GLOBAL
KNOWLEDGE
INDEX

2024

GLOBAL KNOWLEDGE INDEX

2024

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Preface

Welcome to the 2024 edition of the Global Knowledge Index (GKI), a critical resource designed to illuminate the paths to knowledge-driven development and resilience in an ever-evolving world. Now a cornerstone of knowledge measurement worldwide, the GKI was created through the ongoing partnership between the United Nations Development Programme - Regional Bureau for Arab States (UNDP RBAS) and the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF). Since its inception in 2017, this collaboration has advanced the understanding of knowledge as a powerful driver for prosperity, resilience, and inclusive growth across diverse societies.

In an era of accelerating change and unprecedented global challenges, the GKI stands out as a vital tool for translating complex knowledge ecosystems into actionable insights. The 2024 GKI builds on this foundation, offering an adaptable, data-rich resource to inform policies that are both resilient and forward-looking. This edition is part of our shared mission to empower stakeholders—from policymakers to educators and innovators—to harness the transformative potential of knowledge in a world where adaptability and foresight have become essential for sustainable development.

Structured around seven composite sub-indices, GKI 2024 evaluates six critical knowledge pillars—pre-university education; technical and vocational education and training; higher education; research, development and innovation; information and communications technology; and economy. A seventh sub-index, the enabling environment, provides a lens into the socio-economic, governance, health, and environmental factors that shape and support these pillars. Continuing with the refined 2021 methodology, the GKI's insights reflect a balanced, rigorous approach to addressing both emerging trends and longstanding challenges in these areas.

We are pleased to present the 2024 GKI as a dynamic platform for progress, inspiring data-driven action toward inclusive, sustainable, and knowledge-based societies. To dive deeper into the index's country-specific data, methodology, and comprehensive glossary of terms and sources, we invite you to explore our interactive platform at www.knowledge4all.org.

Rankings GKI 2024

Rank	Country	Value
1	Sweden	68.3
2	Finland	68
3	Switzerland	67.9
4	Denmark	66.8
5	Netherlands	66.8
6	Luxembourg	66.5
7	United States	66.2
8	United Kingdom	65.8
9	Norway	65.8
10	Austria	65
11	Belgium	64.7
12	Canada	64.5
13	Singapore	64.2
14	Estonia	64
15	Iceland	63.8
16	Germany	63.7
17	Australia	63.4
18	Israel	63.2
19	Malta	62.8
20	Slovenia	62.7
21	Korea (Republic of)	62.3
22	Ireland	61.7
23	France	61.7
24	New Zealand	61.3
25	Portugal	61.2
26	United Arab Emirates	60.9
27	Czechia	60.4
28	Spain	60.3
29	Hong Kong, China (SAR)	60.1
30	Cyprus	59.9
31	Latvia	59.5
32	Italy	59.1
33	Lithuania	58.8
34	Croatia	58.2
35	Poland	57.6
36	Slovakia	57.2
37	Hungary	56.2
38	Bulgaria	56.1
39	Qatar	55.5
40	Serbia	54.8
41	Saudi Arabia	54.8
42	Romania	54.4
43	Chile	53.4
44	Montenegro	53.3
45	Seychelles	53
46	Malaysia	52.8
47	Greece	52.6
48	North Macedonia	52.6
49	China	51.6

Rank	Country	Value
50	Belarus	51.4
51	Uruguay	51.4
52	Mauritius	50.9
53	Georgia	50.2
54	Brunei Darussalam	50.1
55	Oman	50
56	Barbados	49.9
57	Thailand	49.9
58	Costa Rica	49.6
59	Türkiye	49.2
60	Colombia	49.1
61	Russian Federation	48.4
62	Ukraine	48.2
63	Albania	48
64	Armenia	48
65	Mongolia	47.6
66	Peru	47.6
67	Brazil	47.4
68	Bosnia and Herzegovina	47.2
69	Argentina	47.2
70	Viet Nam	46.8
71	Philippines	46.7
72	Kazakhstan	46.6
73	Moldova (Republic of)	46.4
74	Cabo Verde	46.3
75	Bolivia (Plurinational State of)	46.3
76	Mexico	46.1
77	Panama	46.1
78	Uzbekistan	45.9
79	Botswana	45.7
80	Jamaica	45.7
81	Lebanon	45.3
82	Tunisia	45
83	Indonesia	45
84	South Africa	44.7
85	Ecuador	44.7
86	Guyana	44.6
87	Kyrgyzstan	44.5
88	Jordan	44.2
89	Suriname	44.2
90	Egypt	44
91	Dominican Republic	43.9
92	India	43.8
93	Sri Lanka	43.7
94	Bhutan	43.7
95	Namibia	43.6
96	Samoa	43.4
97	Palestine, State of	42.9
98	Morocco	42.8

Rank	Country	Value
99	Paraguay	42.8
100	Azerbaijan	42.4
101	El Salvador	40.7
102	Iran (Islamic Republic of)	40.6
103	Nigeria	40.3
104	Rwanda	40.3
105	Guatemala	39.9
106	Kenya	39.5
107	Nicaragua	38.8
108	Zimbabwe	38.6
109	Cambodia	38.2
110	Zambia	38.1
111	Eswatini (Kingdom of)	37.8
112	Nepal	37.7
113	Bangladesh	37.5
114	Ghana	37.4
115	Honduras	37.2
116	Malawi	36.9
117	Lao People's Democratic Republic	36.6
118	Lesotho	36
119	Senegal	35.2
120	Pakistan	35
121	Liberia	35
122	Uganda	35
123	Myanmar	34.8
124	Cameroon	34.7
125	Côte d'Ivoire	34.2
126	Sierra Leone	33.7
127	Togo	33.6
128	Benin	32.5
129	Tanzania (United Republic of)	32.3
130	Madagascar	31.7
131	Burundi	31.4
132	Guinea	30.2
133	Mozambique	30
134	Mali	29
135	Mauritania	29
136	Ethiopia	28.9
137	Burkina Faso	28.2
138	Angola	28
139	Congo (Democratic Republic of the)	26.3
140	Niger	25.8
141	Chad	23.4
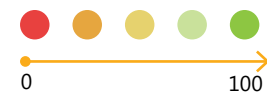
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Heat Map

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Rank	Country	GKI	Pre-university education	Technical and vocational education and training	Higher education	Research, development and innovation	Information and communications technology	Economy	Enabling environment
1	Sweden	68.3	79.8	61.8	61.7	56.3	74.6	68.7	84.7
2	Finland	68	81.2	67.3	59.3	52.4	74.2	67.8	84.6
3	Switzerland	67.9	82.2	58.1	64.6	55.5	69.9	70.6	84.9
4	Denmark	66.8	77	57.7	60.6	52	73.6	74.8	83.3
5	Netherlands	66.8	79.7	68.1	60.7	51.5	71.6	65.8	78.8
6	Luxembourg	66.5	77.2	62.9	67.9	48.2	71.1	66.7	81.7
7	United States	66.2	83.3	58.7	63.9	54.2	70.5	71.1	65.8
8	United Kingdom	65.8	78.3	57.1	62.5	55.4	71.9	66.4	75.9
9	Norway	65.8	78.6	66.6	63	42.4	71.7	67.2	86.6
10	Austria	65	77.9	67.4	61.1	46.3	65.2	68.1	79.1
11	Belgium	64.7	83	64.8	61.6	46.7	62.3	67.7	76.8
12	Canada	64.5	90.2	59.2	58.2	44.7	67	70.5	74.5
13	Singapore	64.2	73.3	51.7	52.7	49	76.5	79.8	81.6
14	Estonia	64	78	62.5	59.9	44.5	73.2	64.9	75.7
15	Iceland	63.8	72.9	62.7	60.5	40.9	73.6	65.6	88.4
16	Germany	63.7	73.5	63.3	58.6	49.2	64.9	66.8	77.9
17	Australia	63.4	79.1	63	57.1	47	64.6	67.1	76
18	Israel	63.2	71.3	54.3	60.6	56.8	68.5	68.9	64.8
19	Malta	62.8	77.3	52.7	57.4	47.1	71.1	70.1	74
20	Slovenia	62.7	80.4	65.9	60.1	41.7	63.5	63.7	75.2
21	Korea (Republic of)	62.3	82.6	53.6	46.6	51.7	71.9	71.6	68
22	Ireland	61.7	65.2	59.5	53.7	46	66.3	72.4	81.4
23	France	61.7	78.8	55.3	52.1	47.8	67.9	66	74.4
24	New Zealand	61.3	71.2	65.1	53.3	42.1	64.7	67	78.8
25	Portugal	61.2	85	62.7	59.6	38.4	60.4	61.3	76.8
26	United Arab Emirates	60.9	74.5	64.2	49.7	40.7	73.7	69.5	63.1
27	Czechia	60.4	77.5	61.9	55.8	40.6	59.4	66.1	73.4
28	Spain	60.3	77.8	61.1	54.4	40.8	65.1	61.5	72.7
29	Hong Kong, China (SAR)	60.1	76.8	53.9	49.6	46.1	70.7	81.4	47.8
30	Cyprus	59.9	75.5	50.6	62.5	45.6	64.9	59.1	70
31	Latvia	59.5	77.9	62.2	55.8	34.4	65.3	64.6	71.1
32	Italy	59.1	76.5	62.1	51.5	44.2	58.5	60.4	69.1
33	Lithuania	58.8	78.7	56.8	54.2	34.4	67.3	63.7	73
34	Croatia	58.2	72.9	60.2	57.4	36.6	62.9	60	68.9
35	Poland	57.6	83.9	57.5	54	33.9	62.2	59.5	68.3
36	Slovakia	57.2	74.9	68.4	56.4	32.5	57.4	57.3	68.6
37	Hungary	56.2	69.9	66.7	47.1	34.5	59.9	61.8	66.7
38	Bulgaria	56.1	71.5	60.3	55.5	35.4	59.9	58	61.5
39	Qatar	55.5	74.6	54.8	57.8	30.2	55.9	66.9	63.5
40	Serbia	54.8	75.8	63.9	48.6	33	60.7	54.6	59.7
41	Saudi Arabia	54.8	84	43.2	44.4	38.7	73.5	60.5	52.9
42	Romania	54.4	63.1	60.9	53.5	33.5	56.3	60.4	64.1
43	Chile	53.4	72.7	51.4	46.4	31.2	62	58.7	68.8
44	Montenegro	53.3	75.2	53.9	60.2	29.3	55.2	52.5	61.4
45	Seychelles	53	73.5	47.5	54.3	36.6	51	57.4	60.1

Rank	Country	GKI	Pre-university education	Technical and vocational education and training	Higher education	Research, development and innovation	Information and communications technology	Economy	Enabling environment
46	Malaysia	52.8	60.5	50.5	44.5	38	59.9	63.3	61.1
47	Greece	52.6	72	46	47.4	38.1	56.7	54.3	65
48	North Macedonia	52.6	72.3	60	53.6	29.6	52.6	54.3	58.4
49	China	51.6	75	75.1	17.2	46	64.8	60.9	57.2
50	Belarus	51.4	85.3	58.9	48.2	29.4	52.9	48.9	51.2
51	Uruguay	51.4	68.9	50.7	50.9	26.8	55.9	52.2	78.4
52	Mauritius	50.9	76.6	52.5	38.9	28.7	53.5	60.7	65.7
53	Georgia	50.2	77.3	50.9	49.4	27.1	48.7	54.7	60.7
54	Brunei Darussalam	50.1	67.6	54.1	49.8	22.9	62	51.2	65.9
55	Oman	50	71.2	59.9	40.7	28.4	57.9	54.4	50.2
56	Barbados	49.9	72.8	44	45.6	32.6	55	51.3	61.9
57	Thailand	49.9	70	50.6	37.4	32.2	52.1	63.2	57.4
58	Costa Rica	49.6	70.8	54.1	47	26.1	51.6	48.9	69.5
59	Türkiye	49.2	68	57.5	37.7	33.6	52.6	54	50.1
60	Colombia	49.1	72.1	49.2	47.9	32.2	47.7	50.5	54.1
61	Russian Federation	48.4	77.3	48.8	44.2	29.2	52.8	50.1	48.3
62	Ukraine	48.2	70.9	51.5	44.7	29.1	55.9	44.3	52.5
63	Albania	48	65.8	43.3	51.2	31.8	49.8	45.7	60.3
64	Armenia	48	71.4	40.2	50.9	28.7	53.5	49.2	55.8
65	Mongolia	47.6	69.6	54	38.7	27.6	49.4	52.5	55.7
66	Peru	47.6	62.4	43.4	52.4	31.7	44	55.6	51.1
67	Brazil	47.4	67.4	53	40.2	29.3	52.8	46.9	53.6
68	Bosnia and Herzegovina	47.2	50.1	62.3	50.9	26.4	50	48.7	53.1
69	Argentina	47.2	64.9	53.2	50.2	27.7	48.7	41.7	56.6
70	Viet Nam	46.8	68.3	52.8	34.7	27.2	47.4	58	55.4
71	Philippines	46.7	62.3	57.2	47	24.9	46.3	51.4	49.8
72	Kazakhstan	46.6	73.5	43.8	42.9	23.2	51.9	53.8	57.4
73	Moldova (Republic of)	46.4	71.1	46.6	40.9	22.8	54.6	52.1	56
74	Cabo Verde	46.3	68.5	46	43.2	29.7	39.8	48.7	65.5
75	Bolivia (Plurinational State of)	46.3	75.4	63.6	51.1	22.4	40.3	43	48.8
76	Mexico	46.1	64.3	54.1	45.1	22.1	47.6	54.3	51.4
77	Panama	46.1	55.5	48.2	45.2	24.2	49.2	55.8	59.6
78	Uzbekistan	45.9	73.8	47	41.1	26.4	44.5	52.3	50.4
79	Botswana	45.7	57.7	53.3	41.3	29.4	39.1	53.1	58.8
80	Jamaica	45.7	65.4	53.3	46.3	24.4	43.1	46	57.7
81	Lebanon	45.3	47.1	45.8	51.1	45.5	42.8	47.7	35.4
82	Tunisia	45	67.7	51	37.6	28.7	43.8	47	51.2
83	Indonesia	45	51.1	50.2	45.5	23	49.6	56.1	53.2
84	South Africa	44.7	50.7	49.5	38.2	32.3	48.8	49	49.9
85	Ecuador	44.7	70.2	48.1	42.2	26.8	40.5	45.3	54.2
86	Guyana	44.6	66.9	53.6	52.7	19.3	36.4	52.9	52.4
87	Kyrgyzstan	44.5	76.3	51.4	43.8	22	44.9	45	45
88	Jordan	44.2	61.7	45.2	34	27.6	49.2	52	51.8
89	Suriname	44.2	47.6	54.1	50.3	31.6	44.1	37.5	50.4
90	Egypt	44	63.4	56.2	37	28.5	42.3	47.7	41.2
91	Dominican Republic	43.9	57.3	42.1	49.8	25.2	41.4	48.4	57
92	India	43.8	58.3	40.4	38	30.6	45.8	55.1	45.3
93	Sri Lanka	43.7	66.1	53.8	38.4	25.3	40.5	44.5	51.6
94	Bhutan	43.7	63.1	37.1	47.8	22.6	40.2	52.4	64.7

