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Remote but well connected? Neighboring but isolated? Measuring remoteness in the context of SIDS

Abstract

Remoteness is one of the main challenges for small island developing States (SIDS). However, this term is commonly used in a narrow sense, referring only to geographical distance from markets resulting in higher transportation costs. This paper argues that remoteness is a broader concept, also involving distance to financing sources and political centers. In addition, it can be aggravated or attenuated by connectivity in transportation networks or through political and cultural linkages. Moreover, with the growing weight of the digital economy, issues of access and performance of information and communication technologies gain a higher importance. The paper proposes six dimensions to study remoteness, as well as available indicators for measuring them. This expanded study of remoteness identifies areas that can be prioritized through targeted investments and appropriate policies for helping SIDS overcome the challenges of geography.

Key words: Remoteness, Distance, Geography, SIDS, Development



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1. Background

The first United Nations (UN) global conference on the sustainable development of small islands developing States (SIDS) recognized the structural disadvantages and specific vulnerabilities faced by this group of economies, including their “distance and isolation” (United Nations, 1994, p. 31). Successive conferences also highlighted their “traditional isolation”, the “limitations of isolation and remoteness”, and the “high transportation costs due to [their] geographical remoteness” (United Nations, 2005, pp. 20, 26, 83), as well as their “unique and particular” vulnerability due to the “remoteness from markets” (United Nations, 2014, p. 59).

Remoteness is only one of the numerous economic disadvantages faced by SIDS. They also face restricted opportunities to reach higher scale economies due to their small size and limited domestic markets. Because of a narrow endowment of natural resources and their dependence on international markets, they are vulnerable to external shocks. Per capita costs of public administration and infrastructure are comparatively high. Also, given their low elevation and economic reliance on the ocean, they are particularly impacted by sea level rise, ocean acidification, natural disasters and other climate change impacts. Considering these challenges, the 2030 Agenda for Sustainable Development recognized that SIDS are among the most vulnerable economies and deserve special attention for progressing along sustainable development goals (United Nations, 2015, pp. 7, 13).

However, among the many challenges faced by SIDS, remoteness remains one of the most formidable. A higher distance translates into increased costs, including transportation and insurance, weakening the competitiveness of domestic products in international markets and increasing the import bill. It also means that they generally lie far from the main transportation routes, potentially making their supply of resources costly and unreliable. Additionally, infrastructure projects, such as those enabling connections to energy and communication networks, are more costly to implement and maintain. Coupled with their small economic and demographic weight, the remote location of SIDS means that they mostly drop off the radar from public and private financial flows, hindering these countries’ capacity to finance development. As noted by House (2013), the isolation of SIDS translates into important economic disadvantages: small economies of agglomeration, high freight costs and reduced competitiveness.

But are remoteness and isolation still insurmountable obstacles for SIDS? We have seen some small island economies reach high income levels based on exports, not of goods, but of financial, logistical or tourism services. Moreover, in a context where financial flows can move from one side of the planet to the other instantaneously and where a growing share of value added comes from the digital economy and intangibles, physical distance might not be the impediment it once was. On the other hand, the toll from geographic separation could also derive from cultural or political factors, from being far away from the global centers where decisions are made and where the “action” takes place. How can connectivity, both digital and in terms of transportation, alleviate the obstacles brought about by economic and social isolation?

In the economics literature, remoteness is traditionally studied as a factor increasing transaction and information-exchange costs, therefore influencing bilateral trade or investment flows. However, this variable is considered in the traditional way: as a geographical barrier increasing trade and transport costs and therefore reducing potential inter-country linkages. Classic gravity models are examples of this. For instance, see the summary presented in Baier and Standaert (2020) and the treatment of a remoteness indicator in Wei (1996) and Harrigan (2003), whose trade models use bilateral distance weighted by GDP as a proxy for remoteness. Chaney (2018), while alluding to the role of informational barriers in international trade, as well as the importance of networks and information technologies, still emphasizes the theoretical and empirical role of geographical distance. Finally, by using geographical distance as a determinant, Ho et al. (2013) and Amidi and Majidi (2020) study the impact of bilateral trade on economic growth.

Beyond trade, the economics literature has also analyzed in great detail the spatial correlation of growth and the empirical evidence indicating regional convergence and agglomeration economies. Commonly, this is studied by focusing on the role of geographical distance on economic spillovers (see, for example, Guastella

and Timpano (2010)). Interestingly, Conley and Ligon (2002) expanded the analysis to the broader concept of “economic distance”, referring to the cost of moving production factors (capital and labor).

One special case of spillovers refers to technological diffusion. Numerous studies have found evidence that remoteness has a significant influence on the spatial spillovers of innovation and knowledge, which fall rapidly as distance increases (Keller, 2004; Bottazzi and Peri, 2003; Piermartini and Rubinová, 2014). Although this has been approached mainly using geographical distance, the role of other factors, such as sociocultural or institutional linkages, has also been recognized (Keller, 2002; Caragliu and Nijkamp, 2016).

Geographical separation plays an equally prominent role in the literature studying the determinant of foreign direct investment, either from a macroeconomic perspective or by studying firm-level decisions (consider, for instance, the results in Carr et al. (2001) and Egger (2008)). However, other studies have found a significant role of other types of separation in explaining the foreign investment decision of firms, including cultural proximity (Ragozzino, 2009; Li et al., 2017), institutional disparities (Aleksynska and Havrylchuk, 2013), economic distance (Le, 2017) and linguistic overlap and technological similarities (Ly et al., 2018).

Another example of the importance of remoteness can be found in political sciences, where the role of proximity as a determinant of cross-border contagion of conflict and political instability has been extensively studied, starting with the influential work in Sambanis (2001) and Gleditsch (2002). In this literature, the channel of conflict contagion is geographic proximity, mostly defined as a shared border or a neighboring location (within a certain distance threshold). However, more recent studies have expanded the analysis to additional factors. Building on this literature, Cantu-Bazaldua (2014) analyzes the role of different proximity matrices considering factors beyond geographic distance, including cultural affinity, bilateral trade and political alliances.

Importantly, remoteness is one of the criteria included in the Economic Vulnerability Index, used to determine inclusion and graduation from the least developed country (LDC) category. In this index, remoteness is defined as the weighted average distance from closest world markets. It is calculated as the average distance to the nearest neighbors with a cumulative share of 50 per cent of world trade (exports and imports of goods and services). In addition, the indicator is adjusted for landlockedness (Committee for Development Policy Secretariat, 2015).

We argue that remoteness relates to more than just geographical distance from markets resulting in higher transportation costs. It also involves integration into transport networks, as well as political and cultural linkages. Moreover, with the growing relevance of the digital economy, access and performance of digital networks gain a greater importance. This paper presents the main dimensions of remoteness and proposes indicators for measuring them. These issues are presented in the context of the sustainable development of SIDS.

In the outcome document of the most recent global conference on SIDS, the signatory countries called on the United Nations, its specialized agencies and relevant intergovernmental organizations to “elaborate appropriate indices for assessing the progress made in the sustainable development of small island developing States that better reflect their vulnerability and guide them to adopt more informed policies and strategies for building and sustaining long-term resilience”, as well as “the tracking of progress and the development of vulnerability-resilience country profiles” (United Nations, 2014, pp. 64-65). The indicators proposed in this paper represent an effort in this direction.

From the policy perspective, the broader analysis of remoteness introduced in this paper allows a more complete monitoring of progress made in sustainable development, fully taking into consideration one of the most salient challenges faced by SIDS. More importantly, although location and geographical distance cannot be changed, the expanded definition of remoteness proposed in this paper considers factors that can be improved through targeted investment and appropriate policies. This can serve as guidance when dissecting how some small island economies have successfully developed and reached a high national income level in spite of their physical remoteness.

The rest of the paper is organized in the following order. The next section proposes a framework to organize the study of remoteness, as well as relevant statistical indicators that could be used for measuring this concept. After that, Section 3 presents recent data for SIDS along the dimensions proposed by using

standardized indices to facilitate comparison between countries and indicators. The following section explores the construction of a remoteness index summarizing the different dimensions presented. The paper concludes by highlighting the relevance of these metrics for policy analysis in SIDS and other countries.

2. Dimensions of remoteness

Some countries situated in geographically distant locations, from the point of view of the largest global markets and worldwide production centers, would not be considered isolated. Think of Australia, Brazil or South Africa: while relatively remote in geographical terms, their products are found all over the world, they are important providers of services, they frequently appear in news coverage and their political influence outweighs their relative population or gross domestic product (GDP). Other countries, on the other hand, lie in the middle of dynamic regions or close to large markets, but they are economically secluded and contribute little to regional trends. Several countries that have pursued autarky as national policy fall in this category.

These examples show that remoteness is not only a geographical construct. Instead, it is also deeply linked with other concepts, such as connectivity and global presence. Moreover, digital technologies are transforming the way economic production takes place and how societies and economies connect, and this process is changing the relative importance of distance.

This paper proposes to study remoteness as geographical distance adjusted for connectivity. All things equal, a greater distance imposes additional costs and increases the isolation from markets and people. However, a better connectivity could considerably reduce the distance premium. We could therefore have an economy that is remote but well connected (such as the three examples cited above), and also a neighboring country that remains isolated. More relevant, while a country has no control about its physical location, it can influence its connectivity through targeted investment in infrastructure and greater participation in cultural and political networks.

Both distance and connectivity are multidimensional concepts. Distance could be measured with respect to main populated areas, markets or sources of financing, for instance. Connectivity could refer to transport routes, socio-cultural linkages or digital networks, among others. This paper proposes the following dimensions to study both aspects of remoteness, including a set of relevant indicators for measuring them.

1. *Geographical distance from markets.* This is the traditional dimension of remoteness, indicating geographical proximity to other territories and separation from relevant economic centers. It will be measured through three variables: distance to nearest neighbor, distance to economic centers, and distance to trading partners.
2. *Distance from financing sources.* While distance is not an obstacle for financial flows, financial activity tends to cluster around specific centers, where most of the business and investment decisions are made. Countries far from these centers risk falling off the radar from these decisions. The indicators included in this dimension are the distance to business centers, distance from sources of foreign direct investment (FDI), and distance from senders of official development assistance (ODA).
3. *Distance from cultural and political centers.* In addition to the economic costs attached to distance, a frequently neglected burden of remoteness is the potential isolation from the centers of cultural and political power. These are the countries with a great deal of influence in defining international rules, shaping the global discourse and setting cultural trends. This dimension will be assessed as the distance to the main centers of global soft power¹ and the countries with the strongest global presence, as measured through international indicators available in the literature.

¹ An idea originally developed in Nye (2004), "soft power" refers to the ability to influence the behavior of others to get the desired outcomes through attraction and co-option rather than coercion (or "hard power"). According to the author, it relies on three pillars: political values, culture and foreign policy.

4. *Transport connectivity.* Well-developed transport links could ease the burden of distance, facilitating the inflow and outflow of products and people. Maritime, air and land connectivity are measured in this dimension.
5. *Social and political connectivity.* It is important to consider not only the physical links of a country through its transport infrastructure, but also its cultural or social connections with the rest of the world. This is a broad dimension that will be studied through indicators on the number of immigrants in the country and the stock of nationals living abroad, foreign (tertiary) students registered in the national education system and nationals studying (tertiary education) abroad, foreign diplomatic representations in the country, and membership in economic, trade, defense or other alliances.
6. *Digital connectivity.* As described above, the digital economy has the potential to mitigate many of the disadvantages of physical remoteness. However, this requires infrastructure in information and communication technology (ICT), as well as widespread access to these tools among businesses and individuals. This dimension will be assessed through three indicators: (i) Internet access of the population; (ii) international bandwidth per Internet user, which functions as a proxy of the available Internet infrastructure; and (iii) the latency rate, a measure of network performance.

Appendix B includes complete information on the variables considered, including their definition, data sources, and details on imputation methods, when relevant. It also includes summary statistics for all variables. The following section will present recent data for SIDS along the dimensions listed above, comparing it to other world regions.

3. Remoteness indicators for SIDS

The variables considered vary considerably in terms of data ranges and units of measurement. They will be transformed to a 0-100 scale through a min-max transformation to facilitate comparisons between countries and indicators.² The variables will be presented for all SIDS, as well as aggregates for relevant comparison groups.³ For more details about the SIDS group and its country composition, see Appendix A. As a guide, the visualizations use lighter colors to indicate a higher relative remoteness. Unless otherwise indicated, all data refer to 2019.

