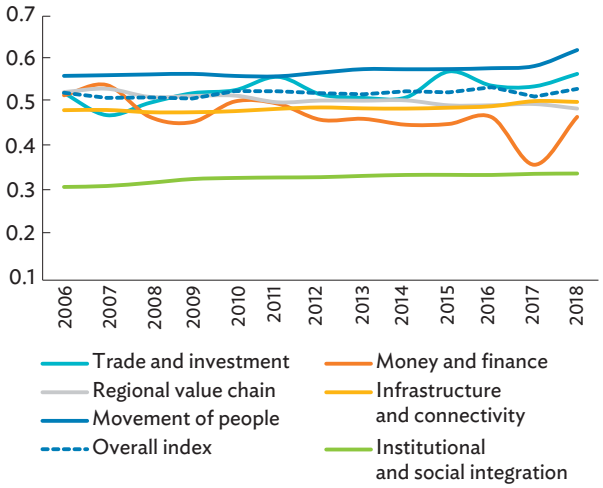
6 Asia-Pacific Regional Cooperation and Integration Index

Regional Integration Moving Ahead as Measured by Integration Index

The Asia-Pacific Regional Cooperation and Integration Index (ARCII) is a broad-based, multidimensional measure of regional integration. The index, established in 2017, tracks progress on a set of relevant dimensions of regional integration, and identifies strengths and weaknesses at regional, subregional, and national levels. The ARCII is composed of 26 indicators that measure regional integration along six dimensions: (i) trade and investment, (ii) money and finance, (iii) regional value chains, (iv) infrastructure and connectivity, (v) movement of people, and (vi) institutional and social integration (Huh and Park 2018). The index covers Asian Development Bank (ADB) member countries in Asia, which include 46 developing member economies along with Japan, Australia, and New Zealand.[58]

Figure 6.1: Overall ARCII and Dimensional Indexes—Asia



ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

Key Regional Integration Trends in Asia

Latest ARCII estimates indicate that regional integration in Asia rose slightly in 2018, due mainly to the rebound in the money and finance dimension (Figure 6.1). Regional monetary and financial integration plunged in 2017 due to fluctuations in two indicators: interest rates dispersion and cross-border equity liabilities. The dispersion in regional interest rates is explained by increases in global interest rates since 2016, mainly led by the United States (US) Federal Reserve (Federal Reserve Bank of New York 2020), without corresponding surges in Asian economies, particularly East Asia, Oceania, and the Pacific. Gradual interest rate hikes in Asia along with global interest rates came in 2018, leading to less regional dispersion and higher financial integration.[59] Likewise, a noticeable dip followed by a recovery during 2017–2018 was observed in cross-border equity liabilities for Central Asia, Oceania, and South Asia.

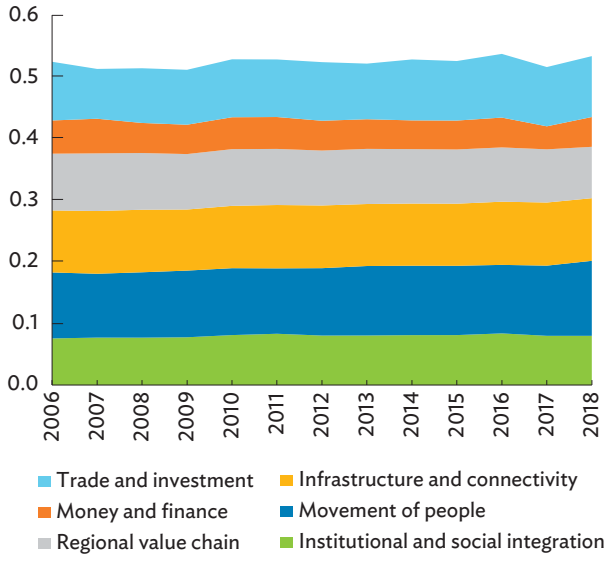
Meanwhile, movement of people, infrastructure and connectivity, and trade and investment continued to drive regional integration in Asia (Figure 6.2). The contribution of indicators for each of the six dimensions remained

[58] For a more information on the ARCII database, methodology, and definitions, see ADB. Asia Regional Integration Center. ARCII. https://aric.adb.org/database/arcii. Asia refers to Asia and the Pacific.

[59] The contribution of this indicator to the money and finance dimension doubled from 9% to 18% during the same period.

broadly stable, with a slight increase in the contribution of the proportion of intraregional countries that do not require an entry visa, in the movement of people dimension, from 19% in 2017 to 22% in 2018.

Figure 6.2: Dimensional Contribution to the ARCII



ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Note: Dimensional contribution is computed as the weight of the dimension multiplied by the dimensional score.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

In 2018, overall regional integration in Asia increased for almost all subregions (Figure 6.3a). Southeast Asia remains the most integrated subregional group within the entire Asian region. Meanwhile, the slight drop in East Asia's overall regional integration could partly be due to policy challenges in the infrastructure and connectivity dimension, including the need to improve cross-border transit with the Central Asia Regional Economic Cooperation (CAREC) Program and the Greater Mekong Subregion (ADB 2019b).

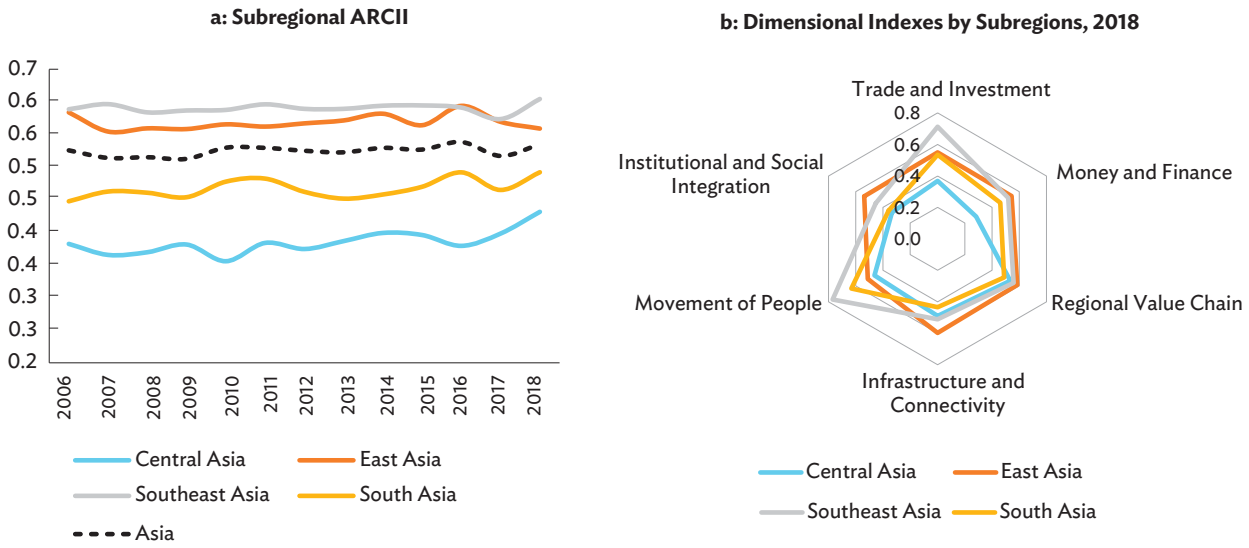
Asian subregions continued to display wide-ranging performance in regional integration across dimensions (Figure 6.3b). For instance, East Asia scored highest in the dimensions of money and finance, infrastructure and connectivity, regional value chain, and institutional and social integration. East Asia's prominence in the regional value chain dimension may be explained by strong and well-integrated regional production networks in manufacturing (ADB 2019b). Meanwhile, Southeast Asia outperformed other subregions in trade and investment and movement of people. Southeast Asia's performance in trade and investment may be driven by trade intensity with regional partners, considering that approximately 60% of its trade were with economies in Asia (UNESCAP 2018).

Finally, South Asia and Central Asia trailed the other subregions in most dimensions (Figure 6.3b). However, ongoing initiatives promoting energy trade and enhancing multimodal transport networks in South Asia are poised to generate direct benefits and spillover effects for countries within the region. For instance, the construction of a pipeline corridor between Bangladesh and India is expected to boost energy trade and supply of crude oil. South Asian countries have also allotted sizable investments in developing ports and airports to increase capacity (ADB 2019b). While the ARCII does not cover the Russian Federation and Islamic Republic Iran, important economic partners of Central Asian economies, the index may underestimate the degree of regional cooperation and integration in Central Asia. The construction of a Eurasia index aims to address this and provide a more complete picture for this subregion (Box 6.1).

The ARCII also shows the degree of regional cooperation and integration (RCI) in Asia's subregional initiatives across the six RCI dimensions. The Association of Southeast Asian Nations (ASEAN) exhibits the highest degree of subregional cooperation and integration, particularly strong in trade and investment and movement of people (Figure 6.4). Ongoing projects promoting border economic zones support the subregion's efforts to establish effective RCI linkages between the People's Republic of China (PRC) and ASEAN, aimed at improving mobility of goods and services, as well as people (ADB 2019b).[60] Initiatives to improve the tourism sector have also taken place, particularly to improve the mobility of tourism professionals and high-potential tourism market segments such as gastronomy and cruise tourism) (ASEAN Secretariat 2019).

