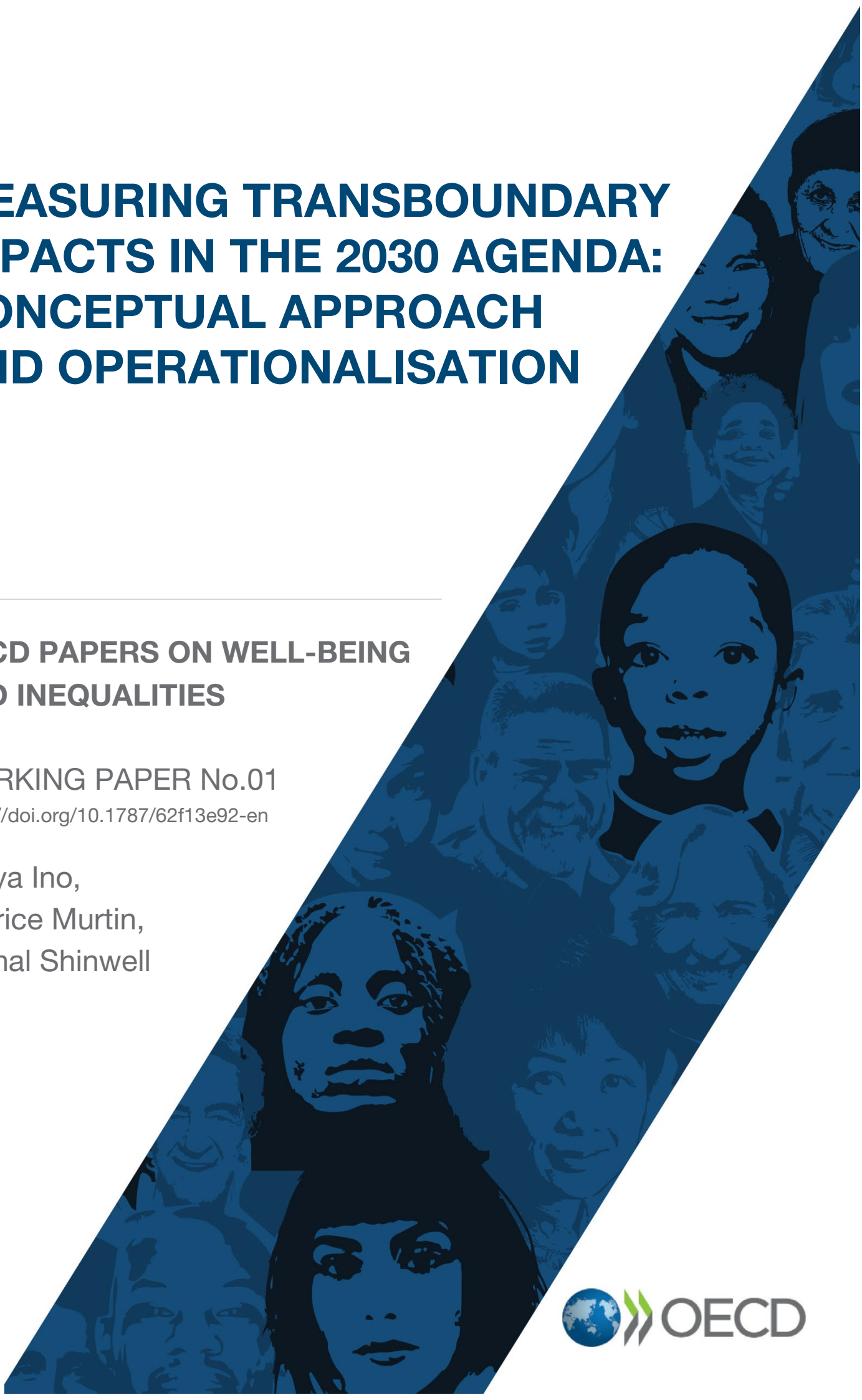
# MEASURING TRANSBOUNDARY IMPACTS IN THE 2030 AGENDA: CONCEPTUAL APPROACH AND OPERATIONALISATION



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Junya Ino,
Fabrice Murtin,
Michal Shinwell

