40
Nepal	19	41	38	7	36	36	64	34	0.49
Haiti	18	24	32	4	27	39	67	26	2.02
Yemen	18	29	28	7	16	35	69	33	1.25
Comoros	17	35	31	4	35	44	72	19	0.76
Ethiopia	17	34	27	3	32	43	62	25	1.60
Rwanda	17	31	33	5	51	48	67	28	0.30
Senegal	17	36	27	8	50	45	73	38	0.12
South Sudan	17	35	26	5	37	47	66	29	0.52
Uganda	17	34	27	5	39	48	65	36	0.31
United Republic of Tanzania	17	33	32	5	39	46	63	26	0.50
Zambia	17	36	27	6	47	57	50	30	0.27
LDCs average	**17**	**32**	**28**	**6**	**36**	**46**	**65**	**28**	**1.12**
The Gambia	16	29	25	8	37	49	76	30	0.18
Benin	15	24	26	6	47	41	71	31	0.17
Guinea	15	30	23	4	30	60	72	30	0.26
Liberia	15	28	30	4	36	59	68	25	0.19
Mozambique	15	33	23	4	39	53	70	31	0.29
Sudan	15	35	29	7	15	35	60	21	0.45
Togo	15	20	28	4	35	53	75	32	0.30
Angola	14	34	22	4	29	52	55	22	0.23
Malawi	14	30	33	3	44	49	65	25	0.23
Mauritania	14	27	25	6	34	50	70	31	0.09
Myanmar	14	38	32	5	28	40	69	28	0.14
Sierra Leone	14	27	30	5	38	57	72	14	0.16
Burkina Faso	13	27	21	5	44	47	62	19	0.18
Eritrea	13	38	20	1	17	54	58	36	1.33
Madagascar	13	31	25	2	36	50	71	32	0.12
Afghanistan	12	33	27	4	17	37	32	34	0.20
Burundi	12	31	26	2	25	52	59	19	0.27
Democratic Republic of the Congo	12	32	19	2	27	56	55	29	0.13
Mali	12	27	20	6	36	40	65	14	0.10
Guinea-Bissau	11	39	24	5	31	59	51	3	0.20
Somalia	11	34	19	2	3	55	69	21	0.88
Central African Republic	10	30	16	2	19	42	47	23	0.25
Chad	9	29	16	2	23	41	30	5	0.34
Niger	9	28	14	2	39	44	53	21	0.03
Other developing countries	**28**	**40**	**41**	**19**	**50**	**40**	**75**	**41**	**4.36**
Developed countries	**40**	**47**	**62**	**37**	**80**	**37**	**83**	**54**	**6.18**

Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May, 2020].

lower productive clusters changed significantly over the years. Bangladesh, Comoros, Djibouti, Gambia and Solomon Islands slid from the high productive capacity cluster into the average capacity

Figure 3.2

Clustering of LDC productive capacities, ranked by cluster-medians, 2001, 2011, 2018

Source: UNCTAD secretariat calculations based on data from UNCTAD, UNCTADStat database [accessed May, 2020].

group, while Eritrea, Guinea, Madagascar, Malawi, Mauritania, Mozambique, Sierra Leone, Togo and Yemen fell from the average capacity group into the least ranked cluster of productive capacities. Only two countries, Rwanda and Myanmar, climbed up the clusters in 2001–2018, moving from the least productive capacity group into the average group.

The disparities in economic development among LDCs and between LDCs and other country

Table 3.2

Productive capacities by country group, medians 2011 and 2018

	PCI total	Human capital	Energy	ICT	Institutions	Natural capital	Private sector	Structural change	Transport infrastructure
2011									
Developed countries	42.1	64.1	42.4	37	80.8	38.5	82.7	55.7	4.9
Least developed countries	14.9	27.8	30.1	3.7	36.9	44.5	66	28.4	0.3
Other developing countries	27.3	41.1	36.6	16.2	50.8	39.9	74.9	42.3	1.9
World	**26.2**	**40.5**	**36.1**	**15.8**	**50**	**40.3**	**74.1**	**40.5**	**1.6**
2018									
Developed countries	39.8	61.3	46.3	38.7	80.3	39.4	83.8	52.5	3.1
Least developed countries	17.2	28.7	31	6.8	36.9	46	69.3	30.9	0.4
Other developing countries	28	41.5	39.3	21.3	50.1	40.3	77.2	42	1.4
World	**27**	**40**	**38.7**	**20.4**	**49.9**	**40.9**	**76.5**	**40.7**	**1.3**
Percentage change (2011–2018)									
Developed countries	-5.4	-4.3	9.4	4.7	-0.6	2.2	1.4	-5.6	-36.3
Least developed countries	15.5	3.3	3	85.7	0	3.4	4.9	9	60.3
Other developing countries	2.5	0.9	7.6	31.3	-1.5	0.9	3.2	-0.7	-29.1
World	**2.9**	**-1.1**	**7.3**	**29.4**	**-0.2**	**1.5**	**3.2**	**0.6**	**-18.4**

Source: UNCTAD secretariat calculations, based on UNCTADStat database [accessed May, 2020].

groups can be explained by their PCI scores. When unbundled, some of the PCI components have been used extensively in the literature to explain differences in economic development among countries. For example, some studies consider the differences in factor productivity, especially of labour, and the accumulation of capital as the main reasons for the divergence (Hulten and Isaksson, 2007). However, total factor productivity only partially explains the underlying causes of the differences among heterogeneous groups of countries. Moreover, as shown in the schematic representation of the PCI, total factor productivity only accounts for the top two or three PCI subcomponents that are traditionally viewed as factors of production. Although the factor productivity decomposition approach explains most of the differences among high growth countries, there are limitations when these methods are applied to LDCs. For instance, the finding by Hulten and Isaksson (2007) that capital deepening was responsible for more than half of the growth rate of labour productivity in many countries may not generally apply to LDCs. As a summary measure, the PCI comprehensively incorporates the contributions of productive factors (e.g. labour, capital, technology and institutions), and other factors expanding the productivity of a country. The PCI analysis therefore provides better policy inferences relevant to the LDCs than the factor decomposition based on selected factors.

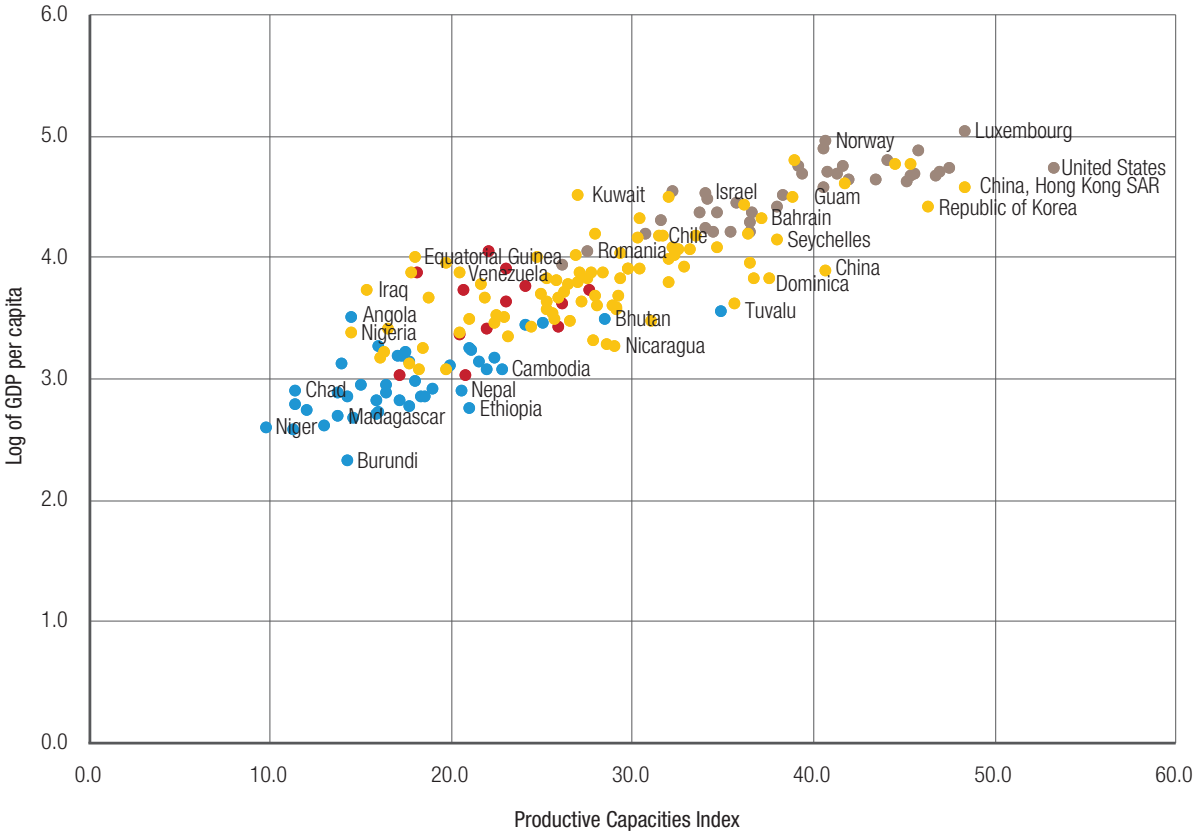
Benchmarking using PCI and other dimensions can help explain the differences among LDCs and between LDCs and other country groups. The PCI values do not reveal anything about past policies or systematic sources of vulnerability of the LDCs, but do show the extent to which countries have developed compared to others. The bottom 50 per cent of the LDCs added to their productive capacities faster than the lower half of the other country groups over the same period (Table 3.2). The LDCs posted major improvements in productive capacities related to ICT, transport infrastructure and structural change categories although, in absolute terms, their values in 2011 and 2018 on the bounded PCI scale (0.100) are too low compared to the scores of other country groups. Except for natural resources, LDCs lag behind ODCs in all PCI categories, and even more so in ICT, human capital and institutions. There are also significant differences among countries with respect to energy, private sector and structural change.

Other methods exist for estimating the efficiency of productive capacity utilization; these seek to extend the standard methods that end with the appraisal of resource endowments, policy and institutional differences, and the innate and structural characteristics that set countries apart.[3] The stochastic frontier discussed in section C estimates the efficiency of capacity utilization; however, it is sufficient to note that for benchmarking purposes countries with low productive capacities – mainly LDCs – are at the bottom of the economic

[3] The approach being described here belongs to a class of data-oriented method of estimating the relative efficiency of entities or decision-making units. The technical term for the assessment is data envelopment analysis, and it includes both non-parametric and parametric methods.

Figure 3.3

Economic development (per capita income) and Productive Capacities Index, 2018



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May 2020].

development frontier, while ODCs are in the middle or catching up to the level of the developed economies (Figure 3.3).

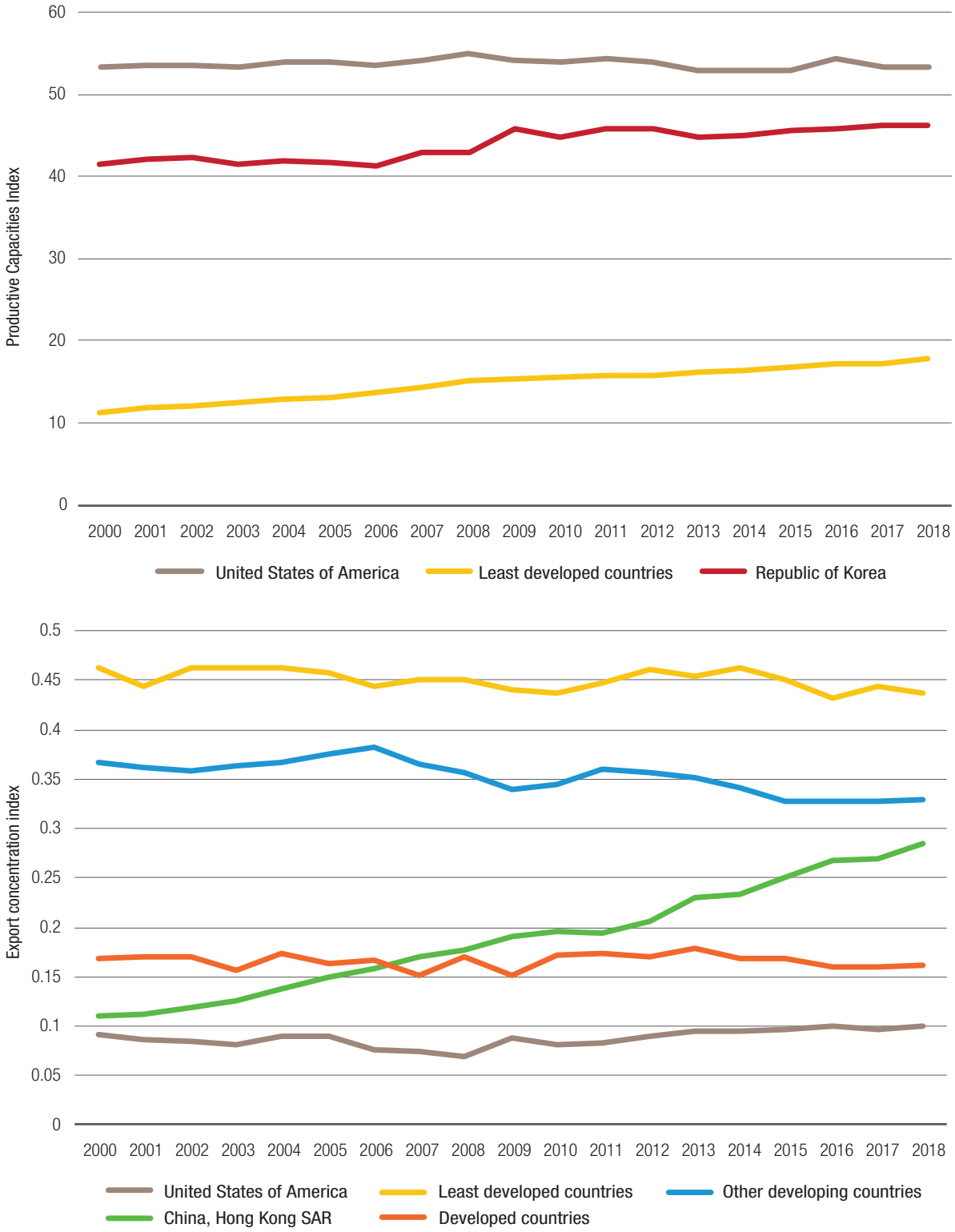
The static picture shows how some LDCs (Angola, Bangladesh, Bhutan, Cambodia, Kiribati, Lao People's Democratic Republic, Lesotho, Solomon Islands, Timor-Leste and Tuvalu) are at the same level of development as ODCs. However, most LDCs are trapped in the low productive capacities cluster and appear to have no path out of this category. In 2018, the PCI of the top two developed countries ranged from 48 (LUX) to 53 (USA), except that LUX had a higher per capita income than the USA (Figure 3.4). The top LDCs scored between 28 and 35 on the PCI scale, and as a group, its exports remain highly concentrated, with the concentration index averaging between 0.43 and 0.45 in 2000–2018, while developed countries and ODCs averaged between 0.17 and 0.35, respectively.

Although the rankings by PCI scores show significant challenges among LDCs, the PCI scores of several LDCs (e.g. Bhutan, Myanmar, Rwanda and Tuvalu) show that with consistency, LDCs can breach the productive capacity of other country groups. A combination of other factors, including population size, geographical location and strategic linkages, play a favourable role for some economies. For example, Bhutan has very small population, comparable to that of Luxembourg, while China, Hong Kong Special Administrative Region and the Republic of Korea are quite populous. The strategic location of China, Hong Kong Special Administrative Region by the South China sea gives it a geographical advantage over the landlocked Asian LDCs, e.g. Bhutan and Nepal. In gravity theoretic terms[4], the pull factors of good regional neighbours in trade plays against most LDCs; for the Asian LDCs their proximity to more advanced economies have helped them, despite having lower factor endowments. The complementary trade structures of the subregion provide incentives for inter-industry trade to flourish among close neighbours. Kabir and Salim (2010) also found a negative elasticity of

[4] The traditional gravity theory of trade suggests that trade between countries is driven by geographic distance between them, relative economic sizes, similarities in consumer preferences, and cultural or historical linkages.

Figure 3.4

PCI of selected economies by income group and LDC average, 2000–2018



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May 2020].

distance in the gravity analysis of the trading pattern of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, which may prove the value of having a good neighbour among Asian LDCs. This further highlights the importance of developing a diversified regional economy, with

strong regional value chains among the contiguous countries, including among neighbouring LDCs. The discussion on what LDCs need to do to catch up with other developing countries is presented in sections C and D.

C. Assessing the progress of LDCs towards IPoA goals

UNCTAD has provided an assessment on the progress made by LDCs in meeting the IPoA objectives over several years (UNCTAD, 2017b and 2019c). This chapter presents the first occasion to extensively assess productive capacities, including their impacts on progress in other thematic IPoA priorities. The argument is that productive capacities are critical building blocks for the structural transformation, value addition and socioeconomic development of these countries. Moreover, since graduation from the LDC category is a key goal of all ISMs specific to LDCs, this section draws on insights on how other countries are performing and how well they are moving towards the overall goal of graduation. It also examines whether LDCs scheduled to graduate have accumulated enough basis to sustain the necessary momentum to nurture and generate lasting structural transformation.

1. GDP growth target and productive capacities

Robust GDP growth was considered critical to achieving the overarching goal of the IPoA. However, the target of at least 7 per cent GDP growth per annum has been elusive. Only 13 LDCs have ever attained the 7 per cent growth target during 2015–2018, and a smaller number still have managed to maintain the pace in successive years. Since 2011, GDP growth among developing countries slowed, and overall, the LDC growth trend was negative (Figure 3.5). The extent of the fallout from the recent COVID-19 pandemic is uncertain as the situation is still evolving. However, what emerged as a public health crisis has exposed the weak structures of LDC economies, their vulnerability to economic shocks, as well as their inability to mobilize productive capacities to adapt to changing market conditions.