[60] Several of these ADB-funded projects include the Guangxi RCI Promotion Investment Program, the Yunnan Lincang Border Economic Cooperation Zone Development project, and the Mongolia's Regional Improvement of Border Services (RIBS) project.

Figure 6.3: Overall ARCII—Asia Subregions



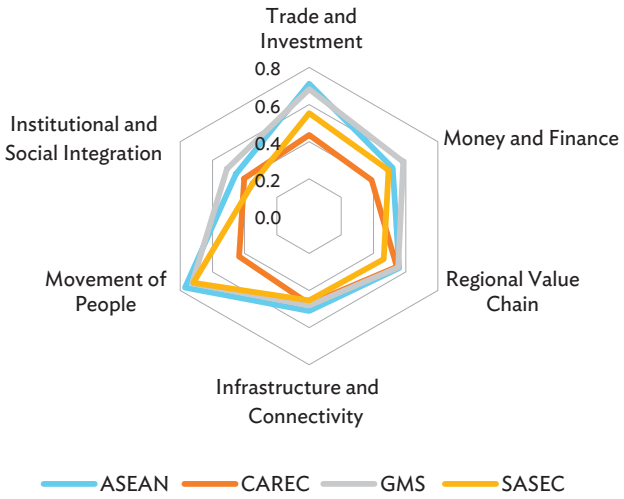
ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

The Greater Mekong Subregion (GMS) shows a similar trajectory to ASEAN. Connectivity in this subregion is expected to be further strengthened by initiatives such as the Ha Noi Action Plan 2018–2020 and the GMS Transport Sector Strategy 2030. South Asia Subregional Economic Cooperation (SASEC)—driven mainly by movement of people, trade and investment, and regional value chains—comes third. For this subregional initiative, improvements in transport linkages with nearby subregions are expected from joint initiatives with the South Asian Association for Regional Cooperation and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (ADB 2019a). Finally, CAREC appears to be the least regionally integrated initiative. This is especially clear in the trade and investment dimension, where CAREC member countries exhibit more volatility (del Rosario 2019). Addressing connectivity gaps, trade linkages, and boosting tourism (e.g., relaxing visa policies) remain a priority for countries in these subregional initiatives (ADB 2019b). Recent developments for CAREC suggest a more encouraging picture, including the region surpassing its Transport and Trade Facilitation Strategy 2020 targets, increasing port capacity, and higher energy trade flows in the Central Asian Power System (ADB 2019b).

Regional integration indexes were also constructed for other regions worldwide. As expected, the European Union (EU) remains the global leader in regional integration (Figure 6.5). The EU was strongest in institutional and social integration, given its solid economic and monetary union institutions, highly integrated labor markets, and established institutional framework for education, research and innovation, security, agriculture and environmental

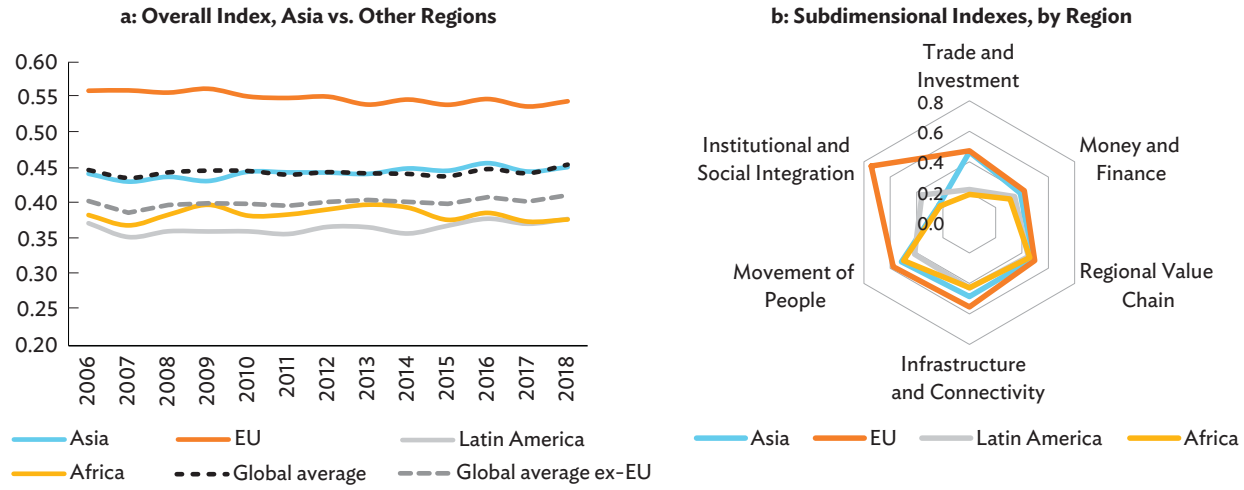
Figure 6.4: Dimensional Subindexes by Subregional Cooperation Initiatives, 2018



ASEAN = Association of Southeast Asian Nations, CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

Figure 6.5: Regional Integration Index, 2018—Asia versus Other Regions



EU = European Union.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

regulation, which position the EU at the forefront of regional cooperation and integration (European Commission 2019). Meanwhile, Asia comes second to the EU and coincides with the global average. In particular, Asia's dimensional scores on trade and investment and regional value chains equal those of the EU over time. The main Asia–EU gaps are on the monetary and financial dimension—where some convergence has occurred in recent years—and infrastructure and connectivity. Latin America outperformed Asia in institutional and social integration, while Africa continued to score the lowest in almost all dimensions.

The Enhanced ARCII Framework

The index structure has been strengthened to accommodate new approaches to the measurement of regional cooperation and integration in Asia.

Key Messages

- The channels of regional cooperation and integration are changing. While countries in Asia have made significant progress in RCI, the nature and pillars of regional cooperation and integration are evolving.
- Digital technologies are determining new forms of connectivity with significant impacts on regional integration. Trends in indicators of technological sharing and digital connectivity show that Asia is increasingly integrated through these channels.
- Regional public goods (RPGs) are also increasingly important, particularly in the area of environmental cooperation, which is evolving, for example, through the inclusion of environmental provisions in trade and investment agreements and environmental goods trade.

Rationale for a new framework. As the channels of regional cooperation and integration expand, the enhanced ARCII framework aims to reflect these by including new relevant dimensions and new indicators to existing ones (Figure 6.6). Two new dimensions are now part of the enhanced ARCII framework: (i) technology and digital connectivity, and (ii) environmental cooperation/regional public goods (Figure 6.7). The technology and digital dimension naturally responds to the growing role of digital technologies in economic activity, which had not been fully captured in other dimensions; it also aims to reflect regional progress in research and technological exchange. The environmental cooperation/RPGs dimension, on the other hand, provides a basis for assessing regional environmental performance

Box 6.1: Emerging Trends in Regional Integration in Eurasia: The Eurasia Integration Index

Whereas indexes provide an overview of regional and subregional performance in regional cooperation and integration (RCI), understanding the underlying factors involves a more comprehensive assessment of historical, institutional, and political factors behind these trends. To improve their interpretation and comparability, RCI metrics should consider different initial conditions, economic systems, production structures, and even extraregional linkages (Huh and Park 2020).

As a pilot to improve the usefulness of the Asia-Pacific Regional Cooperation and Integration Index (ARCII) in a subregional context, the Eurasia Integration Index (EII) applies the ARCII methodology to the subregion covering the three countries of the South Caucasus (Armenia, Azerbaijan, and Georgia), the five Central Asia countries (Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan), and the Russian Federation (which is not an Asian Development Bank member).

Several developments have driven RCI in Eurasia in recent years: First, the establishment of the Eurasian Economic Union in 2015 by Armenia, Belarus, Kazakhstan, the Kyrgyz Republic, and the Russian Federation provided a framework for the free movement of goods, services, capital, and labor among the member countries and policy coordination in areas that included macroeconomic management, foreign trade, agriculture, industry, transport, energy, and investment (Eurasian Economic Commission 2019). Second, the creation in 2011 of the Commonwealth of Independent States free trade area between Armenia, Kazakhstan, the Kyrgyz Republic, the Russian Federation, Tajikistan, and Uzbekistan—along with Belarus, Moldova, and Ukraine—was also a major step toward higher integration in the Eurasia region. Third, regional integration between Eurasia and the People's Republic of China (PRC) has advanced considerably in recent years. The Eurasian Economic Union and the PRC concluded a trade and economic cooperation agreement in 2019. Eurasian countries have supported projects of the Belt and Road Initiative of the PRC.[a] They collaborate within the framework of regional organizations and programs including the Central Asia Regional Economic Cooperation (CAREC) Program and the Shanghai Cooperation Organization (SCO).