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# Measuring transboundary impacts in the 2030 Agenda – Conceptual approach and operationalisation

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Fabrice.Murtin@oecd.org

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# Abstract

This paper explores the conceptual framing and measurement of transboundary impacts in the context of the 2030 Agenda. It starts by defining transboundary impacts and reviewing different measurement approaches used so far. It then proposes a typology of transboundary impacts, classified depending on the type of international flows involved: financial flows, trade flows, movements of people, environmental flows and knowledge transfers. For each of these flows, transboundary impacts can be either positive or negative, depending on the aspect considered and on the conditions in origin and destination countries. Based on this framework, the paper presents evidence from a qualitative survey of experts about the potential impact of these five flows on each of the 17 Goals and 169 targets of the 2030 Agenda. Transboundary impacts are deemed by experts to be quite pervasive across SDGs, but also limited in scope to a small number of well-identified targets. Finally, the framework is operationalised for some specific areas within each of the five types of flows mentioned above, with the help of some proxy indicators. At the global level, the five types of transboundary relationships are dominated by three macro-regions, namely China, the United States-Canada and Europe, mainly reflecting the large size of these regions in most cases. When the assessment is conducted in relative terms (i.e. when impacts are normalised by population size or GDP), the picture becomes more nuanced, as 7 out of the 11 world regions considered record at least two large transboundary impacts. While this operationalisation is only meant to show how the proposed framework could be applied to concrete cases, the paper recommends its applications to other areas within each of the five flows, based on a richer set of indicators.

# Résumé

Cet article explore le cadre conceptuel et la mesure des impacts transfrontaliers dans le contexte de l'Agenda 2030. Il définit tout d'abord la notion d'impact transfrontalier et passe en revue les différents cadres de mesure utilisés jusqu'à présent. Il propose ensuite une typologie des impacts transfrontaliers, qui sont classifiés en fonction du type de flux international impliqué : flux financiers, flux commerciaux, flux migratoires, flux environnementaux et transferts de savoir. Pour chacun de ces flux, les impacts transfrontaliers peuvent être positifs ou négatifs et sont fonction des aspects considérés et des conditions dans les pays émetteurs et récepteurs. Dans ce cadre, l'article présente les résultats d'une enquête qualitative effectuée auprès d'experts sur l'impact potentiel de ces 5 flux sur chacun des 17 Objectifs et des 169 cibles de l'Agenda 2030. Les impacts transfrontaliers sont jugés assez omni-présents au sein des ODDs, mais aussi limités à un nombre restreint de cibles bien identifiées. Enfin, le cadre conceptuel est rendu opérationnel pour certaines sous-dimensions de ces cinq types de flux, en recourant à des indicateurs spécifiques. Au niveau mondial, les cinq types de relations transfrontalières sont dominés par trois macro-régions, la Chine, les Etats-Unis et le Canada, l'Europe, ce qui reflète dans la plupart des cas la taille importante de ces régions. Quand l'évaluation est conduite en termes relatifs (en normalisant les impacts par la taille de la population ou par le PIB), les résultats apparaissent plus nuancés puisque 7 macro-régions sur 11 enregistrent au moins deux impacts transfrontaliers élevés. Bien que cette illustration opérationnelle n'ait pour but que de montrer comment le cadre conceptuel pourrait être mis en pratique, l'article recommande son application à d'autres sous-dimensions des cinq flux, en utilisant un ensemble plus large d'indicateurs.

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# 1. Introduction

1. The world is more interconnected than ever due to increasing globalisation and enhanced technological progress. Global value chains enable goods and services to be consumed far from where they are produced. Investment in human and economic capital has an impact beyond the borders of countries where investment decisions are made, with flows of people, knowledge and data reaching jurisdictions that are far away. Resource depletion and transfers of waste and pollution through global value chains are yet another way in which consumption in one country is having an impact on others. The COVID-19 pandemic has shown us again how interconnected the world is, and how impacts reverberate through markets and countries. These phenomena could all be described as the *transboundary impacts* of countries on other countries or on global common goods.