3.1 Distance from markets

Figure 1 presents the results along the first dimension, geographical distance from markets. The first column in this graph shows that, in terms of distance to nearest (non-SIDS) neighbor, SIDS are indeed situated in remote locations, relatively far away from other countries. While the global (weighted) average is a distance of only eight kms to the nearest neighbor, an average citizen from a SIDS has to travel 371 kms to the closest non-SIDS country. Moreover, there is a broad dispersion in this variable within SIDS, ranging from zero for those countries sharing a border with another country, to the 3264 kms required to cover the distance from Marshall Islands to its nearest non-SIDS neighbor (Indonesia). Tuvalu, Nauru and Samoa also register a high remoteness according to this variable.

This variable shows remoteness in purely geographical terms. However, in terms of economic opportunities for trade, investment, cross-border interactions and spillovers, it is also important to consider the distance to the largest countries in terms of their economic weight. The second column in this chart shows the average distance to all countries weighted by their GDP. In this case, SIDS are also located in remote locations, away from main economic centers. Moreover, in this case variability is more limited, since different SIDS subregions are situated in relative proximity to some large economic centers but far from others. Still, as an

² See Appendix B for summary statistics in the original units, including the data ranges. Tables with complete data in the original units were not included here, but they are available from the author.

³ Note that country aggregates are calculated as a weighted average of the corresponding variables, using population as weight.

Figure 1. Distance from markets, SIDS and selected country groups, 2019

Source: Author's calculations based on data from UNCTAD, UN Statistics Division, UN Population Division, CEPII and R package cshapes.

Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using population as weights. All variables presented as indices with zero indicating the world minimum and 100 the world maximum.

average, SIDS are more remote than other country groups, such as landlocked developing countries (LLDCs) or LDCs, and especially when compared to all middle- and high-income countries. According to this indicator, the most remote SIDS is Tonga, with an average (weighted) distance of 12175 kms, followed by Fiji, Vanuatu and Samoa. However, the top five most remote countries according to this variable are not SIDS and they are mostly located in Oceania and South America: New Zealand, Australia, Chile, Argentina and Uruguay, in that order; Tonga is ranked sixth.

The third variable in this dimension also measures the average distance to all other countries, but this time weighted by their bilateral trade (exports plus imports of goods). As mentioned in the previous section,

remoteness is frequently considered as an obstacle because it increases transport costs and hinders trade. As shown in the third column of Figure 1, SIDS are not necessarily more remote than other country groups when accounting for trade flows. In fact, the average for all groups is remarkably similar, suggesting that countries tend to specialize to nearby markets. However, within the group of SIDS, there is a relatively high dispersion, ranging from Bahamas (3806 kms) to Marshall Islands (8864 kms), with Suriname, Cuba and Mauritius also registering a high trade-weighted average distance. While Marshall Islands is the SIDS member most distant from its trading partners, it is only twelfth in the world rank. The top five countries in this variable are Chile, Brazil, Peru, New Zealand and Argentina, in that order.

3.2 Distance from financing sources

Even if financial funds can be transferred from one corner of the planet to another in an instant, decisions on how to distribute financial funds are taken at the headquarters of firms and capital cities of source governments. Countries that have a low representation in those centers, because of their remoteness or other reasons, risk not being considered. In addition, geographical isolation could turn a country into a riskier or less profitable business or investment option. Because of these reasons, even in financial spheres, distance could still remain an obstacle. Figure 2 shows the situation of SIDS in the three indicators proposed for this dimension.

The three variables are correlated since the countries with the largest companies are also the main sources of other types of financing (in this case, private foreign investment and development assistance). In the three dimensions, SIDS are on average more distant from financing sources than other country groups. In particular, high-income countries and LLDCs tend to be in closer proximity to senders of financial flows.

In terms of distance from main business centers, measured according to the revenues of the largest 500 firms, Tonga is the most isolated SIDS, followed by Fiji, Mauritius, Vanuatu and Samoa. However, the global extremes are located in South America (Uruguay, Argentina, Chile, Paraguay, Brazil, Plurinational State of Bolivia), Oceania (New Zealand and Australia) and Southern Africa (Lesotho, South Africa).

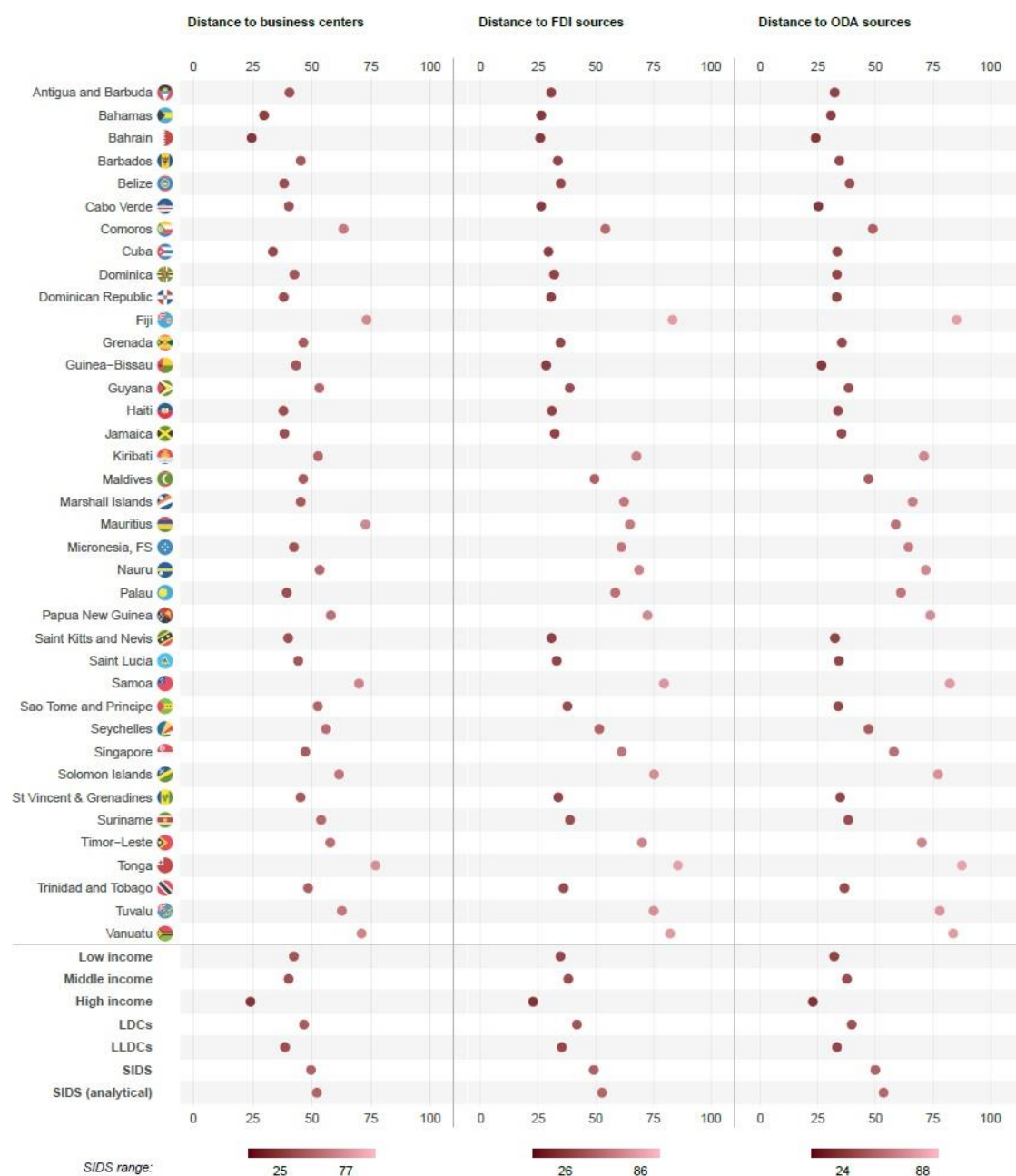
The five SIDS located at the farthest distance from FDI sources are Tonga, Fiji, Vanuatu, Samoa and Solomon Islands. In terms of distance to senders of ODA, the first four SIDS are also the most remote, with Tuvalu taking the fifth place in this variable. According to both metrics, New Zealand and Australia are the most remote countries in the world, but followed closely by the mentioned SIDS.

3.3 Distance from cultural and political centers

In addition to distance from economic and financing powerhouses, remoteness also extends to other spheres. Global political values and cultural trends are defined by a few countries with a disproportionate power that extends beyond their borders and into the international agenda. In addition to their economic and financial means, the source of this power can be based on attraction and emulation (soft power) or direct pressure and intimidation (hard power). This dimension tries to complement the economic factors described in the previous two dimensions, with some measures of remoteness from the global centers of cultural and political power. The analysis is based on two international indicators available in the literature and presented in Figure 3.

First, we rely on the Global Soft Power Index published by Brand Finance (2020). This is a composite index calculated from extensive public opinion surveys and expert assessments, evaluating the soft power of 60 countries, mostly high- and middle-income economies, along seven pillars: business and trade, governance, international relations, cultural and heritage, media and communication, education and science, and people and values. The data collection of the 2020 index took place in autumn 2019, the year covered in this paper. According to this index, the world's top ten countries in that year were, in order, the United States, Germany, the United Kingdom, Japan, China, France, Canada, Switzerland, Sweden and the Russian Federation.

The results, shown in the first column of the figure, show that SIDS are located far away from these centers. This group's average is significantly above those of all other comparison groups. The most remote country according to this indicator is New Zealand, but six SIDS are ranked in the top ten: Tonga, Samoa, Fiji, Vanuatu, Tuvalu and Solomon Islands.

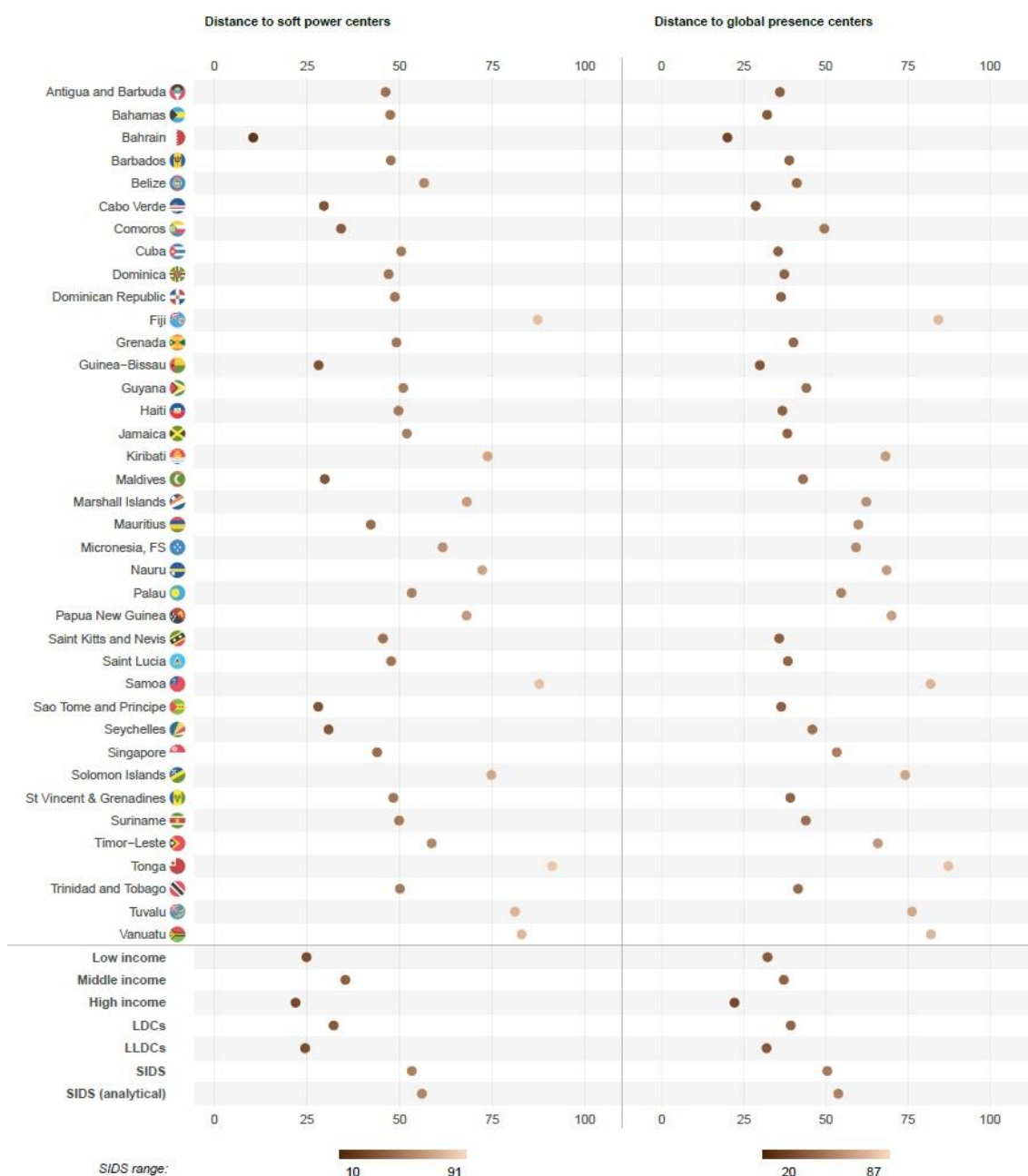
Figure 2. Distance from financing sources, SIDS and selected country groups, 2019

Source: Author's calculations based on data from UNCTAD, Fortune, OECD, UN Population Division and CEPIL.

Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using population as weights. All variables presented as indices with zero indicating the world minimum and 100 the world maximum.

Similar results are observed on the second column of Figure 3, which presents the results for the Global Presence Index (Elcano Royal Institute, 2020). This is a composite index that assesses 130 countries along three pillars: economic (investments and exports of goods, services and energy), military (troops and military equipment) and soft power (development cooperation, education, science, technology, culture, sports, tourism and migration). We recognize that some of the under-lying variables of this index overlap with indicators already included in other dimensions in this paper. However, the potential for double-counting is small given the many variables that compose this composite index. In addition, we prefer to maintain the complete indicator to have a full assessment of a country's global presence, given the large potential for

Figure 3. Distance from cultural/political centers, SIDS and selected country groups, 2019



Source: Author's calculations based on data from Brand Finance, Elcano Royal Institute, UN Population Division and CEPII.
 Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using population as weights. Both variables presented as indices with zero indicating the world minimum and 100 the world maximum.

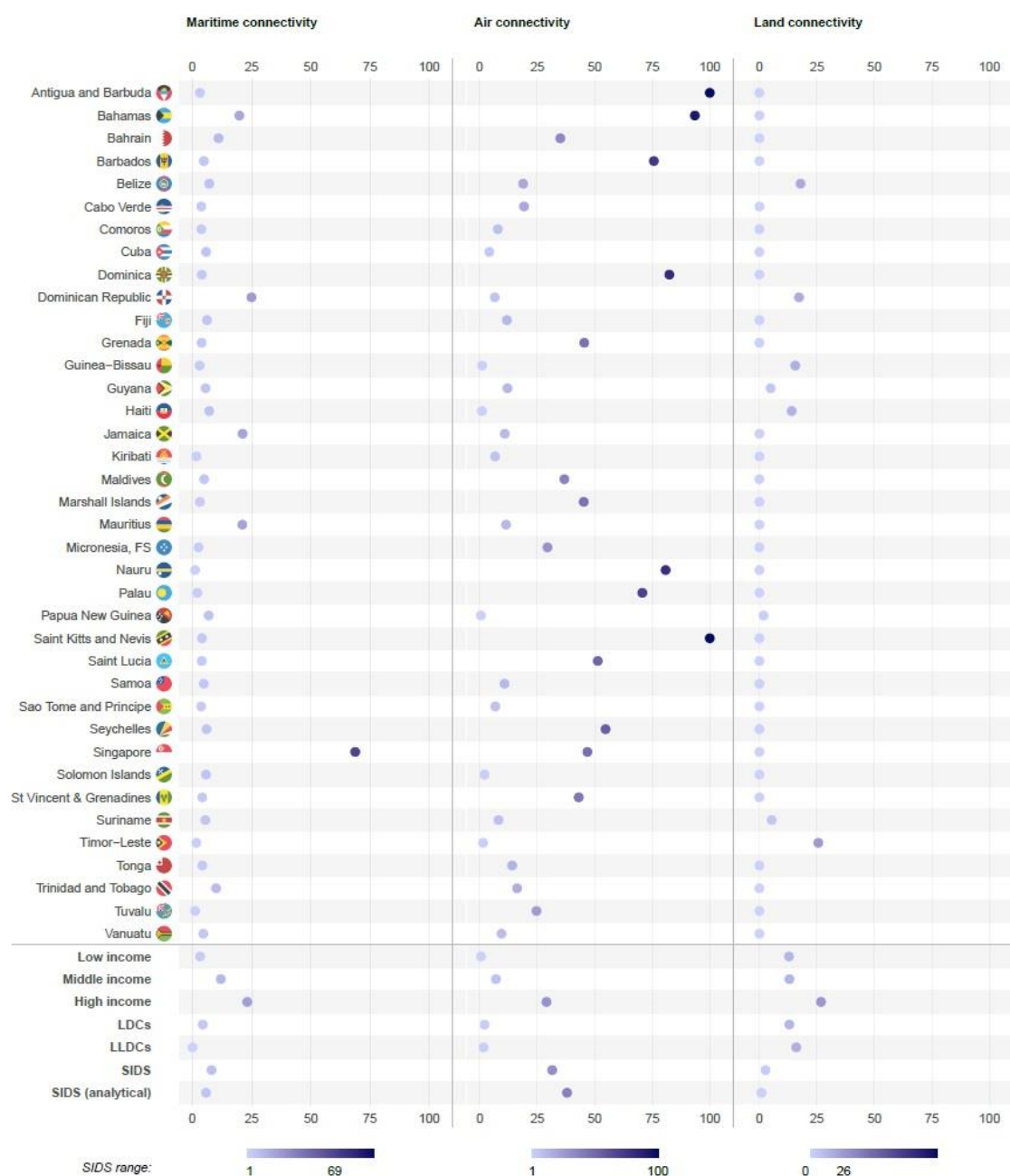
linkages and compounding factors between the three pillars. According to this index, the ten countries with the largest global presence in 2019 were the United States, China, Germany, the United Kingdom, Japan, France, the Russian Federation, Canada, the Netherlands and Italy.

This indicator shows that SIDS are also situated at a greater distance from centers of global presence, although less so than in the previous variable considering only the soft power pillar. Here too, the most remote countries in the world are New Zealand and Australia, and in addition the top ten includes a mix of SIDS (Tonga, Fiji, Vanuatu, Samoa and Tuvalu) and South American nations (Chile, Argentina and Uruguay).

3.4 Transport connectivity

Distance from economic and political centers can be greatly alleviated by good transport connections. A developed connectivity through sea, air or road networks can facilitate the movement of goods and people, reduce transport costs, increase reliability and reduce logistical risks. For island economies, land connectivity is (mostly) non-existent so other means of transport gain a greater relevance. Figure 4 summarizes transport indicators for SIDS.

Figure 4. Transport connectivity, SIDS and selected country groups, 2019



Source: Author's calculations based on data from UNCTAD, ICAO, CIA and UN Population Division.

Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using total population as weights. All variables presented as indices with 0 indicating the world minimum and 100 the world maximum.

Maritime connectivity is estimated through the liner shipping connectivity index, which indicates a country's level of integration into global liner shipping networks. Within SIDS, Singapore is a clear outlier, with a score almost three times higher than the second ranked economy, the Dominican Republic. In fact, Singapore is ranked second globally, after the most connected country in maritime networks (China) and just above the third placed country (Republic of Korea). In addition to Singapore and Dominican Republic, mentioned above, only three more SIDS exceed the average for middle income countries: Jamaica, Mauritius and the Bahamas. On average, SIDS are therefore not very well integrated into shipping connections. For countries with a high dependence on the sea, this low maritime connectivity could further aggravate the challenges of geographical remoteness.

The second column of Figure 4 presents an indicator of air connectivity, measured as the number of international flights per year relative to population. In this case, some SIDS with a high reliance on tourism are among the best connected in the world: Antigua and Barbuda, Saint Kitts and Nevis, the Bahamas, Dominica, Nauru, Barbados and Palau. In addition to these SIDS, most of the top ranked countries are either micro-States (Luxembourg) or other island economies (Iceland, Malta, Cyprus). On average, SIDS are comparatively well connected by air transportation, with international flights per capita at a level comparable to high-income countries. However, not all SIDS are as well integrated. Papua New Guinea, Haiti and Guinea-Bissau are among the lowest ranked economies in this variable.

As a third indicator of transportation, we propose a proxy for land connectivity constructed from the length of land borders, relative to total area, weighted by road infrastructure. Most European micro-States (landlocked, with extensive land borders relative to their area and excellent roadways) are the best ranked.⁴ Unsurprisingly given their lack of land borders, SIDS are mostly scored at zero, with a few exceptions with positive but still low scores (Timor-Leste, Belize, Dominican Republic and other SIDS that are not islands or that share an island with another country).

3.5 Social and political connectivity

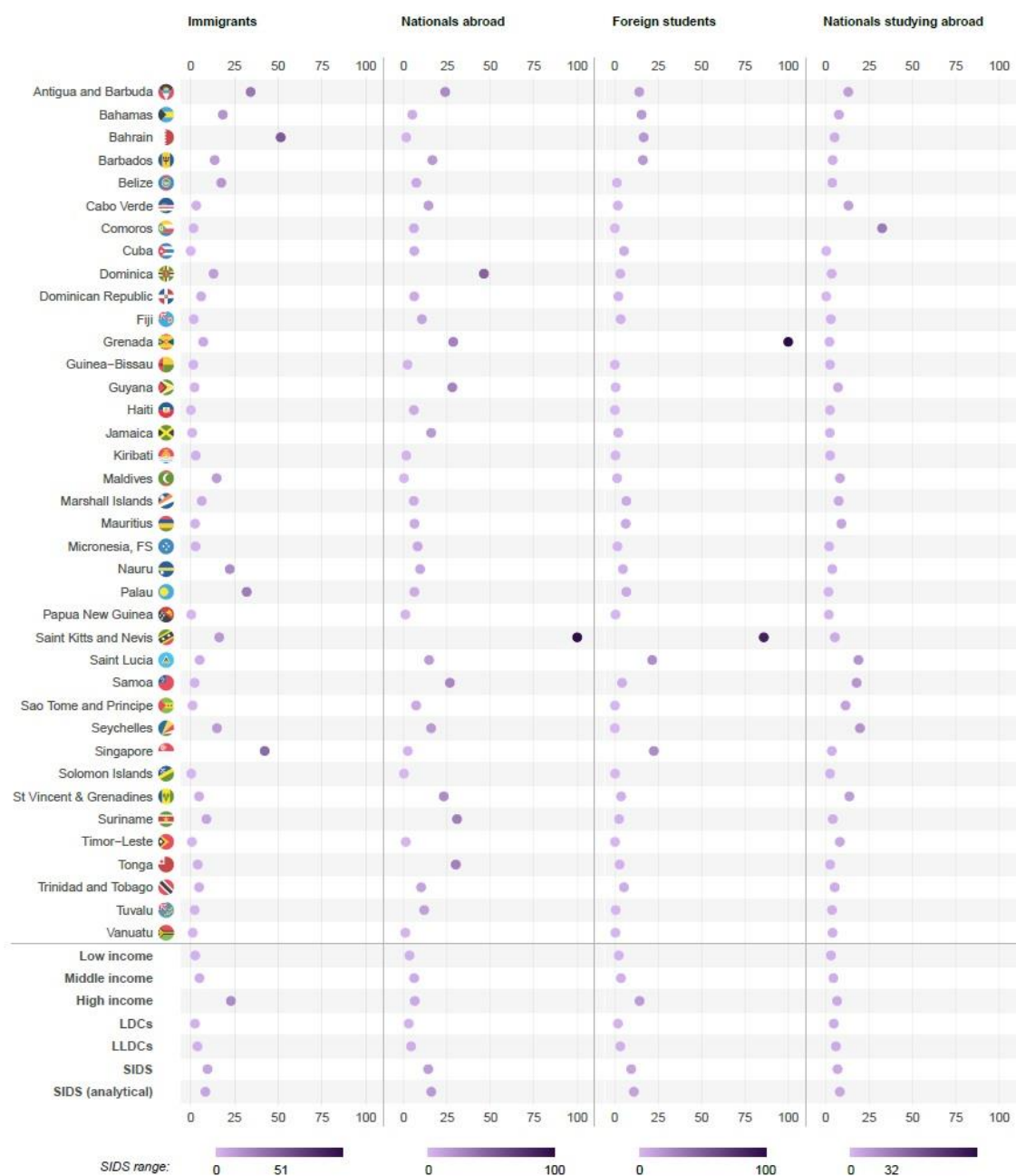
In addition to the economic "tax" of distance and the higher relative infrastructure needs, another important hardship associated with an isolated location could arise from establishing links with other societies and governments situated far away and possibly confronted to different problems. Contrary to centrally located countries, working with neighbors over common border issues or tackling regional challenges, SIDS could lack opportunities to join alliances or shared initiatives. In addition, there could be reduced spaces for the movement of persons and ideas.