Following the methodology of Park and Claveria (2018), the Eurasia Integration Index was estimated for 2006–2017. The estimation generated intraregional scores for Asia (inclusive of Eurasia) and intra-subregional scores for Eurasia alone. To ensure coverage, the index excludes the money and finance dimension due to lack of financial indicators data.

Preliminary results are broadly consistent with recent developments described above. In general, Eurasian countries became more engaged in RCI both within Eurasia and the Asian region over 2006–2017 (box table). Increases in RCI scores in Armenia, Kazakhstan, the Russian Federation, Tajikistan, and Uzbekistan within Eurasia reflect the effect of regional cooperation mechanisms such as the Eurasian Economic Union and the Commonwealth of Independent States free trade area. Increases in most Eurasian countries' scores for RCI within Asia are due largely to increasing integration between Eurasia and the PRC, with some countries, including Georgia and Turkmenistan, reorienting their trade linkages in this direction.

Eurasia Integration Index, based on ARCII Methodology

	Overall Integration			
	With Asia		Within Eurasia	
	2006	2017	2006	2017
Armenia	0.327	0.353	0.496	0.543
Azerbaijan	0.306	0.342	0.481	0.555
Georgia	0.341	0.372	0.579	0.544
Kazakhstan	0.381	0.464	0.639	0.653
Kyrgyz Republic	0.379	0.39	0.645	0.603
Tajikistan	0.338	0.399	0.524	0.612
Turkmenistan	0.215	0.316	0.483	0.399
Uzbekistan	0.443	0.431	0.515	0.646
Russian Federation	0.391	0.451	0.324	0.423
Eurasia	0.347	0.391	0.521	0.553

ARCII = Asia-Pacific Regional Cooperation and Integration Index.

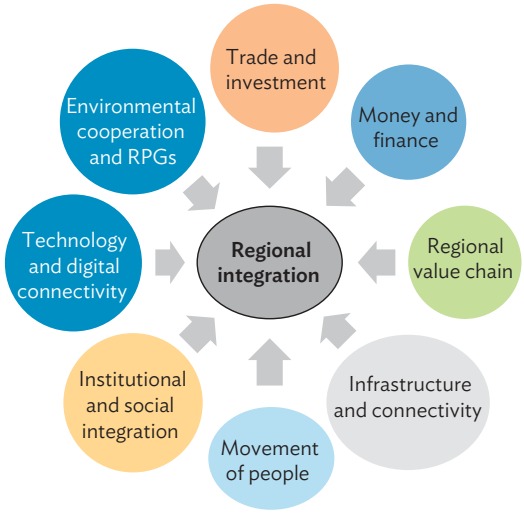
Source: ADB (forthcoming).

These preliminary results suggest that, over the past decade, Eurasian countries made major strides in regional integration. Furthermore, as reflected by the index scores within Asia, RCI between Eurasian countries and the PRC increased significantly. An in-depth analysis of the underlying data will allow to assess how accurately the index scores capture different aspects of RCI in Eurasia. Such an analysis will help determine future improvements on the methodology and data sources to make the index more useful to researchers and policy makers monitoring RCI.

[a] See Kohli, Linn, and Zacker (2020) for a review of Belt and Road Initiative projects in Central Asia and the South Caucasus.

Source: ADB (forthcoming).

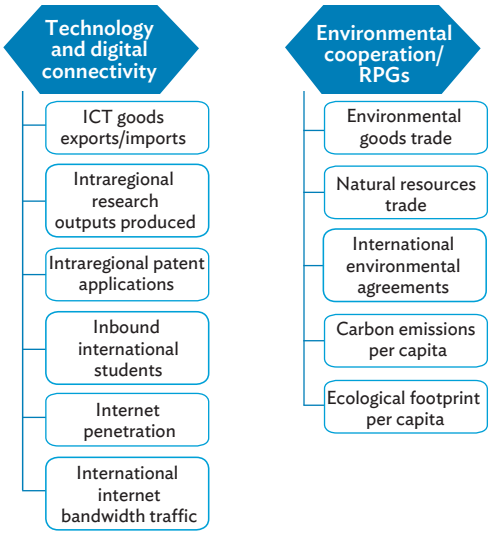
Figure 6.6: Proposed ARCII Enhanced Framework



ARCII = Asia-Pacific Regional Cooperation and Integration Index, RPGs = regional public goods.

Source: ADB (2020).

Figure 6.7: Proposed New Dimensions in the ARCII Enhanced Framework



ARCII = Asia-Pacific Regional Cooperation and Integration Index, ICT = information and communication technology, RPGs = regional public goods.

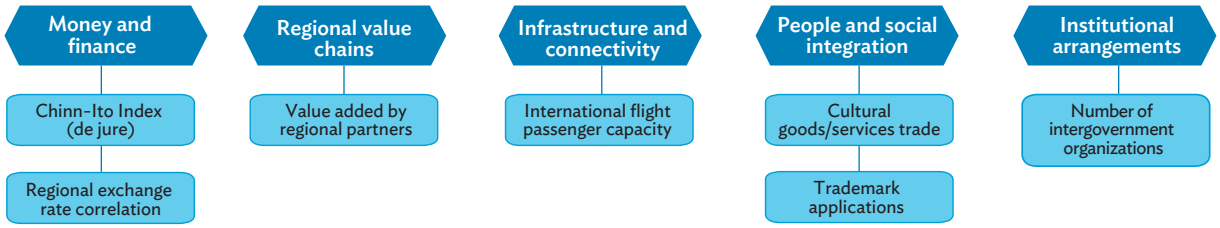
Source: ADB (2020).

in the context of regional cooperation. In a similar vein, UNESCAP (2020) proposes a framework for measuring sustainable regional integration and digital economy integration in the Asian region. In line with the theme chapter of this year's report, this section introduces only a subgroup of indicators in the digital dimension.

Improving indicators in existing dimensions. To ensure that ARCII dimensions adequately capture the underlying RCI dynamics, new indicators are included into existing dimensions (Figure 6.8). New indicators in the money and finance dimension ensure better coverage for Asian countries and aim to capture regional financial vulnerabilities and exchange rate co-movement. Including the Chinn-Ito index as a measure of capital account openness allows the index to determine how lesser restrictions on capital movements affect financial integration, while a measure of exchange rate co-movements provides information on regional synchronization and transmission channels. The regional value chain dimension will be strengthened by a value-added indicator that captures the region's participation in global value chains. A new indicator of international flight passengers is incorporated into the infrastructure and connectivity dimension to account for the role of air transport connectivity in promoting greater access to the global economy, which could further enable economic integration. Indicators for trade on cultural goods and services, trademark applications, and intergovernmental organizations are now also part of the framework.

The enhanced ARCII framework will allow for more flexibility in the inclusion or exclusion of dimensions and indicators. The original six-dimensional ARCII, from now on referred to as the baseline index, will still be reported and shall serve as a comparable series to previous releases, whereas the proposed eight-dimensional ARCII will be an extended version. In addition, the ARCII will be customized for specific needs and priorities of subregions or country groups, including for relevant indicators. Table 6.1 provides the complete list of dimensions and indicators in the enhanced framework. Meanwhile, Box 6.2 provides a description of current ADB initiatives to improve RCI measurement.

Figure 6.8: Proposed New Indicators for Existing Dimensions in the ARCII Enhanced Framework



ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Source: ADB (2020).

Table 6.1: Dimensions and Indicators under the Proposed Enhanced ARCII Framework

Dimension	Indicator	
I. Trade and Investment Integration	I-a	Proportion of intraregional goods exports to total goods exports
	I-b	Proportion of intraregional goods imports to total goods imports
	I-c	Intraregional trade intensity index
	I-d	Proportion of intraregional FDI inflows to total FDI inflows
	I-e	Proportion of intraregional FDI inflows plus outflows to total FDI inflows plus outflows
II. Money and Finance Integration	II-a	Proportion of intraregional cross-border equity liabilities to total cross-border equity liabilities
	II-b	Proportion of intraregional cross-border bond liabilities to total cross-border bond liabilities
	II-c	Pair-wise dispersion of deposit rates averaged regionally relative to that averaged globally
	II-d*	Capital account openness: Chinn–Ito Index (de jure)
	II-e	Correlations of exchange rates vis-à-vis US dollar averaged regionally minus those averaged globally
III. Regional Value Chain	III-a	Ratio between the averaged trade complementarity index over regional trading partners and the averaged trade complementarity index over all trading partners
	III-b	Ratio between the averaged trade concentration index over regional trading partners and the averaged trade concentration index over all trading partners
	III-c	Proportion of intraregional intermediate goods exports to total intraregional goods exports
	III-d	Proportion of intraregional intermediate goods imports to total intraregional goods imports
IV. Infrastructure and Connectivity	IV-a	Ratio between the averaged trade cost over regional trading partners and the averaged trade cost over all trading partners
	IV-b	Ratio between the averaged liner shipping connectivity index over regional trading partners and the averaged liner shipping connectivity index over all trading partners
	IV-c	Proportion of passenger seats sold on regional flights to those sold on all international flights
	IV-d*	Logistics Performance Index (overall)
	IV-e*	Doing Business Index (overall)
V. Technology and Digital Connectivity	V-a	Proportion of intraregional ICT goods exports to total ICT exports
	V-a.2	Proportion of intraregional ICT goods imports to total ICT imports
	V-b	Research outputs with intraregional collaborators relative to research outputs with all international collaborators
	V-c	Patent applications made with intraregional residents relative to patent applications made with all foreign residents
	V-d	Proportion of inbound international students within the region relative to all inbound international students
	V-e*	Proportion of persons using the internet
	V-f*	International internet bandwidth
	V-g	Ratio between the average internet bandwidth with intraregional countries and the average internet bandwidth with all countries