Rank	Country	GKI	Pre-university education	Technical and vocational education and training	Higher education	Research, development and innovation	Information and communications technology	Economy	Enabling environment
95	Namibia	43.6	52	60.2	39.7	26.5	36.5	46	60.3
96	Samoa	43.4	64.6	47.2	49.6	22.8	33.3	46.7	61
97	Palestine, State of	42.9	70.6	52.6	37.5	28.4	33	47.7	43.1
98	Morocco	42.8	58	45.2	37.7	26.2	46.3	46.3	49.5
99	Paraguay	42.8	53.5	46.4	51.9	19.6	44.6	45.9	54.9
100	Azerbaijan	42.4	62.4	51.1	38.2	23.1	44.2	44.4	45.6
101	El Salvador	40.7	56.7	43.6	36.7	24.3	36.6	49.1	49.8
102	Iran (Islamic Republic of)	40.6	58.4	52	31.4	30	40.8	40.5	37.6
103	Nigeria	40.3	45.3	47.7	53.6	31.2	28.4	45.2	35.7
104	Rwanda	40.3	44.8	52.2	32.9	26.8	37.8	43.8	56.6
105	Guatemala	39.9	38.5	50.7	40.4	28.8	35.2	48.9	41.6
106	Kenya	39.5	59.6	40.3	32.6	26.2	34.9	46.9	47.6
107	Nicaragua	38.8	39.9	53.7	36.7	26.7	33.3	43.7	46.2
108	Zimbabwe	38.6	49.2	47.8	32.6	35.8	31.1	36.9	41.5
109	Cambodia	38.2	40.6	48.5	33.9	21.9	39.1	49	44.7
110	Zambia	38.1	48.4	43.7	32.9	26.3	30.1	48.6	47.2
111	Eswatini (Kingdom of)	37.8	49.8	45	34.2	29	33.8	37.1	41.1
112	Nepal	37.7	58.3	37.8	35.6	20.2	36.2	42.1	48.1
113	Bangladesh	37.5	50.7	49.7	33.3	20.4	33.6	46.4	39.9
114	Ghana	37.4	51.5	41.5	33.9	20.8	40.5	36.2	51.8
115	Honduras	37.2	43.6	56	40.8	19.3	30.6	41.3	42.8
116	Malawi	36.9	37.2	36.4	48.6	32.7	23.4	42.2	47.3
117	Lao People's Democratic Republic	36.6	41.3	42	38	22.6	31.4	42.8	47.9
118	Lesotho	36	49.6	56.2	34.6	18	25.5	43.5	42.8
119	Senegal	35.2	36.9	43.4	35.5	18.7	33.8	43.3	47.6
120	Pakistan	35	44.7	42.3	36.1	18.8	31.8	45.3	34.8
121	Liberia	35	37.1	36.4	43.6	31.4	19.6	45.9	40.7
122	Uganda	35	34.5	37.8	38	25.5	24.7	46.8	48.7
123	Myanmar	34.8	46.6	38.8	23.9	25.3	32.4	47.3	38.3
124	Cameroon	34.7	38.2	43.8	26.4	35.8	28.3	35.3	39.9
125	Côte d'Ivoire	34.2	39.4	40.8	35	16.1	33.6	44.5	43.7
126	Sierra Leone	33.7	43.2	35.9	59.7	20.6	21.9	32.1	38.9
127	Togo	33.6	39.1	43.5	32.9	15.5	31.3	43.5	44.3
128	Benin	32.5	33.6	35.6	26.5	27	29.7	38.3	43.8
129	Tanzania (United Republic of)	32.3	34.4	35.8	27.3	21.2	26.8	43.7	51.4
130	Madagascar	31.7	30.3	38.4	40.9	22.4	22.2	37.3	38.4
131	Burundi	31.4	33.1	38.7	39.1	28.1	17.9	32.7	38.9
132	Guinea	30.2	24.4	39.6	35.1	19	30.9	36	32.8
133	Mozambique	30	38.8	25.9	34	20	20.1	44.1	39.9
134	Mali	29	24.5	35.5	28.5	24.7	23.6	38.4	32.7
135	Mauritania	29	32.6	31.8	22.5	23.7	26.2	34.4	37.3
136	Ethiopia	28.9	32.7	38.8	26.7	17.2	18.2	40.9	45.1
137	Burkina Faso	28.2	29.5	36	29.3	17.8	20.7	36	37.6
138	Angola	28	30.4	35.3	37	11.1	28.1	29	42.9
139	Congo (Democratic Republic of the)	26.3	27.6	25.8	19.4	19.8	25.4	41.2	32.8
140	Niger	25.8	18.8	42.3	25.3	16.9	20	33.5	38.5
141	Chad	23.4	22.7	27.8	27.1	15.5	17.7	31.8	27.2

Sectoral Indices

PRE-UNIVERSITY EDUCATION

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

HIGHER EDUCATION

RESEARCH, DEVELOPMENT AND INNOVATION

INFORMATION AND COMMUNICATIONS TECHNOLOGY

ECONOMY

ENABLING ENVIRONMENT

Pre-university education

Rank	Country	Value
1	Canada	90.2
2	Belarus	85.3
3	Portugal	85
4	Saudi Arabia	84
5	Poland	83.9
6	United States	83.3
7	Belgium	83
8	Korea (Republic of)	82.6
9	Switzerland	82.2
10	Finland	81.2
11	Slovenia	80.4
12	Sweden	79.8
13	Netherlands	79.7
14	Australia	79.1
15	France	78.8
16	Lithuania	78.7
17	Norway	78.6
18	United Kingdom	78.3
19	Estonia	78
20	Austria	77.9
21	Latvia	77.9
22	Spain	77.8
23	Czechia	77.5
24	Georgia	77.3
25	Malta	77.3
26	Russian Federation	77.3
27	Luxembourg	77.2
28	Denmark	77
29	Hong Kong, China (SAR)	76.8
30	Mauritius	76.6
31	Italy	76.5
32	Kyrgyzstan	76.3
33	Serbia	75.8
34	Cyprus	75.5
35	Bolivia (Plurinational State of)	75.4
36	Montenegro	75.2
37	China	75
38	Slovakia	74.9
39	Qatar	74.6
40	United Arab Emirates	74.5
41	Uzbekistan	73.8
42	Kazakhstan	73.5
43	Germany	73.5
44	Seychelles	73.5
45	Singapore	73.3
46	Croatia	72.9
47	Iceland	72.9
48	Barbados	72.8
49	Chile	72.7

Rank	Country	Value
50	North Macedonia	72.3
51	Colombia	72.1
52	Greece	72
53	Bulgaria	71.5
54	Armenia	71.4
55	Israel	71.3
56	New Zealand	71.2
57	Oman	71.2
58	Moldova (Republic of)	71.1
59	Ukraine	70.9
60	Costa Rica	70.8
61	Palestine, State of	70.6
62	Ecuador	70.2
63	Thailand	70
64	Hungary	69.9
65	Mongolia	69.6
66	Uruguay	68.9
67	Cabo Verde	68.5
68	Viet Nam	68.3
69	Turkey	68
70	Tunisia	67.7
71	Brunei Darussalam	67.6
72	Brazil	67.4
73	Guyana	66.9
74	Sri Lanka	66.1
75	Albania	65.8
76	Jamaica	65.4
77	Ireland	65.2
78	Argentina	64.9
79	Samoa	64.6
80	Mexico	64.3
81	Egypt	63.4
82	Bhutan	63.1
83	Romania	63.1
84	Peru	62.4
85	Azerbaijan	62.4
86	Philippines	62.3
87	Jordan	61.7
88	Malaysia	60.5
89	Kenya	59.6
90	Iran (Islamic Republic of)	58.4
91	Nepal	58.3
92	India	58.3
93	Morocco	58
94	Botswana	57.7
95	Dominican Republic	57.3
96	El Salvador	56.7
97	Panama	55.5
98	Paraguay	53.5
99	Namibia	52

Rank	Country	Value
100	Ghana	51.5
101	Indonesia	51.1
102	South Africa	50.7
103	Bangladesh	50.7
104	Bosnia and Herzegovina	50.1
105	Eswatini (Kingdom of)	49.8
106	Lesotho	49.6
107	Zimbabwe	49.2
108	Zambia	48.4
109	Suriname	47.6
110	Lebanon	47.1
111	Myanmar	46.6
112	Nigeria	45.3
113	Rwanda	44.8
114	Pakistan	44.7
115	Honduras	43.6
116	Sierra Leone	43.2
117	Lao People›s Democratic Republic	41.3
118	Cambodia	40.6
119	Nicaragua	39.9
120	Côte d'Ivoire	39.4
121	Togo	39.1
122	Mozambique	38.8
123	Guatemala	38.5
124	Cameroon	38.2
125	Malawi	37.2
126	Liberia	37.1
127	Senegal	36.9
128	Uganda	34.5
129	Tanzania (United Republic of)	34.4
130	Benin	33.6
131	Burundi	33.1
132	Ethiopia	32.7
133	Mauritania	32.6
134	Angola	30.4
135	Madagascar	30.3
136	Burkina Faso	29.5
137	Congo (Democratic Republic of the)	27.6
138	Mali	24.5
139	Guinea	24.4
140	Chad	22.7
141	Niger	18.8

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Technical and vocational education and training

Rank	Country	Value	
1	China	75.1	
2	Slovakia	68.4	
3	Netherlands	68.1	
4	Austria	67.4	
5	Finland	67.3	
6	Hungary	66.7	
7	Norway	66.6	
8	Slovenia	65.9	
9	New Zealand	65.1	
10	Belgium	64.8	
11	United Arab Emirates	64.2	
12	Serbia	63.9	
13	Bolivia (Plurinational State of)	63.6	
14	Germany	63.3	
15	Australia	63	
16	Luxembourg	62.9	
17	Portugal	62.7	
18	Iceland	62.7	
19	Estonia	62.5	
20	Bosnia and Herzegovina	62.3	
21	Latvia	62.2	
22	Italy	62.1	
23	Czechia	61.9	
24	Sweden	61.8	
25	Spain	61.1	
26	Romania	60.9	
27	Bulgaria	60.3	
28	Croatia	60.2	
29	Namibia	60.2	
30	North Macedonia	60	
31	Oman	59.9	
32	Ireland	59.5	
33	Canada	59.2	
34	Belarus	58.9	
35	United States	58.7	
36	Switzerland	58.1	
37	Denmark	57.7	
38	Türkiye	57.5	
39	Poland	57.5	
40	Philippines	57.2	
41	United Kingdom	57.1	
42	Lithuania	56.8	
43	Egypt	56.2	
44	Lesotho	56.2	
45	Honduras	56	
46	France	55.3	
47	Qatar	54.8	
48	Israel	54.3	

Rank	Country	Value	
49	Brunei Darussalam	54.1	
50	Suriname	54.1	
51	Costa Rica	54.1	
52	Mexico	54.1	
53	Mongolia	54	
54	Montenegro	53.9	
55	Hong Kong, China (SAR)	53.9	
56	Sri Lanka	53.8	
57	Nicaragua	53.7	
58	Korea (Republic of)	53.6	
59	Guyana	53.6	
60	Botswana	53.3	
61	Jamaica	53.3	
62	Argentina	53.2	
63	Brazil	53	
64	Viet Nam	52.8	
65	Malta	52.7	
66	Palestine, State of	52.6	
67	Mauritius	52.5	
68	Rwanda	52.2	
69	Iran (Islamic Republic of)	52	
70	Singapore	51.7	
71	Ukraine	51.5	
72	Kyrgyzstan	51.4	
73	Chile	51.4	
74	Azerbaijan	51.1	
75	Tunisia	51	
76	Georgia	50.9	
77	Guatemala	50.7	
78	Uruguay	50.7	
79	Cyprus	50.6	
80	Thailand	50.6	
81	Malaysia	50.5	
82	Indonesia	50.2	
83	Bangladesh	49.7	
84	South Africa	49.5	
85	Colombia	49.2	
86	Russian Federation	48.8	
87	Cambodia	48.5	
88	Panama	48.2	
89	Ecuador	48.1	
90	Zimbabwe	47.8	
91	Nigeria	47.7	
92	Seychelles	47.5	
93	Samoa	47.2	
94	Uzbekistan	47	
95	Moldova (Republic of)	46.6	
96	Paraguay	46.4	

Rank	Country	Value	
97	Greece	46	
98	Cabo Verde	46	
99	Lebanon	45.8	
100	Morocco	45.2	
101	Jordan	45.2	
102	Eswatini (Kingdom of)	45	
103	Barbados	44	
104	Cameroon	43.8	
105	Kazakhstan	43.8	
106	Zambia	43.7	
107	El Salvador	43.6	
108	Togo	43.5	
109	Peru	43.4	
110	Senegal	43.4	
111	Albania	43.3	
112	Saudi Arabia	43.2	
113	Pakistan	42.3	
114	Niger	42.3	
115	Dominican Republic	42.1	
116	Lao People's Democratic Republic	42	
117	Ghana	41.5	
118	Côte d'Ivoire	40.8	
119	India	40.4	
120	Kenya	40.3	
121	Armenia	40.2	
122	Guinea	39.6	
123	Ethiopia	38.8	
124	Myanmar	38.8	
125	Burundi	38.7	
126	Madagascar	38.4	
127	Nepal	37.8	
128	Uganda	37.8	
129	Bhutan	37.1	
130	Malawi	36.4	
131	Liberia	36.4	
132	Burkina Faso	36	
133	Sierra Leone	35.9	
134	Tanzania (United Republic of)	35.8	
135	Benin	35.6	
136	Mali	35.5	
137	Angola	35.3	
138	Mauritania	31.8	
139	Chad	27.8	
140	Mozambique	25.9	
141	Congo (Democratic Republic of the)	25.8	