This dimension of remoteness is broader and more difficult to measure than the others. A full account would involve monitoring all spaces that allow exchanges between individuals, societies and governments. Given data limitations, this dimension will be estimated through the seven indicators included in Figures 5 and 6. These include immigration and emigration, cross-border exchange of students, diplomatic representations and participation in defense and trade agreements. While cultural and political links clearly extend beyond the areas measured by these variables, they are difficult to conceptualize and measure, especially through internationally-comparable indicators with worldwide coverage.⁵

When they migrate, individuals take with them ideas, traditions, practices and businesses. They build networks and bridges between their communities of origin and destination. For this reason, the rates of both immigration and out-migration are important to consider. Foreign immigrants constitute a sizable share of the population in several high-income SIDS, such as Bahrain, Singapore, and Antigua and Barbuda. However, other SIDS feature some of the lowest immigration rates in the world: in Cuba, Haiti, Papua New

⁴ This indicator is only a proxy for land connections and does not consider important factors affecting cross-border transportation, including geographical features (mountainous or fluvial borders), border-crossing infrastructure, customs and border-crossing administrative efficiency, or other obstacles.

⁵ For instance, an interesting indicator would be the share of the world population that share the same language. A shared language facilitates exchange and transmission of ideas, and gives access to larger knowledge pool and more media sources, therefore reducing isolation. Although there are specialized databases for this variable (for instance, CEPII or Ethnologue), they present important data gaps, particularly for some SIDS.

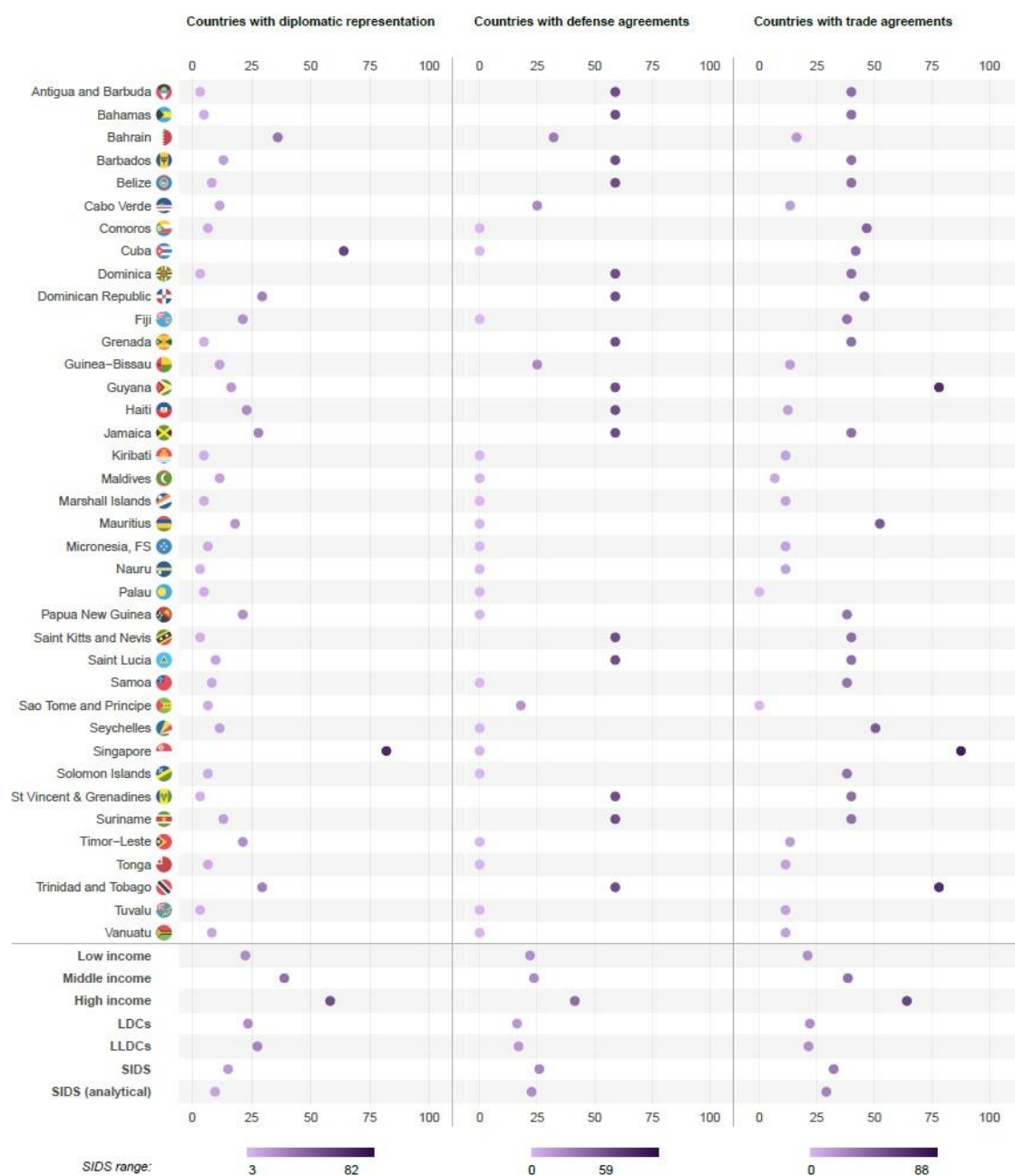
Figure 5. Social and political connectivity (part 1), SIDS and selected country groups, 2019

Source: Author's calculations based on data from UNESCO Institute for Statistics and UN Population Division.

Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using total population as weights. All variables presented as indices with 0 indicating the world minimum and 100 the world maximum.

Guinea, Solomon Islands, Timor-Leste and Jamaica, immigrants constitute less than one per cent of the population. Overall, the average immigration ratio in SIDS is higher than in low- and middle-income countries, although still at about one third of the levels observed in high-income countries.

A similar story is repeated in terms of emigration. One SIDS, Saint Kitts and Nevis, has the largest emigration rate in the world, with 2.4 nationals living abroad for each person living in the country. Other places of out-migration are Dominica, Suriname, Tonga, Grenada, Guyana and Samoa. As before, some SIDS such as

Figure 6. Social and political connectivity (part 2), SIDS and selected country groups, 2019

Source: Author calculations based on data from Lowy Institute, Gibler (2013), WTO and UN Population Division.

Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using total population as weights. All variables presented as indices with 0 indicating the world minimum and 100 the world maximum.

Maldives or Solomon Islands, exhibit a very low ratio in this variable. Nonetheless, with an overall emigration rate of 33.6 per cent, SIDS are significantly above the world average in this aspect.⁶

An interesting group of migrants, for which detailed statistics are available, are students that move to another country to pursue a tertiary education. The inbound mobility rate, measured as the percentage of students from abroad enrolled in a tertiary education program at a local university, is very high in Grenada and Saint

⁶ Some cases could be affected by practices where countries grant citizenship by investment. This could have an ambiguous relationship with social connectivity, but the available data do not allow a more detailed disaggregation.

Kitts and Nevis, where 85 and 73 per cent of tertiary students are foreigners. Although these are clear extremes, the SIDS average remains well above the average for low- and middle-income countries. In terms of outbound mobility rate, SIDS are at par with high-income countries, although far from the high student mobility rates observed in some cases.

Moving to diplomatic representations, covering both cultural and political arenas, we rely on the Global Diplomacy Index (Lowy Institute, 2019), which includes a full listing of all diplomatic representations abroad from 61 countries, for a total of 7320 missions. Although not all countries are covered in terms of the origin country, all destination countries are included. The indicator presented in Figure 6 shows the number of foreign nations that have at least one diplomatic representation (embassy, consulate or permanent mission) in the country. It varies from zero (Yemen), when there are no diplomatic mission at all, to 61 (Switzerland and United States), when all 61 origin countries featured in the dataset are represented in a country. For SIDS, this variable ranges from 50 (Singapore) to two (Antigua and Barbuda, Dominica, Nauru, Saint Kitts and Nevis, Saint Vincent and the Grenadines, and Tuvalu). As a group, SIDS have one of the lowest numbers of diplomatic representations, below low-income countries and other groups such as LDCs and LLDCs.

Another way to analyze inter-country linkages is through agreements, pacts and other alliances. Defense agreements, some of the oldest international pacts in existence, are one manifestation of this. By using a somehow outdated database from Gibler (2013), covering data up to 2012, the most connected nations are the United States and Canada, having some type of defense agreement in force with 56 and 51 nations, respectively. Conversely, 45 countries have no such alliance in force. According to this variable, the average SIDS has defense agreements with 15 countries, above the world average but still limited compared to other cases, particularly high-income countries.

A similar situation is observed when considering trade agreements. Sourced from a database maintained by the World Trade Organization (WTO, 2021), this variable presents active bilateral or plurilateral trade pacts in force. According to this information, Egypt has the highest number of trade links, with active trade agreement with 105 countries, closely followed by members of the European Union, who have a common international trade policy involving trade agreements with 98 countries. On the other hand, a handful of nations have no active agreements covering trade, including two SIDS (Palau and São Tomé and Príncipe). The average SIDS has a trade agreement with 34 partners, less than the average for middle- and high-income countries (40 and 67, respectively).