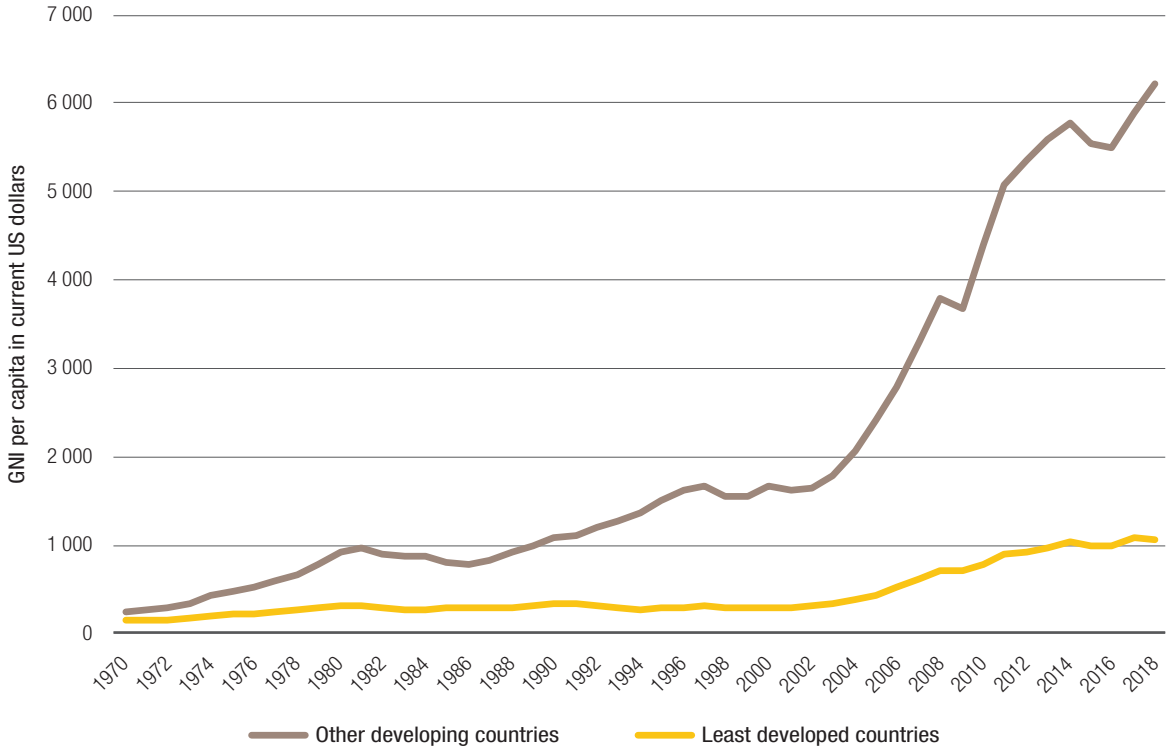
Although LDCs made substantial progress in narrowing the GDP growth performance gap to ODCs, the LDCs as a group need to accelerate their growth to close the income gap with ODCs. In GDP growth terms, the

Figure 3.5
GDP growth rates for developing economies

Source: UNCTAD secretariat calculations based on data from UNCTAD, UNCTADStat [accessed April 2020].

Figure 3.6

GNI per capita gap of least developed countries in comparison to other developing countries, average in current US dollars



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed April 2020].

LDCs have narrowed the gap to within 1–2 percentage points, but in absolute terms the income gap measured in GNI per capita has widened (Figure 3.6). Actual growth rates tend to exaggerate the cyclical positions of countries (Scarpetta et al., 2000), and for small economies, market idiosyncrasies affecting cyclical and trend growth may cause policy paralysis. The GDP growth rate trend for LDCs is similar to that of ODCs (Figure 3.7); however, differences in relative economic sizes show that LDCs have been drifting further from ODCs and clearly highlight the need to track trend growth disparities and the policy variables that can shift it. It was evident at the beginning of the 1970s that LDCs were lagging ODCs, but the speed with which the gap grew in 2000–2018 is unprecedented. Both sets of countries almost quadrupled their average GNI per capita incomes, with LDCs edging slightly over $1000, while ODCs exceeded $6000 (Figure 3.6). If LDCs are to catch up to ODCs, they will have to keep "running while others walk" (Mkandawire, 2011).

a. Productive capacity utilization and efficiency

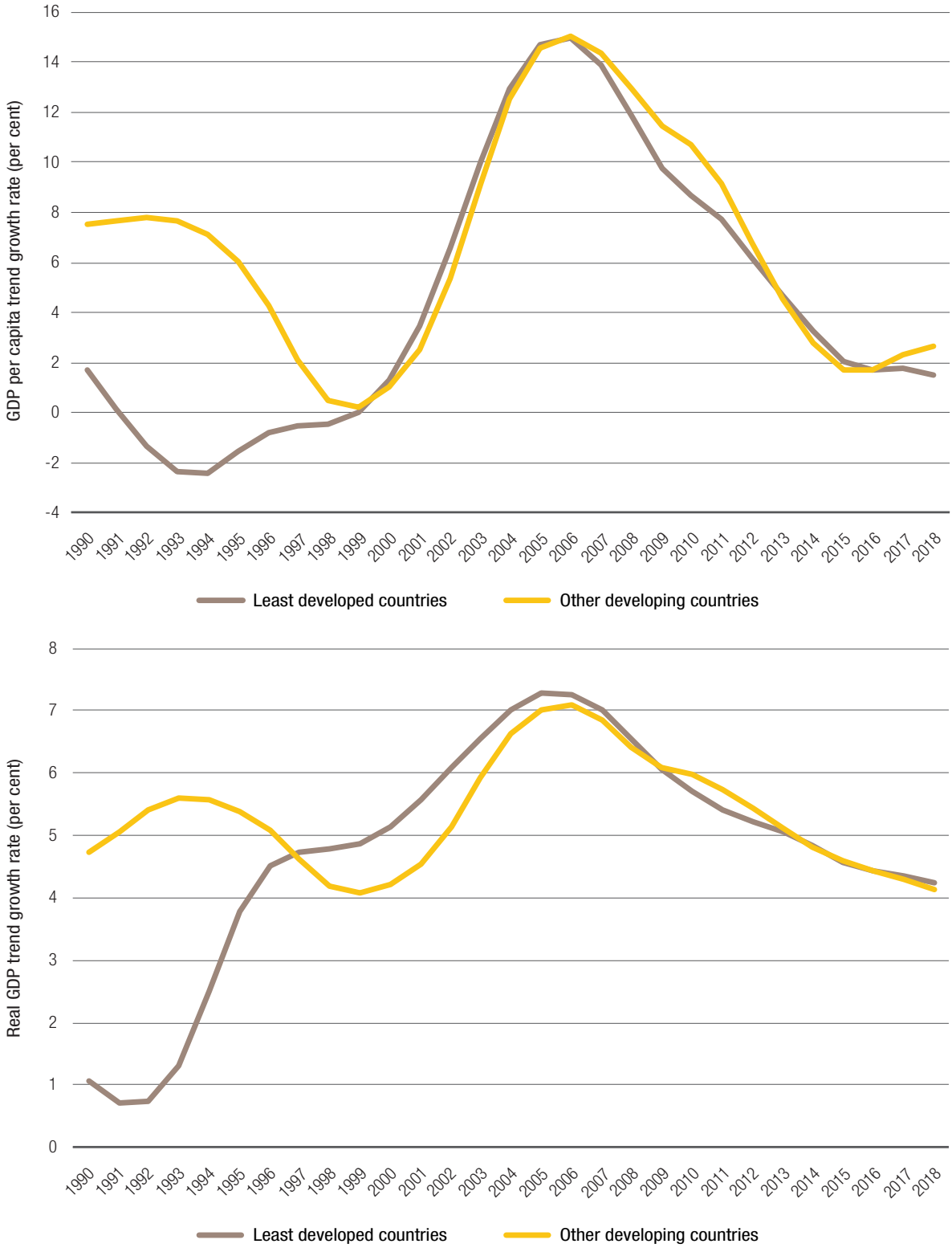
Cyclical noise aside, structural factors, including demographic changes, labour productivity differences and the state of technology, all play a critical role in explaining the growth potential of countries (Scarpetta et al., 2000). Per capita income is a suitable proxy for economic development as it takes demographics factors and an economy's size into account (Kopf, 2018). As explained in section B, the rising disparities in per capita GDP growth among the LDCs on the one hand, and between LDCs and other country groups on the other, is partly due to efficiency differences in the utilization of productive capacities.

The weight of, and changes to, the mix of productive resources, entrepreneurial capabilities and production linkages collectively determine the efficiency of a country to produce goods and services and enable it to make progress. The productive capacities, whether aggregated or clustered in their eight categories, imply an unobservable maximum level of output, $f(PCI) = Y(\text{potential GDP, total or per capita})$, that a country can produce. The observed output may be sub-optimal if it is less than the potential output, or just right if the country efficiently utilizes its capacity, $y \leq Y = f(PCI)$.

A level of productive capacity may be associated with numerous output levels as countries differ in their utilization of productive capacities. A stochastic

Figure 3.7

Hodrick-Prescott filter trend growth rates of GDP per capita and real GDP[5]



Source: UNCTAD secretariat calculation, based on data from UNCTAD, UNCTADStat database [accessed April 2020].

[5] The Hodrick-Prescott (HP) filter is a data smoothing technique used to decompose a time series into trend and cyclical components. In macroeconomics, the technique is used to isolate the impact of short-term fluctuations associated with a business cycle (de Jong and Sakarya, 2015).

Box 3.1 **Stochastic frontier analysis at a glance**

Stochastic frontier analysis is an extension of production analysis. It has its foundations in the analysis of production, cost and profit functions at firm level or the sector (Kumbhakar and Lovell, 2000; Kumbhakar et al., 2015). Given its microeconomic functions, the production frontier at the macroeconomic level represents the maximum output that can be produced from various input combinations (Kumbhakar et al., 2015).

$$y_{it} = f(X_{it},\beta)e^{\varepsilon_{it}} \leq Y_{it}$$

Where y_{it} is the actual output of country i at time t as above, X_{it} is a vector of the eight categories of productive capacities, Y_i is the potential output, representing the maximum possible output that can be produced given the productive capacities level, and the error term $e^{\varepsilon_{it}} \equiv v_{it} + u_{it}$. It is assumed that the first part of the error term, v_{it} are symmetric identically independently distributed, representing a random distribution of output with zero mean and variance, σ_x whereas the second part, u_{it} have a truncated normal distribution. The stochastic frontier can accommodate both technical and time-varying technical inefficiencies, under various assumptions about the technical inefficiency relationship with the explanatory variables (Battese and Coelli, 1995).

The efficiency measure is given by the ratio of actual output to the potential output:

$$\frac{\text{Actual output}}{\text{Potential output}} = \frac{y_{it}}{Y_{it}} = \frac{f(X_{it},\beta)e^{\varepsilon_{it}}}{Y_{it}}$$

It follows that the efficiency values ranges from 0 to 1, with 1 being the most efficient. For recent discussions on the method, see Kumbhakar and Tsionas (2011).

frontier model accounts for these differences by imposing the same production technology (functional form) across all countries and decomposes the deviations from the frontier into inefficiency and noise components (see Box 3.1) (Wijeweera et al., 2010; Kumbhakar and Lovell, 2000; Kumbhakar et al., 2015).

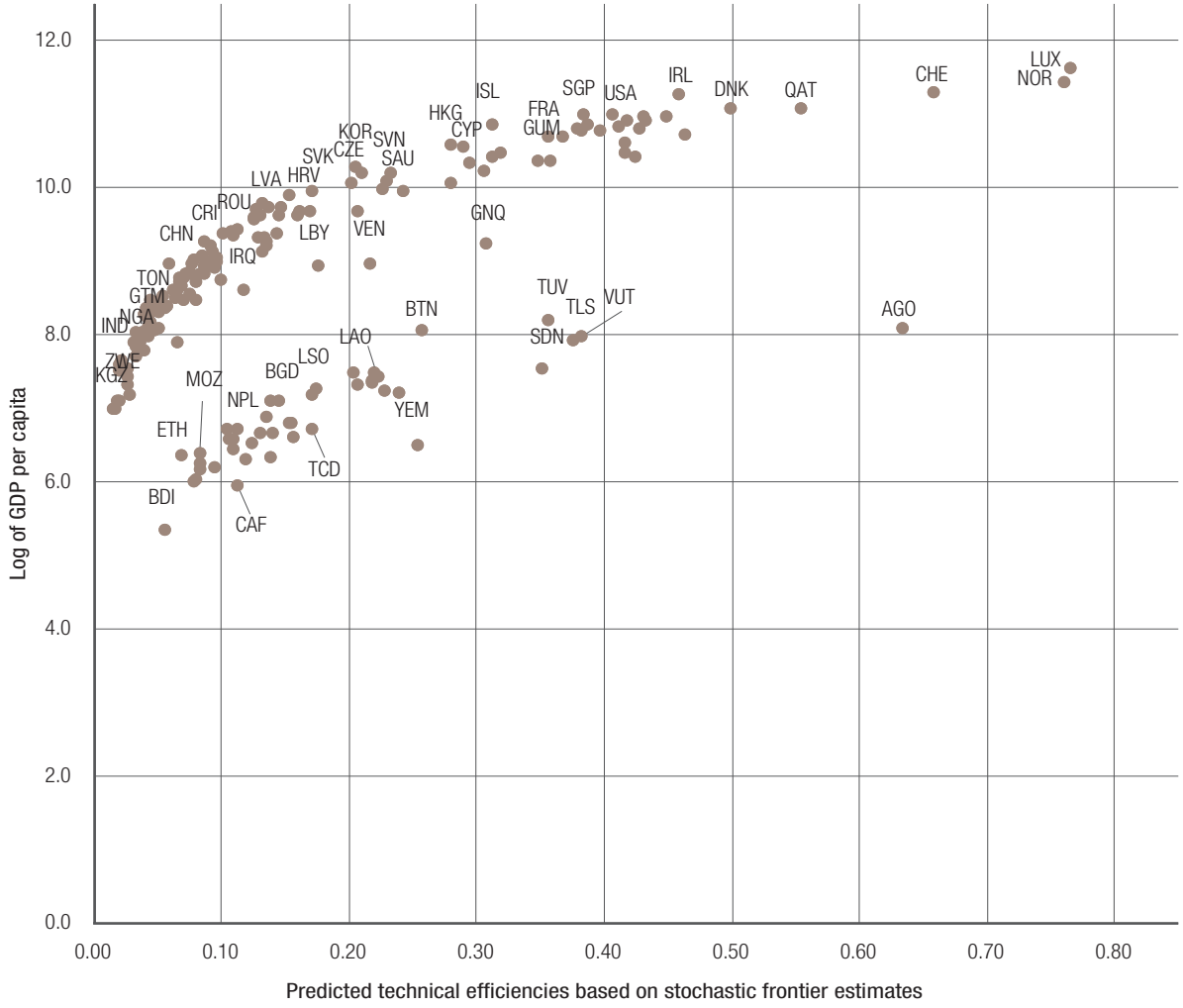
A drawback to comparing LDCs with other country groups using data envelopment approaches is the fact that efficiencies are calibrated against the best performer included in the sample, and could be influenced by external factors which are not in the model (Erkoc, 2012). As a solution, the stochastic frontier model from which the results of the analysis in this chapter draws includes a specific dummy for LDCs. Moreover, since the objective of the analysis is to inform development policy of LDCs and comparing the progress of LDCs with other country groups, it would be uninstructive to estimate the productive frontier of only the LDCs. It is also possible to make two adjustments to the pooled panel data stochastic frontier. As previously proposed, adding a dummy for LDCs takes into account heterogeneity among countries, assuming that inefficiency is time-variant and that it persists at country level. Alternatively, two separate frontier models, one for LDCs alone and the other including ODCs can be estimated and checked for consistency against the pooled sample. For examples of these methods, see Guo et al. (2018) and Kumbhakar and Tsionas (2011).

As expected, the edge of the production frontier is filled by developed countries and other developing countries, with LDCs falling within the frontier (Figure 3.8). Angola, Tuvalu, Vanuatu and Sudan stand out as the most efficient in utilizing their productive capacities, but it must be noted that this relates to output measured by per capita income (Figure 3.9).[6] Although there is a positive relationship between productive capacities and per capita income, the marginal gain in per capita income from a unit increase in efficiency of utilization of productive capacity diminishes rapidly for LDCs compared to other country groups. This is because the sources of per capita income growth among LDCs are associated with an inconsistent performance in certain productive capacity categories; for example, they are stronger in the natural resources productive capacity category, but the utilization of that capacity is either weak or beset with vulnerabilities. The negative partial elasticity of natural resources on per capita income implies that an accumulation of natural resources wealth adds to GDP per capita at a decreasing rate (Table 3.3). The same is true for human capital and structural change, both of which return negative coefficients in the pooled estimation sample. LDCs have struggled to develop their human capital, leading to a weak performance on the variables in the human capital subindex, including years of schooling and health-adjusted life expectancy (HALE). On structural change, the elements in the subindex includes industrial ratio, which in some countries has been pushed up by an increasing

[6] Island LDCs appear as outliers in most of the results due to the usual measurement scale problem. Their small population sizes imply that they score better than other LDCs in productive capacity categories for which per capita variables are used. They also perform better in institutions and human capital, hence any comparison to other country groups should take these qualifications into consideration.

Figure 3.8

Stochastic production frontier 2018



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May, 2020].

share of services rather than industrial growth.[7] Other elements, e.g. gross fixed capital formation and export concentration, have registered positive advances for the LDCs but not as significantly compared to other country groups included in the pooled sample. Of note also is the high negative impact of LDC dummy that confirms the divergence of income per capita between LDCs and other country groups.

The low efficiency in productive capacities utilization cannot be generalized across all LDCs. Per capita incomes grew significantly in several countries (e.g. Bhutan, Sudan and Tuvalu) between 2011–2018. However, other countries (e.g. Angola, Timor-Leste and Yemen) suffered setbacks in per capital incomes, despite making small gains in capacity utilization (Figure 3.9). The security situation in Yemen makes it a special case but the low per capita income reflects the impact of the conflict on the economy and people. For Angola, Bhutan, Sudan, Timor-Leste, Tuvalu and Vanuatu, the return on productive capacity utilization depends on natural resources that are extremely vulnerable to global economic shocks, natural disasters and environmental shocks.