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Higher education

Rank	Country	Value		Rank	Country	Value		Rank	Country	Value
1	Luxembourg	67.9		51	Suriname	50.3		101	Lao People's Democratic Republic	38
2	Switzerland	64.6		52	Argentina	50.2		102	Morocco	37.7
3	United States	63.9		53	Dominican Republic	49.8		103	Türkiye	37.7
4	Norway	63		54	Brunei Darussalam	49.8		104	Tunisia	37.6
5	Cyprus	62.5		55	United Arab Emirates	49.7		105	Palestine, State of	37.5
6	United Kingdom	62.5		56	Hong Kong, China (SAR)	49.6		106	Thailand	37.4
7	Sweden	61.7		57	Samoa	49.6		107	Egypt	37
8	Belgium	61.6		58	Georgia	49.4		108	Angola	37
9	Austria	61.1		59	Malawi	48.6		109	El Salvador	36.7
10	Netherlands	60.7		60	Serbia	48.6		110	Nicaragua	36.7
11	Denmark	60.6		61	Belarus	48.2		111	Pakistan	36.1
12	Israel	60.6		62	Colombia	47.9		112	Nepal	35.6
13	Iceland	60.5		63	Bhutan	47.8		113	Senegal	35.5
14	Montenegro	60.2		64	Greece	47.4		114	Guinea	35.1
15	Slovenia	60.1		65	Hungary	47.1		115	Côte d'Ivoire	35
16	Estonia	59.9		66	Costa Rica	47		116	Viet Nam	34.7
17	Sierra Leone	59.7		67	Philippines	47		117	Lesotho	34.6
18	Portugal	59.6		68	Korea (Republic of)	46.6		118	Eswatini (Kingdom of)	34.2
19	Finland	59.3		69	Chile	46.4		119	Jordan	34
20	Germany	58.6		70	Jamaica	46.3		120	Mozambique	34
21	Canada	58.2		71	Barbados	45.6		121	Cambodia	33.9
22	Qatar	57.8		72	Indonesia	45.5		122	Ghana	33.9
23	Malta	57.4		73	Panama	45.2		123	Bangladesh	33.3
24	Croatia	57.4		74	Mexico	45.1		124	Togo	32.9
25	Australia	57.1		75	Ukraine	44.7		125	Zambia	32.9
26	Slovakia	56.4		76	Malaysia	44.5		126	Rwanda	32.9
27	Latvia	55.8		77	Saudi Arabia	44.4		127	Kenya	32.6
28	Czechia	55.8		78	Russian Federation	44.2		128	Zimbabwe	32.6
29	Bulgaria	55.5		79	Kyrgyzstan	43.8		129	Iran (Islamic Republic of)	31.4
30	Spain	54.4		80	Liberia	43.6		130	Burkina Faso	29.3
31	Seychelles	54.3		81	Cabo Verde	43.2		131	Mali	28.5
32	Lithuania	54.2		82	Kazakhstan	42.9		132	Tanzania (United Republic of)	27.3
33	Poland	54		83	Ecuador	42.2		133	Chad	27.1
34	Ireland	53.7		84	Botswana	41.3		134	Ethiopia	26.7
35	Nigeria	53.6		85	Uzbekistan	41.1		135	Benin	26.5
36	North Macedonia	53.6		86	Madagascar	40.9		136	Cameroon	26.4
37	Romania	53.5		87	Moldova (Republic of)	40.9		137	Niger	25.3
38	New Zealand	53.3		88	Honduras	40.8		138	Myanmar	23.9
39	Singapore	52.7		89	Oman	40.7		139	Mauritania	22.5
40	Guyana	52.7		90	Guatemala	40.4		140	Congo (Democratic Republic of the)	19.4
41	Peru	52.4		91	Brazil	40.2		141	China	17.2
42	France	52.1		92	Namibia	39.7				
43	Paraguay	51.9		93	Burundi	39.1				
44	Italy	51.5		94	Mauritius	38.9				
45	Albania	51.2		95	Mongolia	38.7				
46	Lebanon	51.1		96	Sri Lanka	38.4				
47	Bolivia (Plurinational State of)	51.1		97	South Africa	38.2				
48	Bosnia and Herzegovina	50.9		98	Azerbaijan	38.2				
49	Armenia	50.9		99	Uganda	38				
50	Uruguay	50.9		100	India	38				

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Research, development and innovation

Rank	Country	Value		Rank	Country	Value		Rank	Country	Value
1	Israel	56.8		49	Malawi	32.7		97	Costa Rica	26.1
2	Sweden	56.3		50	Barbados	32.6		98	Uganda	25.5
3	Switzerland	55.5		51	Slovakia	32.5		99	Myanmar	25.3
4	United Kingdom	55.4		52	South Africa	32.3		100	Sri Lanka	25.3
5	United States	54.2		53	Colombia	32.2		101	Dominican Republic	25.2
6	Finland	52.4		54	Thailand	32.2		102	Philippines	24.9
7	Denmark	52		55	Albania	31.8		103	Mali	24.7
8	Korea (Republic of)	51.7		56	Peru	31.7		104	Jamaica	24.4
9	Netherlands	51.5		57	Suriname	31.6		105	El Salvador	24.3
10	Germany	49.2		58	Liberia	31.4		106	Panama	24.2
11	Singapore	49		59	Nigeria	31.2		107	Mauritania	23.7
12	Luxembourg	48.2		60	Chile	31.2		108	Kazakhstan	23.2
13	France	47.8		61	India	30.6		109	Azerbaijan	23.1
14	Malta	47.1		62	Qatar	30.2		110	Indonesia	23
15	Australia	47		63	Iran (Islamic Republic of)	30		111	Brunei Darussalam	22.9
16	Belgium	46.7		64	Cabo Verde	29.7		112	Samoa	22.8
17	Austria	46.3		65	North Macedonia	29.6		113	Moldova (Republic of)	22.8
18	Hong Kong, China (SAR)	46.1		66	Belarus	29.4		114	Bhutan	22.6
19	China	46		67	Botswana	29.4		115	Lao People's Democratic Republic	22.6
20	Ireland	46		68	Brazil	29.3		116	Bolivia (Plurinational State of)	22.4
21	Cyprus	45.6		69	Montenegro	29.3		117	Madagascar	22.4
22	Lebanon	45.5		70	Russian Federation	29.2		118	Mexico	22.1
23	Canada	44.7		71	Ukraine	29.1		119	Kyrgyzstan	22
24	Estonia	44.5		72	Eswatini (Kingdom of)	29		120	Cambodia	21.9
25	Italy	44.2		73	Guatemala	28.8		121	Tanzania (United Republic of)	21.2
26	Norway	42.4		74	Armenia	28.7		122	Ghana	20.8
27	New Zealand	42.1		75	Tunisia	28.7		123	Sierra Leone	20.6
28	Slovenia	41.7		76	Mauritius	28.7		124	Bangladesh	20.4
29	Iceland	40.9		77	Egypt	28.5		125	Nepal	20.2
30	Spain	40.8		78	Oman	28.4		126	Mozambique	20
31	United Arab Emirates	40.7		79	Palestine, State of	28.4		127	Congo (Democratic Republic of the)	19.8
32	Czechia	40.6		80	Burundi	28.1		128	Paraguay	19.6
33	Saudi Arabia	38.7		81	Argentina	27.7		129	Guyana	19.3
34	Portugal	38.4		82	Jordan	27.6		130	Honduras	19.3
35	Greece	38.1		83	Mongolia	27.6		131	Guinea	19
36	Malaysia	38		84	Viet Nam	27.2		132	Pakistan	18.8
37	Seychelles	36.6		85	Georgia	27.1		133	Senegal	18.7
38	Croatia	36.6		86	Benin	27		134	Lesotho	18
39	Cameroon	35.8		87	Ecuador	26.8		135	Burkina Faso	17.8
40	Zimbabwe	35.8		88	Rwanda	26.8		136	Ethiopia	17.2
41	Bulgaria	35.4		89	Uruguay	26.8		137	Niger	16.9
42	Hungary	34.5		90	Nicaragua	26.7		138	Côte d'Ivoire	16.1
43	Latvia	34.4		91	Namibia	26.5		139	Togo	15.5
44	Lithuania	34.4		92	Bosnia and Herzegovina	26.4		140	Chad	15.5
45	Poland	33.9		93	Uzbekistan	26.4		141	Angola	11.1
46	Türkiye	33.6		94	Zambia	26.3				
47	Romania	33.5		95	Kenya	26.2				
48	Serbia	33		96	Morocco	26.2				

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Information and communications technology

Rank	Country	Value		Rank	Country	Value		Rank	Country	Value	
1	Singapore	76.5		49	Ukraine	55.9		97	Cabo Verde	39.8	
2	Sweden	74.6		50	Qatar	55.9		98	Botswana	39.1	
3	Finland	74.2		51	Montenegro	55.2		99	Cambodia	39.1	
4	United Arab Emirates	73.7		52	Barbados	55		100	Rwanda	37.8	
5	Denmark	73.6		53	Moldova (Republic of)	54.6		101	El Salvador	36.6	
6	Iceland	73.6		54	Mauritius	53.5		102	Namibia	36.5	
7	Saudi Arabia	73.5		55	Armenia	53.5		103	Guyana	36.4	
8	Estonia	73.2		56	Belarus	52.9		104	Nepal	36.2	
9	United Kingdom	71.9		57	Russian Federation	52.8		105	Guatemala	35.2	
10	Korea (Republic of)	71.9		58	Brazil	52.8		106	Kenya	34.9	
11	Norway	71.7		59	Türkiye	52.6		107	Senegal	33.8	
12	Netherlands	71.6		60	North Macedonia	52.6		108	Eswatini (Kingdom of)	33.8	
13	Luxembourg	71.1		61	Thailand	52.1		109	Bangladesh	33.6	
14	Malta	71.1		62	Kazakhstan	51.9		110	Côte d'Ivoire	33.6	
15	Hong Kong, China (SAR)	70.7		63	Costa Rica	51.6		111	Samoa	33.3	
16	United States	70.5		64	Seychelles	51		112	Nicaragua	33.3	
17	Switzerland	69.9		65	Bosnia and Herzegovina	50		113	Palestine, State of	33	
18	Israel	68.5		66	Albania	49.8		114	Myanmar	32.4	
19	France	67.9		67	Indonesia	49.6		115	Pakistan	31.8	
20	Lithuania	67.3		68	Mongolia	49.4		116	Lao People's Democratic Republic	31.4	
21	Canada	67		69	Jordan	49.2		117	Togo	31.3	
22	Ireland	66.3		70	Panama	49.2		118	Zimbabwe	31.1	
23	Latvia	65.3		71	South Africa	48.8		119	Guinea	30.9	
24	Austria	65.2		72	Argentina	48.7		120	Honduras	30.6	
25	Spain	65.1		73	Georgia	48.7		121	Zambia	30.1	
26	Cyprus	64.9		74	Colombia	47.7		122	Benin	29.7	
27	Germany	64.9		75	Mexico	47.6		123	Nigeria	28.4	
28	China	64.8		76	Viet Nam	47.4		124	Cameroon	28.3	
29	New Zealand	64.7		77	Morocco	46.3		125	Angola	28.1	
30	Australia	64.6		78	Philippines	46.3		126	Tanzania (United Republic of)	26.8	
31	Slovenia	63.5		79	India	45.8		127	Mauritania	26.2	
32	Croatia	62.9		80	Kyrgyzstan	44.9		128	Lesotho	25.5	
33	Belgium	62.3		81	Paraguay	44.6		129	Congo (Democratic Republic of the)	25.4	
34	Poland	62.2		82	Uzbekistan	44.5		130	Uganda	24.7	
35	Brunei Darussalam	62		83	Azerbaijan	44.2		131	Mali	23.6	
36	Chile	62		84	Suriname	44.1		132	Malawi	23.4	
37	Serbia	60.7		85	Peru	44		133	Madagascar	22.2	
38	Portugal	60.4		86	Tunisia	43.8		134	Sierra Leone	21.9	
39	Hungary	59.9		87	Jamaica	43.1		135	Burkina Faso	20.7	
40	Malaysia	59.9		88	Lebanon	42.8		136	Mozambique	20.1	
41	Bulgaria	59.9		89	Egypt	42.3		137	Niger	20	
42	Czechia	59.4		90	Dominican Republic	41.4		138	Liberia	19.6	
43	Italy	58.5		91	Iran (Islamic Republic of)	40.8		139	Ethiopia	18.2	
44	Oman	57.9		92	Sri Lanka	40.5		140	Burundi	17.9	
45	Slovakia	57.4		93	Ecuador	40.5		141	Chad	17.7	
46	Greece	56.7		94	Ghana	40.5					
47	Romania	56.3		95	Bolivia (Plurinational State of)	40.3					
48	Uruguay	55.9		96	Bhutan	40.2					

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Economy

Rank	Country	Value		Rank	Country	Value		Rank	Country	Value	
1	Hong Kong, China (SAR)	81.4		50	Panama	55.8		99	Paraguay	45.9	
2	Singapore	79.8		51	Peru	55.6		100	Liberia	45.9	
3	Denmark	74.8		52	India	55.1		101	Albania	45.7	
4	Ireland	72.4		53	Georgia	54.7		102	Ecuador	45.3	
5	Korea (Republic of)	71.6		54	Serbia	54.6		103	Pakistan	45.3	
6	United States	71.1		55	Oman	54.4		104	Nigeria	45.2	
7	Switzerland	70.6		56	North Macedonia	54.3		105	Kyrgyzstan	45	
8	Canada	70.5		57	Greece	54.3		106	Sri Lanka	44.5	
9	Malta	70.1		58	Mexico	54.3		107	Côte d'Ivoire	44.5	
10	United Arab Emirates	69.5		59	Türkiye	54		108	Azerbaijan	44.4	
11	Israel	68.9		60	Kazakhstan	53.8		109	Ukraine	44.3	
12	Sweden	68.7		61	Botswana	53.1		110	Mozambique	44.1	
13	Austria	68.1		62	Guyana	52.9		111	Rwanda	43.8	
14	Finland	67.8		63	Mongolia	52.5		112	Nicaragua	43.7	
15	Belgium	67.7		64	Montenegro	52.5		113	Tanzania (United Republic of)	43.7	
16	Norway	67.2		65	Bhutan	52.4		114	Lesotho	43.5	
17	Australia	67.1		66	Uzbekistan	52.3		115	Togo	43.5	
18	New Zealand	67		67	Uruguay	52.2		116	Senegal	43.3	
19	Qatar	66.9		68	Moldova (Republic of)	52.1		117	Bolivia (Plurinational State of)	43	
20	Germany	66.8		69	Jordan	52		118	Lao People's Democratic Republic	42.8	
21	Luxembourg	66.7		70	Philippines	51.4		119	Malawi	42.2	
22	United Kingdom	66.4		71	Barbados	51.3		120	Nepal	42.1	
23	Czechia	66.1		72	Brunei Darussalam	51.2		121	Argentina	41.7	
24	France	66		73	Colombia	50.5		122	Honduras	41.3	
25	Netherlands	65.8		74	Russian Federation	50.1		123	Congo (Democratic Republic of the)	41.2	
26	Iceland	65.6		75	Armenia	49.2		124	Ethiopia	40.9	
27	Estonia	64.9		76	El Salvador	49.1		125	Iran (Islamic Republic of)	40.5	
28	Latvia	64.6		77	Cambodia	49		126	Mali	38.4	
29	Lithuania	63.7		78	South Africa	49		127	Benin	38.3	
30	Slovenia	63.7		79	Guatemala	48.9		128	Suriname	37.5	
31	Malaysia	63.3		80	Costa Rica	48.9		129	Madagascar	37.3	
32	Thailand	63.2		81	Belarus	48.9		130	Eswatini (Kingdom of)	37.1	
33	Hungary	61.8		82	Cabo Verde	48.7		131	Zimbabwe	36.9	
34	Spain	61.5		83	Bosnia and Herzegovina	48.7		132	Ghana	36.2	
35	Portugal	61.3		84	Zambia	48.6		133	Burkina Faso	36	
36	China	60.9		85	Dominican Republic	48.4		134	Guinea	36	
37	Mauritius	60.7		86	Lebanon	47.7		135	Cameroon	35.3	
38	Saudi Arabia	60.5		87	Palestine, State of	47.7		136	Mauritania	34.4	
39	Romania	60.4		88	Egypt	47.7		137	Niger	33.5	
40	Italy	60.4		89	Myanmar	47.3		138	Burundi	32.7	
41	Croatia	60		90	Tunisia	47		139	Sierra Leone	32.1	
42	Poland	59.5		91	Brazil	46.9		140	Chad	31.8	
43	Cyprus	59.1		92	Kenya	46.9		141	Angola	29	
44	Chile	58.7		93	Uganda	46.8					
45	Bulgaria	58		94	Samoa	46.7					
46	Viet Nam	58		95	Bangladesh	46.4					
47	Seychelles	57.4		96	Morocco	46.3					
48	Slovakia	57.3		97	Namibia	46					
49	Indonesia	56.1		98	Jamaica	46					