continued on next page

Table 6.1 continued

Dimension	Indicator	
VI. People and Social Integration	VI-a	Proportion of intraregional outbound migration to total outbound migration
	VI-b	Proportion of intraregional tourists to total tourists (inbound plus outbound)
	VI-c	Proportion of intraregional remittances to total remittances
	VI-d	Cultural proximity with interregional countries relative to that with all other countries
	VI-e	Proportion of intraregional cultural goods trade (exports plus imports) to all cultural goods trade
	VI-f	Trademark applications made with intraregional residents relative to trademark applications made with all foreign residents
VII. Institutional Arrangements	VII-a	Proportion of intraregional countries that have signed FTAs with
	VII-b	Proportion of intraregional countries that have an embassy
	VII-c	Proportion of intraregional countries that have signed business investment treaties with
	VII-d	Proportion of intraregional countries that have signed double taxation treaties with
	VII-e*	Number of international intergovernment organizations in which a country is a member
	VII-f	Proportion of intraregional countries that do not require an entry visa to the total number of intraregional countries
VIII. Environmental Cooperation	VIII-a	Proportion of intraregional environmental goods trade (exports plus imports) to total intraregional goods trade
	VIII-b	Proportion of interregional natural resources trade (exports plus imports) to total intraregional goods trade
	VIII-c*	Number of international environmental agreements ratified
	VIII-d*	Carbon emissions (metric tons per capita)
	VIII-e*	Ecological footprint of imports and exports as a share of biocapacity

ARCII = Asia-Pacific Regional Cooperation and Integration Index, FDI = foreign direct investment, FTA = free trade agreement, ICT = information and communication technology, US = United States.

Notes: Highlighted cells indicate new dimensions or indicators included in the enhanced ARCII framework. Indicators marked with an asterisk are national-level indicators.

Source: Asian Development Bank.

Box 6.2: Recent Initiatives among Subregional Programs for Improving RCI Measurement

The Asian Development Bank regional departments and subregional programs are producing metrics of regional cooperation and integration (RCI) to help monitor progress and address the gaps and challenges specific to each subregion.

In 2017, the Greater Mekong Subregion (GMS) established a statistical database that includes economic and sector indicators to monitor RCI.[a] The Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area and the Indonesia–Malaysia–Thailand Growth Triangle have also developed statistical working groups to institutionalize the data collection process with national statistics offices. The GMS is developing a new statistical framework with sector groups, including energy and education, to improve the availability of RCI indicators. There are also efforts aimed toward improving the quality of existing RCI indicators by ensuring consistency, strengthening database management, and institutionalizing mechanisms for data production and dissemination. These have helped improved data comparability across years and countries.

Operational indicators, as well as contract awards and disbursements, are used in South Asia Subregional Economic Cooperation (SASEC) to measure RCI progress. National indicators with implications for cross-border connectivity have also been used. For example, for trade facilitation projects, indicators include improvements in cargo clearance time. Transport, energy, and economic corridor development indicators focus on national targets (e.g., increases in traffic of project roads and electricity access rates). Regional indicators include intraregional trade share, customs revenues in the subregion, and growth of cross-border power flows. SASEC is also taking a sector approach to RCI indicators. In transport, examples include connectivity measures, such as the length (in kilometers) of SASEC corridor roads meeting AH1 standards, the use of regional ports to handle cargo, and the number of flying passengers between regional airports. In trade facilitation, trade efficiency is measured through regional trade agreements (e.g., negative list of products) and mutual recognition indicators.

continued on next page

Box 6.2: Recent Initiatives among Subregional Programs for Improving RCI Measurement *(continued)*

For Central Asia Regional Economic Cooperation (CAREC), the CAREC Regional Integration Index (CRII) was developed and used as a measure to monitor progress on the CAREC 2030 Strategy. CRII results suggest that policies promoting trade openness, regulatory reforms to formalize informal trade, and financial reform must be put in place.

In the case of the Pacific countries, common RCI issues involve the fisheries, environment, trade, and tourism sectors. Current data gaps, particularly in the money and finance dimension, pose an issue in capturing the level of financial development. To resolve this, the subregion is continuously improving the collection of the data to address these gaps.

[a] Greater Mekong Subregion Statistical Database. https://www.greatermekong.org/stats/index-static.php (accessed November 2020).

Source: ADB (2020).

Technology and Digital Connectivity: A New Lens for Exploring Recent Integration Trends

Key Messages

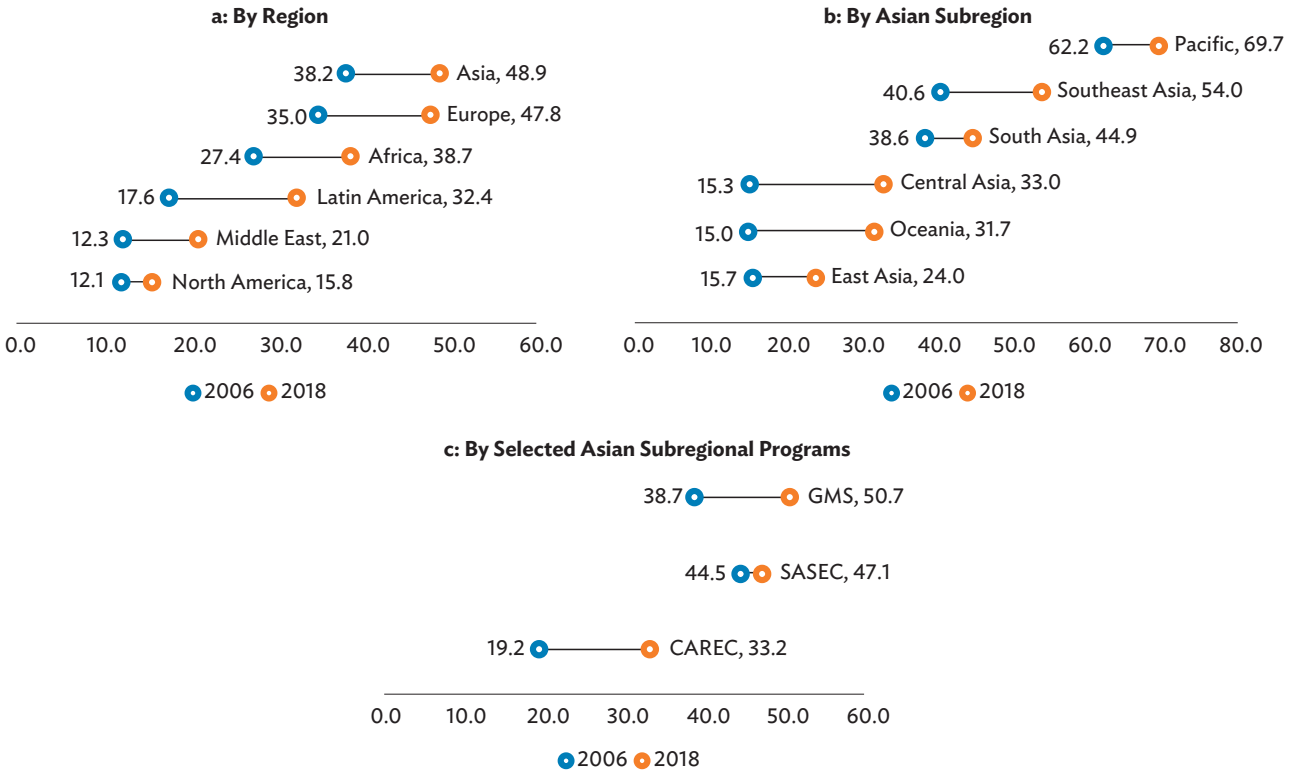
- Trends in technology sharing in Asia have improved over the past 15 years, with an increase in regional collaboration in research outputs and patent applications.
- Improvements in digital connectivity in Asia are remarkable over the same period, with overall increasing internet penetration and well-established intraregional bilateral bandwidth among countries in the region. Still, the gaps in access and quality remain important for a number of countries.

Asia has made significant progress toward regional integration, driven by trade and investment, increasing participation in global production networks and better infrastructure. As in other spheres, digital technologies are redefining these same channels and creating new ones. Technology sharing and collaboration on research and development are, for instance, driving innovation. E-commerce and digital trade are adapting to consumer behavior and the coronavirus disease (COVID-19) is marking a turning point for the digital transformation (see Chapter 8: Making Digital Platforms Work for Asia and the Pacific). The following section describes some of the indicators in the enhanced ARCII framework that intended to capture these effects.