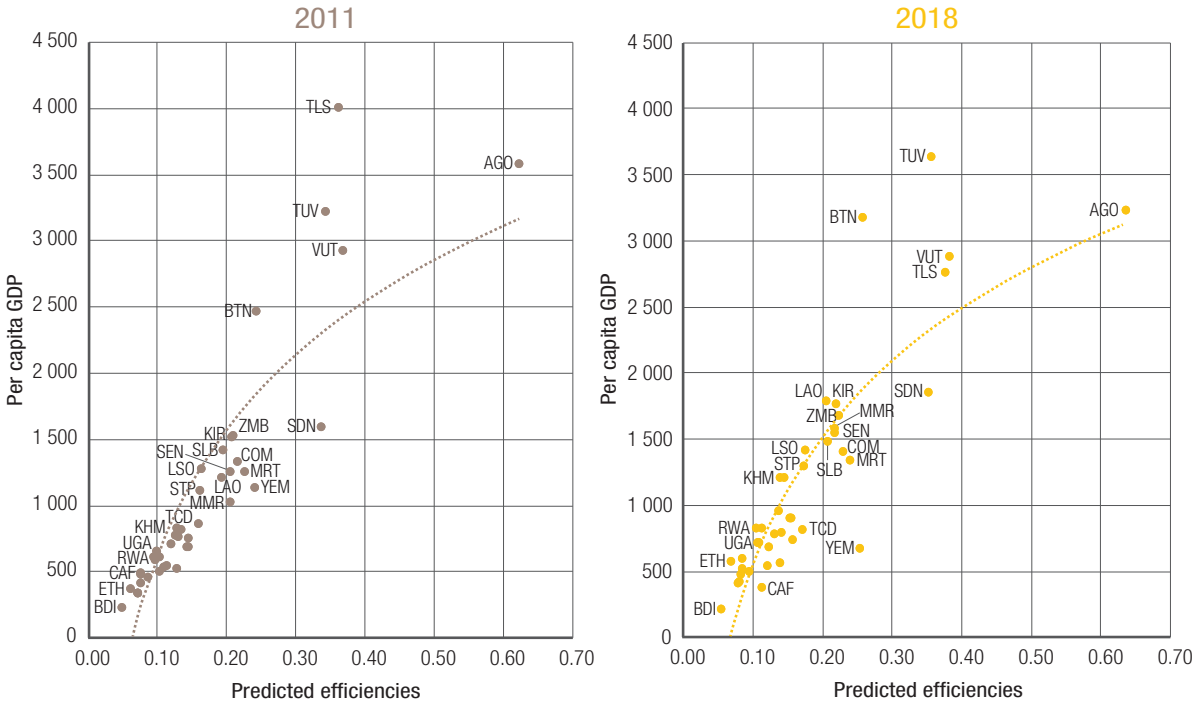
b. Marginal impacts of the individual productive capacities, as per IPoA

The IPoA identifies infrastructure, energy, science, technology and innovation (STI) and private sector development as the critical productive capacities. The stochastic frontier estimates are consistent with previous UNCTAD findings that show that economic development is positively affected by infrastructure development, and that the level of industrial energy use is associated with a country's income level and stages

[7] The industrial ratio is calculated as the ratio of industry and services value added over total GDP, See the Annex for more details.

Figure 3.9

Marginal change in per capita income, per unit of productive capacity utilization



Source: UNCTAD secretariat calculations based on UNCTAD, UNCTADStat database [accessed May, 2020].

of development of a country. The stochastic frontier results suggest that a 1 per cent increase in energy infrastructure leads to only a 0.12 per cent increase in per capita income (Table 3.3). It will take a substantial boost in energy infrastructure to raise per capita GDP in LDCs: "the minimum level of electricity generation needed for productive use would mean an increase by a factor of between 3.4 and 6.8" (UNCTAD, 2017a).

Table 3.3

Partial elasticities of GDP per capita to productive capacity components based on the stochastic frontier estimates

Factor/productive capacity category	Elasticity of GDP per capita to factor change
Energy	0.120*
Human capital	-0.016
ICT	0.013*
Institutions	0.139*
Natural resources	-0.004
Private sector	0.030**
Structural change	-0.037*
Transport infrastructure	0.001*
LDC dummy	-0.051*

Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May, 2020].
Note: * significant at 5 per cent; ** significant at 10 per cent.

The confirmed positive roles of institutions, the private sector, ICT and transport infrastructure are also familiar; the negative impact of structural change may, however, not be so obvious. Structural change is a lengthy process and occurs at a pace determined by factors such as: (i) the growth dynamics in the economy; (ii) discoveries of new technology or natural resources; (iii) innovation and learning; and (iv) market forces (Islam and Iversen, 2018). As explained in Chapter 1, the sectors that have benefited the most from the structural shift in production in LDCs are not the sort of economic activities that would leverage growth. These activities include service sectors characterized by low wages, self-employment rather than job creation, high informality and income volatility (Bah, 2011). The blending of unproductive agricultural sector offering large numbers of employment opportunities, and an uncompetitive services sector with low productivity, high levels of informality and weak integration into global value chains, all contribute to reducing the impact of structural change on real GDP per capita (UNCTAD, 2018a).

2. Agriculture, food security and rural development

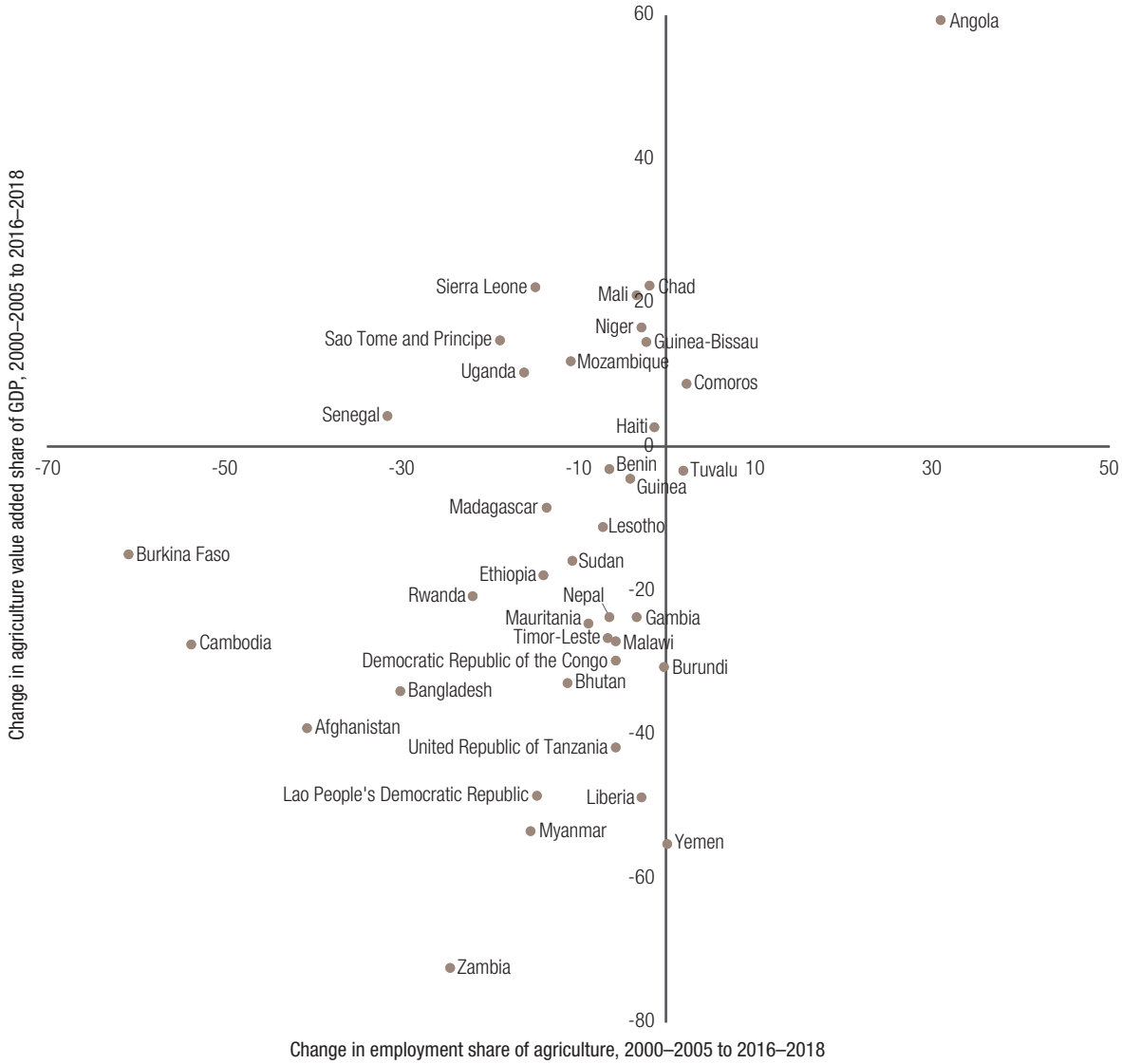
Agriculture plays a vital role in developing countries and provides one of the main opportunities for

gainful employment and is one of the key sectors supplying essential food and raw materials to domestic and international markets. As a traditional sector, agriculture offers a livelihood to millions of people who would otherwise be unemployed. A rise in agricultural production shields people from hunger and poverty but during 2000–2019 low productivity and investment and other structural challenges have reduced the sector's contribution to economic growth. The role of agriculture in promoting structural change and productive capacities of LDCs are discussed in chapter 4. This section reviews the progress of LDCs on specific agriculture targets in the IPoA, namely progress towards eradicating hunger by 2020 and other indicators of structural change in the agricultural sector.

Agriculture is a priority because of the concentration of populations in rural areas, and the centrality of agriculture as a dominant employment sector in many LDCs (UNCTAD, 2015a). In 2011, the majority of the LDC labour force were employed in agriculture (58.8 per cent), and the situation has remained virtually unchanged with 56.1 per cent of the labour force still active in the same sector. A sharp divergence between the share of employment and value-added by agriculture flags rising inequality and poverty. For example, Liberia and Burundi have seen a sharp decline in the agriculture value-added share in GDP but without a corresponding fall in employment (Figure 3.10). A few countries, such as Sierra Leone and Chad, increased value-added from agriculture as employment shares receded. For example, Chad's

Figure 3.10

Change in employment and agriculture value added, per cent: 2000–2008



Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators database [accessed April, 2020].

agriculture value-added rose from 38 per cent in 2000–2005 to 47 per cent in 2016–2018 but employment only dropped marginally from 83 to 82 per cent of the total.

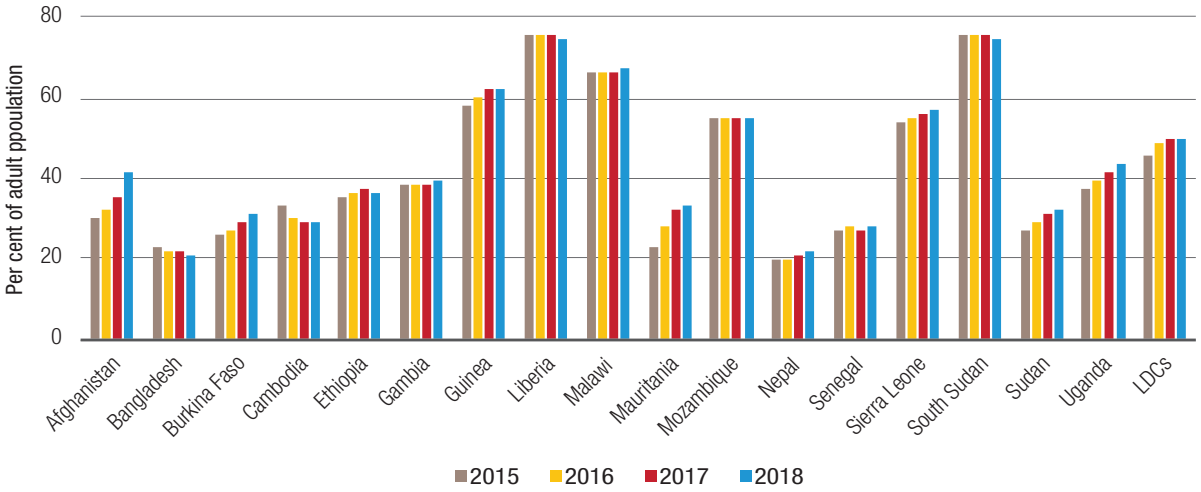
There has also been a growing disconnect between agriculture and food security, with some of the countries employing the largest proportion of the labour force in agriculture also appearing among the food insecure. FAO estimates that the global number of those that are food insecure is 2 billion. In LDCs, the number of chronically hungry people rose from 194.7 million to 225 million in 2014–2018 (FAO et al., 2019). UNCTAD estimates show that there has been a spike in chronically hungry people in Bangladesh, Malawi, Mozambique, Niger and the United Republic of Tanzania. The situation is extremely critical in countries where the number of severely food insecure is above two-fifths of the population, for example, Guinea, Lao People's Democratic Republic, Lesotho, Liberia, Malawi, Mozambique and Sierra Leone (Figure 3.11).

The centrality of agriculture in LDCs suggests that agricultural transformation may be the quickest path to poverty eradication and inclusive development. However, if the sector is to effectively reduce poverty, labour productivity in agriculture has to be raised considerably, as well as to a level which can generate an income above the poverty line, taking into consideration the high concentration of subsistence livelihoods in the sector (UNCTAD, 2015a). LDCs should not simply aim for food sufficiency and increase the production of agricultural commodities but should instead aim to achieve surpluses from which to earn re-investible returns. Burkina Faso and Bangladesh were able to change the structure of employment from one predominantly based on agriculture in 2000 to a more diversified labour force in 2019, without a net loss in the contribution of agriculture to GDP. Generally, an increase in labour productivity would lead to a change in the structure of labour employment over time, as labour shifts from more productive sectors to others. The concern with the instability of agricultural incomes through trade would become a secondary issue to building export capacity through productive labour and competitive agriculture. Only Liberia, Nepal and Lao People's Democratic Republic have substantially increased their value-added per worker during 2011–2017 compared to the previous decade, while the positions of Comoros and Kiribati are subject to the previously stated qualification about Island LDCs (Figure 3.12).

The widening agricultural productivity gap between LDCs and ODCs is consistent with the slow growth of investment in the agriculture sector, as well as a gradual shift in economic structure to high-value manufacturing and services sectors, which are typically labour saving in character. Investment in agriculture remained unchanged in many LDCs in 2001–2016. In Comoros, the relative share of investment in agriculture doubled with no visible gains in value-added, while investment dropped drastically in several other countries, as in the case of Ethiopia, Myanmar, Sudan and Niger (Figure 3.13). Several factors are responsible for this, including: (i) long-standing government neglect of the sector;

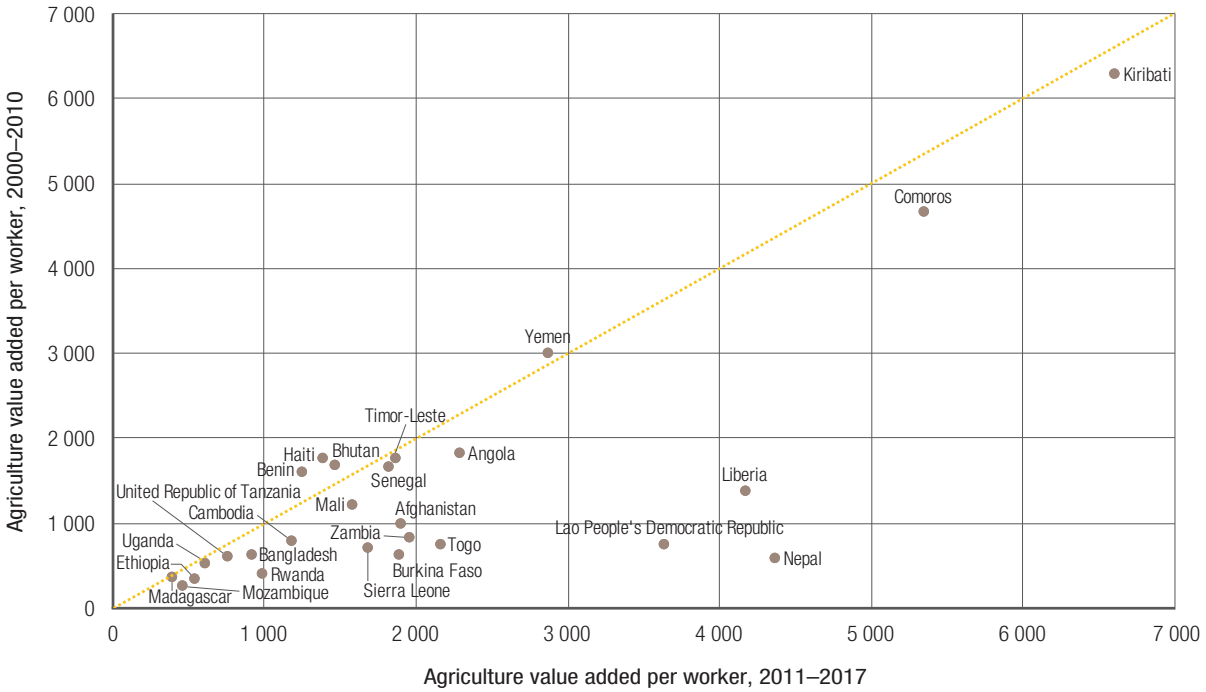
Figure 3.11

Prevalence of moderate or severe food insecurity in the adult population, 2015–2018



Source: UNCTAD secretariat calculations based on data from United Nations, Global SDG Indicators Database.
Note: Data missing for countries not included in the chart. LDC average is as provided by source.

Figure 3.12
Agriculture value added per worker in dollars, at 2010 prices



Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators database [accessed April 2020].

(ii) low investment by both the public and the private sectors; and (iii) low growth of land productivity (yields) and failure by the LDCs to improve labour productivity to the level comparable to ODCs. Global food supply chains have also become more capital intensive and concentrated, which contributes to inequality in food supply systems. As discussed in chapter 4, agricultural production boomed owing to green revolution technologies but a significant portion of the growth is due to extensification, i.e. the use of more natural resources (water, land), rather than intensification (Nkamleu, 2011; FAO, 2017).

The rise in food imports also implies a crucial role of income in the development of agriculture in the LDCs. The low productivity of agriculture in LDCs, as well as the changing pattern of food consumption expose the countries to large food import bills. According to UNCTADStat, in 2018 total LDC imports stood at $270 billion, $47 billion (17 per cent) of which was for food. However, the bigger LDCs, such as Bangladesh (15 per cent), Democratic Republic of the Congo and Ethiopia (9 per cent, respectively), also spend quite a lot on food imports. These are lost opportunities for LDCs that could benefit from close cooperation in trade, including agricultural commodities. Urbanization and income effects on food consumption patterns may also play a role in changing the structure of food production and trade among LDCs, as it is projected that by 2030 about 60 per cent of the population in developed countries will be based in urban areas (Cohen, 2006).