3.6 Digital connectivity

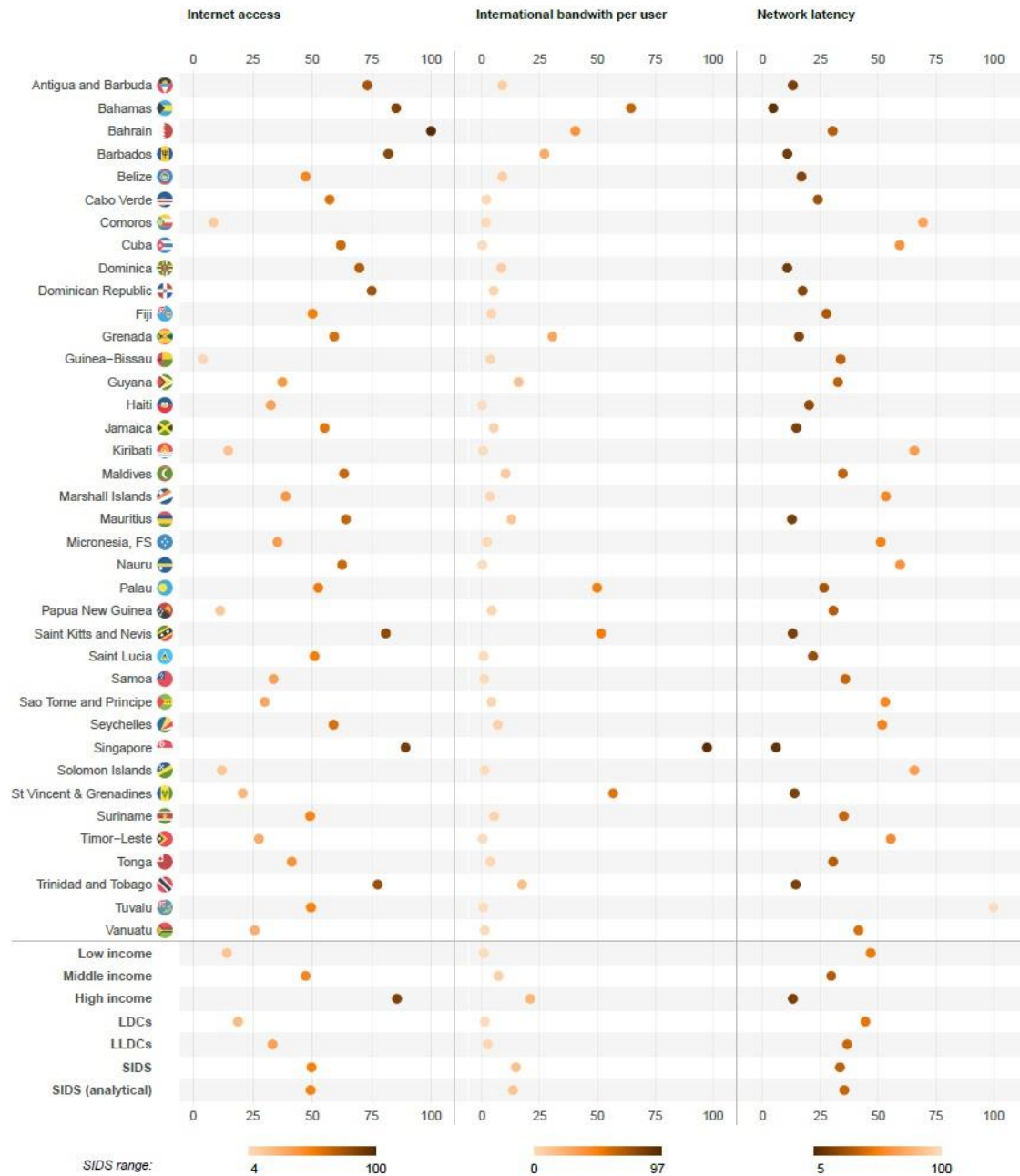
The final dimension of remoteness has a strong potential to offset some disadvantages of distance. While goods will still need to be transported physically, digital tools increasingly facilitate the exchange of services, financial assets, know-how and information. However, significant infrastructure investments and skill development of the population are required in order to take advantage of these tools. Figure 7 presents the three indicators that are included as a proxy of this emerging pillar of connectivity.

The first indicator, the share of population that has access to the Internet, shows that SIDS are well connected, although with a great variability. Indeed, this variable ranges from 99.7 per cent in Bahrain, the highest proportion in the world, to only 3.9 per cent in Guinea-Bissau, the country with the fifth lowest Internet access. On average, SIDS have similar outcomes that middle-income countries and better scores than LDCs and LLDCs.

The variable *International bandwidth per Internet user* in SIDS shows a skewed distribution, with a few countries (Singapore, the Bahamas, Saint Vincent and the Grenadines, and Saint Kitts and Nevis) among the best performers in the world, while many other SIDS' score is virtually indistinguishable from zero. This mirrors the world distribution of this variable, which serves as a proxy for the Internet infrastructure in place. On average, SIDS have a relatively good attainment in this variable, outperforming the average for low- and middle-income economies, although still behind the high-income group.

Finally, we include the latency rate. This is a network performance metric, measured as the round-trip time that it takes for a packet of data to travel from a sending node to the nearest receiving server in each country

Figure 7. Digital connectivity, SIDS and selected country groups, 2019



Source: Author's calculations based on data from ITU, Measurement Lab and UN Population Division.
 Note: Lighter colors indicate a higher relative remoteness. Country groups are calculated as averages using population as weights. All variables presented as indices with zero indicating the world minimum and 100 the world maximum.

and back. It is collected by Measurement Lab from a high number of tests performed across networks every day. The indicator presented here shows the median latency rate for each country over all tests conducted in 2019. A higher latency indicates a worse connection quality, therefore affecting network performance and opportunities to use ICTs for business or private connections. The third column of Figure 7 shows that the average SIDS performs as well as the average middle-income country and LLDC, and significantly better than low-income countries or LDCs. Also in this case, the average hides a large variance, with one SIDS at the bottom of the world rank (Tuvalu, with a median latency of 1821 milliseconds), while other members of this group have some of the best Internet connections worldwide (the Bahamas, Singapore).

4. Towards a remoteness index

The previous chapter presented 21 variables that can provide a comprehensive assessment of remoteness along six dimensions. This shows that traditional measures of geographical distance to markets are not sufficient to give a complete panorama of the challenges of distance. Moreover, a large number of connectivity factors could mitigate or accentuate remoteness, and they should be taken into account.

With the objective of facilitating comparisons between variables measured in different units, Figures 1 to 7 presented all indicators transformed through a min-max transformation into a common scale, with a minimum of 0 and a maximum of 100. From there, it is a small step to aggregate variables into composite indicators of remoteness. This section presents the steps for calculating a remoteness index and the results for SIDS and relevant benchmarks.

The construction of a composite index immediately raises questions about variable weights and aggregation choices. This calls for exploring different methods and assigning weights to variable in an optimal manner for dimensionality reduction or according to their links with development outcomes. This is not the objective of this paper and a more elaborate construction is left for future research. However, in an attempt to reduce the multidimensionality of remoteness and present summary indicators, a simple aggregation exercise will be presented below and in the next two charts.

One important preliminary step is transforming all variables into a common direction. For some of the variables (e.g. distance to trading partners or network latency), a higher score indicates a higher remoteness. Other variables follow the opposite direction (e.g. maritime connectivity or Internet access). When required, variables were transformed so that a higher value corresponds to higher remoteness.

With all variables in a common scale, the index for each dimension was calculated through a simple average of the variables included.⁷ The results were then adjusted to a 0-100 scale through a min-max transformation so that, for each dimension, the most remote country takes a value of 100 and the most proximate country a value of zero. The overall remoteness index was then calculated as a simple average of the aggregate indicators for the six dimensions.⁸

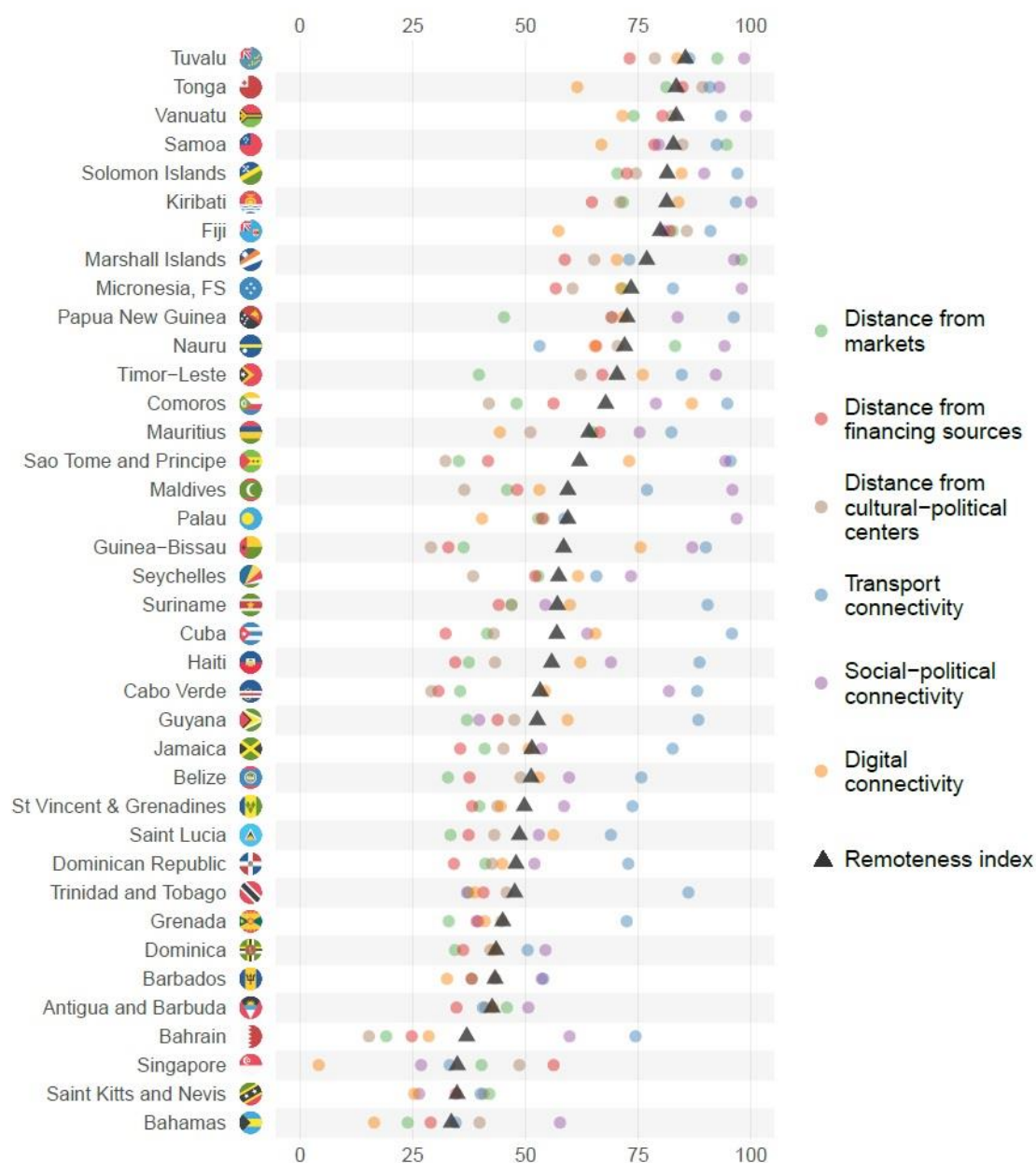
The results for the 38 SIDS are presented in Figure 8, where each of the colored circles represents one of the six dimensions of remoteness and the triangle indicates the overall index. This chart is ordered from the most remote to the least remote SIDS, in terms of the overall index.

According to this indicator, the most remote SIDS is Tuvalu, closely followed by Tonga and Vanuatu. Samoa and Solomon Islands complete the top five. The top ten is composed exclusively of Pacific SIDS, which are remote on all or most dimensions.

After that, we observe some variability, where the overall index is improved by positive scores in one or a few dimensions of remoteness. For example, while Timor-Leste and Papua New Guinea score high in most of the dimensions, the general index is reduced by their geographical location, relatively closer to main markets and trading partners. A similar situation is observed in Nauru, although in this case it is a relatively high transport connectivity, mostly based on air transport, which lowers the overall score. The score of Mauritius is significantly improved by its well-developed digital connectivity.

⁷ Only two exceptions were considered. First, the variables *Immigrants* and *Nationals abroad* were first averaged before including them in the average for the dimension Social and political connectivity, since they represent two sides of the same phenomenon. This avoids assigning a double weight to this factor. A similar procedure was followed for the variables *Foreign students* and *Nationals studying abroad*.

⁸ Many composite indicators use a geometric average to account for non-substitutability between dimensions. However, this is not possible here because of the min-max transformation at the dimension level, which will make a country with a value of zero in one dimension to also have zero in the overall index. Moreover, the idea of substitutability, or how one dimension of remoteness can be mitigated through better outcomes in another dimension, is precisely at the core of the definition of remoteness presented in this paper.

Figure 8. Remoteness index for SIDS, 2019

Source: Author's calculations based on data from different sources (see Appendix B).

Note: For all dimensions, a higher score indicates a higher remoteness.

On the other hand, the graph also shows some SIDS that are more proximate, in relative terms, across most dimensions, but whose score is penalized by a poor result in one dimension. For Suriname, Cuba, Guyana and Trinidad and Tobago, the area lagging behind is transport connectivity. For Maldives and Palau, it is their social and political isolation.

We observe the least remote SIDS at the bottom of the graph, starting with the Bahamas, which compensates for a relatively low social/political connectivity through a shorter average distance to markets and an excellent digital infrastructure. Following closely are Singapore, Bahrain and some of the high-income SIDS in the Caribbean (Saint Kitts and Nevis, Antigua and Barbuda and Barbados).