Asian economies have improved on their regional collaboration through research outputs. Research collaboration and innovation among regional partners can have beneficial effects (Guerrero Bote, Olmeda-Gómez, and Moya-Anegón 2013). Indicators on technology transfer through research in Asia and the Pacific show a steady increasing trend since 2006, with the Pacific and Southeast Asia having the highest share of research outputs produced with intraregional collaborators relative to its total, followed by South Asia and Central Asia. Meanwhile, research collaboration among regional peers is lower in Oceania and in East Asia, which is explained by higher extraregional research collaboration in these subregions (Figure 6.9).

At the subregional level, research collaboration has gradually increased in subregional initiatives, including CAREC, GMS, and SASEC subregional programs. In 2018, around half of the total research output produced from international collaboration were made with regional collaborators (Figure 6.9). In comparison to some subregions, collaboration within CAREC, SASEC, and GMS seems to be stronger. Individual country performance also suggests large heterogeneity in research outputs across Asia. The PRC and Australia have encouraged collaboration among local researchers within Asia, with the PRC producing

Figure 6.9: Research Outputs with Intraregional Collaboration
(% of total international collaboration)



CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB calculations using data from Clarivate Analytics. Web of Science Database. https://www.webofknowledge.com (accessed August 2020).

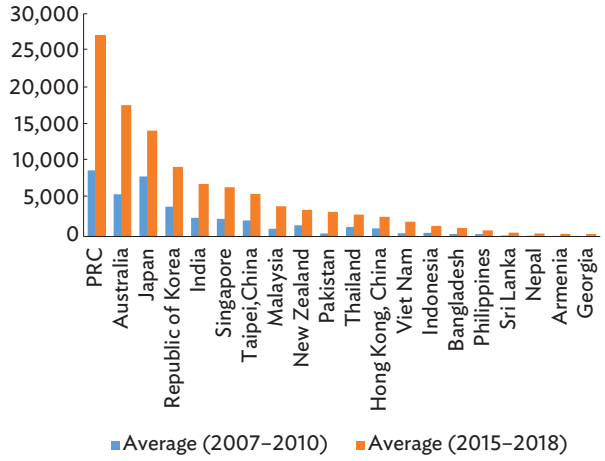
an average of more than 27,000 research outputs, and Australia more than 17,000, from 2015 to 2018. Other countries in Asia (e.g., Japan, the Republic of Korea, India, Singapore) have also enlarged the pool of intraregional research outputs (Figure 6.10).[61]

Intraregional patent applications in Asia have been consistently high, with clear gaps among subregions. Patterns of registration of patent applications can reflect synergies for research production and innovation at the regional level applications.[62] Europe's share has gradually declined from 19% to 4% between 2006 and 2018. Meanwhile, Asia has maintained its share within the 80% to 95% range over the same period (Figure 6.11). Within Asia, East Asia has filed the greatest number of intraregional patent applications relative to its total, with Southeast Asia's share catching up in recent years. The top three countries in the region are all from East Asia, led by the PRC with almost more than 1.4 million applications filed in 2018 (Figure 6.12).

[61] In the ARCII methodology, intraregional research is defined as research outputs produced with intraregional collaborators considering the author's affiliation rather than nationality. For instance, a publication produced by an Asian researcher affiliated with an institution in the United States counts in favor of the United States. Meanwhile, if an Asian researcher based in the United States coauthored a paper with a researcher in Canada, this counts as an intraregional research output for the US (North America region). The equivalent ARCII indicator is computed as a ratio between the number of research outputs with intraregional collaborators relative to research outputs with all international collaborators.

[62] The ARCII indicator is computed as the number of patent applications made with intraregional residents relative to patent applications made with all foreign residents.

Figure 6.10: Number of Intraregional Research Outputs in Asia

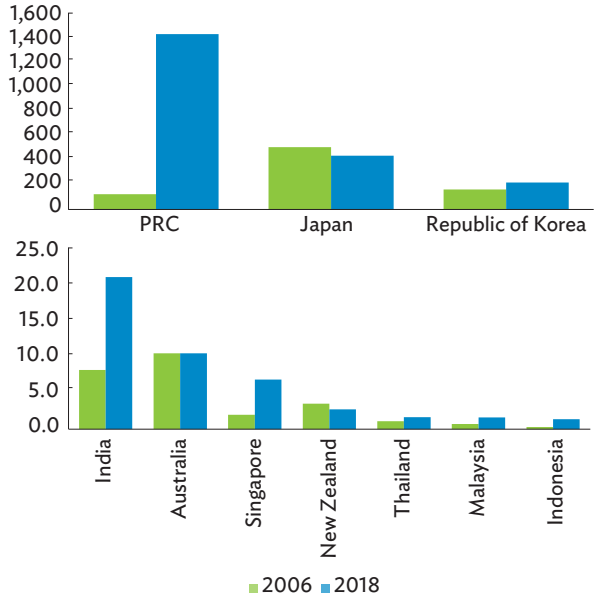


PRC = People's Republic of China.

Note: Refer to research outputs from the Science Citation Index Expanded collection, with all languages, and all research output included.

Source: ADB calculations using data from Clarivate Analytics. Web of Science Database. https://www.webofknowledge.com (accessed August 2020).

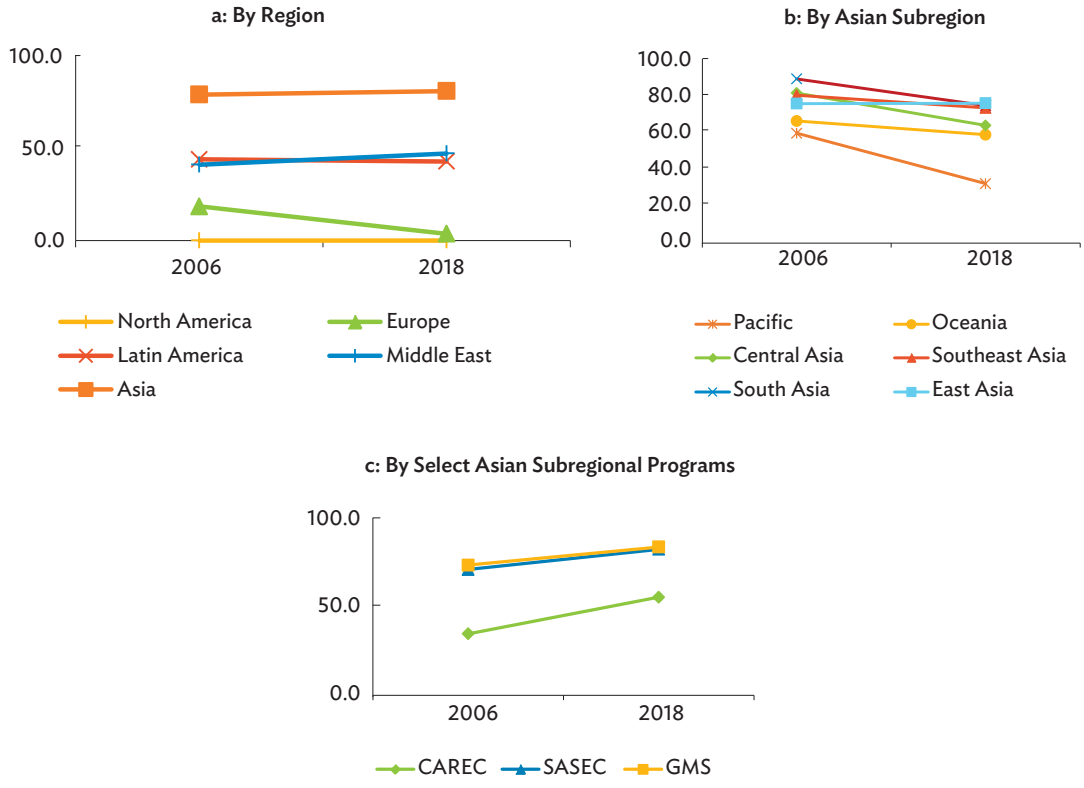
Figure 6.12: Number of Intraregional Patent Applications in Selected Asian Economies ('000)



PRC = People's Republic of China.

Source: ADB calculations using data from World Intellectual Property Organization (WIPO). WIPO Statistics Database. https://www3.wipo.int/ipstats/ (accessed May 2020).