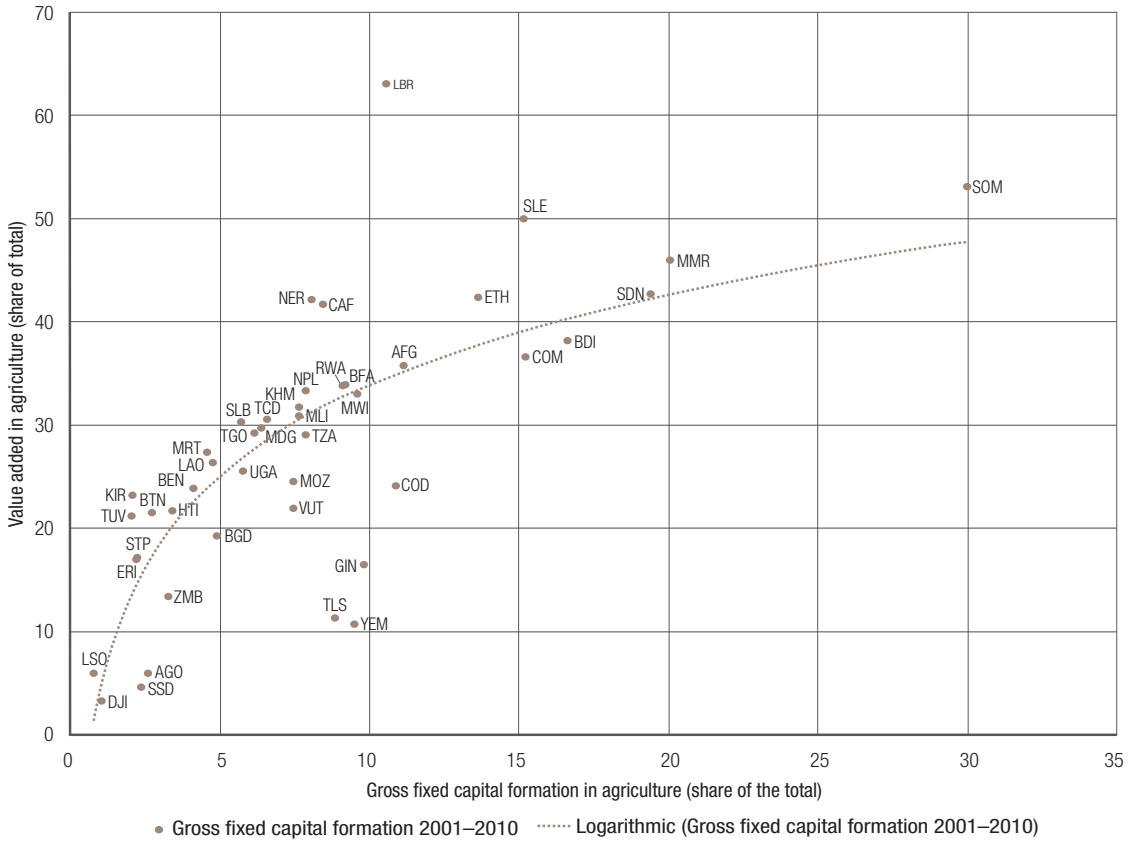
3. Trade and commodities

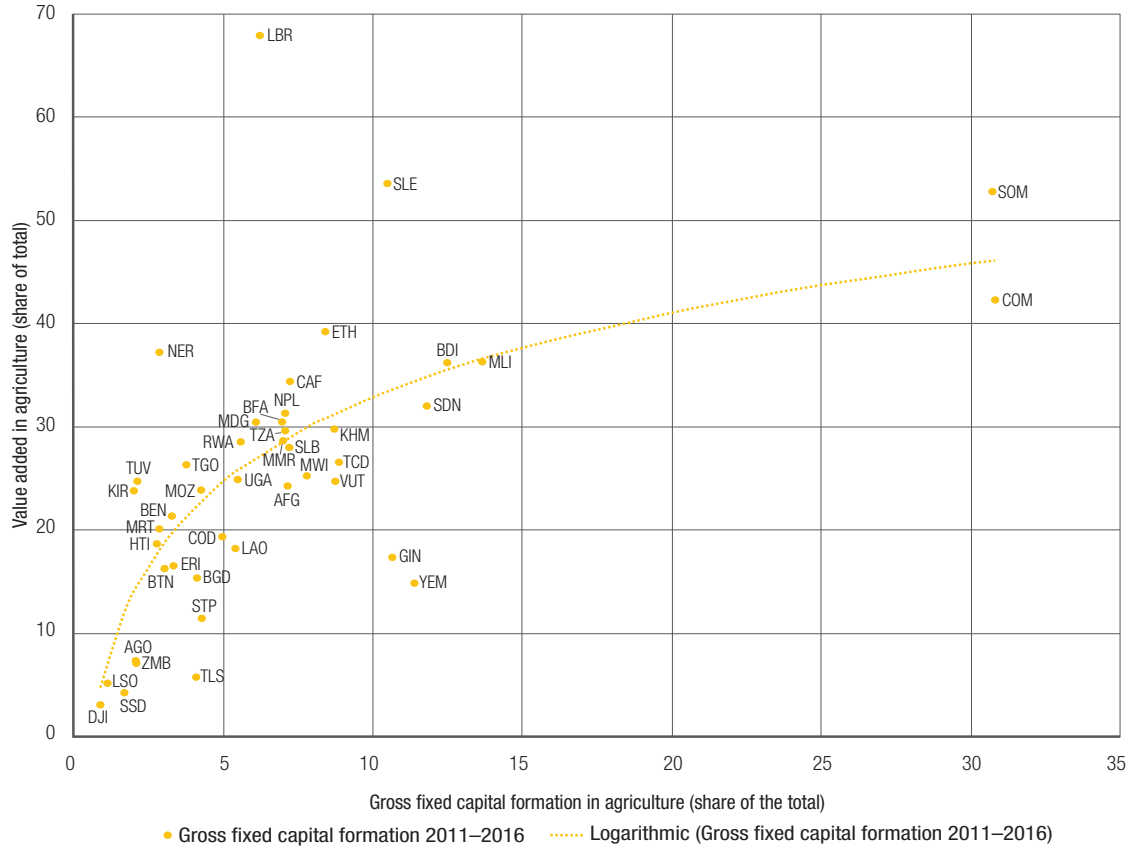
Trade and commodities are separate thematic priorities under the IPoA. However, due to their interrelatedness, the two are jointly discussed in this section. Despite duty-free quota-free market access for products originating in LDCs, their participation in world trade has not improved during the IPoA. The long-standing marginalization of LDCs in international trade has persisted as the commodities trade faltered under unfavourable commodity market conditions (UNCTAD, 2018b). Overall, the target of doubling the share of global exports from LDCs has failed to materialize. Instead, the LDC share in world merchandise exports deteriorated in five consecutive years to as low as 0.89 per cent in 2015 before recovering slightly to 0.98 per cent in 2018 (Figure 3.14).

World merchandise exports increased from $18 trillion in 2011 to $19 trillion in 2019, while those of LDCs also increased from $189 billion in 2011 to $192 billion in 2018 but faltered to $181 billion in 2019. There were notable declines in merchandise exports in 2015–2016, reflecting weak global demand, low

Figure 3.13

Gross fixed capital investment and value added in agriculture



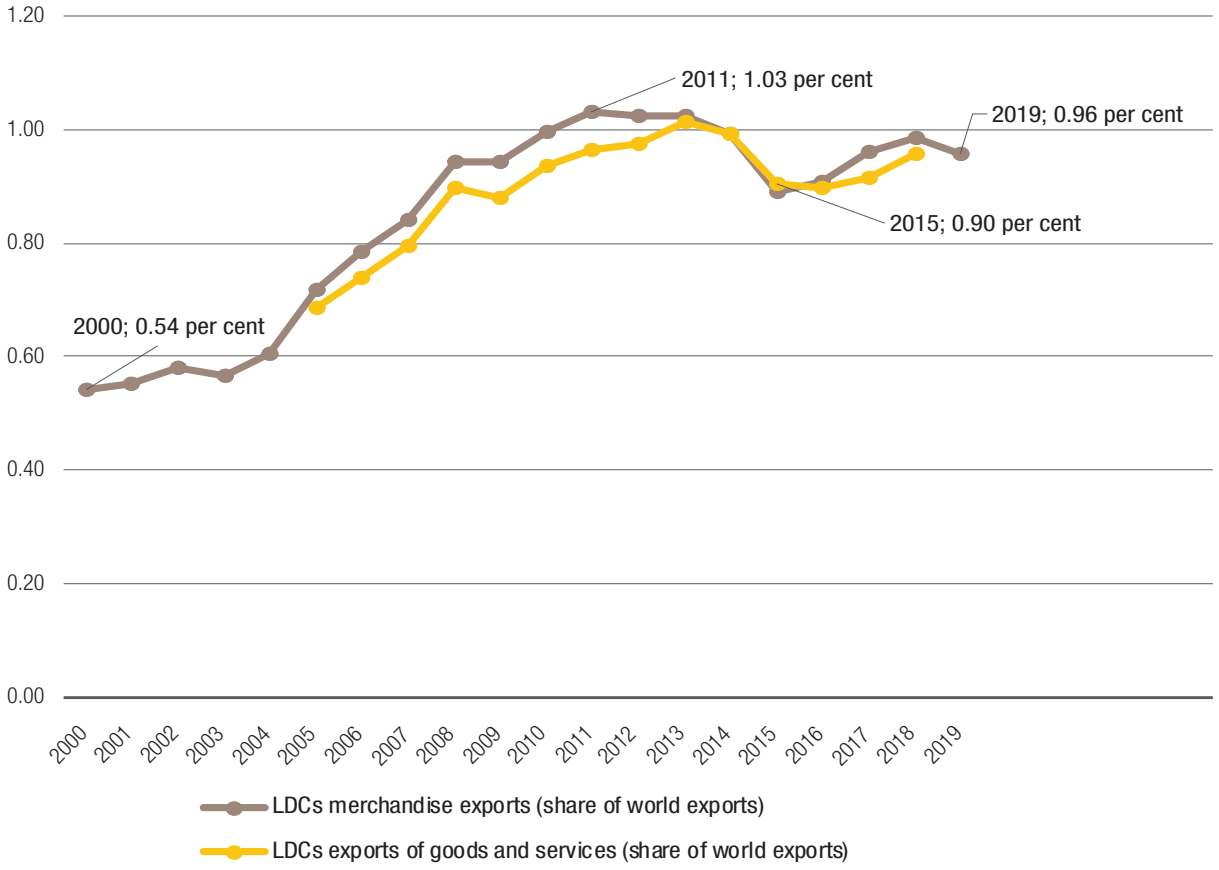


Source: UNCTAD secretariat calculations based on FAOSTAT [accessed April, 2020].

Figure 3.14

LDC exports as a share of world exports

(Per cent)



Source: UNCTAD secretariat calculations based on UNCTAD, UNCTADStat database [accessed April, 2020].

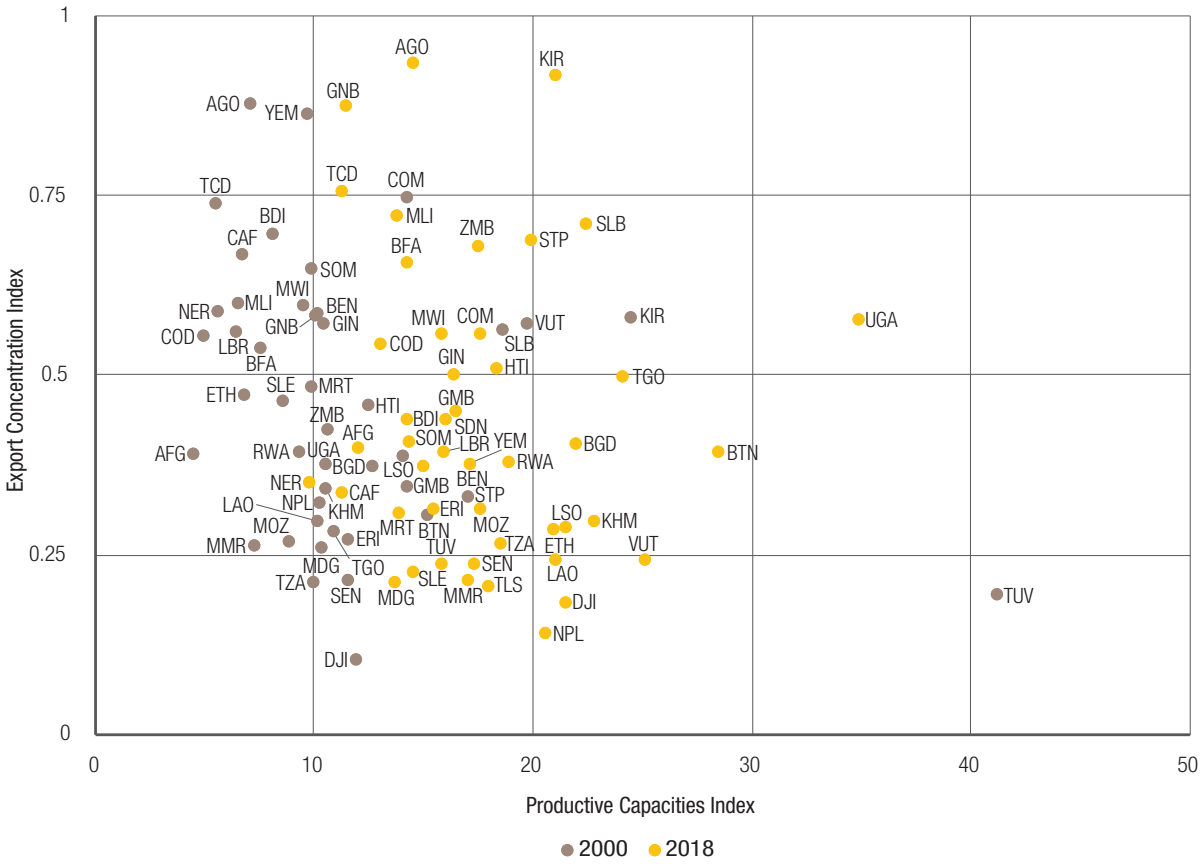
commodity prices, dollar appreciation and production constraints (UNCTAD, 2016a). LDC exports continued to be dominated by a few countries, with the top 5 exporters (Angola, Bangladesh, Myanmar, Cambodia and Zambia) accounting for 62 per cent of all merchandise exports from LDCs in 2019.

Relative cost advantages and geographical advantages offering better linkages to global value chains have continued to play a critical role in boosting exports, particularly among Asian LDCs; African LDCs have for their part relied more heavily on their abundant natural resources. Structuralists, particularly those that view the market as the only determinant of trade, will point to the value differences in total factor productivity and other efficiency measures that affect the relative production costs. These Ricardian comparative advantages typically do not favour LDCs, except for labour-intensive sectors (agriculture and other non-extractive natural resources). Product varieties and dynamic export growth may foster an economy's capacity to trade and, if accompanied by buoyant growth, an economy may experience trade-led structural change over time (Gagnon, 2007).

What constitutes a structural change in the context of trade capacities is not a trivial matter, considering that not all commodities (sectors) are tradeable, and that sectoral composition based on GDP leaves out information about capacity utilization and productivity at the lowest level of aggregation. For example, it may not be immediately clear that higher productive capacities are associated with a lower product concentration of exports, except that most countries with PCIs between 15 and 30 have an export concentration of less than 0.5 (Figure 3.15). The product concentration index shows the extent to which the exports and imports of individual economies, or groups of economies, are dominated by a few products rather than being distributed among several products. The few LDCs with higher product concentrations in the 15–30 range of productive capacities are commodity-dependent

Figure 3.15

LDC export concentration and Productive Capacities Index, 2000 and 2018



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May 2020].

exporters, including Angola (fuels), Zambia (metals), Malawi (tobacco), Kiribati (fisheries), and Sao Tome and Principe (cocoa). However, Bhutan, Cambodia, Nepal and Sierra Leone, all diversified their exports as their productive capacities increased.

The trade performance of individual LDCs has been variable but manufactured goods exports grew faster than other commodity types (Figure 3.16). An exception to this are Island LDCs that have seen ores and metals exports growing astronomically in 2011–2018, replacing fuels that were their main drivers during 2000–2010. However, the weight of their exports is too low compared to the other LDCs. Fuels have been on a downward spiral since the financial crisis of 2009, and sporadic spikes in fuel prices since then were insufficient to boost exports during 2011–2018. Fuel prices remained weak in 2019 and slipped further in the first quarter of 2020 as the effect of the COVID-19 pandemic on economic activities began to bite.

The concentration of primary commodities and fuels in exports have always been a source of concern for LDCs. With fuel and other commodities facing secular stagnation, the trade balance of LDCs with other country groups has deteriorated, further aggravating the marginalization in international trade that globalization was supposed to cure. Imports of goods and services rose sharply, jumping from $211 billion in 2010 to $338 billion in 2018, and imports accelerated by about $44 billion in 2015–2018 alone.

According to the IPoA, diversification of exports would mitigate the impact of external trade shocks due to the volatility of commodity prices. Specific productive capacities, e.g. better energy and transport infrastructure services, are positively associated with export diversification and overall trade performance. Generally, an increase in the share of manufacturing value-added is directly linked to export diversification, whereas natural resource endowments have the opposite effect through their tendency to trap countries into commodity specialization (Giri et al., 2019). Weaknesses in trade performance are linked to lack of industrial capacity and in some cases, the size of the economy

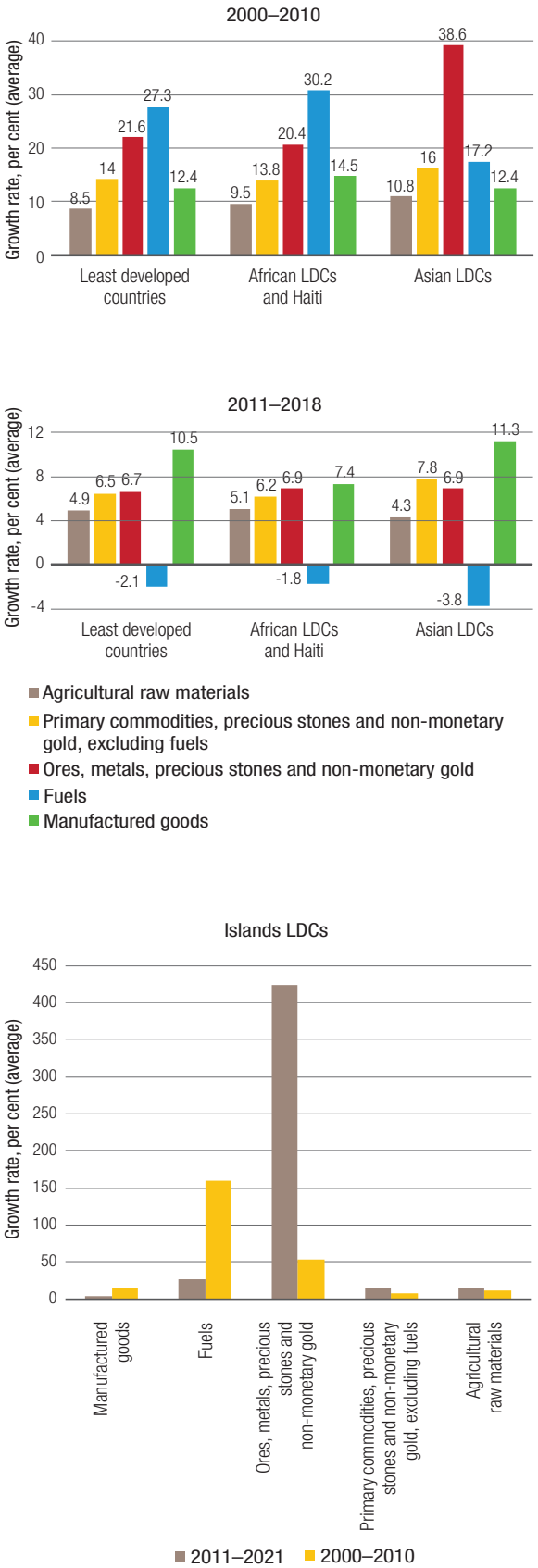
(population) may also positively influence the diversification of exports (Osakwe and Kilolo, 2018). Improving human capital accumulation, institutions, reducing trade barriers and developing better industrial policies could also support export diversification. Giri et al. (2019) identified factors that predispose countries towards lower levels of export diversification but found that the relative influence of the size of an economy is less intensive than an abundance of natural resources.