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Enabling environment

Rank	Country	Value	
1	Iceland	88.4	
2	Norway	86.6	
3	Switzerland	84.9	
4	Sweden	84.7	
5	Finland	84.6	
6	Denmark	83.3	
7	Luxembourg	81.7	
8	Singapore	81.6	
9	Ireland	81.4	
10	Austria	79.1	
11	New Zealand	78.8	
12	Netherlands	78.8	
13	Uruguay	78.4	
14	Germany	77.9	
15	Belgium	76.8	
16	Portugal	76.8	
17	Australia	76	
18	United Kingdom	75.9	
19	Estonia	75.7	
20	Slovenia	75.2	
21	Canada	74.5	
22	France	74.4	
23	Malta	74	
24	Czechia	73.4	
25	Lithuania	73	
26	Spain	72.7	
27	Latvia	71.1	
28	Cyprus	70	
29	Costa Rica	69.5	
30	Italy	69.1	
31	Croatia	68.9	
32	Chile	68.8	
33	Slovakia	68.6	
34	Poland	68.3	
35	Korea (Republic of)	68	
36	Hungary	66.7	
37	Brunei Darussalam	65.9	
38	United States	65.8	
39	Mauritius	65.7	
40	Cabo Verde	65.5	
41	Greece	65	
42	Israel	64.8	
43	Bhutan	64.7	
44	Romania	64.1	
45	Qatar	63.5	
46	United Arab Emirates	63.1	
47	Barbados	61.9	
48	Bulgaria	61.5	
49	Montenegro	61.4	

Rank	Country	Value	
50	Malaysia	61.1	
51	Samoa	61	
52	Georgia	60.7	
53	Namibia	60.3	
54	Albania	60.3	
55	Seychelles	60.1	
56	Serbia	59.7	
57	Panama	59.6	
58	Botswana	58.8	
59	North Macedonia	58.4	
60	Jamaica	57.7	
61	Thailand	57.4	
62	Kazakhstan	57.4	
63	China	57.2	
64	Dominican Republic	57	
65	Argentina	56.6	
66	Rwanda	56.6	
67	Moldova (Republic of)	56	
68	Armenia	55.8	
69	Mongolia	55.7	
70	Viet Nam	55.4	
71	Paraguay	54.9	
72	Ecuador	54.2	
73	Colombia	54.1	
74	Brazil	53.6	
75	Indonesia	53.2	
76	Bosnia and Herzegovina	53.1	
77	Saudi Arabia	52.9	
78	Ukraine	52.5	
79	Guyana	52.4	
80	Ghana	51.8	
81	Jordan	51.8	
82	Sri Lanka	51.6	
83	Mexico	51.4	
84	Tanzania (United Republic of)	51.4	
85	Belarus	51.2	
86	Tunisia	51.2	
87	Peru	51.1	
88	Suriname	50.4	
89	Uzbekistan	50.4	
90	Oman	50.2	
91	Türkiye	50.1	
92	South Africa	49.9	
93	Philippines	49.8	
94	El Salvador	49.8	
95	Morocco	49.5	
96	Bolivia (Plurinational State of)	48.8	
97	Uganda	48.7	

Rank	Country	Value	
98	Russian Federation	48.3	
99	Nepal	48.1	
100	Lao People's Democratic Republic	47.9	
101	Hong Kong, China (SAR)	47.8	
102	Kenya	47.6	
103	Senegal	47.6	
104	Malawi	47.3	
105	Zambia	47.2	
106	Nicaragua	46.2	
107	Azerbaijan	45.6	
108	India	45.3	
109	Ethiopia	45.1	
110	Kyrgyzstan	45	
111	Cambodia	44.7	
112	Togo	44.3	
113	Benin	43.8	
114	Côte d'Ivoire	43.7	
115	Palestine, State of	43.1	
116	Angola	42.9	
117	Honduras	42.8	
118	Lesotho	42.8	
119	Guatemala	41.6	
120	Zimbabwe	41.5	
121	Egypt	41.2	
122	Eswatini (Kingdom of)	41.1	
123	Liberia	40.7	
124	Mozambique	39.9	
125	Bangladesh	39.9	
126	Cameroon	39.9	
127	Burundi	38.9	
128	Sierra Leone	38.9	
129	Niger	38.5	
130	Madagascar	38.4	
131	Myanmar	38.3	
132	Iran (Islamic Republic of)	37.6	
133	Burkina Faso	37.6	
134	Mauritania	37.3	
135	Nigeria	35.7	
136	Lebanon	35.4	
137	Pakistan	34.8	
138	Guinea	32.8	
139	Congo (Democratic Republic of the)	32.8	
140	Mali	32.7	
141	Chad	27.2	

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Executive Summary

Statistical Methodology

The Global Knowledge Index (GKI) consists of seven sub-indices – pre-university education; technical and vocational education and training; higher education; research, development and innovation (RDI); information and communications technology (ICT); economy; and enabling environment – each of which is constructed in accordance with standard international methodologies for the design of composite indicators.[1]

The structure of the Index features a hierarchy comprising sectoral indices (referred to as sub-indices), pillars, sub-pillars and variables. Each of the sub-indices has a weight of 15 percent, except for enabling environment, which is assigned a weight of 10 percent (Figure 1).

Figure 1: GKI structure
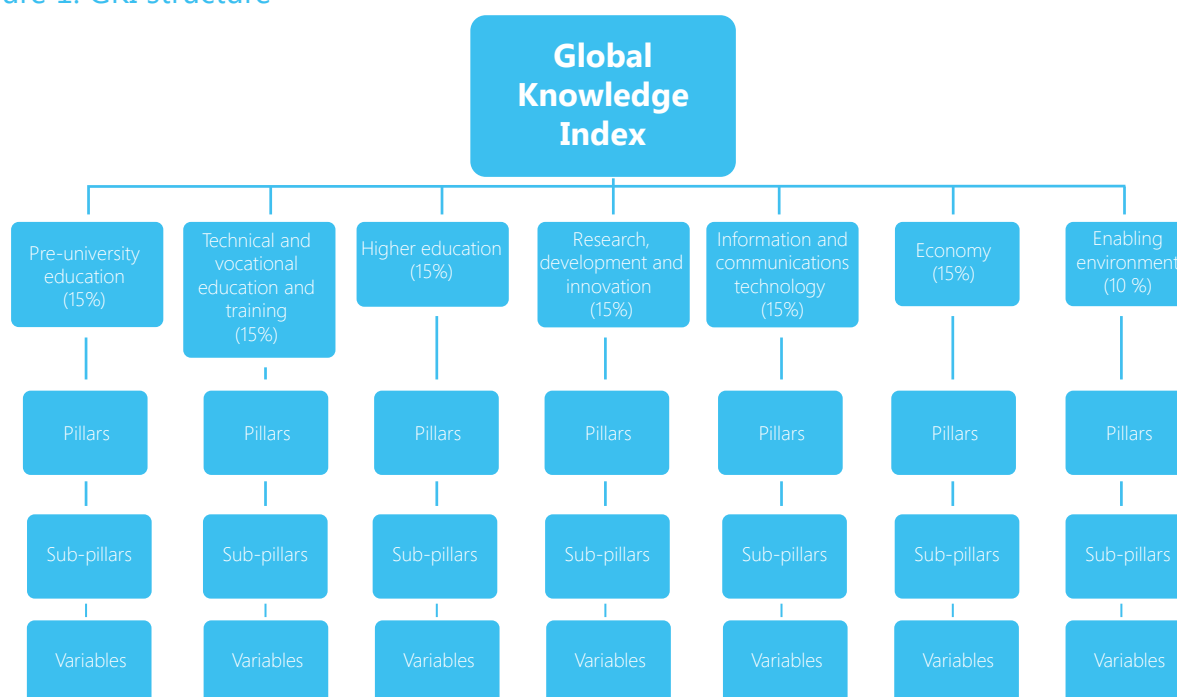
SELECTION OF VARIABLES

The selection of variables included in the construction of each of the seven sub-indices is based on a clearly defined scientific methodology drawn from an extensive review of relevant local and international literature, as well as the experiences of, and concepts employed by, international organizations and agencies such as the European Commission's Competence Centre on Composite Indicators and Scoreboards.[2] It also relies on an intensive consultation process that took place in 2021 and engaged high-level advisory board members from different countries with a variety of different backgrounds and affiliations, all specialized in fields related to the sectors of the GKI. This process began

with a mapping of the proposed variables (i.e. whether the variable is still reported or has been discontinued) while also assessing their methodologies and limitations. A complementary mapping exercise was undertaken to list variables capturing emerging trends that could potentially be included within the new structure of the Index. Focus group meetings were also held to discuss the propositions and feedback from the advisory board, chaired by the core team members who prepared the report. Based on these discussions and focused workshops, final structures – including pillars, sub-pillars and variables – were produced.

A factor analysis is used to confirm the consistency of the selected variables and the structure of their classification within the various sub-indices, further supporting the consistency of the broader conceptual context across the variables and sub-groups – for which the explained variance ratio in most cases exceeded 65 percent.[3]

The results of the in-depth correlation analysis and Cronbach's Alpha coefficient (exceeding 0.70 in most cases) confirmed the validity of the selection and classification of the variables. Furthermore, the correlation matrix for normalized variables was analysed to ensure that they followed the same direction as the composite index.

DATA COLLECTION

The 155 variables employed in the 2024 GKI are drawn from over 40 international sources and databases, including those of the United Nations Educational, Scientific and Cultural Organization (UNESCO); the World Bank; the International Telecommunication Union (ITU); the World Economic Forum (WEF); the International Monetary Fund (IMF); the Organisation for Economic Co-operation and Development (OECD); the International Labour Organization (ILO) and other United Nations agencies and international organizations. The collected data is reviewed multiple times to ensure no errors had occurred during data entry; consequently, data is processed on the assumption that it is error-free. Also, all variables are taken in relative terms, and for those not linked to other size-dependent variables – such as population or GDP – results are recalculated after adjusting for the effect of size. Variables included are in the form of either hard data, composite indicators or survey questions/responses.

The most recent data for each variable within the period 2014–2024 is used.[4] As a prerequisite, data employed in the construction of the sub-indices had to meet certain statistical criteria. This applies to all sub-indices and for all countries. Where no data for a variable was available for at least half of the countries, such variable was excluded from the structure.

Missing data are not estimated or imputed; instead, they are left blank and excluded from the sub-pillar aggregation. This means that missing variables do not count as zero for a country; rather, they are excluded from the calculation of sub-pillars.

DATA TREATMENT

Outliers are identified using the skewness and kurtosis measures, which are considered less invasive compared to the interquartile range and z-score measures. Outliers were treated, as they often lead to biased rankings and misinterpretations of results. Given that the min-max normalization technique is adopted, outliers' identification is required whereby as few observations as possible will be treated.

It was deemed necessary to treat variables when the absolute skewness coefficient is above 2.25, and absolute kurtosis coefficient above 3.5.[5] Variables with skewness lower than the threshold defined but with absolute kurtosis above 10 are also treated.

By applying the rules for identifying outliers through severe skewness and severe kurtosis in the data, the team found 34 variables with outliers that required treatment.

The methods adopted follow the COINr tool package, an R-based and Excel-based software tool to help develop and analyse composite indicators and scoreboards.[6]

Variables with identified outliers are then treated to be prepared for normalization and aggregation with the goal of treating as few observations as possible. Variables with fewer than five outliers are treated using the Winsorization technique – treating only few potentially problematic observations by capping values so they fall at the edge of the main distribution. In cases of positive skewness, these values are assigned the second-highest value, while in cases of negative skewness, they are assigned the second-lowest value until skewness or kurtosis fell within the desired ranges.

If applying Winsorization to at most five observations did not sufficiently correct skewness or kurtosis, the logarithmic transformation[7] is employed for variables with positive skewness and the second power was applied for variables with negative skewness. These two methods transform all the values in the indicator.

Table 1 displays the frequency distribution of these outlying variables according to their respective sub-indices and the treatment methods used.

Table 1: Frequency distribution of GKI variables with outliers, by treatment method

Sub-index	Treatment		Total count
	Winsorization	Logarithmic or square root transformation	
Pre-university education	3	-	3
Technical and vocational education and training	4	-	4
Higher education	6	-	6
Research, development and innovation	4	4	8
Information and communications technology	3	4	7
Economy	5	-	5
Enabling environment	1	-	1
Total	**26**	**8**	**34**

For example, in the pre-university education sub-index, within the variable 'pupil-trained teacher ratio in primary education', outliers were identified and were treated, using the Winsorization technique, whereas in the information and communications technology sub-index, within the variable 'fixed-broadband basket (% GNI per capita)', outliers were identified and treated using logarithmic transformation. A detailed list of the outlying GKI 2024 variables with the sector they belong to, and the treatment method applied is presented in Table 2.