When comparing the scores of SIDS to the world distribution, they are indeed among the most remote economies in the world, particularly Pacific SIDS. Among the top 15 most remote countries according to the overall index, all of them are Pacific SIDS except New Zealand (8th), Australia (13th) and Madagascar (15th).⁹ The most remote SIDS outside the Pacific is Comoros, ranked 18th in the world. The complete scores for all countries are presented in Appendix C.

Figure 9 presents the aggregate results for SIDS and several benchmarks. A first highlight of this graph is the strict ordering observed for each of the six dimensions of remoteness according to income level. This indicates a clear link between remoteness and economic performance, as well as a clustering effect. SIDS have a score in the remoteness index comparable to low-income economies.

Another striking result is that SIDS are not worse off than LDCs or LLDCs in terms of remoteness. While they are located at a greater distance from markets, financing sources and cultural centers, they partially compensate for this disadvantage through better connectivity, especially in terms of ICT and digital technologies. This draws attention to the importance of connectivity and considering all aspects of remoteness beyond just geographical distance when studying the development of SIDS.

As shown in the country-level results shown in Figure 8, the SIDS average hides some important differences between countries. SIDS in the Pacific Ocean are distinctly more remote, with a higher score in most dimensions, particularly transport and socio-political connectivity. SIDS in the Atlantic and Indian Ocean (AIMS) are the least remote, thanks in part to their improved digital and transport connectivity.

All charts have also included an aggregate for “Analytical SIDS”. As described in Appendix A, the intra-group heterogeneity of SIDS is affected by the inclusion of several countries that might not fully meet the characteristics of a SIDS. MacFeely et al. (2021) propose a subset of 28 countries that are closely aligned with the SIDS definition. This increases the homogeneity in the group and reflects more closely the remoteness challenge faced by SIDS across the six dimensions.

Figure 9. Remoteness index for selected country groups, 2019



Source: Author's calculations based on data from different sources (see Appendix B).

Note: Country groups are calculated as averages using total population as weights. For all dimensions, a higher score indicates a higher remoteness.

⁹ On the other hand, the 30 least remote countries in the world are all located in Europe. The five less remote countries are Luxembourg, Belgium, the Netherlands, Cyprus and the United Kingdom.

5. Conclusions

In terms of geographical isolation, New Zealand is a remarkable case. Across all geographical indicators (the first three dimensions presented in this paper), this is the most remote country in the world, sometimes by a large margin. However, it partially makes up for this disadvantage through a well-developed connectivity infrastructure, especially in terms of ICT. A similar situation can be observed in Australia. As additional examples, Uruguay compensates for its location by excellent digital and transport connections, while Chile has well developed social and political networks (including one of the world's highest number of defense and trade pacts). The remoteness ranks for these four selected countries are shown in Table 1, where top ranks (i.e., high relative remoteness) in the first three dimensions are offset by good performance in the connectivity dimensions, therefore improving the overall remoteness score.

Table 1. Ranks in remoteness index by dimension, selected countries, 2019

Dimension	New Zealand	Australia	Uruguay	Chile
Distance from markets	1	9	14	7
Distance from financing sources	1	2	7	5
Distance from cultural and political centers	1	3	10	7
Transport connectivity	90	80	118	100
Social and political connectivity	81	130	92	165
Digital connectivity	175	151	131	107
Overall remoteness	8	13	20	23

Source: Author's calculations based on data from different sources (see Appendix B).

These four cases show that remoteness is not an insurmountable obstacle. While geographical distance does entail higher transportation costs and a limited participation in global decision-making, this can be offset by targeted investments in transport, communication and information connectivity, as well as an active participation in cultural and political networks. SIDS have already done important progress in this front and, on average, they are not more remote than other groups of countries (LDCs or LLDCs), according to the index presented here.

The broader study of remoteness presented in this paper also highlights the heterogeneity within SIDS. While most SIDS located in the Pacific Ocean are objectively remote in all dimensions, SIDS in the Caribbean Sea or in the AIMS subregion are not more remote than an average middle-income country. This calls for a more detailed disaggregation of SIDS that reflects the most pressing challenges they face.

The remoteness index proposed in this paper could be used as an objective measure to evaluate the challenges faced by SIDS as a result of their isolated location. This index reflects the importance of geography, but also of attenuating factors stemming from targeted policies for improving connectivity. Moreover, this index reflects all aspects of remoteness, including the limited options for transport connectivity (no land borders in the case of most SIDS, but also lack of access to maritime transport for most LLDCs). It could therefore be used as a broad indicator measuring the economic vulnerabilities arising from remoteness, and it could be used for determining objective inclusion and graduation criteria for SIDS, LDCs, LLDCs and other groups of countries.

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Appendix A. Country classifications

SIDS were first recognized as group with specific challenges for development in the Earth Summit of 1992 in Rio de Janeiro, Brazil (United Nations, 1992). However, contrary to LDCs, for which clear criteria for membership and graduation are defined, there is no definitive list of SIDS. The UN recognizes a modified list of the Alliance of Small Island States as SIDS members (UN-OHRLLS, 2021a). The group of SIDS is further subdivided into three regions: the Caribbean, the Pacific and the Atlantic and Indian Ocean (subgroup referred to as AIMS) (United Nations, 2021). Mostly because of data availability, this paper focuses on the 38 SIDS that are UN members; these are listed in Table 2.

However, in terms of conceptual consistency, this list is debatable because it includes economies that are not small in economic or demographic terms (Cuba, Dominican Republic, Haiti, Papua New Guinea, Singapore), that can hardly be considered as “developing” economies given their high income per capita (Singapore, Bahrain) or that are not islands (Belize, Guinea-Bissau, Guyana, Suriname). MacFeely et al. (2021) propose a subgroup of SIDS economies that are closely aligned to the conceptual definition of SIDS (UNCTAD, 2021). These 28 countries are marked with an asterisk in Table 2. In this paper, all tables and SIDS aggregates are based on the broader list of 38 countries, but the narrower analytical list is also reported whenever aggregates are presented.

In addition to both groups of SIDS, this paper mentions additional country groups for comparison purposes. These are the LDCs and the LLDCs (see UN-OHRLLS (2018; 2021b) for the UN-recognized lists for these groups).¹⁰ The 2021 country groups by income level defined by the World Bank are also presented (World Bank, 2021).¹¹

Table 2. SIDS membership (UN member States)

Caribbean	
Antigua and Barbuda*	Guyana
Bahamas*	Haiti
Barbados*	Jamaica*
Belize	Saint Kitts and Nevis*
Cuba	Saint Lucia*
Dominica*	Saint Vincent and the Grenadines*
Dominican Republic	Suriname
Grenada*	Trinidad and Tobago*
Pacific	
Fiji*	Samoa*
Kiribati*	Solomon Islands*
Marshall Islands*	Timor-Leste*
Micronesia (Federated States of)*	Tonga*
Nauru*	Tuvalu*
Palau*	Vanuatu*
Papua New Guinea	
AIMS	
Bahrain	Mauritius*
Cabo Verde*	São Tomé and Príncipe*
Comoros*	Seychelles*
Guinea-Bissau	Singapore
Maldives*	

¹⁰ Note that Vanuatu graduated from the group of LDCs in December 2020. Since the indicators presented in this paper refer to 2019, this country is still included in this group.

¹¹ The 2021 classification from the World Bank is based on per-capita income levels in 2019, the same reference year used in this paper.

Appendix B. Variable definitions, sources and data summary

There are important statistical gaps in many SIDS. National sources are at times lacking, while international sources sometimes have out-of-date or missing information for many SIDS. This paper presents 21 variables across six dimensions, selected after a careful exploration of available data sources. Many important factors, for example in terms of social and political connectivity, could not be measured because of lack of data with sufficient coverage. The variables considered represent the best effort in collecting relevant indicators for remoteness that provide complete information on SIDS.

A crucial issue is the measurement of inter-country distance. Different methodologies for measuring distance can lead to vastly different results, particularly for large countries. For example, the distance between Brazil and Trinidad and Tobago (a SIDS) can vary from 547 km when considering the minimum distance between the two countries to 3287 km when measuring inter-capital distance. In this study, we rely on the variable *distw* of the GeoDist database produced by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). To account for cases where the capital is not the main economic center of the country, or when a country has multiple economic poles, this variable defines the bilateral distance between two countries as the average distance (calculated using the great circle formula) between all pairs of cities in the two countries, weighted by their respective population shares; up to 25 cities per country are considered (Mayer and Zignago, 2011). For the countries that are not included in the CEPII database (Montenegro, Serbia and South Sudan), we replaced the missing values with inter-capital distances calculated from the R package *cshapes*. One exception to the use of this distance measure is the first variable, *Distance to nearest neighbor*, which reflects isolation only in terms of geographical distance, without accounting for population or economic centers. For this variable, the minimum distance between pairs of countries was used.

Table 3 summarizes the 21 variables included, as well as their sources. Unless otherwise indicated in the table, all data is for 2019. Although at the time of writing some variables were already available for 2020, they were not considered to avoid the confounding effect of COVID-19.

Table 3. Definitions and data sources of variables

Variable	Definition	Units	Source
Distance from markets			
Distance to nearest (large) neighbor	Minimum distance to nearest non-SIDS country	Kilometers	R package <i>cshapes</i>
Distance to economic centers	Average distance to all countries, weighted by their GDP	Kilometers	UN Statistics Division and CEPII
Distance to trading partners	Average distance to all countries, weighted by bilateral trade (exports and imports of goods)	Kilometers	UNCTAD and CEPII
Distance from financing sources			
Distance to business centers	Average distance to registration countries of the 500 largest companies, weighted by their revenues	Kilometers	Fortune and CEPII
Distance to FDI sources	Average distance to sources of FDI, weighted by their FDI stocks abroad	Kilometers	UNCTAD and CEPII
Distance to ODA sources	Average distance to senders of ODA and other official flows, weighted by their contributions in 2010-2019	Kilometers	OECD and CEPII
Distance from cultural and political centers			
Distance to soft power centers	Average distance to countries, weighted by Global Score Power Index	Kilometers	Brand Finance and CEPII

Distance to global presence centers	Average distance to countries, weighted by score in the Global Presence Index	Kilometers	Elcano Royal Institute and CEPPII
Transport connectivity			
Maritime connectivity	Liner shipping connectivity index, average of quarterly data	Index, world maximum Q1 2016 = 100	UNCTAD
Air connectivity	International flight departures, yearly departures per 1000 population	Number per 1000 people	ICAO and UN Population Division
Land connectivity	Relative length of land borders index (kms. of land borders per 100 km ² of territory, adjusted for closed land borders, world maximum = 100), weighted by a road density index (kms. of roadways per 100 km ² of territory, world maximum = 100), both indices censored at 95th percentile	Index, world maximum = 100	CIA
Social and political connectivity			
Immigrants	Stock of international immigrants living in the country as a share of total population	Percentage	UN Population Division
Nationals abroad	Stock of nationals living abroad as a share of total national population	Percentage	UN Population Division
Foreign students	Inbound mobility rate (number of tertiary students from abroad as a percentage of total tertiary enrollment), 2018-2019	Number of foreign students per total enrollment	UNESCO Institute for Statistics
Nationals studying abroad	Outbound mobility ratio (number of nations studying abroad as a percentage of total tertiary enrollment), 2018	Number of national students abroad per total enrollment	UNESCO Institute for Statistics
Countries with diplomatic representation	Number of countries with at least one diplomatic foreign representation (embassy, consulate or permanent mission) in the country	Number of countries	Lowy Institute
Countries with defense agreements	Number of countries with at least one formal defense agreement (defense, neutrality, nonaggression, entente) in force, 2012	Number of countries	Gibler (2013)
Countries with trade agreements	Number of countries with at least one formal trade agreement (bilateral, plurilateral) in force	Number of countries	WTO
Digital connectivity			
Internet access	Proportion of individuals using the Internet, 2017-2019	Percentage	ITU
International bandwidth per Internet user	International bandwidth per Internet user, 2017-2019	Kbits per second	ITU
Network latency	Median latency rate (round-trip delay when sending/receiving a package of information over a network)	Milliseconds	Measurement Lab

The worldwide dataset (SIDS and other countries) used in the analysis includes 190 countries: the 193 UN member States minus three States that could not be considered because of incomplete data in one or a few dimensions: Liechtenstein, Monaco and San Marino. Table 4 presents summary statistics for all variables. All country aggregates in this table and throughout the publication are calculated as averages using population as weights.