The clustering of LDCs around various subcomponents of the UNCTAD PCI confirms the existence of specialization enclaves based on productive capacities which determine the level of export diversification and sophistication. Clustering around productive capacities is not a new phenomenon: it is a well-known concept in industrial economics as a process through which sectoral concentration of firms transform entire economies into national, regional or even global players in their value chains (Nadvi and Schmitz, 1994). The process of clustering around productive capacity subcomponents impacts the production and trade structures of countries. For instance, among agricultural commodity exporters, an expansion of transport infrastructure, private sector capacities, institutions, ICT and structural change, could trigger diversification and value addition, as these productive capacities are negatively correlated with agricultural raw material exports (Table 3.4). In itself, the productive capacity potential of natural resources is a deterrent to structural change, while the accumulation of quality labour plays a role in value-added exports growth because human capital is negatively correlated with primary exports (agricultural raw material exports, ores/metals and fuels), but positively correlated with manufactures, high technology and services exports.

Manufacturing and agriculture in LDCs may be negatively affected by industrial policy and infrastructure quality. Efforts to diversify LDC exports should focus on reducing trade costs, which account for a large share of transaction costs. Poor infrastructure prevents LDCs from fully utilizing their productive capacities, and an improvement in the transport sector alone could significantly alter trade specializations. The LDCs exporting manufactures are generally countries that have transformed their export structures over time (UNCTAD, 2015c), with transport connectivity and structural change at the centre of that transformation. In contrast, countries with static trade structures have not developed much capacity in infrastructure and scored poorly in structural change and other productive capacity subcomponents.

Figure 3.16

Commodity export growth rates for LDCs: 2000–2018



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed April 2020].

Table 3.4

Pairwise correlations between components of the productive capacities index and major export commodities

Export type	Natural resources	Energy	Transport	Human capital	Institutions	Private sector	Structural change	ICT
Agricultural raw materials (SITC2 less 22, 27 and 28)	-0.0669**	0.014	-0.1616*	0.0098	-0.1495*	-0.0236	-0.0881*	-0.0817*
All food items (SITC 0+1+22+4)	0.0093	0.1877*	-0.1689*	0.1396*	-0.0721**	0.0654**	0.0525	0.0032
Ores and metals (SITC 27+28+68)	0.3053*	0.0991*	-0.1091*	-0.0584	0.0984*	-0.1293*	0.023	0.0271
Fuels (SITC 3)	0.1623*	0.0395	-0.0745**	-0.1422*	-0.1129*	-0.1572*	-0.1250*	-0.0129
Manufactured goods (SITC 5 to 8 less 667 and 68)	-0.0679**	0.1459*	-0.0196	0.2383*	-0.0257	0.0666**	0.1050*	0.0444
High-skill and technology-intensive manufactures	0.0316	0.1296*	-0.1682*	0.1019*	0.1060*	0.0308	0.1208*	0.0524
Low-skill and technology-intensive manufactures	0.0691**	0.2807*	-0.1145*	0.3405*	0.1369*	0.1193*	0.1299*	0.1296*
Labour-intensive and resource-intensive manufactures	-0.0739**	0.1384*	-0.0103	0.2320*	-0.0339	0.0643**	0.0993*	0.0397
Service exports	-0.134*	0.359*	0.139*	0.263*	-0.107	0.012	0.161*	0.183*
Commercial services exports	-0.121	0.348*	0.108	0.229*	-0.108	0.019	0.140**	0.175*

Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May 2020].
Note: * significant at 5 per cent; ** significant at 10 per cent.

4. Human and social development

The IPoA lists the human and social development priorities as education and training; population and primary health; youth development; shelter; water and sanitation; gender equality and empowerment of women; and social protection. LDCs have made mixed progress on these priorities, with a few positives in some areas but have generally disappointing when considered as a whole. LDCs have a youthful population, which account for close to 60 per cent of the total population. The youth population will increase by 62 per cent over the next three decades, surging from 207 million in 2019 to 336 million in 2050 (UN DESA, 2019). Among the goals of the IPoA is to build on the educational and skills capacity of youth and ensure their full and effective participation in society. Several countries have tailored their social policies to include specific interventions to enable them to reap dividends from their youthful population. However, LDCs faced several challenges in human and social development. For instance, while working-age cohorts are on the rise, not enough jobs are being created to accommodate them and reduce the burden of dependency (Ashford, 2007).

a. Education and training

Progress on education and training was measured through primary school enrolment and completion rates. While primary school enrolment rates are above 90 per cent in some LDCs, many others still have low enrolment rates. The goal of universal primary education with increased quality in outcomes will not be achieved in 2020 and may become harder to attain in the next decade. Of grave concern are countries that have seen an increase in the proportion of dropouts among school-age children, including in Eritrea, Sao Tome and Principe, South Sudan and Sudan (Figure 3.17). In Burkina Faso, Central African Republic, the Democratic Republic of the Congo, Djibouti, Eritrea, the Gambia, Guinea, Mali, Mozambique, Niger, Senegal, South Sudan and Sudan, more than 20 per cent of school-aged children have dropped out of school – setting the dropout threshold at 5 per cent of school-aged children would almost double the number of countries affected by this phenomenon.

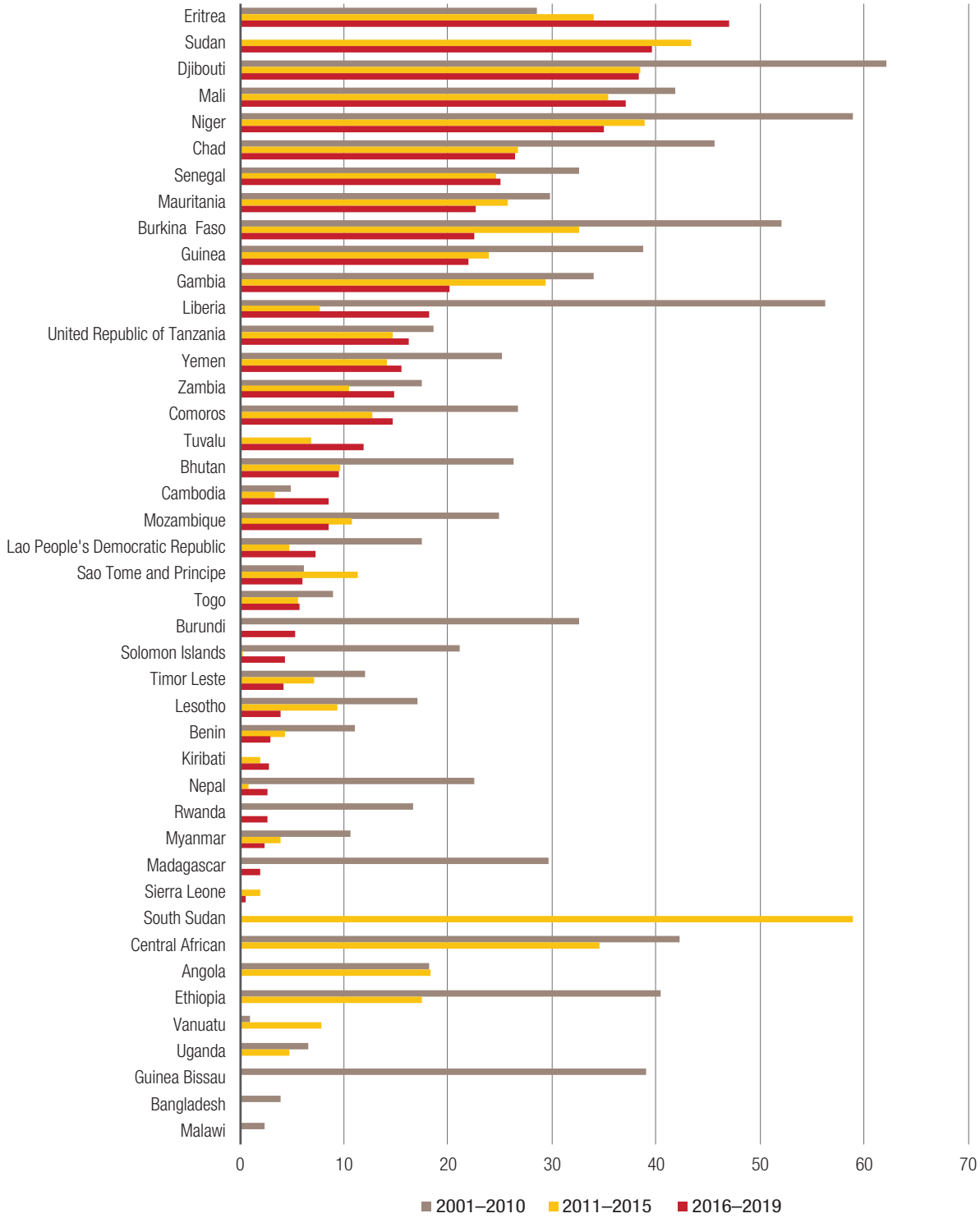
Apart from challenges carried forward from the era of the Millennium Development Goals, with its focus on basic education at the expense of the transition from primary to secondary education, it is well established that the quality of education facilities, curriculum and other supporting environments for learners contribute to increasing enrolment and retention; however, the best measure of progress are retention and success rates at higher levels of education. The cost of fees has fallen but the cost of other household expenditures on education, e.g. learning materials, have risen. These costs may be too high for the poor, for example, in some urban locations of the United Republic of Tanzania, where monthly household expenditures on education per child were higher than the average monthly household expenditure reported in World Bank's Living Standards Measurement Study (Dennis and Stahley, 2012).

Gross secondary school enrolment rates reflect the struggles that countries are facing in retaining children in school. Of the countries with data, Bangladesh, Bhutan, Nepal, Tuvalu, Timor-Leste and Sao Tome and Principe have made significant strides in increasing gross secondary enrolments to well above 60 per cent. However, several other countries, e.g. Niger, Central African Republic and the United Republic of Tanzania, have stagnated at less than 30 per cent. As expected, gross enrolment

Figure 3.17

Children out of school

(Per cent of primary school age)

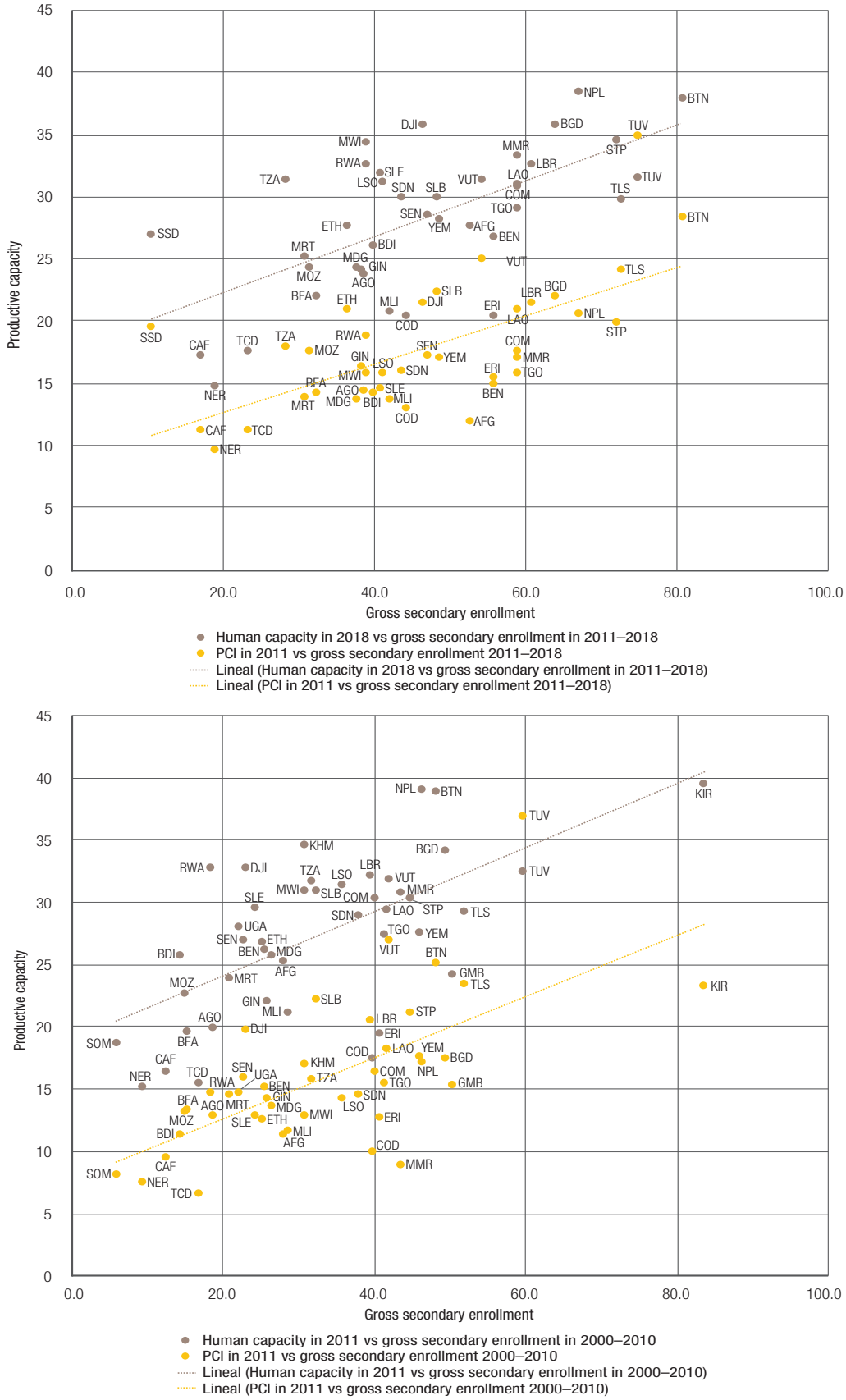


Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators database [accessed April 2020].

is positively associated with both total PCI and the human capacity subcomponent (Figure 3.18). Secondary enrolment rates have improved for some countries but the bottom three countries have remained unchanged during 2000–2018, with Bhutan replacing Kiribati at the top of the list. Notable improvements were also recorded in secondary enrolment in Bangladesh, Djibouti, Nepal, Sao Tome

Figure 3.18

Gross secondary enrollment and productive capacities



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database and data from World Bank, World Development Indicators database [accessed April 2020].

and Principe and Timor-Leste, which are reflected in the sizeable productive capacities gains achieved by these countries over this period.

b. Population and primary health

Concerned with high child and maternal mortality rates, the prevalence of communicable diseases including, among others, HIV/AIDS, malaria, tuberculosis, and other major diseases, the IPoA set population and primary health targets to reduce their burden on LDCs. It also encouraged countries to provide universal access to reproductive health by 2015 and promote access to medicines and invited international partners to assist in this regard. The COVID-19 pandemic has exposed the interlinkages among public health, the environment, and the economy, and need for better healthcare services across countries, including the access to medical supplies at critical moments.

Global efforts to reduce under-five mortality have yielded positive results in many countries, with the average under-five mortality rate dropping from 93 deaths per 1000 live births in 1990 to 39 in 2018 (Children: reducing mortality, 2019). However, for LDCs, Goal 3.2 of the Sustainable Development Bank of reducing under-five mortality to – at most – 25 per 1000 live births in every country by 2030 is unlikely to be met, judging from the progress made since 2011. Only the Solomon Islands and Tuvalu have already met the target, while 38 of the 47 LDCs have under-five mortality rates hovering above the world average of 39 in 2018. The only positive development is that every country has recorded some progress but that the number of preventable deaths from diseases or treatable remains too high. In light of the COVID-19 pandemic, strengthening health systems in the most vulnerable countries remains necessary but future efforts should focus on better targeting and upscaling of interventions, particularly in rural areas, as well as supporting the development and transfer of technology to produce affordable, safe, effective and good quality medicines in the developing countries.

The technology gap in developing countries with respect to the manufacture of influenza vaccines has been highlighted by Friede et al. (2011). The concentration of production capacity in a few countries in Europe and North America is a global public health risk that can be reduced by scaling up the WHO initiative on technology transfer and non-exclusive licences on specific vaccines and other types of medicines. Ideally, patents and R&D are best left to market forces but public funding is needed in the case of R&D. Moreover, capacity development and technology transfer to developing countries

Strengthening health systems and technology transfer in pharmaceuticals are priorities for the LDCs

are a global public good. Technology transfer is ineffective in the absence of intra-industry productivity spillovers, support for R&D, and the capacity to absorb and utilize the technology (UNCTAD, 2014). Although technology transfer is heavily constrained in sectors with high value intellectual property (e.g. pharmaceuticals), innovative policies could diminish the distortion caused by patent misuse and practices that impede trade (UNCTAD, 2018c). The pooling of resources and specialized skills through special mechanisms, including those under the auspices of WHO and WTO, could help to delink R&D costs in new medicines for diseases affecting populations in LDCs (Røttingen and Chamas, 2012).