Table 2: Data treatment

	Data treatment	Outliers
Pre-university education		
Pupil-trained teacher ratio in primary education	Winsorization	2
Pupil-trained teacher ratio in secondary education	Winsorization	2
Pupil-trained teacher ratio in pre-primary education	Winsorization	5
Technical and vocational education and training		
Share of students enrolled in post-secondary vocational programmes	Winsorization	3
Average monthly earnings for high-skill TVET occupations relative to total average wage	Winsorization	1
Average monthly earnings for medium-skill TVET occupations relative to total average wage	Winsorization	1
Unemployment rate with vocational education	Winsorization	1
Higher education		
Teaching staff compensation (% tertiary expenditure)	Winsorization	1
Pupil-teacher ratio in tertiary education	Winsorization	1
Teachers in tertiary education, gender parity	Winsorization	2
Inbound mobility rate	Winsorization	2
Educational attainment rate, doctoral or equivalent	Winsorization	3
Citable documents per R&D personnel in higher education	Winsorization	2
Research, development and innovation		
Intellectual property payments (% total trade)	Winsorization	4
Resident patent applications (per 100 billion GDP)	Logarithmic transformation	-
Intellectual property receipts (% total trade)	Square root transformation	-
Industrial design applications (per 100 billion GDP)	Logarithmic transformation	-
PCT applications (per 100 billion GDP)	Winsorization	5
Cultural goods exports (% exports)	Logarithmic transformation	-
Printing and publishing output (% manufactured output)	Winsorization	3
Research institutions prominence	Winsorization and square root transformation	-
Information and communications technology		
3G/4G mobile network coverage (% population)	Winsorization	2
Secure Internet servers per 1 million population	Logarithmic transformation	-
Investment in telecommunication services (% GDP)	Winsorization	2
Fixed broadband basket (% GNI per capita)	Logarithmic transformation	-
Mobile broadband basket (% GNI per capita)	Winsorization	1
International Internet bandwidth per user	Logarithmic transformation	-
ICT PCT patent applications (per 100 billion GDP)	Logarithmic transformation	-
Economy		
Trade (% GDP)	Winsorization	1
High-technology trade (% total trade)	Winsorization	1
Foreign direct investment, net inflows (% GDP)	Winsorization	4
Tax and contribution rate (% profit)	Winsorization	1
Bank non-performing loans (%)	Winsorization	2
Enabling Environment		
Female-to-male ratio in Internet usage	Winsorization	2

NORMALIZATION

A rescaling of variables onto a common scale to permit comparability among variables with different units of measurement and ranges of variation is performed. The min-max method is used for normalization, prior to aggregation, where the values of variables are normalized into the [0,100] range, in which higher values indicated better results. The normalization criterion depends on whether the variable has a positive or a negative relationship with the overall Index.

Variables with a positive relationship are normalized using the following formula:

$$\textit{Normalized value} = \frac{\textit{Country value - Minimum sample value}}{\textit{Maximum sample value - Minimum sample value}} \times 100$$

In the case of variables with an inverse relationship, the formula is adjusted as follows:

$$\textit{Normalized value} = \frac{\textit{Maximum sample value - Country sample value}}{\textit{Maximum sample value - Minimum sample value}} \times 100$$

For survey data or composite indices, the theoretical ranges of values are retained in the form of minimum and maximum values; for instance, in the case of the [1,7] range for the World Economic Forum Executive Opinion Survey variables, the minimum and maximum are kept as 1 and 7, respectively, regardless of the observed minimum and maximum.

INDEX WEIGHTING

Weighting across the different components of the Index (sub-indices, pillars and sub-pillars) is not unified; rather, it varies according to the nature of the components and their relative importance. Weightings identified for the seven constituent sub-indices ranges from equal weighting and budget allocation to factor analysis. Equal weights are used in the absence of any clear evidence of a diversity of significance among variables, as well as in the absence of sound and complete information concerning the existence of causal relationships, or where a lack of consensus exists on a classical method for estimating weights. The budget allocation process method is also used for weighting. A group of specialists and experienced experts were each given a budget consisting of 100 points to allocate across the variables. If the variable was believed to have greater relative importance, it was allocated a greater number of points. Subsequently, the weights were calculated according to the average of the total points allocated to each variable.[8]

The weights are also assessed using factor analysis, which is based on aggregating the linked sub-indicators to form a single factor containing as much information as possible that is shared between the linked indicators. The weights produced by using both the budget allocation and factor analysis methods are consistent with each other and with the initial weight estimates, based on the intellectual and conceptual framework.

All sub-indices have equal weights across all hierarchies except for the research, development and innovation (RDI) sub-index, due to theoretical reasons outlined under the section on the RDI sub-index.

INDEX CALCULATION

The 2024 GKI is calculated for 141 countries, using the most recent and reliable available data to calculate the variables for each country, with 2014 as a cut-off year.

Owing to the lack of availability of data covering all the components for each country, and in view of the need to maintain a sufficient level of accuracy, the composite index is calculated in a bottom-up approach by applying a series of successive aggregations. Consequently, pillars are calculated using at least half of their sub-pillars, whereas sub-pillars require at least one variable. The availability of at least two-thirds of the pillars is required to calculate the sub-index. The overall GKI is calculated only if data for all seven sub-indices are available.

The arithmetic aggregation formula is used to calculate all sub-indices, pillars and sub-pillars of the Index. The composite indicator *(CI)* is calculated by aggregating its sub-components *(SC)* as follows:

$$CI = \sum_{j=1}^{n} W_j \times SC_j$$

CI is the proposed composite indicator to be computed (sub-index, pillar or sub-pillar); w_j is the relative weight of the sub-component **SC (pillar, sub-pillar, or variable)**; and **n** is the number of sub-components aggregated to form the composite indicator.

The geometric mean was used to compute the overall Global Knowledge Index, given that no perfect substitutability exists among the seven sectoral indices. Looking into the ranking differences between the arithmetic and geometric aggregation of the overall Index, only 3 countries differed by 5 ranks; 4 countries by 6 ranks; 1 country by 7 ranks; 3 countries by 8 ranks; 2 countries by 9 ranks; and 1 country by 10 ranks.

Pre-university education sub-index

The pre-university education sub-index, covering the stage of pre-primary education through the end of secondary education, was established as one of the branches of the Global Knowledge Index to serve as a systematic tool for measuring the performance of the pre-university education system at various stages. Various consultations with experts have confirmed the significance of this achievement. Statistical procedures have revealed encouraging indicators regarding the soundness of the sub-index structure and the consistency and stability of its components.

The structure of the pre-university education sub-index

The sub-index comprises two interactive pillars: knowledge capital and educational enabling environment, with each containing several sub-pillars.

The first pillar: Knowledge capital

The sub-index measures knowledge capital as one of the main goals of educational systems, with the necessity to highlight the contextual variables that are directly related and influential in the value and quality of the educational output; i.e., the set of inputs and processes that enable the student to achieve the desired objectives.

The knowledge capital pillar consists of three sub-pillars: enrolment, completion and outcomes:

» The enrolment sub-pillar: employs rates of the extent to which countries are able to provide access to education institutions at all levels, from pre-school education to the end of secondary education. This sub-pillar includes three variables:

- Net enrolment rate in primary education
- Net enrolment rate in lower secondary education
- Net enrolment rate in upper secondary education.

» Completion sub-pillar: Two important aspects are taken into consideration when selecting the variables for this sub-pillar: a legislative aspect related to compulsory education, and a realistic aspect related to actual completion. The variables in this sub-pillar are as follows:

- Number of years of compulsory primary and secondary education guaranteed in legal frameworks
- Completion rate in upper secondary education
- Gross intake ratio to the last grade of lower secondary education.

» As for the outcomes sub-pillar, the variables employed are the 'assessment of 15-year-old students in mathematics, science and reading', as well as another variable that relates to student learning: learning-adjusted years of schooling.

The second pillar: Educational enabling environment

This pillar encompasses sub-pillars of expenditure, resources (which include variables that relate more closely to the learning environment), early learning, and a fourth sub-pillar recognizing the increasing significance of equity and inclusiveness in international charters, and their close connection with the right to education. Below is a detailed description of the sub-pillars and their rationale:

» Regarding the expenditure sub-pillar, higher rates of enrolment in education entail increased expenditure on education, as this requires the construction of school buildings, the preparation of teachers, the provision of educational devices and aids, and other necessary services. As such, countries must spend on education to ensure its continuity and improve its internal and external efficiencies. Expenditure on education is often measured as a percentage of a country's budget or GDP. Accordingly, the expenditure sub-pillar includes four variables relating to different integrated aspects of government spending, as follows:

- Government expenditure on primary education (% GDP);

- Government expenditure on secondary education (% GDP)
- Government funding per primary student (% GDP per capita)
- Government funding per secondary student (% GDP per capita).

» Concerning the resources sub-pillar, the human capital entrusted with the task of teaching is a key factor that is no less important than expenditure on education. Without highly qualified and well-trained education cadres, education goals and curricula cannot be effectively translated into reality and will remain largely theoretical. While we are certain that a proper approach to measuring this factor requires a number of variables in relation to teachers' preparation, continuous training and professional self-development, given the scarcity of data, only two variables were included in relation to the availability of trained teachers:

- Pupil–trained teacher ratio in primary education (headcount basis)
- Pupil–trained teacher ratio in secondary education (headcount basis).

The early learning sub-pillar highlights the role of learning in building children's personalities and preparing them cognitively, emotionally and socially for learning in the subsequent stages of education. This sub-pillar includes four variables:

- Gross enrolment ratio in early childhood education
- Proportion of children aged 24–59 months who are developmentally on track in terms of health, learning and psychosocial well-being
- Proportion of children under five years experiencing positive and stimulating home learning environments
- Pupil-trained teacher ratio in pre-primary education (headcount basis).

» The equity and inclusiveness sub-pillar was determined in line with the principle of the sustainable development agenda of 'leaving no one behind', where equity and inclusiveness should be given special attention. A number of significant variables were suggested in relation to the differences between students in reading, mathematics and science scores by gender, location, immigration, disability, and guaranteed level of inclusion in primary and secondary education for students with disabilities.

However, in view of the scarcity of such data and the difficulty of measuring aspects of equity in education beyond the issue of parity, three main dimensions were taken into account: gender, location and wealth:

- Completion rate in upper secondary education, gender parity
- Completion rate in upper secondary education, wealth parity
- Completion rate of upper secondary education, location parity.

Figure 2: Structure of the pre-university education sub-index
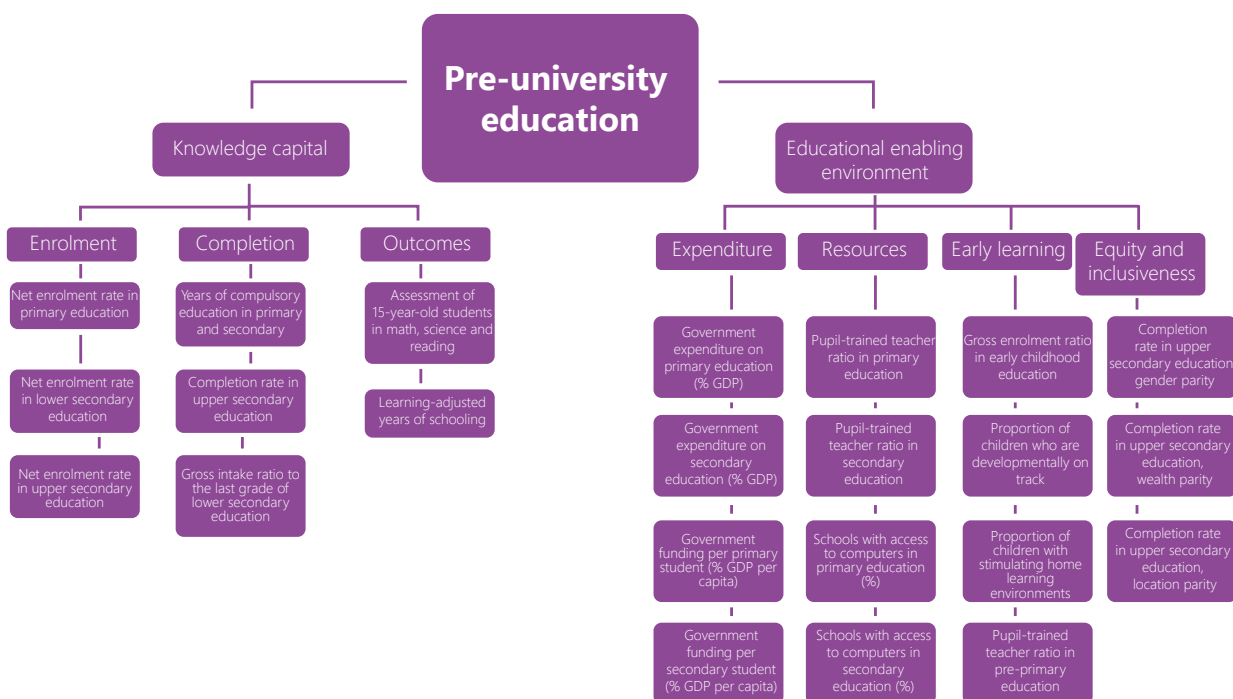
Technical and vocational education and training (TVET) sub-index

The GKI considers TVET to be an essential sector that combines training and qualifications of the human capital at the professional level and one of the most critical sectors linked to the labour market. Meeting labour market requirements and integrating them into academic courses and curricula is a complex process that is subject to the fluctuations of the economy, competitiveness and international conditions. Professions come and go rapidly, making it difficult to respond quickly to changing requirements. Proactive policy adoption is therefore required based on a long-term vision, rather than economic fluctuations.

The structure of the TVET sub-index

The structure of the sub-index is based on a methodological foundation built on numerous relevant international studies. These studies focus on creating a balanced view of the sector, built on fundamental rights in education and training as one of the pillars of the Sustainable Development Goals established by the United Nations' 2030 Sustainable Development Agenda. Therefore, quantitative variables such as enrolment and completion were linked to qualitative variables, as is the case for extent of staff training and quality of vocational training.

The economic structure, especially in terms of its relation to contemporary and knowledge transformations, has an essential role in this approach. Therefore, the sub-index measures the extent to which national economies are able to diversify their offerings and modernize their structures to ensure both their positive interaction with education and training systems, and their positive contribution to the development of human capital. There are three main factors that affect the structure of the economy and the dynamics of social systems today: the environment of the economy, the structure of the labour market, and qualifications. These factors

are all interconnected and enable societies to respond to challenges, including most notably the integration of young people into their economies.[9]

The sub-index also focuses on the element of training efficiency and the principles of fairness and inclusivity. It underscores the role of education and training integration in combating poverty and social exclusion, especially within productive environments.