Table 4. Summary statistics

Variable	Global average	SIDS average	SIDS (analytical) average	Global standard deviation	Global minimum	Global maximum
Distance from markets						
Distance to nearest (large) neighbor	8.1	371.2	706.9	69.4	0.0 (multiple)	3264.2 (Marshall Islands)
Distance to economic centers	8514.2	9297.6	9880.9	1246.2	6063.1 (Serbia)	13236.0 (New Zealand)
Distance to trading partners	6160.2	5950.6	5808.9	1799.8	798.5 (Andorra)	12449.4 (Chile)
Distance from financing sources						
Distance to business centers	8495.0	9679.4	9861.4	1389.8	5975.2 (Finland)	13437.8 (Uruguay)
Distance to FDI sources	8301.0	9626.1	9974.6	1470.7	4850.2 (Luxembourg)	13569.9 (New Zealand)
Distance to ODA sources	7821.4	9627.3	10066.3	1790.0	3554.2 (Luxembourg)	15718.1 (New Zealand)
Distance from cultural and political centers						
Distance to soft power centers	7623.7	10020.4	10285.4	1606.1	4825.5 (Serbia)	14577.8 (New Zealand)
Distance to global presence centers	8155.4	9732.9	10034.3	1397.9	5178.3 (Serbia)	14206.2 (New Zealand)
Transport connectivity						
Maritime connectivity	63.0	12.6	9.0	50.4	0.0 (multiple)	155.7 (China)
Air connectivity	1.6	25.4	31.0	3.5	0.0 (multiple)	133.4 (Antigua and Barbuda)
Land connectivity	15.6	2.7	0.9	14.8	0.0 (multiple)	100.0 (Belgium)
Social and political connectivity						
Immigrants	3.5	8.5	7.4	7.1	0.0 (Cuba)	87.9 (United Arab Emirates)
Nationals abroad	3.3	33.6	37.8	4.7	0.4 (Korea DPR)	236.5 (Saint Kitts and Nevis)
Foreign students	2.0	8.0	9.4	4.0	0.0 (multiple)	85.2 (Grenada)
Nationals studying abroad	2.7	16.8	20.1	4.8	0.3 (Korea DPR)	245.3 (Andorra)

Countries with diplomatic representation	48.2	9.2	5.9	14.5	0 (Yemen)	61 (multiple)
Countries with defense agreements	13.2	14.5	12.6	14.5	0 (multiple)	56 (United States)
Countries with trade agreements	45.1	33.9	30.6	24.6	0 (multiple)	105 (Egypt)
Digital connectivity						
Internet access	47.5	49.6	49.2	27.2	0.0 (Korea DPR)	99.7 (Bahrain)
International bandwidth per Internet user	68.1	144.1	132.1	108.3	0.0 (Korea DPR)	8329.0 (Luxembourg)
Network latency	167.9	284.1	308.0	107.7	13.3 (Andorra)	1821.0 (Tuvalu)

In a few variables, there were one or a few countries with extreme values. For example, while the (unweighted) median network latency rate is 175.8 milliseconds (ms) and the 90th percentile is 410.7 ms, there is one country with an extremely high value: Tuvalu (1821.0 ms). The second ranked country is almost half of Tuvalu's value (Eritrea, 948.3 ms). The objective of the analysis is to reflect the actual situation of remoteness and this involves dealing with extremely distant observations. However, in cases such as the variable described above, one or a few countries were so far from the rest that they masked the situation in the bulk of the distribution. To strike a balance between reflecting real-life remoteness while allowing a meaningful analysis for all countries, the maximum of a few variables was censored at the 99th percentile when calculating the min-max transformation. The variables concerned are *Air connectivity*, *International bandwidth per Internet user* and *Network latency*.¹² No variable reflecting geographical distance was modified in this way.

As a final remark, despite best efforts to select variables with as complete coverage as possible, some variables were still affected by missing values. Since the data are in all likelihood not missing at random, it is important to take this into account to avoid introducing bias in the aggregates. Table 5 presents the methodology followed to impute missing data, as well as the SIDS that were imputed. Only those variables where imputation was required are included in the table.

Table 5. Imputation methodology applied

Variable	Methodology	SIDS with imputed values
Distance	Missing data imputed by using inter-capital distance calculated from the R package <i>cshapes</i> .	None
Maritime connectivity	Most (but not all) landlocked countries were not included in the data source, given their lack of access to the sea; a value of zero is implied in these cases. Missing values: last observation carried forward (LOCF) from 2010.	None
Foreign students	LOCF from 2010 (year indicated in parentheses). Countries with no data since 2010 were imputed through a regression of the target variable on GDP per capita (UNSD), global soft power index (Brand	<u>LOCF</u> : Antigua and Barbuda (2012), Barbados (2011), Comoros (2014), Cuba (2012), Dominican Republic (2017), Guyana (2012), Mauritius (2017), Saint Kitts and Nevis (2014), Singapore (2012).

¹² Note also the censorship at the 95th percentile applied during the construction of the variable *Land connectivity*, as described in Table 3.

	Finance), school attainment of the 25+ population (IIASA), political stability and absence of violence (World Bank) and an LDC indicator.	<u>Regression</u> : the Bahamas, Belize, Dominica, Fiji, Guinea-Bissau, Haiti, Jamaica, Kiribati, Maldives, Micronesia (Federated States of), Nauru, Palau, Papua New Guinea, Saint Vincent and the Grenadines, São Tomé and Príncipe, Solomon Islands, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu.
Nationals studying abroad	LOCF from 2010 (year indicated in parentheses). Countries with no data since 2010 were imputed through a regression of the target variable on GDP per capita (UNSD), global soft power index (Brand Finance), school attainment of the 25+ population (IIASA), enrollment rates in tertiary education (UNESCO-UIS), regional indicators, indicators for one of the six official UN languages as an official national language, and an LDC indicator.	<u>LOCF</u> : Antigua and Barbuda (2012), Barbados (2011), Comoros (2014), Dominican Republic (2017), Guyana (2012), Jamaica (2015), Maldives (2017), Marshall Islands (2012), Mauritius (2017), Palau (2013), Saint Kitts and Nevis (2015), Saint Vincent and the Grenadines (2015), São Tomé and Príncipe (2015), Singapore (2012), Timor-Leste (2010). <u>Regression</u> : the Bahamas, Dominica, Guinea-Bissau, Haiti, Kiribati, Micronesia (Federated States of), Nauru, Papua New Guinea, Solomon Islands, Suriname, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu.
Internet access	LOCF from 2010 (year indicated in parentheses). Countries with no data since 2010 were imputed through a regression of the target variable on the proportion of households with Internet access at home (ITU).	<u>LOCF</u> : Antigua and Barbuda (2016), Saint Vincent and the Grenadines (2016). <u>Regression</u> : Palau.
International bandwidth per Internet user	LOCF from 2010 (year indicated in parentheses). Countries with no data since 2010 were imputed through research in news articles and business reports.	<u>LOCF</u> : Antigua and Barbuda (2016), Nauru (2011), Saint Vincent and the Grenadines (2016). <u>Desktop research</u> : Palau (2019).

Appendix C. Scores in the remoteness index

The scores for all countries across the six dimensions and the overall index are presented in Table 6. Countries are presented in decreasing order according to the overall index (from most remote to least remote).

Table 6. Remoteness index, results by country

Rank	Country	Distance from markets	Distance from financing sources	Distance from cultural and political centers	Transport connectivity	Cultural and political connectivity	Digital connectivity	OVERALL INDEX
1	Tuvalu	92.5	73.1	78.7	86.3	98.5	83.7	85.5
2	Tonga	81.2	84.8	89.2	90.8	93.0	61.4	83.4
3	Vanuatu	74.0	80.3	82.5	93.3	98.9	71.5	83.4
4	Samoa	94.6	78.6	84.8	92.4	79.5	66.8	82.8
5	Solomon Islands	70.4	72.5	74.5	97.0	89.6	84.6	81.4
6	Kiribati	71.6	64.7	70.9	96.7	100.0	83.9	81.3
7	Fiji	82.6	81.9	85.8	91.0	80.7	57.3	79.9
8	New Zealand	100.0	100.0	100.0	83.5	63.8	31.2	79.8
9	Marshall Islands	97.8	58.7	65.2	73.0	96.2	70.3	76.9
10	Micronesia (Federated States of)	71.4	56.7	60.4	82.7	97.9	71.1	73.4
11	Papua New Guinea	45.2	69.1	69.0	96.2	83.7	71.7	72.5
12	Nauru	83.2	65.6	70.4	53.1	94.1	65.3	72.0
13	Australia	75.0	92.8	87.6	84.8	47.7	36.8	70.8
14	Timor-Leste	39.6	67.0	62.2	84.6	92.2	76.0	70.3
15	Madagascar	60.3	63.2	48.1	98.3	78.2	67.7	69.3
16	Bolivia (Plurinational State of)	60.8	67.1	67.4	96.7	56.8	64.0	68.8
17	Paraguay	62.4	73.0	69.4	91.9	63.0	48.3	68.0
18	Comoros	48.0	56.2	41.9	94.7	78.9	86.9	67.8
19	Malawi	42.7	56.7	42.7	91.1	88.3	82.3	67.3
20	Uruguay	71.4	80.2	74.7	76.0	59.3	42.3	67.3
21	Argentina	73.2	79.9	76.4	84.3	35.6	54.1	67.3
22	Lesotho	41.9	68.2	53.8	85.8	80.5	64.8	65.8
23	Chile	82.6	80.8	79.5	80.5	22.5	46.6	65.4
24	Eswatini	33.6	66.3	51.7	85.8	76.6	74.4	64.7
25	Botswana	41.8	63.2	49.2	95.4	79.2	57.4	64.3
26	Mauritius	64.9	66.4	51.1	82.3	75.3	44.3	64.0
27	Namibia	41.5	61.2	48.2	89.7	75.3	66.8	63.8
28	Zambia	41.3	55.7	42.2	96.3	79.2	66.6	63.5
29	Mozambique	47.5	62.3	47.8	94.3	58.9	69.7	63.4

30	Congo	48.1	45.8	34.8	84.4	85.9	80.5	63.2
31	Somalia	32.9	42.7	30.0	96.6	91.1	84.4	62.9
32	South Sudan	36.2	35.8	25.6	94.8	94.7	90.5	62.9
33	Congo, Dem. Rep. of the	37.6	47.1	35.4	96.4	74.5	83.3	62.4
34	Angola	54.2	50.7	39.2	89.0	70.7	69.9	62.3
35	São Tomé and Príncipe	35.2	41.7	32.2	95.4	94.3	73.0	62.0
36	Brazil	70.1	65.2	61.5	83.9	40.0	46.0	61.1
37	Liberia	50.0	37.3	31.5	91.4	85.3	70.8	61.0
38	Central African Republic	34.8	38.0	27.6	97.9	86.2	81.6	61.0
39	Zimbabwe	36.6	59.7	45.7	92.7	56.5	73.9	60.9
40	Equatorial Guinea	40.4	39.6	30.1	86.9	87.4	77.9	60.4
41	South Africa	58.7	68.1	54.6	76.6	53.7	50.6	60.4
42	Gabon	45.9	42.1	32.1	89.5	83.7	67.7	60.2
43	Peru	66.8	62.8	67.8	81.3	26.0	56.1	60.1
44	Chad	34.4	32.3	23.1	99.2	89.6	81.3	60.0
45	Eritrea	26.7	31.8	20.8	91.1	88.7	100.0	59.8
46	Maldives	45.9	48.1	36.4	76.9	95.9	53.0	59.4
47	Palau	52.8	53.6	54.0	58.5	96.8	40.3	59.3
48	Mauritania	35.8	27.3	24.5	96.7	84.0	86.5	59.1
49	Sierra Leone	40.1	35.6	30.6	89.5	87.4	70.1	58.9
50	Tanzania, United Republic of	39.5	49.9	36.5	90.7	58.9	75.3	58.5
51	Guinea-Bissau	36.2	32.9	29.0	90.0	87.0	75.5	58.4
52	Niger	29.4	29.5	22.4	100.0	82.1	84.8	58.0
53	Korea, Dem. People's Rep. of	37.5	24.9	30.1	92.3	79.1	83.0	57.8
54	Cambodia	30.3	45.0	39.9	85.1	85.8	59.9	57.7
55	Indonesia	43.7	61.3	54.4	80.3	56.5	48.4	57.4
56	Yemen	27.2	33.1	21.9	95.4	86.8	79.8	57.4
57	Seychelles	52.8	52.1	38.4	65.7	73.4	61.6	57.3
58	Ecuador	50.2	54.3	61.0	81.9	42.4	53.9	57.3
59	Mali	29.4	30.9	25.7	96.5	78.3	82.2	57.2
60	Rwanda	33.2	45.3	32.8	86.2	77.6	67.7	57.1
61	Uganda	31.5	43.3	31.0	95.7	75.6	65.6	57.1
62	Burundi	33.9	46.4	33.8	76.9	80.7	70.7	57.1
63	Suriname	46.8	44.0	46.9	90.4	54.4	59.8	57.1
64	Gambia	39.1	31.6	28.2	78.8	90.8	73.3	57.0