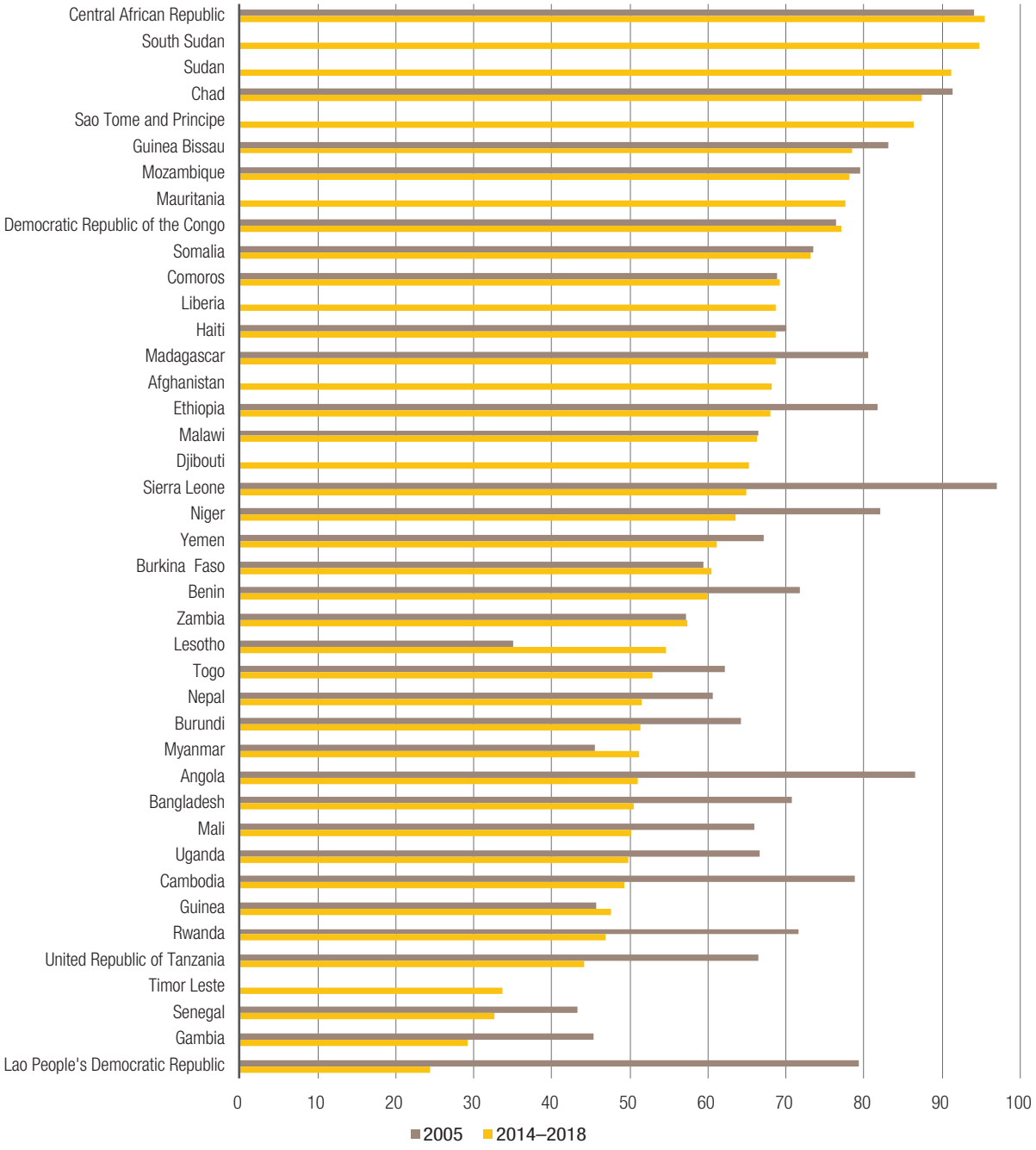
Apart from the health challenges facing children and expectant mothers, shelter, water and sanitation are the other priorities of the IPoA. They are also covered in Goal 11 of the Sustainable Development Goals on sustainable cities and communities, and Goal 6 of the Sustainable Development Goals on clean water and sanitation. The number of people currently living in inadequate housing in the LDCs is quite high, and the problem of inadequate shelter is not limited to urban dwellers. However, based on available data, the proportion of the urban population living in slums ranged from 95 per cent in the Central African Republic to 21 per cent in Lao People's Democratic Republic (Figure 3.19). The problem of slums may signal a dichotomy between unproductive rural economies and growing urban economies which is better at attracting excess rural labour as the socioeconomic opportunities are more interesting. However, the continuing existence of slums reflects: (i) a lack of public and private capacity to mobilize adequate housing investments and infrastructure services for urban populations; (ii) a policy failure to attract investments in rural and urban economies; and (iii) a general weakness in social development policies (Marx et al., 2013).

Between 2000–2010 LDCs have made gains on the UNCTAD productive capacity subindex on human capital but progress since 2011 has been lacklustre. Some countries have continued to grow their human capital, although at a marginal page and others have lost momentum. This is due to stalling progress on years of schooling as dropouts piled up, while other

Figure 3.19

Proportion of the urban population living in slums

(Per cent)



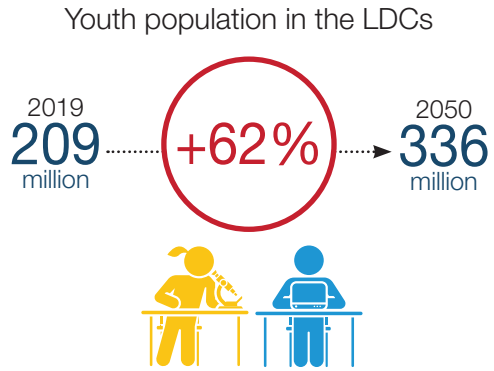
Source: UNCTAD calculations based on data from the UN Habitat, Urban Indicators Database.

components (e.g. life expectancy) have not improved by much. The upper limit of the human capacity index achieved hovered around 38–39 among the best LDC performers, with the low performers scoring less than 20 (Figure 3.20). In contrast, among ODCs, the worst performer in terms of human capital development (at 23) was close to the LDC median (26) in 2018, while the best performer in LDCs in 2018 (at 39), which was three points below the median human capacity index (at 42) for ODCs.

Human capital development is the main driver for productive capacity development. Ultimately, human beings determine investments in technology and knowledge, including in how existing production systems are utilized and the structural changes necessary to improve production systems.

Castellacci (2011) explains the widening gulf in economic development between country groups in terms of the technology gap (or distance to the frontier). The two dimensions of the technology gap, namely: (i) adaptive capacity, i.e. the ability to mimic advanced technologies; and (ii) absorptive capacity, i.e. the extent to which countries produce new advanced knowledge, are both heavily dependent on human capital and the stock of machines. There is, therefore, a need for LDCs to embrace a knowledge-based, productive capacities-centred view of development, with emphasis on developing the absorption, adaptation and organizational dimensions that drive technological change.

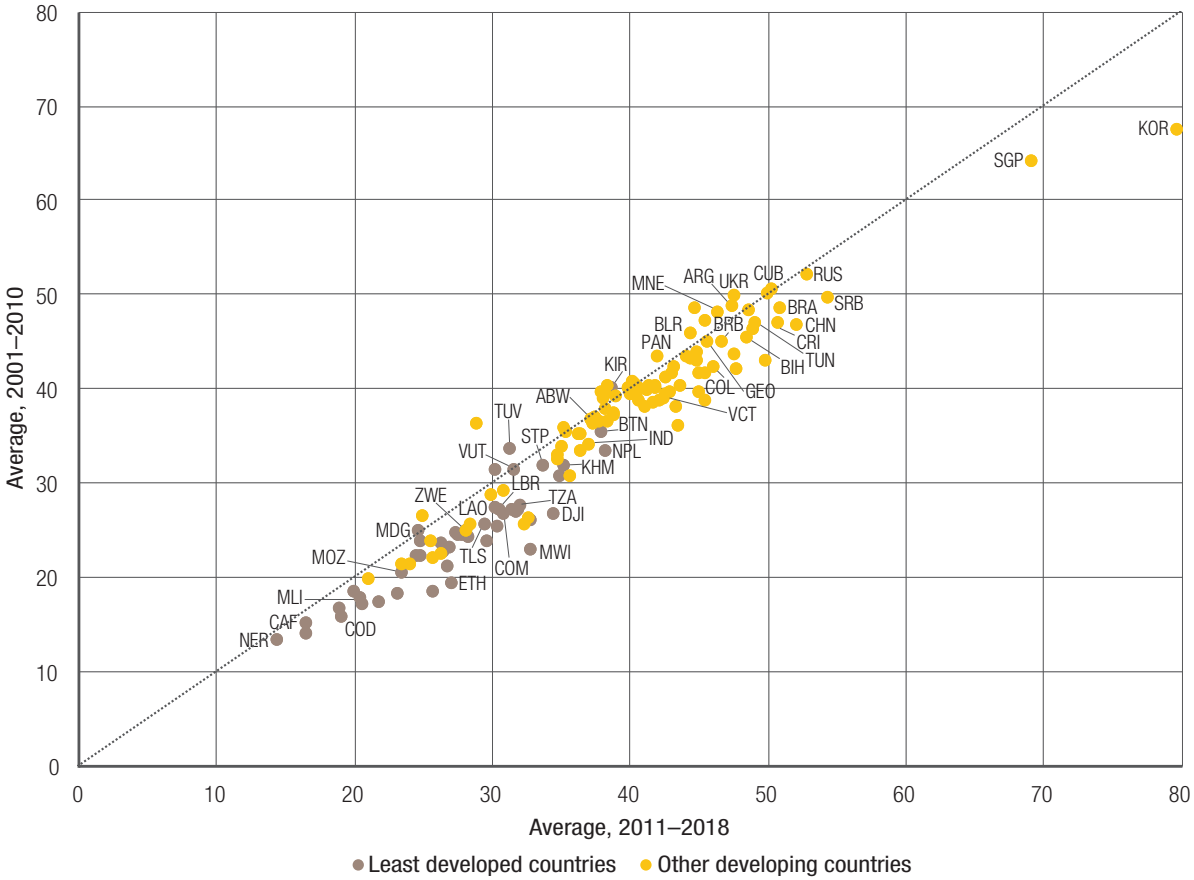
Skills acquired through education and work determine the utilization of all other productive capacities including hard and soft assets (e.g. infrastructure, institutions and policies). In general, if LDCs are to catch up to the level of ODCs, they should at least attain the same level of human capacity development, which can be best done through tangible investments in education and training, and targeting the right demographic group. With low education and health outcomes in LDCs, there is every likelihood that LDCs may be in the second and third industrial revolution phases of development, with oil and other primary commodities



Quality education and training for the youth will be key in reducing the technology gap between LDCs and other developing countries

Figure 3.20

Human capital component of the Productive Capacities Index, LDCs and ODCs



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database [accessed May, 2020].

remaining as the mainstay of their economies. LDCs have low technology development and investment in learning compared to ODCs, or the frontier countries already tearing into the mesosphere of the Fourth Industrial Revolution (4IR), as well as perfecting its use of big data, the internet of things, artificial intelligence, nanoscience and nanotechnologies (Gauri, 2019). If artificial intelligence is the stratosphere of 4IR and the heartbeat of the digital economy, LDCs should not underrate the value of innovation, knowledge and the linkages created through innovation. As highlighted earlier, the difference between countries on the edge of the stochastic production frontier and those falling within (Figure 3.8) is due to variations in innovation and knowledge. Similarly, the difference between the best performers and the ODCs, particularly Singapore, and the Republic of Korea, is down to disparities in educational attainment and overall human assets.

5. Multiple crises and other emerging challenges

The vulnerability of LDCs to various shocks, including commodity price vagaries, financial and economic downturns, climate change and natural disasters, remain a concern. Several factors, such as conflict and weak institutional and governance systems, heighten the risk exposure to specific shocks. The IPoA sought to contribute to building the resilience of LDCs to withstand multiple emerging crises as they seek to attain sustainable development. Graduation from the LDC category is a fundamental goal of the IPoA, as well as other ISMs focusing on LDCs, but progress towards this goal has been disappointing.

A comparison of graduated countries and countries scheduled to graduate reveals some fundamental issues concerning the economic vulnerability of LDCs. Specifically, the performance of the countries during the IPoA implementation period shows that, with respect to economic vulnerabilities, there are important similarities and differences among graduated countries and those scheduled to graduate, or among those that have met one or more graduating criteria (Table 3.5).

The graduation threshold for the economic vulnerability index (EVI) is a score below 32. Some LDCs were able to lower their EVI scores in 2011–2020, but the vulnerability scores of 24 LDCs have worsened, and include countries such as Angola, Benin, Comoros, Guinea, Mali, Sao Tome and Principe, Sierra Leone and Timor-Leste (Figure 3.21). Fewer countries (21 in all) are below the 45-degree line in the figure, which indicates a higher economic vulnerability score in 2020 compared to 2011. However, a handful of countries met the criterion in both 2011 and 2020, and include Bangladesh, Central African Republic, Guinea, Myanmar, Nepal, Sao Tome and Principe, Togo and Uganda. Based on the average change in EVI scores over the period, the median was 0.09 per cent (Afghanistan), but the best performer in reducing vulnerability over the period was Liberia (-3.3 per cent) and the lowest Angola (+1.6 per cent).

The LDC with the highest reduction in economic vulnerability is Liberia, a coastal country with relatively stable structural variables (Figure 3.22). For example, its population in low elevated coastal areas grew marginally from 10.8 per cent in 2011 to 11.7 per cent in 2020, while the share of agriculture, fisheries and forestry in GDP remained above 70 per cent. The lower score in economic vulnerability was driven mainly by a fall in agricultural instability and individual victims of natural disaster. There were also reductions in export concentration and export instability, which are linked to positive dynamics in the agriculture sector.

Except for the group of countries that meet two graduating criteria, the country groups in Table 3.5 have lower average EVI scores in 2020 compared to 2011. However, they all scored poorly since the graduation threshold for the EVI is below 32.

Table 3.5

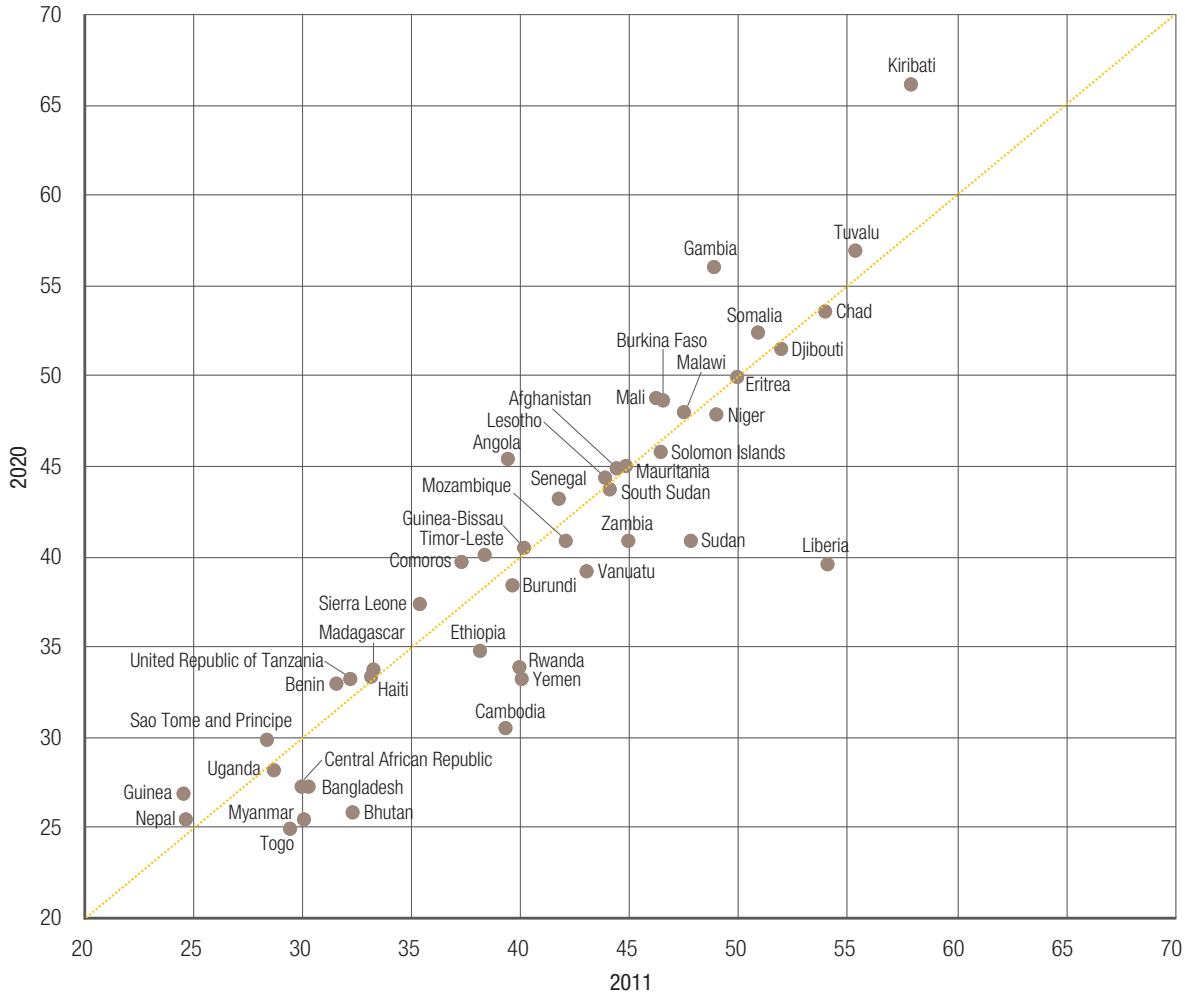
Country groups by graduation status and criteria

Countries that graduated	Countries scheduled for graduation	Countries that met two criteria in 2018	Other LDCs with GNI> $2,460
Botswana (1994)	Vanuatu (2020)	Bangladesh	Angola
Cabo Verde (2007)	Angola (2021 – GNI only criteria)	Kiribati	Bhutan
Maldives (2011)	Bhutan (2023)	Lao People's Democratic Republic	Kiribati
Samoa (2014)	São Tomé and Príncipe (2024)	Myanmar	Timor-Leste
Equatorial Guinea (2017 – GNI only criteria)	Solomon Islands (2024)	Nepal	Tuvalu
		Timor-Leste	Vanuatu

Source: UNCTAD secretariat elaboration, based on information from the United Nations Committee for Development Policy website, URL: https://www.un.org/development/desa/dpad/our-work/committee-for-development-policy.html [accessed April 2020].

Figure 3.21

Economic and environmental vulnerability index, 2011 and 2019



Source: UNCTAD secretariat calculations, based on data from United Nations Committee for Development Policy Secretariat. Time series estimates of the LDC criteria [April 2020].