Figure 6.11: Intraregional Patent Applications
(% of total patent applications made with all foreign residents)



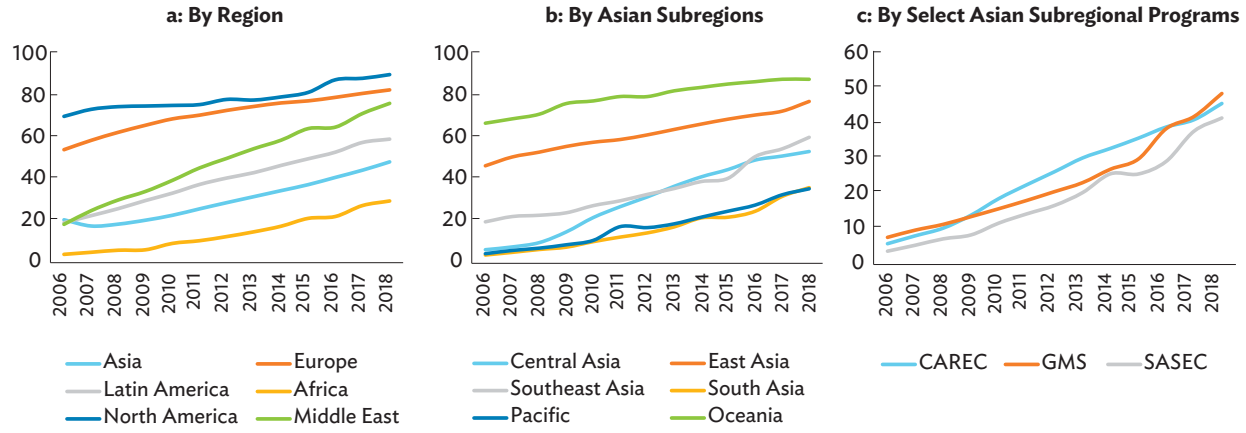
CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB calculations using data from World Intellectual Property Organization (WIPO). WIPO Statistics Database. https://www3.wipo.int/ipstats/ (accessed May 2020).

Digital connectivity in Asia has increased, with rising internet penetration, but large subregional gaps persist. Greater access to online resources through internet connectivity allows consumers, businesses, and governments to gain wider and better access to goods and services beyond geographic borders. Overall, global trends in internet penetration show a steady increase over the last decade, with significant gaps among regions (Figure 6.13). However, looking at the proportion of the population using the internet, Asia lags behind most regions. More than half of the populations of North America, Europe, and the Middle East had access to the internet by 2013, whereas for Asia, only in 2018 did the region reach the same level.

Within Asia, progress on digital connectivity varies across economies, with a significant improvement over the past decade (Figure 6.14). While economies like Australia; Hong Kong, China; Japan; New Zealand; and the Republic of Korea have an average internet penetration rate of more than 85%, the Pacific countries—including Kiribati, Papua New Guinea, and Solomon Islands—continue to struggle, with fewer than 15% of their populations having internet access.

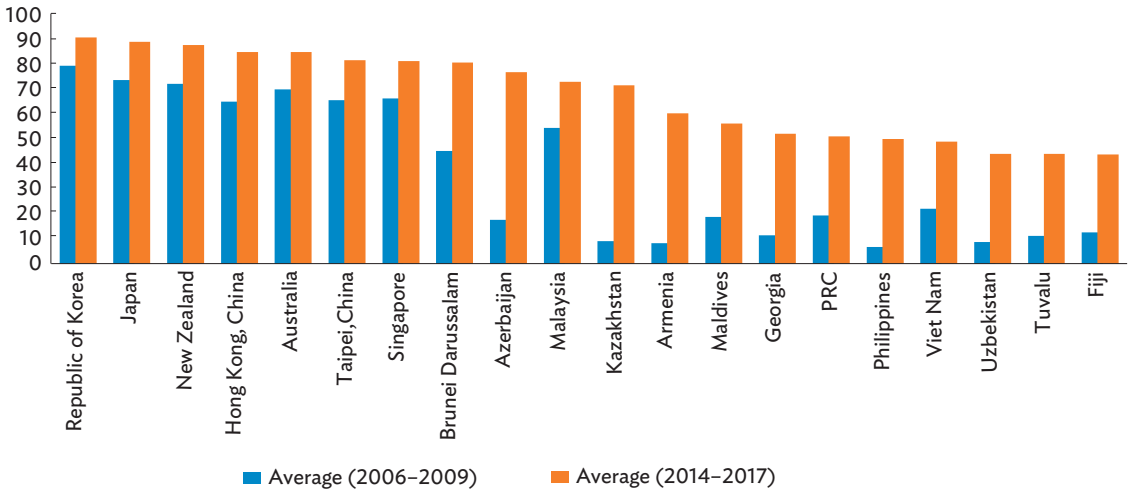
Figure 6.13: Internet Penetration (% of population)



CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB calculations using data from ITU (2019).

Figure 6.14: Internet Penetration for Select Asian Economies (% of population)



PRC = People's Republic of China.

Source: ADB calculations using data from ITU (2019).

Asia's bilateral internet bandwidth performs better regionally than with the rest of the world. Asia's intraregional internet bandwidth capacity has improved considerably over the last decade, in contrast to the region's bandwidth with other regions (Table 6.2).[63] The share of bandwidth to North America dropped from 49% in 2010 to almost 25% in 2019. A possible explanation for this trend could be the growing efforts of key content providers such as Google and Facebook in augmenting their proprietary bandwidth across the Pacific to connect their data centers and to push their content closer to end users (TeleGeography 2019). As a result, there is little incentive for Asian carriers to operate a high-capacity link to North America. Crucially, the significant share of international internet bandwidth capacity within Asia reflects high internet traffic among Asian countries and shows that digital connectivity is well-established within the region (Figure 6.15). For instance, internet traffic between Indonesia and Singapore rose from 2.4 Gbps in 2006 to 7,041.6 Gbps in 2019 (Table 6.3).

Table 6.2: International Internet Bandwidth by Regional Routes

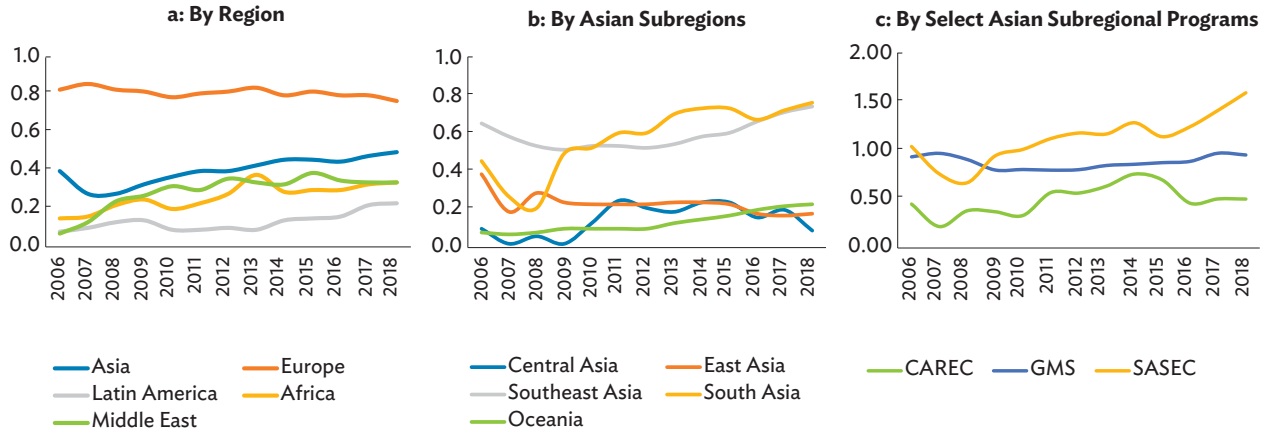
		Gbps		Share to Total (%)	
Origin	Destination	2010	2019	2010	2019
Asia	Asia	1,776	58,019	37.8	54.0
Asia	US and Canada	2,314	26,729	49.2	24.9
Asia	Europe	499	20,150	10.6	18.7
Asia	Middle East	81	2,480	1.7	2.3
Asia	Africa	32	112	0.7	0.1
Asia	Latin America	0	0	0.0	0.0

Gbps = gigabyte per second, US = United States.

Notes: Values refer to the internet bandwidth connected across international borders as of 30 June 2020. The order of region pairs does not imply directionality. Domestic routes are excluded. Regional totals may differ from the sum of connected regions due to rounding.

Source: ADB calculations using data from Telegeography. Global Internet Geography.

Figure 6.15: Intraregional Internet Bandwidth (% of total internet bandwidth traffic)



CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Note: Values refer to the average internet bandwidth with economies belonging to the same region/subregion/subregional program, expressed as ratio to the average internet bandwidth with all economies worldwide.

Source: ADB calculations using data from Telegeography. Global Internet Geography.

[63] The reported indicator builds on ARCII Indicator V-f. International internet bandwidth traffic. TeleGeography defines internet bandwidth capacity as the amount of data transmitted in the public internet, which includes general internet traffic through email, webpages, video streaming, voice over internet protocol (VOIP) calls, and corporate IP VPN traffic over a given period. The values in Table 6.2 present the internet bandwidth capacity measured in gigabytes per second (Gbps) within Asia (intraregional) and across other regions (interregional).