2. The Sustainable Development Goals (SDGs), adopted by world leaders in September 2015, are a call for action by all nations for achieving a global vision for 2030. Achieving the 2030 Agenda, given its complex and interlinked nature, requires looking beyond the immediate time horizon and beyond national borders, in order to achieve the SDGs globally. That is why it is important to assess not just the domestic performance of individual countries in terms of achieving the SDGs, but also how they might impact upon other countries' own performance, as well as on those global public goods whose delivery is a collective responsibility of all countries.

3. Measuring and monitoring progress on the SDGs has advanced since the adoption of the Agenda in 2015, with the development of the *Global Indicator Framework*[1] developed by the Inter-Agency and Export Group on SDG Indicators, as adopted by the UN ECOSOC, as well as of many national measurement frameworks. The OECD has also assisted member countries in their implementation of the SDGs and in navigating its data-landscape through the *Measuring Distance to SDG Targets* report (OECD, 2019[1]), which included a preliminary assessment of the transboundary aspects of the SDGs. However, within both national and international measurement frameworks for SDGs, focus is primarily on domestic performance and country-level indicators. Questions on the impacts that countries have outside of their borders must be addressed in order to achieve the SDGs globally.

4. This paper explores the conceptual framing and measurement of transboundary impacts across borders in the context of the 2030 Agenda.[2] It makes three key contributions. First, transboundary impacts are classified depending on the type of flows that are involved: financial flows, trade flows, movements of people, environmental flows and knowledge transfers. This novel approach is instrumental in understanding the nature of transboundary impacts in the context of the SDGs. Second, the paper presents evidence from a qualitative survey of experts about the potential impact of these five flows on each of the 17 Goals and 169 targets of the 2030 Agenda. Finally, the approach is operationalised for some specific areas within each of the five types of transboundary flows mentioned above (e.g. ODA, rather than

[1] The United Nations Statistical Commission (UNSC) created the Inter-Agency Expert Group on SDG indicators (IAEG-SDGs) to develop and implement a global indicator framework for the goals and targets of the 2030 Agenda in 2015. The framework is comprised of 247 indicators, which cover the 169 targets and 17 goals (United Nations, 2017[53]). Among these indicators, 231 are "unique", while the other 16 are used for monitoring more than one target.

[2] The terms *2030 Agenda* and *SDGs* are used interchangeably in this document.

international remittances, in the case of financial flows; or $CO_2$ emissions, rather than transboundary flows of particulate matter in the air between neighbouring countries, in the case of environmental flows) with some proxy indicators presented to depict global patterns in transboundary flows and their impacts. While this operationalisation is limited in scope by the focus on specific areas and the choice of specific indicators, it is intended to illustrate how the proposed approach could be extended to other areas, and to help policy makers and SDG practitioners in assessing the challenges that should be faced when considering transboundary impacts at the national or regional level, in order to capture the full impacts on SDGs.

5. The main conclusions from the paper are as follow:

- All transboundary impacts between countries take the form of cross-country flows of goods and services (trade), financial instruments, people, knowledge transfers and environmental media. While any given policy or development pattern may act on more than one flow at the same time, looking at these flows provide the lens for assessing all transboundary impacts. The impacts of these flows on development "elsewhere" can be either positive or negative, depending on countries' context and to the specific aspects cosndiered.
- Transboundary impacts, as captured by the five types of flows used in this paper, are deemed by experts to be quite pervasive across SDGs. According to the experts' views, 10 out of the 17 Goals display at least one strong relationship with some transboundary flows. Also, all of the 17 Goals record at least one moderate linkage with a transboundary flow.
- Conversely, the large majority of linkages between transboundary flows and SDG targets are deemed to be either weak or non-existing according to the experts' views. Only 2% and 11% of the 845 (i.e. 5 flows times 169 targets) possible relationships are deemed by experts to be strong or moderate, respectively. Among those, financial flows are those believed to have the strongest linkages to SDG targets, followed by knowledge transfers. Altogether, these views suggest that transboundary impacts are pervasive to all SDGs but limited in scope to a small number of well-identified targets. These results may also reflect the fact that SDG targets were not designed to capture transboundary impacts.
- At the global level, the five types of transboundary relationships are dominated by three macro-regions, namely China, the United States-Canada and Europe. These regions have therefore the highest potential of impacting upon the SDGs in other countries (e.g. Europe and United States-Canada via ODA) or on common global goods (e.g. China and United States-Canada via $CO_2$ emissions). In some cases, however, these large impacts simply reflect the large size of these regions.
- When the assessment is conducted in relative terms (i.e. impacts are normalised by population size or GDP), the picture becomes more nuanced, as 7 out of the 11 world regions record at least two large transboundary impacts. Among these, Europe, Central Asia, United States-Canada and MENA display the largest transboundary impacts relatively to the size of their economy or population. Conversely, Sub-Saharan Africa, South Asia and Latin America record lower transboundary impacts relatively to size.