65	Cuba	41.5	32.2	42.9	95.7	63.7	65.5	56.9
66	Burkina Faso	29.2	31.4	25.2	96.5	81.9	76.9	56.9
67	Ethiopia	34.9	36.6	25.1	96.9	71.0	76.1	56.8
68	Haiti	37.4	34.4	43.2	88.6	68.9	62.2	55.8
69	Lao People's Dem. Rep.	16.1	39.6	35.5	88.9	84.3	69.9	55.7
70	Venezuela (Bolivarian Rep. of)	48.5	41.9	48.9	92.4	47.5	54.3	55.6
71	Honduras	29.7	39.7	50.6	88.1	61.2	62.7	55.3
72	Benin	40.6	35.2	27.5	84.8	68.6	75.4	55.3
73	Togo	34.1	35.7	28.1	72.6	87.6	73.2	55.2
74	Sri Lanka	37.9	45.8	35.5	76.6	71.2	63.3	55.1
75	Nicaragua	31.1	42.1	52.3	90.3	45.7	67.0	54.7
76	Philippines	33.3	46.0	45.7	88.9	55.9	58.5	54.7
77	Guatemala	31.5	40.5	51.7	82.2	56.5	62.7	54.2
78	Cameroon	36.5	36.8	27.5	86.9	59.4	76.9	54.0
79	Guinea	43.7	34.4	29.7	86.7	66.8	62.3	53.9
80	Cabo Verde	35.5	30.7	29.1	88.0	81.8	54.3	53.2
81	Senegal	32.0	30.7	27.6	88.5	70.2	70.0	53.2
82	El Salvador	30.1	41.2	52.0	74.9	57.9	62.8	53.1
83	Côte d'Ivoire	36.2	37.0	30.2	84.3	65.6	65.1	53.1
84	Guyana	37.0	43.8	47.5	88.3	39.7	59.3	52.6
85	Afghanistan	11.9	22.1	15.6	97.5	83.6	81.9	52.1
86	Nigeria	38.8	34.9	27.1	87.7	48.7	74.6	52.0
87	Myanmar	22.3	38.7	33.5	89.5	64.5	63.3	52.0
88	Bhutan	10.7	30.6	25.7	80.5	98.8	64.9	51.9
89	Nepal	13.7	29.7	24.0	89.5	87.7	64.9	51.6
90	Jamaica	40.9	35.5	45.1	82.6	53.5	50.7	51.4
91	Sudan	25.7	30.9	20.4	96.5	45.0	89.0	51.2
92	Kenya	37.0	45.8	32.9	85.7	64.0	42.0	51.2
93	Belize	32.8	37.5	48.9	75.7	59.6	52.9	51.2
94	Panama	50.9	44.5	53.2	62.0	50.9	45.7	51.2
95	Costa Rica	37.6	44.0	53.5	82.3	52.1	36.6	51.0
96	Colombia	46.5	46.7	54.6	77.1	30.2	45.4	50.1
97	Ghana	40.6	36.5	29.1	80.1	49.1	63.3	49.8
98	Saint Vincent and the Grenadines	39.8	38.1	43.7	73.7	58.5	44.5	49.7
99	Mongolia	10.1	18.7	21.0	97.0	93.3	57.9	49.7

100	Brunei Darussalam	30.6	52.9	48.4	55.6	75.1	33.4	49.3
101	Djibouti	20.8	35.5	23.8	76.6	76.6	60.4	48.9
102	Tajikistan	11.2	19.6	14.1	86.9	84.9	76.7	48.9
103	Saint Lucia	33.4	37.4	43.1	68.9	52.9	56.2	48.6
104	Dominican Republic	41.1	34.1	42.5	72.8	52.0	44.8	47.9
105	Turkmenistan	14.8	17.7	11.4	95.3	75.5	70.8	47.6
106	Trinidad and Tobago	37.3	40.6	45.8	86.1	37.0	38.7	47.6
107	Kyrgyzstan	11.7	18.3	14.3	89.1	82.4	64.0	46.6
108	Pakistan	22.8	26.5	19.5	78.5	55.2	74.5	46.2
109	Thailand	32.1	43.1	38.3	67.6	52.5	42.7	46.0
110	Viet Nam	34.0	43.2	39.8	59.6	53.9	43.5	45.7
111	Malaysia	36.7	52.7	46.5	49.7	53.1	34.4	45.5
112	Uzbekistan	13.0	18.2	13.2	91.3	75.7	61.1	45.4
113	Syrian Arab Republic	11.6	15.4	8.1	85.6	65.7	83.8	45.0
114	Grenada	33.0	39.1	44.6	72.4	39.5	40.9	44.9
115	Bangladesh	29.2	33.5	28.4	47.1	65.4	65.7	44.9
116	India	31.3	33.6	26.3	66.7	48.4	60.4	44.4
117	Japan	32.4	35.8	39.1	70.8	50.2	35.6	44.0
118	Mexico	31.6	36.1	50.0	78.9	20.2	46.3	43.8
119	Libya	16.3	14.2	8.8	94.7	60.5	67.7	43.7
120	Dominica	34.3	36.2	42.2	50.5	54.4	43.2	43.4
121	Barbados	38.1	38.0	43.2	53.9	53.6	32.6	43.2
122	Antigua and Barbuda	45.8	34.7	41.1	40.5	50.6	42.7	42.6
123	China	37.8	36.7	33.7	35.8	54.2	54.4	42.1
124	Kazakhstan	12.6	14.7	12.2	98.2	63.5	45.8	41.2
125	Iran (Islamic Republic of)	16.1	18.9	11.7	90.3	56.2	51.3	40.8
126	United States of America	44.7	41.5	45.4	59.9	16.5	34.7	40.4
127	Azerbaijan	11.0	14.6	8.2	87.3	73.9	44.2	39.9
128	Iraq	18.7	18.2	10.6	85.4	56.5	48.5	39.6
129	Oman	19.2	28.6	18.8	66.1	57.8	45.3	39.3
130	Algeria	15.1	10.4	8.3	94.3	43.8	57.1	38.2
131	Armenia	10.3	13.7	7.3	85.3	69.2	43.1	38.1
132	Saudi Arabia	27.2	26.1	16.3	71.9	49.2	32.7	37.2
133	Bahrain	19.1	24.7	15.2	74.4	59.7	28.5	36.9
134	Albania	4.7	7.7	3.6	85.7	72.3	44.1	36.3

135	Korea, Republic of	25.3	28.4	33.7	57.3	37.9	33.5	36.0
136	Georgia	9.8	12.5	6.6	80.4	62.0	42.4	35.6
137	Jordan	19.2	17.4	9.5	78.6	37.7	49.4	35.3
138	Singapore	40.2	56.2	48.6	33.2	26.8	4.1	34.9
139	Saint Kitts and Nevis	42.0	34.6	40.6	40.0	26.4	25.3	34.8
140	Egypt	18.8	18.0	10.5	74.8	29.7	56.2	34.7
141	Kuwait	23.0	22.0	13.0	69.1	40.9	39.4	34.6
142	North Macedonia	4.9	7.6	3.4	73.6	74.6	43.2	34.5
143	Tunisia	9.0	10.4	6.8	90.3	40.7	45.4	33.8
144	Bahamas	23.9	28.9	39.8	34.5	57.6	16.4	33.5
145	Belarus	3.2	3.3	1.5	83.9	71.8	33.7	32.9
146	Morocco	15.7	13.2	12.0	72.7	35.6	47.7	32.8
147	Moldova, Republic of	2.4	6.1	2.4	79.5	66.1	38.4	32.5
148	Russian Federation	11.0	7.7	7.1	83.6	46.0	39.3	32.5
149	Bosnia and Herzegovina	0.8	5.3	2.2	78.5	62.4	43.2	32.1
150	Ukraine	7.6	6.4	3.2	80.7	47.2	44.8	31.6
151	Israel	23.8	17.3	9.9	44.6	52.3	40.6	31.4
152	Canada	18.4	17.6	30.5	76.4	9.1	33.9	31.0
153	Qatar	26.7	25.6	16.5	44.4	35.9	36.7	31.0
154	Turkey	12.1	11.7	6.1	73.8	32.1	43.2	29.8
155	Serbia	0.5	1.9	0.0	73.3	57.9	37.9	28.6
156	United Arab Emirates	22.8	27.2	17.9	45.2	23.1	26.9	27.2
157	Andorra	0.0	5.1	4.7	71.1	52.6	29.3	27.1
158	Montenegro	0.9	3.1	0.8	58.4	75.4	23.8	27.1
159	Lebanon	14.2	16.0	8.4	33.1	42.8	47.9	27.1
160	Norway	4.7	0.2	2.4	74.2	38.4	31.5	25.2
161	Romania	3.2	6.2	2.8	76.8	18.8	40.8	24.8
162	Bulgaria	4.2	7.7	3.3	84.8	21.0	27.6	24.8
163	Iceland	20.1	2.0	7.7	44.8	55.6	18.2	24.7
164	Slovakia	2.9	3.1	1.0	64.6	27.4	36.8	22.6
165	Portugal	8.9	9.2	10.1	50.1	14.2	41.6	22.4
166	Malta	14.0	10.9	6.4	36.9	33.5	27.9	21.6
167	Finland	5.2	1.7	2.6	65.7	19.1	34.9	21.5
168	Greece	8.6	10.4	5.5	52.5	13.2	38.7	21.5
169	Estonia	1.4	1.7	1.9	61.9	28.9	32.3	21.4

170	Ireland	8.6	1.7	4.6	55.9	17.3	37.4	20.9
171	Czechia	1.1	1.7	1.1	71.2	12.0	38.3	20.9
172	Italy	9.1	6.3	4.3	51.2	8.3	44.3	20.6
173	Spain	12.1	8.5	8.3	45.7	11.1	36.8	20.4
174	Croatia	0.5	4.3	2.2	55.9	19.7	35.4	19.7
175	Hungary	2.3	3.8	1.7	56.3	13.1	38.4	19.3
176	Latvia	0.0	1.8	1.2	52.8	25.4	33.7	19.2
177	Switzerland	9.8	3.6	2.6	31.6	33.4	32.6	18.9
178	Lithuania	0.7	2.0	1.0	54.5	30.1	24.2	18.8
179	France	7.5	5.4	4.7	52.8	1.9	39.1	18.6
180	Poland	3.6	2.0	1.2	56.8	8.8	38.9	18.5
181	Sweden	3.3	0.7	1.9	58.6	12.1	31.7	18.1
182	Slovenia	1.6	3.4	1.5	33.3	33.6	32.0	17.6
183	Austria	3.7	2.8	1.7	48.1	5.5	38.1	16.6
184	Denmark	3.1	0.0	1.3	51.3	11.4	30.2	16.2
185	Germany	8.3	4.2	2.9	38.1	2.8	36.4	15.4
186	United Kingdom	10.7	3.0	4.7	48.3	2.0	21.0	14.9
187	Cyprus	13.5	15.0	7.6	16.1	19.2	7.1	13.1
188	Netherlands	5.8	2.1	2.2	7.5	8.9	31.6	9.7
189	Belgium	4.2	1.4	2.1	0.0	2.5	31.9	7.0
190	Luxembourg	0.3	0.6	1.2	25.9	0.0	0.0	4.7