As can be expected, countries with the lowest values happened to have graduated in both years. Those LDCs that are scheduled to graduate have a higher than average EVI index and are far above the

Table 3.6

Correlation between economic vulnerability and productive capacities

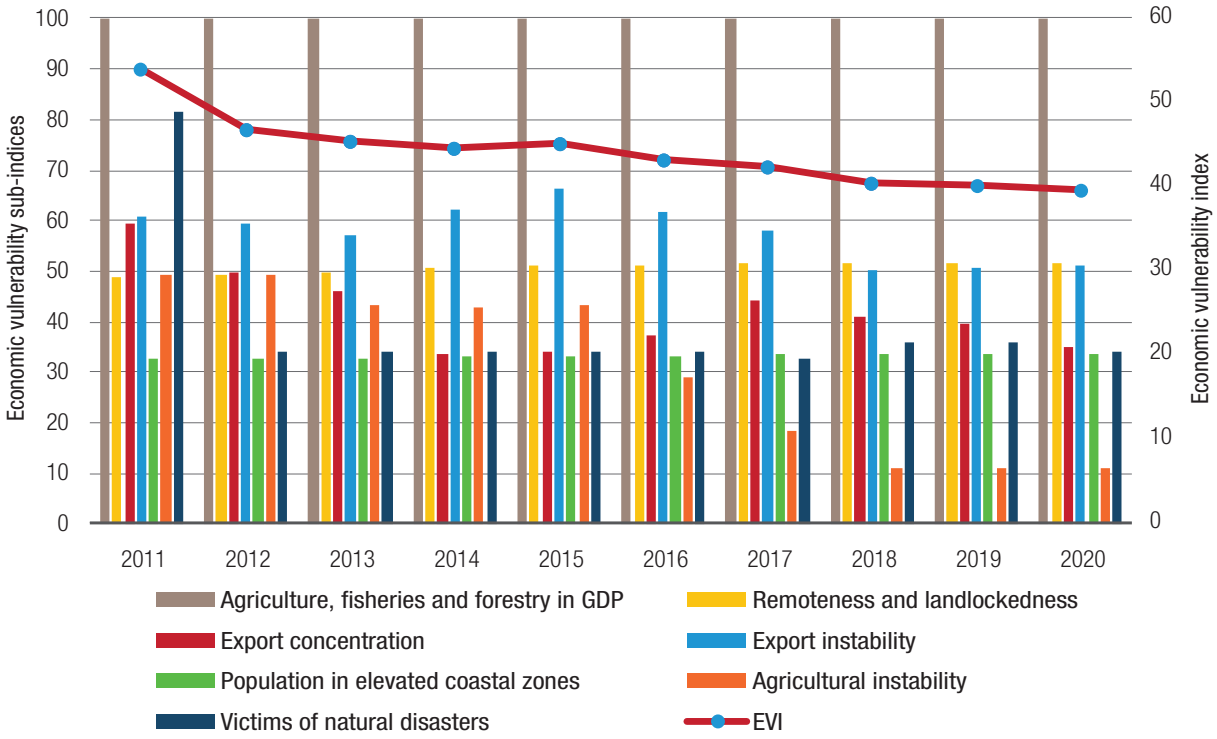
	Country groups based on Table 3. 5				Other country groups	
	Graduated	**Scheduled to graduate**	**Countries that met two criteria in 2018**	**Other LCDs with GNI greater than $2,460(in 2018)**	**LDCs not in graduation frame**	**Other developing countries**
Energy	0.4748*	0.4041*	0.081	-0.5408*	0.0418	-0.1466*
Human capital	0.4240*	-0.3890*	-0.6985*	0.6186*	0.1026*	-0.1289*
ICT	0.0261	-0.9279*	-0.2813*	0.3446*	-0.0234	0.0176
Institutions	0.1889	-0.3757*	-0.2878*	0.5182*	-0.0787*	0.1109*
Natural resources	-0.2003	0.0361	0.4823*	-0.7855*	0.1177*	0.047
Private sector	0.2004	0.2669	-0.4468*	0.6007*	0.0326	-0.1790*
Structural change	-0.1215	-0.1367	0.3355*	-0.0333	-0.2798*	-0.3669*
Transport infrastructure	0.6829*	0.6268*	-0.2735*	0.6491*	0.0958*	0.3700*

Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database and data from United Nations Committee for Development Policy Secretariat. Time series estimates of the LDC criteria [April 2020].

Note: * significant at 5 per cent.

Figure 3.22

Liberia: Economic vulnerability and subindices, 2011–2020



Source: UNCTAD secretariat calculations based on data from the Secretariat of the United Nations Committee for Development Policy. Time series estimates of the LDC criteria. [Latest available update, April 2020].

threshold. It follows that countries in this group will graduate based on the GNI per capita indicator and the human asset index, as graduation only requires two out of the three criteria to be fulfilled. The result highlights the need to address the sustainability of momentum after graduation, particularly as the risk of falling back into the LDC category increases for countries that graduated only on the basis of their GNI per capita income criterion. In such cases, it is critical to question whether graduated countries, regardless of the criteria that was used, should be granted a grace period in which they could lower their economic vulnerability before losing all their LDC-related support measures and exemptions.

A further examination of the relationship between economic vulnerability and the PCI shows that structural change is associated with lower economic vulnerabilities for all country groups in Table 3.5, except for LDCs that met two graduation criteria in 2018. Natural resources are also associated with a lower EVI for countries that graduated, as well as LDCs with a high GNI in 2018. By contrast, human capital, ICT and institutions are associated with lower economic vulnerability for countries scheduled to graduate. Beside the overlap in the graduation-framed subgroups, the countries that met the two criteria were more vulnerable in the natural resources dimension which they compensated with a higher GNI, a vibrant private sector or better transport infrastructure.

An important asymmetry is also observed between the countries that graduated from the LDC category and the entire set of ODCs. Components such as energy, human capacity, ICT, institutions, private sector and structural diversity, were all found to be associated with the lower economic vulnerability of ODCs, but natural resources and transport infrastructure had the opposite effect. For countries that graduated from the category, energy, institutions, transport infrastructure and human capital are associated with higher economic vulnerability, with only natural resources contributing significantly to lowering economic vulnerability. This confirms the observation that graduated LDCs, or those scheduled to graduate based on the income criterion, do so based on the wealth of their natural resources. The weaknesses exposed by their low score in other productive capacity components should be the focus of their policies if they aspire to reach the level of ODCs. This is clear from the productive capacity components associated with lower economic vulnerability scores among ODCs.

LDCs reduced their economic vulnerability by a 5 per cent mean reduction between 2011 to 2019 but countries that managed to lower their EVI scores either did so through improved trade or production indicators from outcomes of better productive capacities which, in turn, boosted economic performance and diversification. However, 12 out of 47 LDCs have become economically vulnerable since 2011. Graduated countries performed consistently better in 2011–2019 on both the total EVI index and its subcomponents, whereas countries scheduled to graduate met the criteria set in the human asset index and GNI per capita, giving a high group mean compared to the mean of all other LDCs. Some Island LDCs will struggle to lower their overall EVI score as they have small populations, a large proportion of people living in low coastal areas and their remoteness, which accounts for almost half of the total EVI index are structural and impossible to change with policy over the short term.

6. Mobilizing financial resources for development and capacity-building

A major feature of the development finance architecture promoted by the Addis Ababa Action Agenda is the promise for larger and more diversified development finance for developing countries. However, the growing gap between investment requirements and mobilized resources highlights the importance of bolstering tax capacities in developing countries to achieve Goal 17.1 of the Sustainable Development Goals. Domestic resource mobilization is constrained by their small economic bases, as well as their ability to implement broader and progressive taxation. It also corresponds to the capacity to close leakages through international cooperation on investment, taxation, combating illicit financial flows, and other avenues to leverage finance.

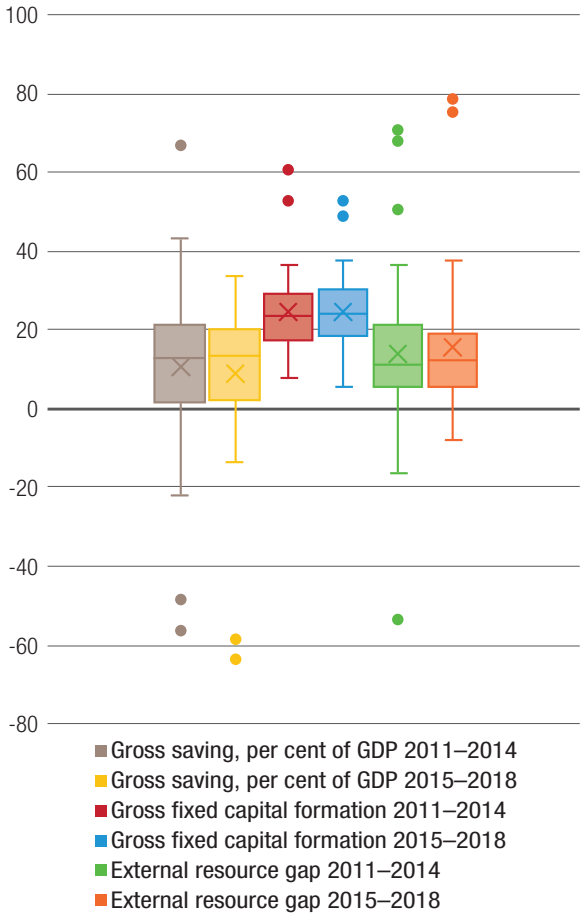
Among LDCs with recent data for 2011–2018, tax revenue to GDP averaged less than 20 per cent. Low savings are typical of small economies but a higher gross fixed capital formation of above 25 per cent of GDP shows that the investment climate in LDCs is still healthy. However, it is important to note that capital formation in LDCs is driven mainly by public spending on infrastructure and other durable assets. The external resource gap (i.e. the difference between the gross fixed capital formation rate and the gross domestic savings rate) of LDCs with data was 15.6 per cent of GDP in 2015–2018, up from 13.8 in 2011–2014 (Figure 3.23).

Typically, external resource gaps are wider in smaller economies that have very low savings. The gap becomes a concern if the countries involved continue to record negative trade and balance of payments scores. As emphasized in this chapter, LDC trade deficits are worsening their long-standing marginalization in international trade. For most LDCs, the investment gap in 2015–2018 was narrower than in 2011–2014 as investment demand fell due to secular stagnation in commodity markets (Figure 3.24). In general, the LDCs should boost private sector investments to achieve structural transformation, which is the best route out of the primary commodity trap. Arguably, a higher allocation of credit to the private sector may indicate a healthy domestic financial environment that is supportive of productive investments, even though these claims may include credit to state-owned enterprises (Khaltarkhuu and Sun, 2014).

The relationship between productive capacities and domestic resource mobilization arises from utilization; in other words, a country with better

Figure 3.23

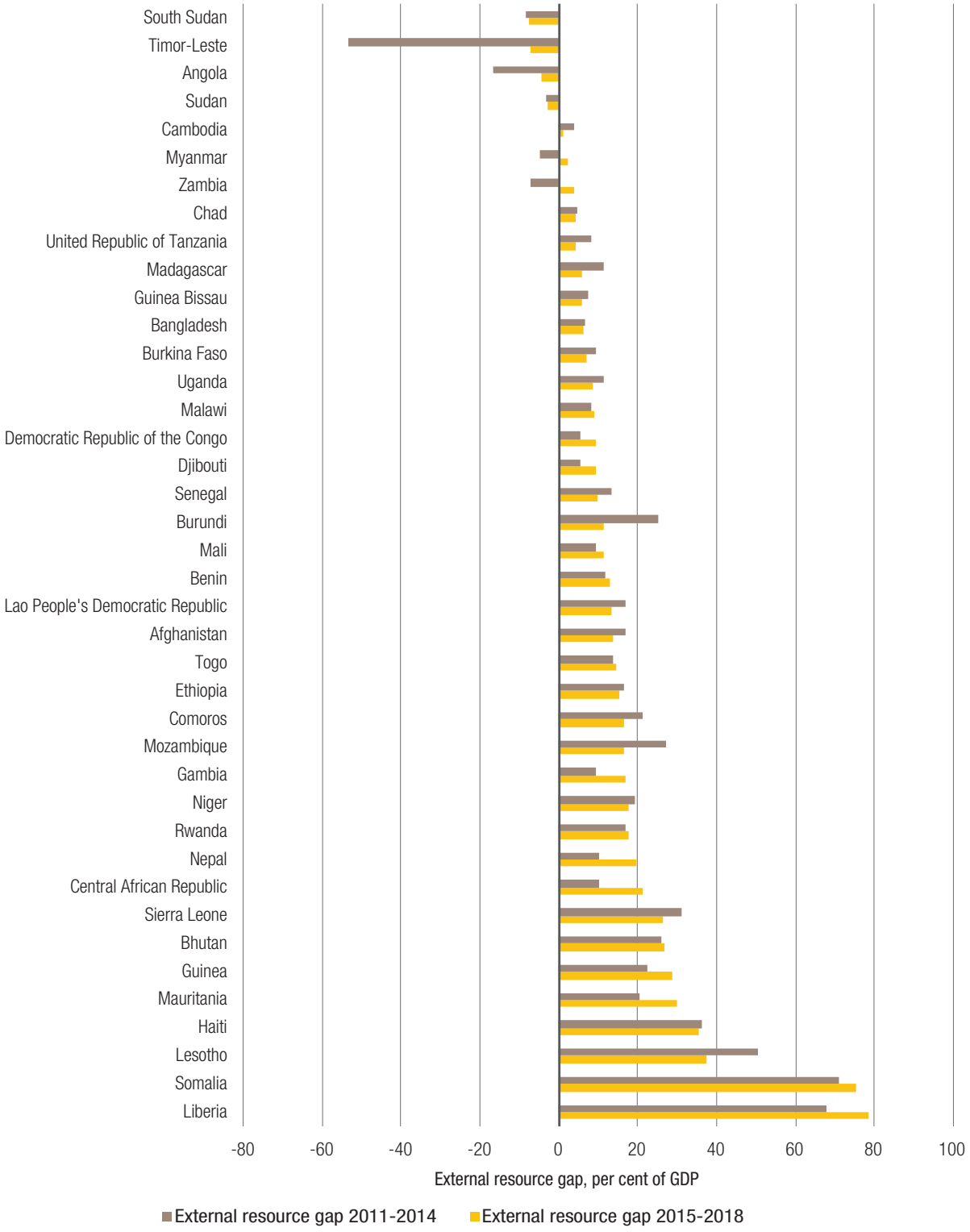
Savings, investment and external resource gaps



Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators database [accessed April 2020].

Figure 3.24

External resource gaps as a percentage of GDP, 2011–2014 and 2015–2018



Source: UNCTAD secretariat calculations, based on data from World Bank, World Development Indicators database [accessed April 2020].

utilized productive capacities has more means to generate a higher national income and therefore tax revenue. There is a two-way relationship between tax revenue and productive capacities, depending on the role of fiscal policy in stimulating growth and the real economy. The correlation between tax revenue and the various productive capacity components, except natural resources were significant and positive,

suggesting that natural resource-rich countries have failed to broaden their tax bases to efficiently boost tax revenue. This result is consistent with the observation that resource-rich countries, e.g. Angola and Sudan, could improve the efficiency of their tax collection systems through a rationalization of their tax revenue components. Also, the level of revenue collection is still too low relative to their economy sizes (UNCTAD, 2019b).

A strategy for boosting economic growth and domestic resource mobilization is private sector-led development. Countries that need to transform their economies are also, by default, the same countries that have failed to attract competitive private investment, except for the countries with natural resources capacity. The complementarity between industrial policies and structural transformation policies derive from the common goal of cultivating positive feedbacks and interlinkages in the economy, even though the former may focus on a narrow set of industries. Policies to diversify the economy should, therefore, be consciously designed to stimulate private sector development, particularly in sectors shunned by market-seeking investors. It should, however, be noted that emerging activities will, by necessity, spring from existing capabilities including the labour, capital, technology, knowledge and skills developed over time (Brooks, 2007).

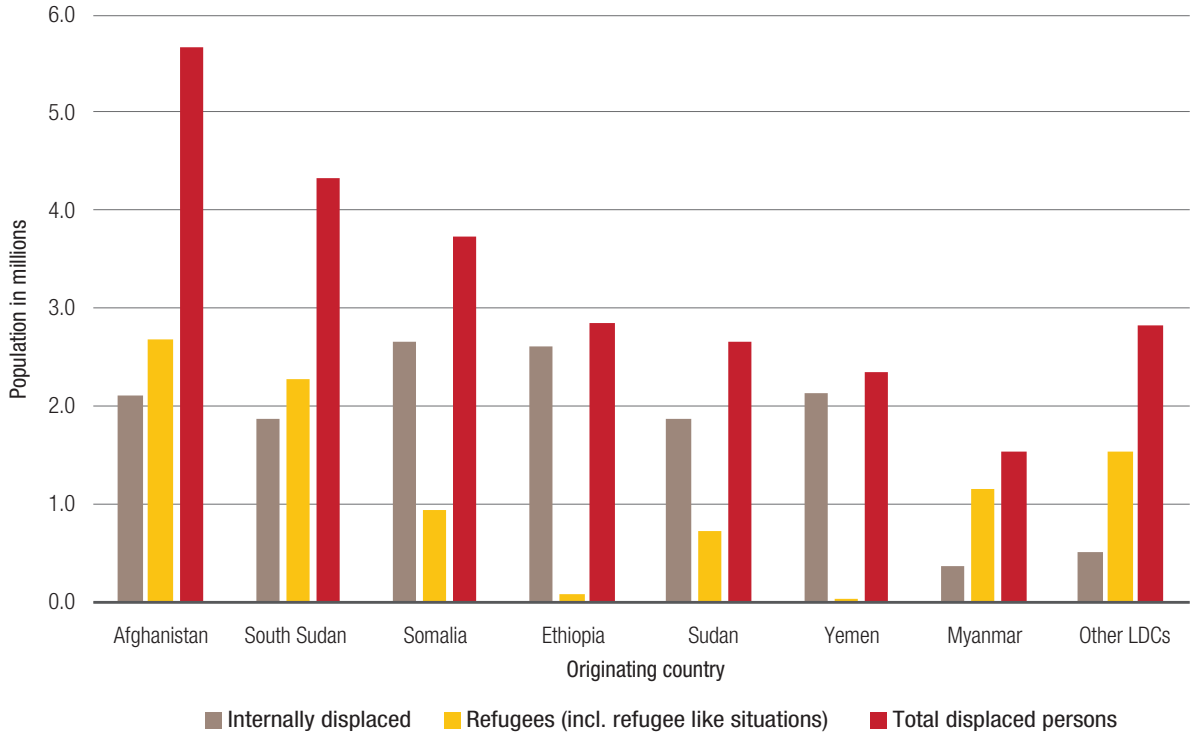
7. Good governance at all levels

Among the specific objectives of the IPoA was to enhance good governance at all levels by, among others, strengthening the capacity of governments to play an effective role in their economic and social development. LDCs made progress on some governance indicators in 2011–2018 but there are still several countries with on-going conflicts or recovering from past conflicts. Globally, the population of forcibly displaced people in 2018 was 70.8 million (UNHCR, 2019), 33 million of whom originated from LDCs (Figure 3.25). The situation of internally displaced people (IDPs) and refugees scattered in neighbouring or more distant countries challenges the perception of improved governance, particularly in countries with large populations of forcefully displaced people.

The acute rise in the number of displaced individuals from 16.8 million to 33 million in 2011–2018 is a growing problem in LDCs. Conflict-affected or post-conflict LDCs, e.g. Afghanistan, the Central African Republic, the Democratic Republic of Congo, Eritrea, Ethiopia, Myanmar, Somalia, South Sudan, Sudan and Yemen,

Figure 3.25

Population of displaced people in least developed countries, 2018



Source: UNCTAD secretariat calculations, based on data from UNHCR, Refugee Population Statistics Database [accessed April 2020].

Transformational policies can unleash the dynamic impacts of productive capacities on the economy

have significant numbers of IDPs. Pockets of IDPs can also be found in Mali, Chad and Niger, as well as in other LDCs. These displaced populations, together with conflict-related deaths, exert a substantial drag on governance appraisals of LDCs.

The World Bank's Worldwide Governance Indicators (WGI) project has provided data on six broad dimensions of governance over the period 1996–2018, and covers indicators, such as voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption (Worldwide Governance Indicators, 2020). An analysis of these indicators shows that several LDCs made progress in some areas but regressed in others. Based on this analysis, Rwanda scores relatively well on aggregate, while Somalia is the lowest ranked among African LDCs and Haiti. It should be noted that despite its overall ranking, a country may perform poorly or better in some governance dimensions; one example of this is the case of Rwanda which is ranked low on voice and accountability. Similarly, Bhutan and Tuvalu have a better overall governance scores among Asian LDCs and Island LDCs, respectively, while Yemen and Comoros were the lowest ranked in their respective subgroups.