6. Several caveats and limitations are attached to the current analysis. The first and most important one concerns the identification of causal impacts from transboundary flows to SDG targets. Establishing causal impacts requires sophisticated empirical frameworks that are out of scope of the present analysis, given the large number of potential relationships between flows and SDG targets. Moreover, for a given flow and target, a causal impact may depend on country-specific characteristics, policies and institutions. Second, the operationalisation of the conceptual framework has required focusing on specific areas within each transboundary flow (e.g. ODA within the broad category of financial transfers) and on the choice of specific indicators, which are often imperfect. For instance, proxying knowledge transfers with patents is unattractive as patents, while contributing to knowledge creation that will ultimately benefit all countries,

aim to limit knowledge diffusion across countries by protecting intellectual property over a given period of time. This is an area where data limitations have been a real constraint.

7. The structure of the paper is as follows. Section 2 defines transboundary impacts and recalls the various approaches and indicators that have been used for measuring them. Section 3 introduces the flow approach used in this paper, which explains these impacts in terms of transboundary flows of goods and services, people, financial resources, environmental media and knowledge. Section 4 describes the relationships between these transboundary flows and each of the 169 SDG targets as inferred from an expert survey. Finally, Section 5 uses some proxy indicators for these flows covering some selected aspects of the flow in question, to describe how a more general methodology could be implemented to assess how actions and development patterns in a country might have an impact elsewhere.

# 2. Defining transboundary impacts in the context of the SDGs

8. Transboundary impacts can be defined as the impacts of one country beyond their borders on (i) other countries and (ii) global common goods. These impacts can be both bilateral (from one country to another) and multilateral (from one country to many others). They can affect both private goods as well as public goods and global commons. They can result from deliberate actions having an explicit transboundary objective, such as Official Development Assistance (ODA) but also from domestically focused policies and circumstances unrelated to measures put in place with a deliberate goal to help achieve the 2030 Agenda. For example, a country with high forest coverage will be positively affecting several public goods and global commons, such as biodiversity and mitigation of climate change.

9. Both global commons and global public goods are terms which have been described in economic literature (International Task Force on Global Public Goods, 2006[2]). Global commons are those parts of the planet that fall outside national jurisdictions and to which all nations have access, such as oceans and the climate system (UN DESA & UNEP, 2013[3]; United Nations, 1997[4]), whereas global common goods, which are also non-jurisdictional, are subtractive and depletable, such as fisheries, forests and lands. Public goods are non-rivalrous (i.e. they are not diminished by other people's consumption) and non-excludable (i.e. no one can be excluded from benefitting from them), as opposed to private goods (which are rivalrous and excludable); they can also cross borders, as in the case of cultural goods and knowledge, which makes them global public goods.

10. In the context of the SDGs, transboundary impacts are important in at least two different ways. On one hand, countries can contribute to global achievement of the 2030 Agenda outside their borders, whether directly (e.g. through funds and resources such as Official Development Assistance), or indirectly (e.g. by minimising their negative impacts on global goods such as climat)e. On the other hand, countries can negatively influence the ability of other countries to achieve the 2030 Agenda, such as by placing strain on the environment resources of other countries through consumption of their natural resources.

11. While many of the SDG targets focus on domestic measures such as reducing poverty (Goal 1), improving access to clean water (Goal 6) and raising educational attainment (Goal 4), the 2030 Agenda also includes international commitments, with at least 24 of the 169 targets referring to the transfer of resources to, or capacity building in, developing countries. In addition, several of the goals of the 2030 Agenda relate to global goods such as climate (Goal 13), oceans (Goal 14) and sustainable production (Goal 12).