Table 6.3: International Internet Bandwidth Traffic for Selected Asian Economies (Mbps)

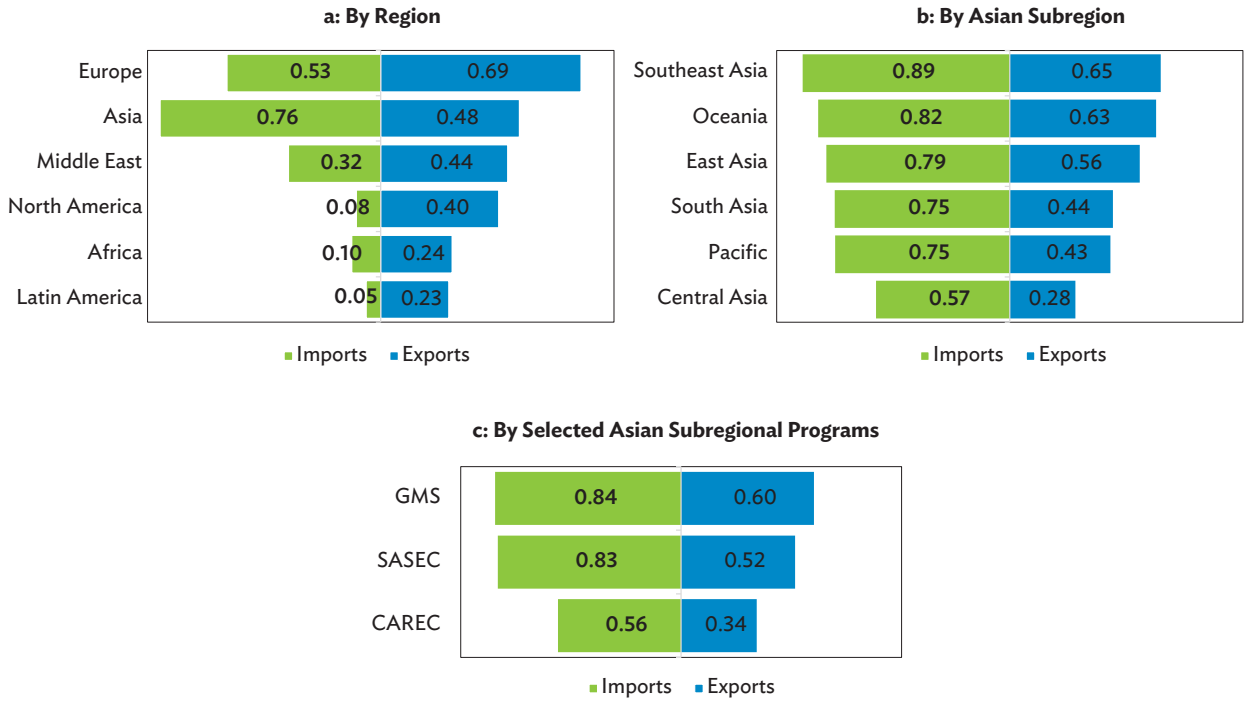
Origin	Destination	2006	2012	2019
Indonesia	Singapore	2,437	159,406	7,041,643
India	Singapore	6,153	241,969	5,537,849
People's Republic of China	Singapore	14,337	373,804	5,069,763
People's Republic of China	Viet Nam	3,265	194,729	5,069,000
People's Republic of China	Japan	51,489	745,156	4,800,856
Singapore	Thailand	417	87,223	4,313,075
Malaysia	Thailand	90	21,272	2,600,000
Singapore	Viet Nam	977	32,443	2,351,000
Malaysia	Singapore	4,377	154,524	2,316,755
Japan	Singapore	10,427	265,912	2,297,443
People's Republic of China	Taipei,China	38,033	323,234	2,011,201
People's Republic of China	Republic of Korea	26,212	267,608	1,382,555
People's Republic of China	Malaysia	2,782	99,546	1,176,155
Japan	Republic of Korea	32,174	174,042	1,095,266
Australia	New Zealand	2,862	43,193	1,022,864

Mbps = megabyte per second.

Notes: Values refer to the internet bandwidth connected across international borders as of 30 June 2019. The order of region pairs does not imply directionality. Domestic routes are excluded. Regional totals may differ from the sum of connected regions due to rounding.

Source: ADB calculations using data from TeleGeography. Global Internet Geography Report.

Figure 6.16: Intraregional ICT Goods Exports and Imports, 2018 (% of total exports and imports)



CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, ICT = information and communication technology, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB calculations using data from United Nations Conference on Trade and Development. ICT goods categories and composition. https://unctadstat.unctad.org/en/Classifications/DimHS2017Products_Ict_Hierarchy.pdf (accessed June 2020).

Box 6.3: Extending the Research Agenda

The new indicators of regional integration collected for the Asia-Pacific Regional Cooperation and Integration Index (ARCII) enhanced framework should allow extension of the current research agenda and investigation of new areas in the future. Some of these include: first, assessing the contribution and trade-offs of the two new dimensions, Digital connectivity and Environmental cooperation, on patterns of regional integration. Second, using new available indicators to further assess some dimensions. For instance, new indicators of financial integration in regions where data were previously not available, and the air transportation indicator for movement of people. And third, subregional analyses on the determinants of regional cooperation and integration where new indicators may capture idiosyncratic features of subregional integration, as illustrated in the case of the Eurasia Index, could be implemented in other subregions.

Source: ADB (2020).

Asia's production networks reflect high regional integration in ICT exports and imports. Indicators on intraregional trade of ICT goods show that the share of intraregional exports relative to total ICT exports is higher in Europe than in Asia (Figure 6.16). In the case of imports, Asia outperforms Europe. Within Asia, intraregional imports of ICT goods comprise more than 70% of total ICT imports. At the subregional level, Southeast Asia leads in the proportion of intraregional ICT goods exports and imports, whereas Central Asia tends to perform lower than the rest of the region. This could reflect higher backward and forward linkages in Southeast Asian industries (e.g., Cambodia, Myanmar) compared with other subregions (e.g., Central Asia, the Pacific).

Regional Integration in Asia: To What Extent Does Location Matter?

Key Messages

- Regional integration in the Asian region tends to exhibit positive spatial autocorrelation: economies with low (high) levels of regional integration tend to be surrounded by economies with low (high) levels of regional integration.

- Clusters of low regional integration can be found in geographically disadvantaged economies such as landlocked countries in Central Asia and sea-locked countries in the Pacific.

- An economy's level of regional integration is positively associated with its neighbors' level of regional integration and with its income.

An economy's geographic location can play an important role in its ability to forge linkages with other economies in the region. For instance, geographically disadvantaged economies are no doubt at the low end of the regional integration spectrum. Landlocked economies have no territorial access to the sea, limited border crossings, and transit dependence. Due to their remoteness, landlocked countries are dependent on neighboring transit countries for their external trade and suffer from high transaction costs. Therefore, it comes as no surprise that Central Asia remains the subregion least integrated with Asia. Meanwhile, sea-locked economies face greater risk of marginalization due to their small size, remoteness from large markets, and high economic vulnerability to economic and natural shocks.

At the same time, an economy's level of regional integration tends to depend on its neighbors' levels of regional integration. As evident in Figure 6.17, economies with low ARCII scores seem to be near one another, and those with high ARCII scores are clustered in the same manner. This is not surprising, given that the ARCII dimensions likewise depict that neighboring economies generally have similar index scores (Figure 6.18). This suggests that countries might influence their neighbors'

integration potential through certain dimensions of regional integration such as trade, investment, and movement of people.

Indeed, spatial analysis using the ARCII confirms that an economy's location influences its level of regional integration (Table 6.4). A significantly positive (negative) statistic from a Global Moran's I test shows clustering of economies with similar (dissimilar) levels of regional integration for the whole Asia and the Pacific. In this regard, results confirm that economies with low (high) levels of overall regional integration tend to be surrounded by economies with low (high) levels of regional integration. The same is true for most of the individual dimensions of regional integration included in the index.

Table 6.4: Results for Global Moran's I Statistic for the ARCII and Dimensional Subindexes