It emphasizes the importance of certain indicators that delineate the dynamic equation between the training structure and the labour market. These indicators are key to evaluating the training and development system's ability to interact positively with labour market constraints and determinants, such as unemployment and qualifications.

Data availability and source quality represented determining factors in the adoption of new variables. Hence, the structure of the TVET sub-index remains both realistic and credible.

Thus, the structure of the TVET sub-index comprises two pillars:

The first pillar: TVET components

This pillar monitors the structures of TVET institutions, the qualifications they provide, and their ability to diversify their educational offerings and make them available to various segments of society—especially females. This relates primarily to factors including enrolment and graduation ratios at all levels, as well as the nature and size of the human resources working in the sector—especially trainers and teachers—and the ability to

leverage continuous training programmes to achieve improvements in quality. This pillar is divided into three sub-pillars:

» The first sub-pillar is continuous training and skilling. It is measured through the following variables: percentage of firms offering formal training; labour force participation rate with short-cycle tertiary education; and participation rate of youth and adults

in formal and non-formal education and training.

» The second sub-pillar focuses on TVET structure. It is measured through the following three variables: government expenditure on secondary, post-secondary and non-tertiary vocational education (%); share of all students in secondary education enrolled in vocational programmes; and share of all students in post-secondary non-tertiary education enrolled in vocational programmes.

» The third and final sub-pillar focuses on TVET quality and qualifications and is measured through the following variables: extent of staff training; quality of vocational training; average monthly earnings for high-skill TVET occupations relative to total average wage; and average monthly earnings for medium-skill TVET occupations relative to total average wage.

The second pillar: TVET labour market

The labour market pillar monitors the realities of the employment system in relation to TVET as an integral part of the economy. It is measured through three sub-pillars and offers a picture of conditions in the labour market and the extent to which the principles of efficiency, equity and inclusiveness are respected.

» The first sub-pillar, efficiency of the labour market, comprises four variables: percent of firms identifying an inadequately educated workforce as a major constraint; proportion of employees who are over or undereducated; proportion of skilled workers (out of all production workers); and unemployment rate among

individuals with upper secondary, post-secondary non-tertiary, and short-cycle tertiary education.

» The second sub-pillar, post-TVET employment, is measured through the following variables: share of TVET occupations as a percentage of total employment; and manufacturing employment as a proportion of total employment.

» The last sub-pillar is equity and inclusiveness. It is measured through two variables: 15- to 24-year-olds enrolled in vocational education, adjusted gender parity; and vulnerable employment as a percentage of total employment.

Figure 3: Structure of the TVET sub-index
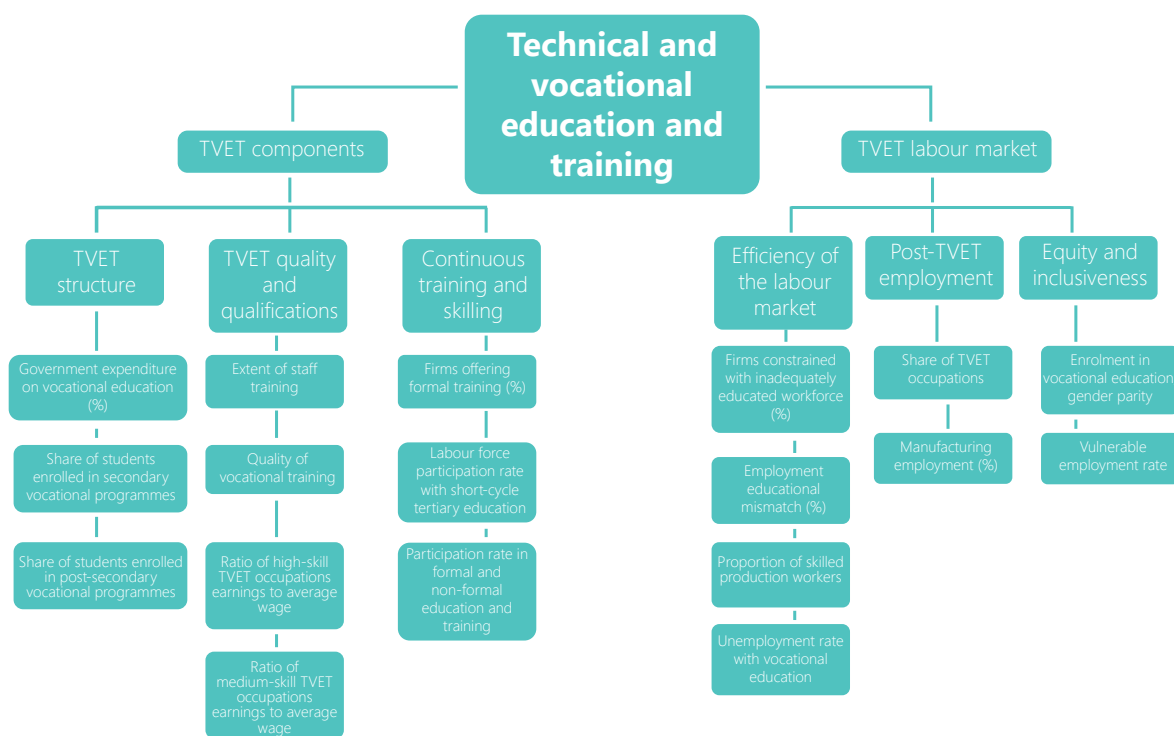
Higher education sub-index

Higher education plays a key role in driving knowledge and innovation by producing human capital with the qualifications and skills necessary to meet the needs of industries that drive the global knowledge economy. Hence, it was imperative that higher education be included as a core sub-index under the GKI. For the purpose of this index, higher education includes short-term programmes, bachelor's or equivalent degree levels, master's or equivalent degree levels, and doctoral or equivalent degrees offered by public and private higher education institutions, falling within levels 5 to 8 according to the International Standard Classification of Education (ISCED 2011) by the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

The structure of the higher education sub-index

The higher education sub-index comprises three main pillars: inputs, which includes three sub-pillars: expenditure, enrolment, and resources; learning environment, which consists of two sub-pillars: diversity and academic freedom, and equity and inclusiveness; and outputs, which includes three sub-pillars: attainment, employment, and impact.

The first pillar: Inputs

The inputs of higher education are those factors that enable systems to achieve their objectives. They come from different sources including fiscal and human. With regard to the expenditure sub-pillar, it includes two variables; government expenditure per student in tertiary education, and teaching staff compensation as a percentage of total expenditure in tertiary public institutions.

For the second sub-pillar on enrolment, two variables are considered relating to share of population enrolled in bachelor's or equivalent level, and the share of population enrolled in master's, doctoral or equivalent level, to measure enrolment rates for all groups covered by the higher education sub-index.

In the resources sub-pillar, two variables are adopted: pupil-teacher ratio in tertiary education, and percentage of researchers (FTE) in higher education. While the second variable could also be considered an output of the system, it is nonetheless a resource available to higher education institutions and is considered an input to the Index.

The second pillar: Learning environment

The aim of the learning environment pillar is to provide an indication of the learning and teaching climate that students and instructors experience in higher education institutions. Therefore, four themes were suggested: diversity, academic freedom, equity and inclusiveness— where diversity and academic freedom are grouped in one sub-pillar, and equity and inclusiveness grouped in another.

In the diversity and academic freedom sub-pillar, the first theme on diversity was measured through two variables: female-to-male ratio of teachers in tertiary education, and inbound mobility rate. The second theme, on academic freedom, reflects issues of freedom and openness. A higher education sector is responsive to issues of diversity and freedom if it considers a balanced representation of male and female teachers, opens its doors to both sexes from abroad, and maintains an atmosphere of freedom of expression, freedom in teaching and research, institutional autonomy, academic exchange and campus integrity.

For the equity and inclusiveness sub-pillar, three variables were adopted: gross attendance ratio for tertiary education, gender parity; gross attendance ratio for tertiary education, wealth parity; and gross attendance ratio for tertiary education, location parity. Taken together, these three variables relate to the composition of students in higher education institutions by their gender, location and wealth and provide a good indicator for equity in the sector.

The third pillar: Outputs

The outputs pillar aims to provide an assessment of the outcomes and impact of the system and its contribution to the economic and social development of its graduates. The outputs pillar consists of three sub-pillars: attainment, employment and impact.

The attainment sub-pillar comprises three variables: educational attainment rate, bachelor's or equivalent; educational attainment rate, master's or equivalent; and educational attainment rate, doctoral or equivalent.

The employment sub-pillar includes two variables: the labour force participation rate with advanced education as a percentage of the total labour force (15+); and unemployment rate with advanced education as a percentage of total labour force (15+).

The impact sub-pillar features two variables: university-industry collaboration in R&D, which indicates economic and business impact; and citable documents normalized by total R&D personnel in higher education (FTE), which indicates research and knowledge creation impact.

Figure 4: Structure of the higher education sub-index
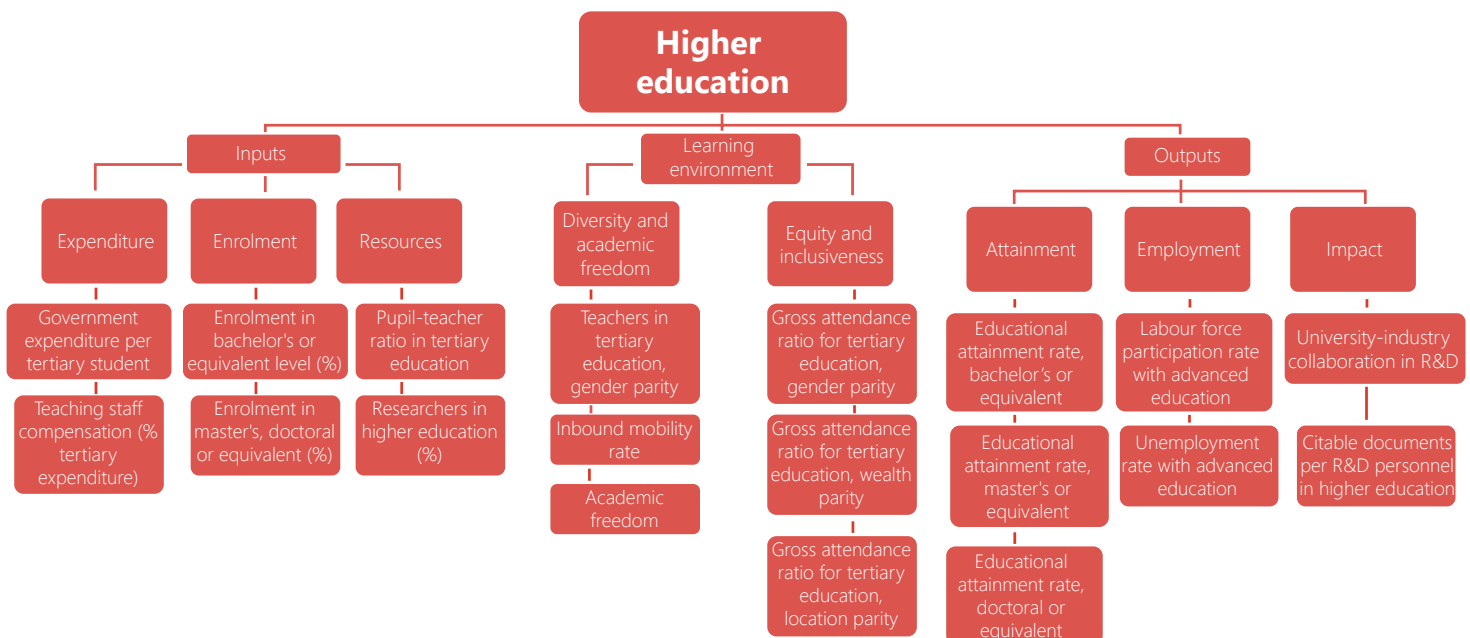
Research, development and innovation (**RDI**) sub-index

Research and development (R&D) "comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge".[10] Innovation, on the other hand, is viewed as creative activity leading to the development of new products or processes that differ significantly from the product previously delivered to consumers, or the process previously used by the company or the industry.[11,12] Based on these definitions and rationale, scientific research, development and innovation (RDI) represent a central aspect of knowledge generation, dissemination and application processes in support of development.

The structure of the RDI sub-index

The first pillar: Inputs

The inputs pillar is composed of three sub-pillars: inputs of R&D institutions; inputs of RDI in business enterprises; and inputs of societal innovation. The constituent variables of the inputs of R&D institutions sub-pillar are gross expenditure on R&D (GERD) as a percentage of GDP; GERD per researcher (computed as full-time equivalent [FTE]); and the share of researchers per thousand labour force. Furthermore, the percentage of graduates from science, technology, engineering and mathematics (STEM) programmes in tertiary education is included here, given its relevance to R&D processes.

In the sub-pillar related to the inputs of RDI in business enterprises, two types of gross expenditure are considered. The first estimates the total amount of spending allocated to RDI in business enterprises (GERD performed by business enterprises [%]), whereas the second type of spending concentrates on the business sector's own financing (GERD financed by business enterprises [%]). Based on this definition, the first spending variable reflects the interest of a country in enhancing R&D in the business sector, while the second variable estimates the internal policy of enterprises to finance R&D needs. The percentage of researchers in business enterprises represents RDI inputs that determine research capacity and resources in an enterprise. Finally, the percentage of firms that spend on R&D in a given country is included to show the dissemination of a research culture in business sector.

Inputs of societal innovation, as a third sub-pillar, is composed of three variables. The first variable reflects the importance of having knowledgeable and skilled labour to achieve societal innovation, with the variable high-skilled employment share as a percentage of the total number of employed people. High-skilled labour is generally required in the knowledge-intensive industries that characterize developed economies. In order to produce innovative or creative goods and services, civil societies need to acquire intellectual property rights. This represents the second variable of societal innovation, namely intellectual property payments as a percentage of total trade. Finally, the state of cluster development is another measure that reflects the capacity of a country to have well-established cluster industrial and services units that are geographically distributed in support of innovation.

The second pillar: Outputs

The sub-pillar, outputs of R&D institutions, concentrates mainly on publications (average documents per FTE researcher), citations (citations per document) and resident patent applications.

The sub-pillar, outputs of RDI in business enterprises, is based on four variables. Two relate to the number of receipts the business sector collects against the utilization by other national institutions of their intellectual property rights and industrial design applications. The increase in this type of income means that the business enterprises of a country are more productive and innovative. A third variable measures the number of patents under the Patent Cooperation Treaty (PCT)—administrated by the World Intellectual Property Organization (WIPO) to provide patent protection in a number of countries simultaneously—which reflects the level of advanced

innovation products. Finally, the percentage of firms producing new goods and services constitutes a direct measure of the innovative capacity of a business sector in a country.