12. Within the 2030 Agenda, global commons are mostly concentrated under goals relating to sustainable production and consumption, climate change, oceans, and biodiversity (Goals 12 to 15). While these goals focus on domestic policies and outcomes such as consumption or protection of natural resources, they also implicitly encompass transboundary impacts on these global commons and public goods. For example, while targets under Goal 15 relate to actions within national borders aimed at protection and conservation of ecosystems and endangered species, as well as deforestation, degradation and desertification, taking action on these will have an impact beyond borders on the global public goods related to biodiversity, ecosystems and climate change.

13. In addition to these environmental global goods, the 2030 Agenda addresses global goods through international agreements and other forms of cooperation on peace and security (addressed in Goal 16). Similarly, countries' contributions to the total sum of human knowledge, such as through investment in research and development, education and skills, form part of the global commons that people can enjoy worldwide.

14. International cooperation and action play a direct and central role in achieving the SDGs globally. Goal 17 addresses partnerships for sustainable development, with emphasis on official development assistance and capacity-building. In addition to Goal 17, 62 of the 169 targets that underpin the SDGs are identified as "means of implementation" targets, with 19 of these under Goal 17, and another 43 spread through Goals 1 to 16. These targets often emphasise the relationships between countries and their shared responsibility for achieving sustainable development, especially in less developed countries. Thus, particularly when viewed from an OECD country perspective, actions taken to achieve many of these targets are transboundary in nature.

# 3. Measuring transboundary impacts

15. The question of how to measure transboundary impacts comprehensively, rather than on an ad hoc basis, has yet to be addressed in practice. However, several studies have set some foundations, both in general as well as within the context of the SDGs (as described in Section 3.1). These initiatives and country experiences vary conceptually and in their scope – both in terms of the countries and of the issues covered – as well as in the methodology used for measuring transboundary effects. Most of these initiatives consider how transboundary effects contribute to sustainable development either in a broad sense or within an SDG context, but only from the perspective of a single country.

16. Measuring transboundary impacts can help countries enhance policy coherence, which presents a major challenge for SDG implementation (OECD, 2019[5]). Developing meaningful collaboration and co-ordinated action across both policy sectors and different levels of government with the aim of achieving the 2030 Agenda also requires understanding the impacts of policy actions and development patterns outside country borders. Policy coherence also means balancing short-term priorities with long-term sustainability objectives, and taking into account the impact of domestic policies on global well-being outcomes. Thus, developing a comprehensive framework for measuring these transboundary impacts is essential for policy coherence for sustainable development, as recommended by SDG target 17.14.

17. Ideally, a comprehensive global model should be used to identify the impacts of countries' actions and policies "elsewhere". Such a model would need to identify, attribute and isolate drivers, barriers and impacts across borders. Additionally, it would cover the full range of economic, social and environmental outcomes included in the 2030 Agenda. At a practical level, the scope of existing efforts to measure impacts beyond national borders is much more limited. National statistical systems focus primarily on what happens *within* national borders, and their measurement of transboundary phenomena such as trade or migration is mainly directed to measuring the size of the in/outflows, rather than their impacts.