The shared trait among the countries that were ranked highly on governance in the African and Asian LDC subgroups are their strong performances in government effectiveness and control of corruption. Island LDCs performed strongly on voice and accountability, as well as political stability and absence of violence. Asian LDCs also shared high rankings in political stability and absence of violence; but the best ranked African country was rated poorly on these components.

LDCs need to improve on all aspects of governance, as subgroup dimensions reveals areas of concern. For example, the Island LDCs have socially cohesive communities, which may explain their stable political systems and strong rankings on voice and accountability. However, their close communities may be contributing to lowering the quality of regulatory systems, fuelling corruption and reducing government effectiveness. In contrast, African countries have more fragmented societies, which may explain the lower ranking of political stability and absence of violence, as well as on voice and accountability. The role of social cohesion and social capital in economic development has been studied extensively by others (e.g. Woolcock et al., 2000). Corruption erodes trust in societies and breeds contempt for the government at all levels. Both the failure by the state to control corruption and the loss of trust in government by citizens can be detrimental to social inclusion and social cohesion (Sapsford et al., 2019).

Further analysis of the WGI and PCI reveal that better-governed countries generally have higher per capita GDPs, although not exclusively. A typical dilemma for resource-rich economies is their tendency to overly rely on the income weight when benchmarking their economic development against other countries. However, the insights provided by the PCI are revealing: well-governed countries tend to have better productive capacities, and the income distortion on economic ranking dissipates (Figure 3.26). This is clear in the case of Angola, Sudan and Zambia, and to some extent, Timor-Leste and Cambodia.

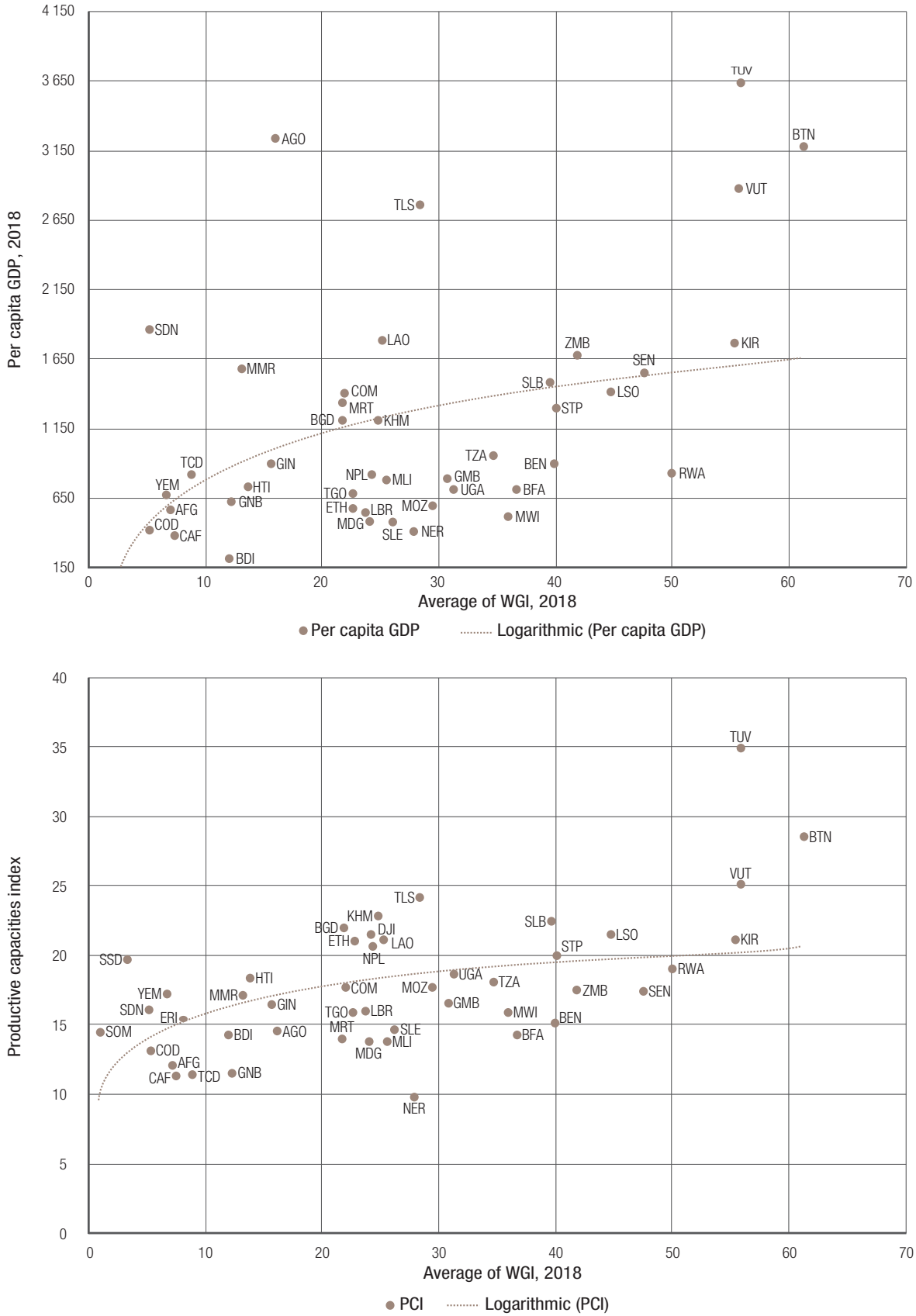
D. Conclusion

The chapter has analysed the progress that LDCs have made towards attaining the goals of the IPoA. This section further explores the implications of the lack of progress or improvements made on some dimensions of productive capacities, as well as the interactions among them. Overall, LDC progress towards achieving the targets of IPoA was unsatisfactory and lacked traction in many respects. Using UNCTAD's newly launched PCI revealed that an increasing number of LDCs are trapped in low productive capacities and find themselves in a specialization cul-de-sac. Specialization enclaves have always existed, driven by commodity dependence (African LDCs and Island LDCs), or market interlinkages (among Asian LDCs), but the persistence of crisis-linked setbacks affecting some LDCs are a new phenomenon.

Productive capacities are key building blocks for structural transformation and trade but their dynamic impacts on the economy will not come alive until they are activated by government policy. The state of productive capacities in LDC economies limit the extent to which public policies can influence development; for some of them, moreover, their geographical location and subregional dynamics have compounded the challenge. The analysis of the productive capacity categories suggests a trade-off among the building blocks, with most of the categories having complementarity impacts;

Figure 3.26

Worldwide governance index rankings and the UNCTAD PCI



Source: UNCTAD secretariat calculations, based on data from UNCTAD, UNCTADStat database and data from World Bank, World Development Indicators database [accessed April 2020].

however, the existence of non-conventional negative correlations among the categories suggest low synergy. LDCs need to exploit complementary trade structures offered by their subregional markets. Asian LDCs could, for example, value their neighbours for providing the necessary inputs, including the technology they need, and as markets for the goods and services they export. African and Island LDCs also need to exploit their subregional markets but they will have to invest more in interlinkages, institutions and infrastructure.

Productive capacities subcomponents may impact economic sectors and individual LDCs differently. However, for primary sectors, such as agriculture and natural resources, a strong human capacity could be the trigger for structural reforms. Agriculture is a special sector for LDCs because of the critical roles it plays in employing most of the labour force and as a source of exports and supplier of raw materials. The dilemma for policymakers is to work out how to reduce dependence on unproductive labour that dampens the contribution of agriculture to poverty reduction, while at the same time as ensuring a sustainable livelihood for a growing population. Structural change capacities in LDCs also fail to elicit the same effect on growth as they do in ODCs because the burgeoning services sector is not driven by improvements in labour productivity but rather joblessness and widespread informality.

Building productive capacities is a slow process. Although productive capacities among LDCs have improved, three key trends have emerged, namely: (i) countries have progressively enhanced their capacities; (ii) countries have increased their capacities at a declining pace; and (iii) others have stagnated or regressed. As explained above, these have also meant specialization enclaves developing alongside stagnating productive capacities. Breaking these patterns of specialization would require altering not just the mixture of productive capacities but also the drivers of specialization. For example, energy capacity is positively related with both agriculture and manufacturing, but as noted earlier, the industrial-scale energy investment needed to spark value addition in agriculture and expansion of manufacturing capacity is in multiples of the current level (UNCTAD, 2017c). Moreover, policy-induced changes in economic orientation may reduce some of the inefficiencies observed. For example, export-promotion in narrowly defined sectors may be placing an undue burden on some economies, leading to some of the distortions related to economic structure. Some of the commodity-dependent economies are extremely vulnerable to the vagaries of global markets due to their inadvertent policy discrimination against other economic sectors (UNCTAD, 2015b).

LDCs have missed many opportunities to build human capital and promote human development more widely. While the available indicators do not comprehensively capture human and social development, they nevertheless highlight the need to reduce inequalities, build resilient communities and eliminate all forms of poverty. In line with what UNCTAD has been advocating over the years, LDCs should take advantage of their youthful population to close the widening gap between them and the ODCs. To do this, they need to ensure that youth are productive and not used a source of cheap labour in agriculture and other sectors. Uneducated and untrained labour remains an unproductive and underutilized resource, hence the key to reaping the demographic dividend and bridging the technology gap between LDCs and ODCs is to refocus public investments in education and training by bringing the skills development and knowledge at the centre of the efforts.

It is getting harder for LDCs to graduate from the category. The few countries that have graduated have done so based on their large natural resource capacity. However, natural resources also pose the a great source of instability to exports and may raise the vulnerability of the countries. The result is that economic vulnerability persists, even after countries have graduated from the LDC category. There may be a need for the international community to agree on specific support measures for those countries in the graduation frame, as well as to recently graduated countries to ensure a sustainable momentum. A differentiated support structure seems inevitable given the low graduation rates, and the slow progress towards graduation among the LDCs.

ANNEX: A technical introduction to the UNCTAD Productive Capacities Index

The following material draws from the methodological note about the UNCTAD PCI (UNCTAD, forthcoming).

The Productive Capacities Index (PCI) is a composite of an initial list of 46 indicators extracted from various sources (Appendix Table 3.1). It is calculated as a geometric average of eight domains or components, namely, natural capital, human capital, energy, transport, ICT, institutions, structural change and the private sector. The categories are selected based on their relevance to conceptual and analytical framework for building productive capacities. Mathematically, the PCI is defined as follows:

$$PCI = \sqrt[N]{\Pi X_i^{PCA}} \quad (1)$$

Where X_i^{PCA} is the weighted score extracted from the principal component analysis on the i-th category, for $i = 1,\ldots,$ N categories. The *PCI* values range from 0 and 100, with 100 being the best score.

The process of constructing the index consists of a sequence of data-intensive steps as follows. The steps were implemented in R-programming language, a free software widely used for data management and statistical analysis.

a. Imputation of missing data

Data for each country, calendar years and indicators are difficult to come by. Data imputation for missing values is therefore an unavoidable exercise when organizing data for a large set of countries. Two approaches were used: the first involved extending data for missing years, and it works only if there is an acceptable set of existing data points from which the missing data can be inferred by way of simple interpolation; the second case is more challenging, as the data for countries with missing observations are imputed from the closest neighbouring economies with identified observations. By design, per capita incomes are used as weights in calculating imputed values, but other suitable weights may also be used. This is operationalized through the following expression:

$$x_i^{NA} = log(y_i) * \left(\frac{1}{5} \sum_{j=1}^{5} \frac{x_j}{log(y_j)}\right) \quad (2)$$

Where x_i^{NA} is the imputed value for country i from observations, x_j of the neighbouring countries, for $j = 1,\ldots,5$ while y_j is the j - *th* country's per capita income.

b. Forecasting

It may be desirable in some cases to obtain new observations for each indicator. New observations may be generated by using an Auto Regressive Moving Average where *AR(p)* and *MA(q)* are selected by Bayesian Information Criterion or by using local linear forecast using smoothing splines (Hyndman et al., 2005). Applied to the PCI, the two forecast methods yield highly correlated estimates with the correlation coefficient of the observations,

$$p\,(PCI_{splines}, PCI_{ARMA}) = 0.99 \quad (3)$$

Similarly, the forecast error show high correlation with the real *PCI*, but *ARMA* achieves a slightly lower mean squared error than the local linear forecast based on smoothing splines,

$$\begin{cases} MSE(splines) = E\,[\Sigma(x_{i,splines} - \hat{x})^2] = 0.004 \\ MSE(ARMA) = E\,[\Sigma(x_{i,ARMA} - \hat{x})^2] = 0.002 \end{cases} \quad (4)$$

c. Multivariate analysis

In this step, the Principal Component Analysis (PCA) is applied to reduce the dimensions of the data by extracting a group of factors that best represented the original data. The resulting factor weights are then used in the weighting of the individual indicators to construct the PCI components.

In this context, PCA is used to cluster individual indicators and capture the information common to individual indicators into a latent factor. In the PCI framework, weights are applied to the indicators to capture their common information. Moreover, such weights only measure the explanatory capability of each of the indicators in terms of the overall variance in the data, and therefore do not imply any form of ranking of their theoretical importance.

The first step in PCA is to check the correlation structure of the data, thus explaining the variance of the observed data through a few linear combinations of the original data. Correlated principal components indicate that they are measuring the same domain, while lack of correlation highlights divergence of latent structures of the variables. Then, a certain number of latent factors are identified to represent the data. In this context, each of the selected factors fulfil the following binding constraints:

- The factor's eigenvalue is greater than one; and
- The factor explains at least 10 per cent of total variance.

Finally, the PCI category scores are built on the F_i scores of the rotated factors, weighted by their respective share of total explained volatility. The scores are standardized as below.

$$X_i^{PCA} = \frac{F_{i,o} - F_{i,min}}{F_{i,max} - F_{i,min}} \quad (5)$$

d. Computing the PCI

The overall PCI scores are obtained by aggregating the individual scores for each of the eight categories. This is done by using the geometric mean, instead of the arithmetic mean because the geometric mean reduces the level of substitutability between dimensions and is less sensitive to outliers, thus reducing the effect of skewed PCI components. This choice is fully justified by the theoretical framework underlying the productive capacities, where a balanced mix of inputs is necessary to foster economic development.

$$PCI = \sqrt[N]{\Pi_{i=1}^{N} X_i^{PCA}} \quad (6)$$

Where X_i^{PCA} are the scores of PCI categories extracted using principal component analysis.

The final step is to estimate the significance and internal consistency of each category. This is done using Cronbach's alpha, a widely used measure for assessing the reliability or internal consistency of a set of scale or test items. Generally, the higher the Cronbach's alpha, the more intercorrelated the indicators are among themselves. For this reason, Cronbach's alpha was applied to assess the level to which the set of indicators for each category adequately represent a single unidimensional latent construct, namely, the PCI categories, and how the categories correspond to the overall PCI. The Cronbach's alpha is defined as:

$$\alpha = \frac{M_i}{M_{i-1}} \left(1 - \frac{\sum_{j=1}^{M_i} \sigma_{I_{j,i}}}{\sigma_i}\right) \quad (7)$$

Where M_i is the total number of weighted indicators in the category i, $\sigma_{I_{j,i}}$ is the variance of the indicator j and σ_i is the total variance of the category i.

Interested readers will find a practical illustration of this step in the methodological note referred to above. The indicators and the data sources used in constructing the PCI and its subindices are outlined in the table below.

Annex Table 3.1

Indicators used in constructing the PCI and its subindices

Category	Indicator Name	Source
Energy	Share of people with access to electricity	World Bank, Sustainable Energy for All (SE4ALL)
	Transmission and distribution losses as share of primary supply	IEA Statistics © OECD/IEA
	Renewable energy consumption (share of total final energy consumption)	World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.
	GDP per kg of oil consumption	IEA Statistics © OECD/IEA 2014 (iea.org/stats/index.asp), subject to iea.org/t&c/termsandconditions
	Total primary energy supply per capita	IEA Statistics © OECD
	Total energy consumption per capita	IEA Statistics © OECD

Annex Table 3.1 (continued)

Category	Indicator Name	Source
Human capital	Expected years of schooling (years)	UN Development Program
	Research and development expenditure (share of GDP)	UNESCO Institute for Statistics
	Researchers in R&D per million people	UNESCO Institute for Statistics
	Health Adjusted Life expectancy (years)	IHME, http://ghdx.healthdata.org/gbd-2017
	Health expenditures (% GDP)	World Health Organization Global Health Expenditure database
	Fertility rate	United Nations Population Division. World Population Prospects: 2019 Revision. (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) United Nations Statistical Division. Population and Vital Statistics Report (various years), (5) U.S. Census Bureau: International Database, and (6) Secretariat of the Pacific Community: Statistics and Demography Programme.
Information & Communication Technologies	Fixed broadband subscriptions per 100 people	International Telecommunication Union (ITU)
	Number of mobile subscriptions per 100 people	International Telecommunication Union, World Telecommunication/ICT Development Report and database.
	Number of fixed lines per 100 people	International Telecommunication Union, World Telecommunication/ICT Development Report and database.
	Secure internet servers per million population	WDI (Infrastructure)
	Number of internet users (percent of population)	International Telecommunication Union, World Telecommunication/ICT Development Report and database.
Institutions	Control of corruption	World Governance Indicators
	Government effectiveness	World Governance Indicators
	Political Stability and Absence of Violence/Terrorism	World Governance Indicators
	Regulatory quality	World Governance Indicators
	Rule of law	World Governance Indicators
	Voice and accountability	World Governance Indicators
Natural capital	Agricultural land (share of land area)	Food and Agriculture Organization
	Forest area (share of land area)	Food and Agriculture Organization
	All extraction flows over GDP	http://www.materialflows.net/
	Material Intensity	Own computation on UN Stat National Accounts – Analysis of Main Aggregates (AMA) and materialflows.net. Material Intensity is the total extraction flows over industrial value added
	Total natural resources rent (share GDP)	Sustainable Development Goals
Private sector	Domestic credit to private sector (% of GDP)	International Monetary Fund, International Financial Statistics
	Cost to export a container	World Bank, Doing Business project
	Time to export (days)	World Bank, Doing Business project
	Cost to import a container	World Bank, Doing Business project
	Time to import (days)	World Bank, Doing Business project
	Enforcing contracts (time to enforce days)	WDI (Private Sector)
	Starting a business (time in days)	World Bank, Doing Business project
	Trademarks applications	WIPO
	Patent Applications	WIPO
Structural change	Export concentration index	UNCTADStat
	Economic complexity index (value)	Own Computation on trade data (UNCTAD)
	Gross fixed capital formation (% of GDP)	UN Stats, https://unstats.un.org/unsd/snaama/
	Industrial ratio	Own computation on UN Stat National Accounts – Analysis of Main Aggregates (AMA). Industrial ratio is Industry and Services over total GDP
Transport	Air transport registered carrier departures worldwide per 100 people	International Civil Aviation Organization
	Air transport freight (million ton-km)	International Civil Aviation Organization
	Air passenger per capita	Own computation
	Logarithm of km roads / 100 sq. km. land	International Road Federation, World Road Statistics
	Logarithm of total km rail lines per capita	Own computation on WDI Database Archives