The third sub-pillar is concerned with outputs of societal innovation which is generally broken down into the acquisition of intangible assets, outputs of creative and culture products, and online creativity. Investment in intangible assets is represented in the output of societal innovation sub-pillar by trademark applications per GDP. Creative and cultural products are measured within the structure of the sub-pillar by two variables: share of cultural goods exports as a percentage of total goods exports, and printing and publishing output as a percentage of manufactured total output.

The third pillar: Impact

This impact axis incorporates several elements of the impact of research, development, and innovation to the extent permitted by the international scientific and socio-economic database. This pillar comprises three sub-pillars with variables pertaining to the quality of RDI, RDI linkages and how RDI affects the business sector development process—business development.

The quality of RDI is measured using both survey questions and hard data. Two survey questions determine the prominence of research institutions, and growth of innovative companies of a country. A third variable estimates the management quality of institutions (ISO 9001) (% GDP), and a fourth variable determines eco-innovation performance measured by ISO 14001 environmental certificates (%GDP).

GERD financed by the outside world is allocated to the linkages sub-pillar to measure the cooperation between domestic and foreign RDI institutions. Furthermore, joint ventures per strategic alliance deals (% GDP) is another measure of linkages.

Finally, computer software spending (% GDP) is interpreted as a way of ensuring linkages between RDI and information technology (IT). A third sub-pillar included under the impact pillar is business development. Since the development of ideas of new business enterprises are considered as innovation outcomes, a measure of new business density per thousand population can be viewed as part of the innovation impact on business development. Finally, the variable percent of firms with new products or services that are considered new or significant improvements to the main economic market is viewed as a measure leading to the development of business enterprises.

Figure 5: Structure of the RDI sub-index
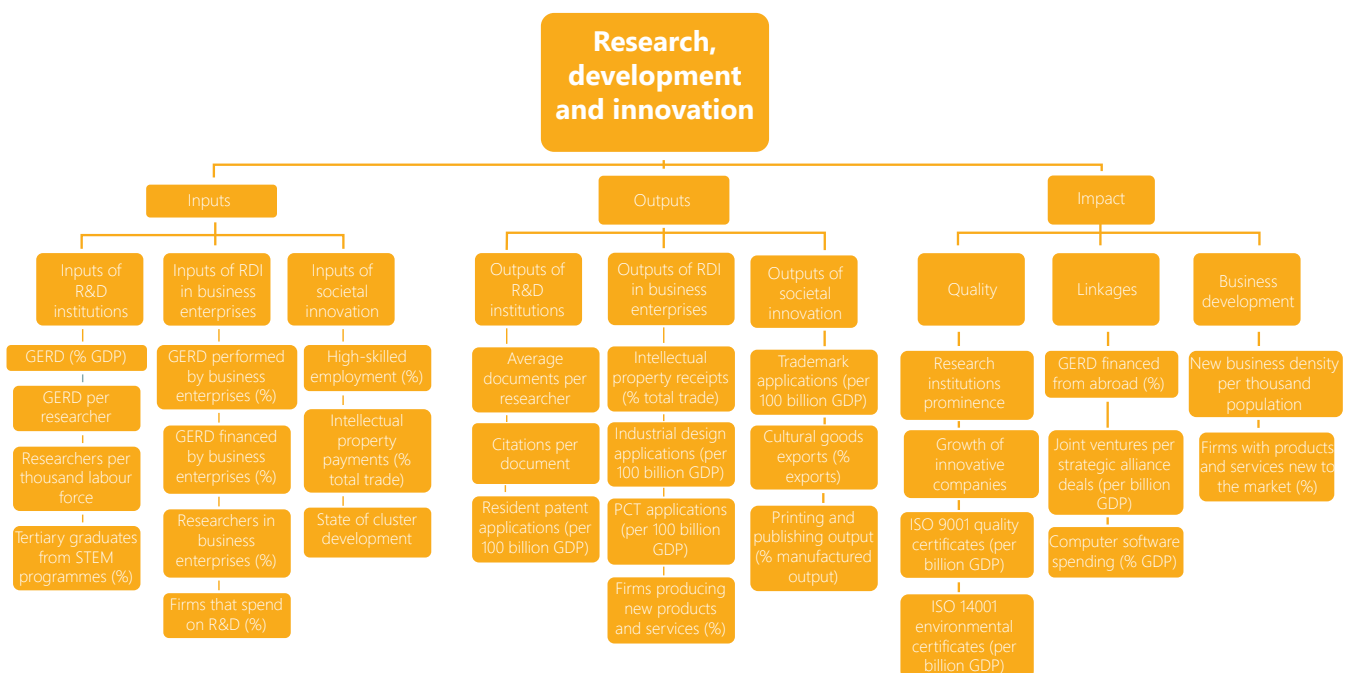
Information and communications technology (ICT) sub-index

As the digital economy grows to constitute an increasingly significant portion of the broader global economy, industries in all sectors are striving to meet the requirements of the Fourth Industrial Revolution,[13] and its demands on information and communications technology (ICT) and other knowledge sectors. For ICT to reach its full potential, knowledge creation should not be restricted to a cluster of countries or regions; rather, it should be localized and shared for the well-being of all societies. Therefore, to gain an insight into how the future will unfold, we must acknowledge the interactions embedded within a number of mutually reinforcing trends in ICT.

The structure of the ICT sub-index

In the framework of the GKI, the ICT sub-index considers variables relating to ICT infrastructure, and access to, and usage of, technologies.

The first pillar: Infrastructure

The infrastructure pillar reflects the importance of infrastructure as a prerequisite for the realization of the gains of technologies, and as an enabler for digital transformation. The deployment of mobile network coverage, and investments in telecommunication networks, tangible and intangible assets, are critical for the development of the sector in any country. Not only should governments invest in their fixed assets, but they should also guarantee that quality services are provided at affordable prices.

Accordingly, the infrastructure pillar is divided into three sub-pillars: coverage, quality and affordability.

The coverage sub-pillar includes three variables: percentage of population covered by at least 3G/4G mobile networks; secure Internet servers per 1 million people; and annual investment in telecommunication services as a percentage of GDP.

The quality sub-pillar measures the quality of fixed- and mobile-broadband subscriptions provided in terms of speed using three variables: average mobile upload and download speeds; average fixed-broadband upload and download speeds; and fixed-broadband subscriptions by speed per 100 people. It is worth noting that while mobile-broadband technology is advancing at a fast pace, it is not yet an alternative for fixed-broadband, given that businesses to date are highly dependent on fibre-optic communication to conduct business. As such, equal importance is allocated to both fixed- and mobile-broadband in measuring the penetration and quality of telecommunication services in a country.

While the availability of quality services is essential, ensuring that the services are provided at affordable prices is also indispensable. Hence, a third sub-pillar, affordability, measures the relative prices of ICT services; it encompasses three variables: fixed-broadband basket, 5GB as a percentage of GNI per capita; data-only mobile-broadband basket, 2 GB as a percentage of GNI per capita; and level of Internet and telephony competition.

The second pillar: Access

The development of an advanced and integrated ICT infrastructure alone is not sufficient for the development of a dynamic and inclusive ICT sector. Access and usage of ICTs by citizens, businesses, and governments to drive innovation, maximize the growth potential of technologies and realize development goals, remains at the core of the digital agenda. Accordingly, the access pillar was introduced to measure the penetration of ICT in the country and human capacities in the ICT field. It is divided into two sub-pillars: subscriptions, and skills and employment.

The sub-pillar, subscriptions, measuring the penetration of ICT services among citizens, includes three variables: active mobile-broadband subscriptions per hundred inhabitants; international Internet bandwidth per Internet user; and estimated proportion of households with Internet access at home.

The skills and employment sub-pillar assesses the capacity of human capital to integrate the new technologies and to contribute to the growth of the ICT sector. As the demand for digital skills is increasing with the rise in digital-oriented jobs, and the adoption of technologies

in the workplace and by governments, citizens should acquire a set of digital skills to harness these technologies for economic and social development. Furthermore, as global competition is now concentrated over ICT-enabled goods and services, creating a massive number of jobs in the field, the need for self-motivated and talented ICT specialists that possess programming and analytical skills is paramount. Therefore, this sub-pillar measures the proportion of individuals with standard ICT skills; percentage of graduates from tertiary education graduating from information and communications technology programmes; and ICT employment as a percentage of total employment.

The third pillar: Usage

The technological, societal, and scientific impacts of ICT remain the utmost factors in determining the contribution of this sector to the development of a country. While the infrastructure and access pillars set the digital foundations for a strong ICT sector, the usage of technological services to promote development and create new opportunities is fundamental in measuring the advancement of this sector in an economy. An increase in the use of ICT services promotes the rapid exchange of knowledge—as more people are connected through social networks—and enables the effective development of solutions to pressing challenges via Internet-enabled innovation, creativity and entrepreneurship.[14] Additionally, the availability of online government services and the transition towards digital government is imperative in promoting transparency, accountability and governance in public administrations.

To illustrate the exchange of knowledge and the impact driven by ICT, the usage pillar consists of two sub-pillars: services and outcomes.

The sub-pillar, services, measures the provision of adequate ICT services, and includes four variables: government online services; fixed-broadband Internet traffic per subscription; mobile-broadband Internet traffic per subscription; and percentage of Internet users.

The second sub-pillar, outcomes, reflects the efficacy of the sector and its dynamic effects on other aspects of the economy such as trade, innovation, governance and doing business. It covers four variables: ICT PCT patent applications (per 100 billion GDP); e-participation; percentage of Internet activities by individuals; and international trade in digitally deliverable services as a percentage of total trade.

Finally, the gender digital divide is reflected in the seventh GKI sub-index, enabling environment, as it impacts all sectors presented in the GKI and is considered an important variable in measuring gender equity. The variable, female-to-male Internet users' ratio, measures the usage of Internet and knowledge-enhancing applications and services by females relative to that of males, which is in turn a good measure of female empowerment, as the use of ICTs enables women greater independence and autonomy, providing them with economic and social opportunities.[15]

Figure 6: Structure of the ICT sub-index
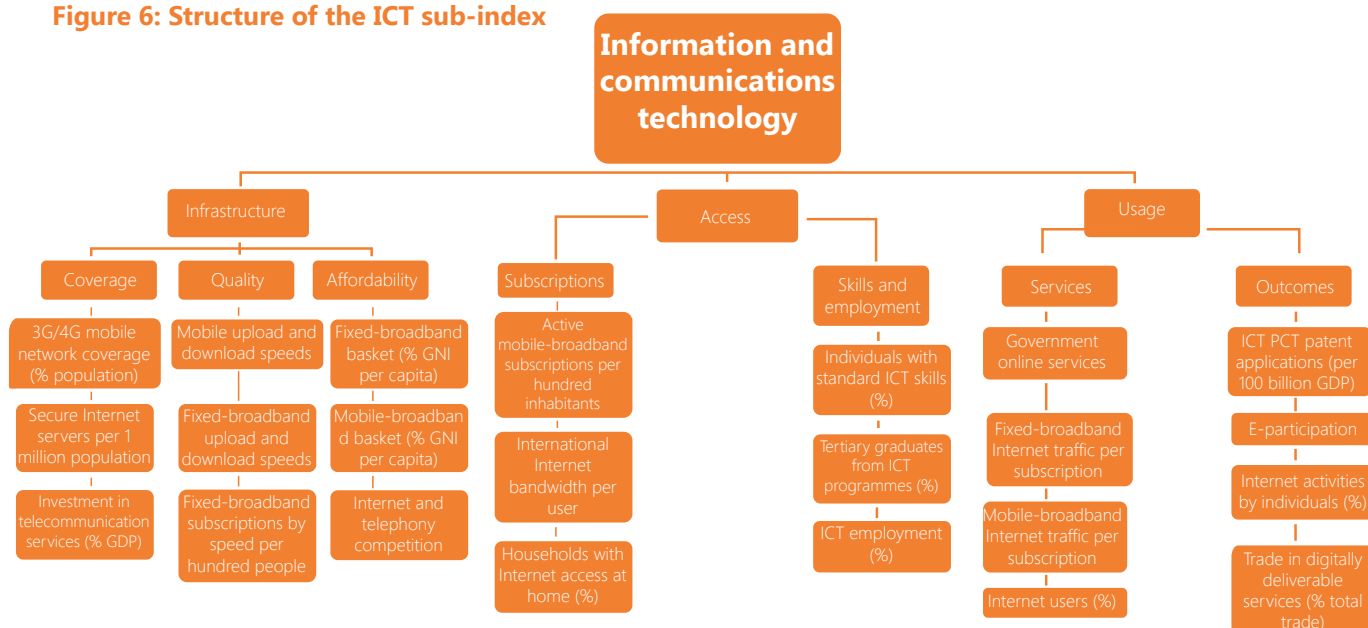
Economy sub-index

The establishment of knowledge economies—characterized by their diversity of production, productivity, labour and human capital—has become the main determinant of the ability of countries to adapt to global transformations and developments. Within the GKI, the components of the knowledge economy related to economic competitiveness, economic openness, and financing and domestic value added, represent important indicators of the ability and resilience of economies to face global transformations and developments.

The structure of the economy sub-index

The economy sub-index seeks to reflect the intertwined organic nature of the knowledge economy, taking into consideration two key aspects. First, the overlap between the economy and other knowledge sectors included in the GKI that represent essential components of a knowledge economy. Second, the concept of the knowledge economy in the contemporary world requires clarification, as it complements other sectors; for example, the infrastructure needed to attract investment—which requires knowledge, funding, production, and access to markets. In addition, economic openness, financing and domestic value added play important roles in the localization, adoption and transfer of knowledge both locally and globally. Indeed, the definition of knowledge economy has been much debated among researchers since the 1960s.[16]

The structure of the economy sub-index consists of three main pillars: economic competitiveness, economic openness, financing and domestic value added.

The first pillar: Economic competitiveness

The economic competitiveness pillar consists of two sub-pillars: infrastructure investment and business agility. This pillar is one of the most important determinants of qualifying economies for competitiveness and attracting investments, which together constitute the backbone of the economy.

Investment in infrastructure facilitates access to resources, which in turn accelerates the pace of innovation and knowledge production. According to the Organisation for Economic Co-operation and Development (OECD), infrastructure investment includes all variables and indicators relating to the infrastructure of the economy, including roads, buildings, transportation, and even financial legislation and the availability of capital.[17] This sub-pillar comprises four variables that represent the concept of investment infrastructure in its broad sense, as follows: gross fixed capital formation as a percentage of GDP; logistics performance index; transport productive capacity index; and building quality control index.