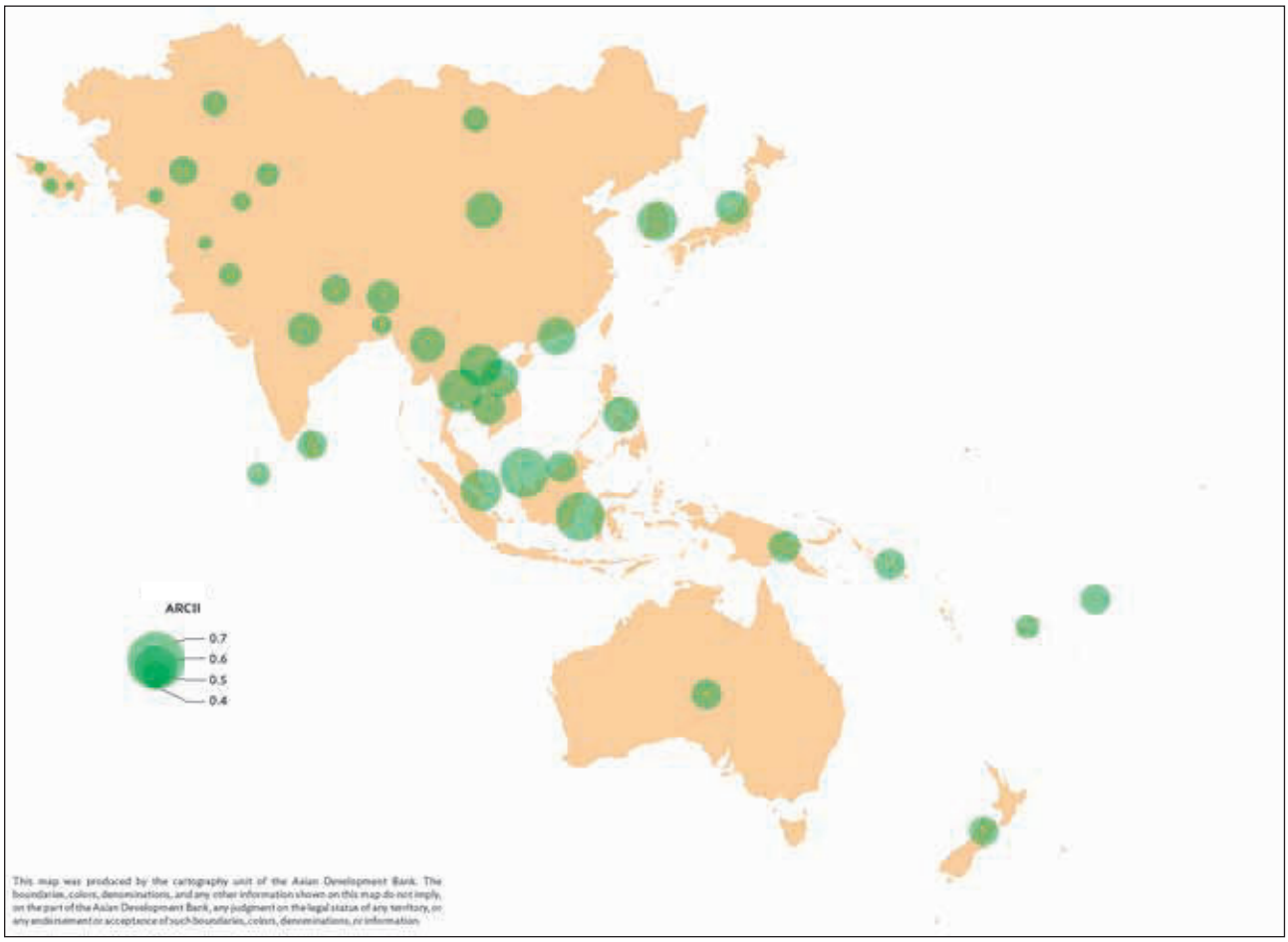
	Moran's I Statistic
Overall ARCII	0.386**
Trade and investment	0.211**
Regional value chain	0.281**
Infrastructure and connectivity	0.054
Movement of people	0.297**
Institutional and social integration	0.191**

ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Notes: ** indicates significance at 5% level. A significantly positive (negative) Moran's I statistic indicates the presence of positive (negative) spatial autocorrelation. Positive (negative) spatial autocorrelation implies that neighboring economies tend to have the same (different) levels of regional integration.

Source: ADB calculations using data from ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

Figure 6.17: Spatial Distribution of the ARCII, 2018



ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Notes: The green circles represent the ARCII score of each country. Large circles translate to a higher ARCII score, while smaller circles mean a lower score.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

Figure 6.18: Spatial Distribution of ARCII Dimensions, 2018

ARCII = Asia-Pacific Regional Cooperation and Integration Index.

Notes: The colored circles represent the ARCII dimensional score of each country. Large circles translate to a higher score for the specified dimension, while smaller circles mean a lower score.

Source: ADB. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

To assess the nature of clustering among the subregions in Asia, the localized version of Moran's I test was employed.[64] The test assesses the presence of clusters of economies with high levels (hot spots) and low levels (cold spots) of regional integration. In general, and as expected, geographically disadvantaged economies such as landlocked countries in Central Asia and sea-locked countries in the Pacific appear to be cold spots of regional integration in Asia, whereas high levels are clustered in Southeast Asia.

The previous findings suggest the presence of spatial autocorrelation in countries' RCI scores. Looking forward, as a first step to analyze the drivers of regional integration using the ARCII, the spatial effects can be corrected through a Spatial Autoregressive model or a Spatial Error Model. As a second step, the analysis could be extended not only to understand the determinants of regional integration but also to evaluate the impact of regional integration on development outcomes including economic growth, income inequality (Park and Claveria 2018, Huh and Park 2020), or income convergence. The spatial component provides a viable instrument to address the potential endogeneity between these outcomes and the ARCII scores.

The significant influence exerted by neighboring economies' regional integration underscores the importance of understanding the spatial effects of regional cooperation. As the role of regional public goods, including environmental and health initiatives, is being discussed today, exploring further the contribution of spatial factors to specific dimensions of regional integration will be essential.

[64] The global Moran's I test provides a single measure of spatial autocorrelation in regional integration for the whole Asia. Meanwhile, the local Moran's I test decomposes the global version, thereby providing a measure of spatial autocorrelation within subregions.

References

Asian Development Bank (ADB). Asia Regional Integration Center. Asia-Pacific Regional Cooperation and Integration Index Database. https://aric.adb.org/database/arcii (accessed October 2020).

———. 2019a. *Maritime Cooperation in SASEC*. Manila. https://doi.org/10.22617/SPR190418-2.

———. 2019b. *Asian Economic Integration Report 2019/2020: Demographic Change, Productivity, and the Role of Technology*. Manila. https://doi.org/10.22617/TCS190461-2.

———. 2020. New Approaches to Measuring and Assessing Regional Cooperation and Integration: Workshop Highlights. https://dx.doi.org/10.22617/TCS200310-2.

———. Forthcoming. *Tracking Progress in Regional Cooperation and Integration: The Eurasia Integration Index.* Manila: ADB.

Association of Southeast Asian Nations (ASEAN) Secretariat. 2019. *ASEAN Integration Report 2019*. Jakarta: ASEAN. https://asean.org/storage/2019/11/ASEAN-integration-report-2019.pdf.

Clarivate Analytics. Web of Science Database. https://www.webofknowledge.com (accessed August 2020).

del Rosario, T. 2019. *CAREC Regional Integration Index (CRII): Interpretation and Policy Implications*. Urumqi, Xinjiang: Central Asia Regional Economic Cooperation Institute. https://www.carecinstitute.org/wp-content/uploads/2019/12/CI-CRII-Interpretation-and-Policy-Perspective-27-Dec-2019.pdf.

Eurasian Economic Commission. 2019. Eurasian Economic Union: Facts and Figures. Moscow.

European Commission. 2019. *The EU in 2018—General Report on the Activities of the European Union.* Brussels: European Union. p. 154.

Federal Reserve Bank of New York. 2020. *Federal Reserve Board—Open Market Operations*. 16 March. https://www.federalreserve.gov/monetarypolicy/openmarket.htm.

Greater Mekong Subregion Statistical Database. https://www.greatermekong.org/stats/index-static.php (accessed November 2020).

Guerrero Bote, V. P., C. Olmeda-Gómez, and F. de Moya-Anegón. 2013. Quantifying the Benefits of International Scientific Collaboration. *Journal of the American Society for Information Science and Technology.* 64 (2). pp. 392–404. https://doi.org/10.1002/asi.22754.

Huh, H.-S. and C.-Y Park. 2018. Asia-Pacific Regional Integration Index: Construction, Interpretation, and Comparison. *Journal of Asian Economics.* 54. pp. 22–38. https://doi.org/10.1016/j.asieco.2017.12.001.

Huh, H.-S. and C.-Y. Park. 2020. A New Index of Globalisation: Measuring Impacts of Integration On Economic Growth and Income Inequality. *The World Economy.* 2020 (00). pp. 1–35.

International Telecommunication Union. 2019. *World Telecommunication/ICT Indicators Database, 2019 Edition.* Geneva.

Kohli, H., J. Linn, and L. Zacker, eds. 2020. *China's Belt and Road Initiative: Potential Transformation of Central Asian and the South Caucasus.* New Delhi: SAGE Publishing India.

Park, C.Y. and R. Claveria. 2018. Does Regional Integration Matter For Inclusive Growth? Evidence From The Multidimensional Regional Integration Index. *ADB Economics Working Paper No. 559.* Manila: ADB.

TeleGeography. 2019. *Global Internet Geography Report*. https://www2.telegeography.com/global-internet-geography.

United Nations Conference on Trade and Development. ICT goods categories and composition. https://unctadstat.unctad.org/en/Classifications/DimHS2017Products_Ict_Hierarchy.pdf (accessed June 2020).

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2018. *Asia-Pacific Trade and Investment Report 2018: Recent Trends and Developments*. Bangkok: United Nations.

———. 2020. Regional Integration for Sustainable Development in Asia and the Pacific: ESCAP Digital and Sustainable Regional Integration Index and Indicator Framework. Bangkok: United Nations.

World Intellectual Property Organization (WIPO). WIPO Statistics Database. https://www3.wipo.int/ipstats/ (accessed May 2020).