Economics literature today clearly indicates the importance of agility in economic decision-making at the micro and macro levels, among individuals and institutions.[18] Therefore, as part of the development and modernization of the economy sub-index, business agility is introduced as a sub-pillar within the economic competitiveness pillar to reflect data that measures the economy's agility in relation to complex and unprecedented changes and transformations—whether global, regional or local. The business agility sub-pillar includes four variables as follows: ease of starting a business; insolvency recovery rate; entrepreneurial employee activity rate; and extent of corporate transparency index.

The second pillar: Economic openness

Two sub-pillars were employed within this pillar: trade and diversification, and financial openness.

While developing the structure of the economy sub-index, the components of the trade and diversification sub-pillar were reconsidered to reflect the level of knowledge associated with trade exchange between countries on the one hand, and because diverse markets offer an opportunity to increase knowledge at the level of micro and macroeconomics. This sub-pillar contains the following variables: trade as a percentage of GDP; high-technology trade as a percentage of total trade; product concentration index; and market concentration index.

Within the concept of economic openness, financial openness is an essential component that determines the ability of countries to obtain and circulate knowledge. The sub-pillar on financial openness contains the following variables: Chinn-Ito financial openness index; foreign direct investment, net inflows as a percentage of GDP; and debt dynamics.

The third pillar: Financing and domestic value added

This pillar is based on two sub-pillars: financing and taxes, and domestic value added.

The financing and taxes sub-pillar reflects the positive impact of financing on the dissemination and localization of knowledge in countries. It also clarifies the effects of taxation on the generation and dissemination of knowledge. The latter occurs through the legalization of easy transfers of goods and services between countries, which is considered one of the most important factors in knowledge exchange and transfer. This sub-pillar includes four variables: domestic credit to private sector as a percentage of GDP; MSME financing gap as a percentage of GDP; total tax and contribution rate as a percentage of profit; and bank non-performing loans to total gross loans.

The term, domestic value added, within the concept of economy, refers to the potential resources of countries in producing knowledge. It necessarily implies the extent to which local human and material resources are used in the production processes of both goods and services. This sub-pillar includes the following variables: share of medium and high-tech activities in total manufacturing value added; industry and services value added as a percentage of GDP; composite rate of labour underutilization; and output per worker.

Figure 7: Structure of the economy sub-index
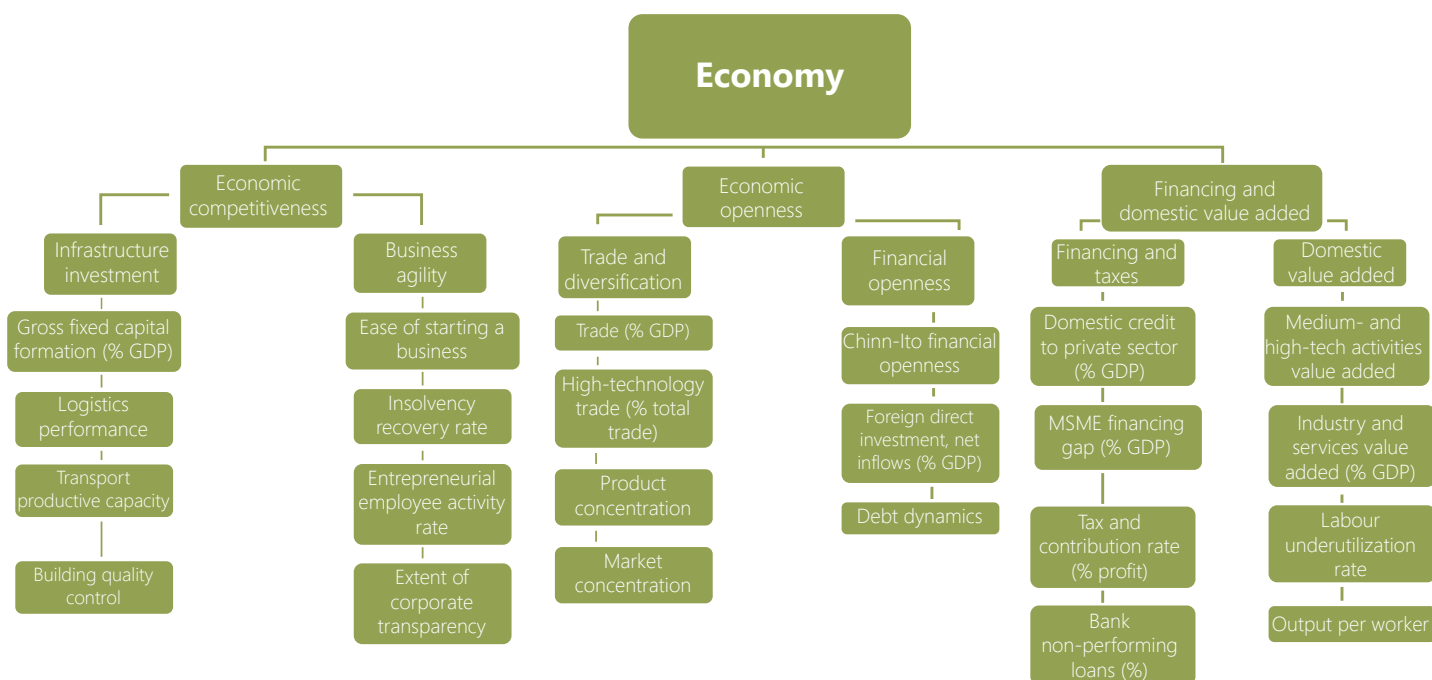
Enabling environment sub-index

The enabling environment represents the necessary conditions for the incubation and support of the production, development, and utilization of knowledge to achieve sustainable development. It is a key determinant for the development of knowledge indicators as it is related to all sectors—institutional, social, economic, and political enabling factors are considered as the main pillars for knowledge empowerment. This sub-index comprises multiple elements, such as development, education and qualification policies and plans; economic and political reform projects; and legislative frameworks that help support the processes of nurturing new generations, establishing the rule of law and strengthening human rights systems to ensure human safety, welfare, and equality. Health services, quality of life and the environment are also general elements that play a key role in achieving and sustaining human development.

Therefore, the six sectoral sub-indices that make up the GKI are open and dynamic systems that constantly interact with each other on the one hand, and with their surroundings within the general context on the other. They are linked to several contextual variables that have been proven to influence the functioning of sectors and their outputs, based on a holistic view of development and its components, placing them in the context of an integrated synthetic system that is dynamically active and interactive, without being closed or confined to one factor or component.

The structure of the enabling environment sub-index

The enabling environment sub-index reflects dimensions that intersect and influence all six sub-indices. The index is based on three-pillars: governance; socio-economic; and health and environment.

The first pillar: Governance

Governance is an issue that transcends all sectors and determines their performance. It is an essential requirement for establishing an incubating environment for development.

The effectiveness of the political environment is an important indicator due to its role in unlocking potentials, setting priorities, working to promote justice and equal opportunities, and controlling corruption. These are the dimensions emphasized by the World Bank in its efforts to monitor and measure governance at the global level by collecting and documenting data on aggregate and individual governance indicators.

Based on the above, the governance pillar was divided into two sub-pillars:

» Political environment, which is measured through two variables: political stability and absence of violence/terrorism; and voice and accountability.

» Quality of institutions, which is measured through three variables: rule of law; control of corruption; and government effectiveness.

The second pillar: Socio-economic

The socio-economic environment falls within the context of concepts adopted by the United Nations, such as human development and sustainable development, or those related to equity, inclusion and integration, among others. The agreed definition focuses on enabling individuals and groups to acquire increased control over their lives, and the variables and factors affecting them, as well as raising their income and standard of living. It also helps individuals to build their capabilities and skills, become full partners in society, and access mechanisms that regulate their influence in society.[19]

Since social, economic and knowledge dimensions necessitate the ability to influence and participate in change, this pillar comprises three sub-pillars:

» Gender equity, which comprises three variables: female-to-male ratio in parliament; female-to-male labour force participation; and female-to-male ratio in Internet usage.

» Social inclusion, which also includes three variables: proportion of population covered by at least one social protection benefit; adult literacy rate, population 15+ years; and share of youth not in employment, education or training.

» Standard of living, which is measured using two variables: poverty headcount ratio at national poverty lines as a percentage of population; and GDP per capita.

The third pillar: Health and environment

Health and environment are among the most prominent current issues in the global agenda that require swift, appropriate solutions that protect the safety of humans and all living creatures, and their right to enjoy a normal life in a healthy environment. This requires the adoption of integrated policies that adhere to fair and equitable standards and can achieve development by combining scientific and technological development with the preservation of physical and mental health, and protection of the natural environment.

Given the significant inherent challenges in achieving these goals, responsibility for their realization does not lie solely with professionals and specialists in these fields; rather, it is a shared, collective responsibility. Dealing with health issues is not the responsibility of medical professionals alone, just as dealing with environmental challenges is not the task of environmentalists alone. Thus, any policy that is good for the environment is also good for health. The World Health Organization (WHO) Committee on Health and Environment has stated that human health depends primarily on the ability of society to manage the interaction between human activities and its biological environment in a manner that protects and promotes health without compromising the integrity

of the ecosystems that form the basis for the physical and biological environment. This requires the provision of a stable climate and the availability of environmental resources (soil, drinking water and clean air) in a sustainable manner, as well as the proper functioning of the natural systems that receive the waste produced by human societies.[20]

Hence, health and environment were combined in a third independent pillar. This choice was necessitated by the correlative relationship between them, which has been underlined by global health studies,[21] as well as human development reports that link environmental degradation with the resultant change in living conditions. Therefore, greater attention was paid to the expected effects on, and threats to, human health, security and life.[22] This pillar is divided into two sub-pillars:

» The health sub-pillar comprises three variables: universal health coverage (UHC) service coverage index; healthy life expectancy at birth; and under-five mortality rate (probability of dying by age of 5 per 1,000 live births).

» The environmental performance sub-pillar comprises three variables: renewable energy consumption as

a percentage of total final energy consumption; ecological footprint per capita; and natural hazard exposure.

These sub-pillars and their variables are characterized by the interactive relations between them and can be included within a broader concept of human well-being, which is a basic goal of sustainable development. Human well-being can only be achieved through comprehensive health care for all biological, mental, psychological and social aspects of life; and effective policies to eradicate poverty and reduce the frequency of environmental threats and other threats related to life and society. Perhaps the greatest evidence of the importance of this interactive relationship and its direct impact on economic growth and human development is the paralysis of vital sectors throughout the COVID-19 pandemic, which led

to the most severe recession the world has witnessed since World War II. The severity of the effects of these factors varied from country to country, depending on their health, economic and social infrastructure, and the resilience of existing health systems and their ability to respond to the requirements of the crisis. It was not possible to contain the crisis and its repercussions on various aspects of economic, social, health and environmental life without adopting coordinated and comprehensive measures targeting collective health. These required global financial and technical solidarity to help the poorest and most affected countries, providing the basis for the resumption of efforts to achieve safe and equitable development and prosperity for all.

Figure 8: Structure of the enabling environment sub-index
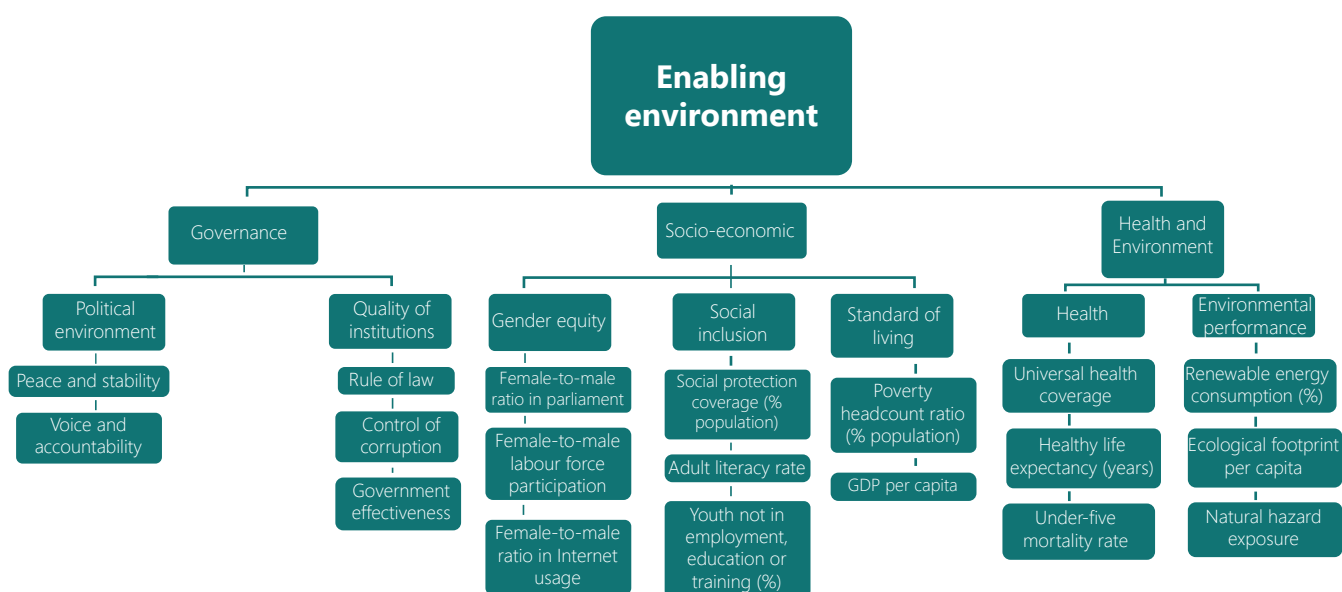
Endnotes

1   Organisation for Economic Co-operation and Development (OECD), 2008.

2   See European Commission, n.d.

3   For more information about Principal Component Analysis, see Hair et al., 2015.

4   Only very few exceptions were made.

5   The condition was relatively relaxed because the qualifying sample size is 141 countries (conditioned by data availability from credible international sources).

6   See European Commission, 2022.

7   The following transformation for all values is applied: new value = ln(value – min + 1)

8   For more information about the Budget Allocation Process method, see OECD, 2008.

9   See Biavaschi et al., 2012.

10   OECD, 2015.

11   Ibid.

12   OECD and Eurostat, 2018.

13   See Schwab, 2015.

14   OECD, 2016.

15   International Telecommunication Union (ITU), 2015.

16   Piotrowski, 2015.

17   OECD, 2021.

18   See Su, 2011.

19   Desmons, 2018

20   World Health Organization (WHO), 1994.

21   See WHO, 2008.

22   See European Environment Agency, 2020.

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