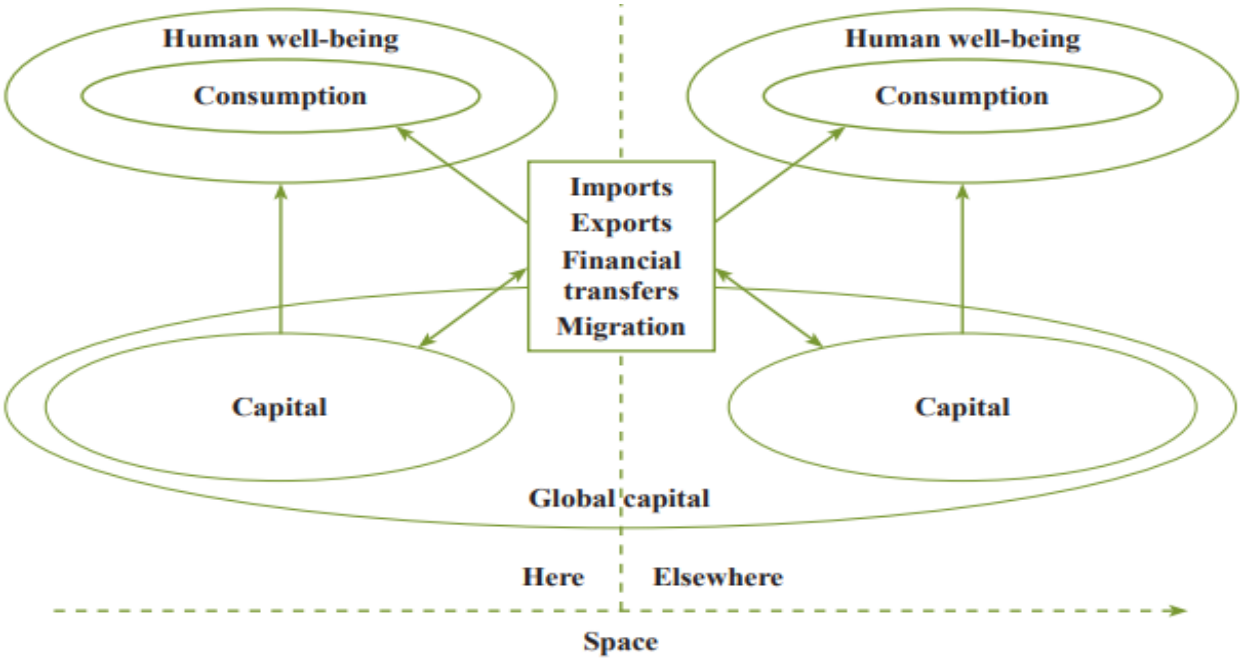
18. Nonetheless, there are several useful tools and data frameworks for measuring transboundary effects and global phenomena. Inter-country input-output (ICIO) tables are useful sources for assessing direct and indirect impacts of trade flows, as they describe the sale and purchase relationships between producers and consumers, showing flows of final and intermediate goods and services[1] across industries (industry by industry tables) or by product outputs (product by product tables). The ICIO tables underpin the Trade in Value Added (TiVA, OECD[4]) data, which record the value added embedded in the goods and services produced in a country and consumed elsewhere.

19. ICIO tables are also used to assess the demand-based $CO_2$ emissions of each country, i.e. the $CO_2$ embedded in the goods and services consumed domestically, wherever the $CO_2$ was emitted along the production chain (Wiebe and Yamano, 2016[6]). Demand based $CO_2$ is one of several "footprint" indicators popularised in the field of environmental performance, which assess the environmental impacts of human activity. Recent applications of footprint indicators have also assessed the social impacts of foreign trade, such as those on income inequalities and employment (Alsamawi et al., 2017[7]). A similar approach has used ICIO tables to assess the prevalence of child labour, forced labour and human trafficking in global value chains (ILO, OECD, IOM, UNICEF, 2019[8]). Input-output tables have also been used in network analysis, to show the complexities of global value chains (Giammetti, Russo and Gallegati, 2020[9]).

20. Other measures of how trade flows might affect the environment include trade flows of environmental goods and services, raw materials (whose extraction typically has large environmental impacts), domestic support to either fossil fuels or renewable energy, and nutrient balance of exported grains (Garsous, 2019[10]).

## 3.1. Different approaches to measuring transboundary impacts

21. A few interesting approaches to measuring the impacts that countries have outside of their borders has been developed in recent years. The conceptual framework for measuring sustainable development proposed by the **UNECE/**Eurostat**/OECD Task Force on Measuring Sustainable Development** (TFSD, convened by the Conference of European Statisticians) (UNECE, OECD, ESTAT, 2013[11]) distinguished among three dimensions of sustainable development: "here and now", i.e. the well-being of the present generation in a particular place; "later", i.e. the well-being of future generations in the same locality; and "elsewhere", i.e. the well-being of people in other places. The TFSD suggested measuring transboundary impacts by looking at the mechanisms through which these impacts occur. It identified four important channels through which countries affect the rest of the world: financial transfers, trade flows, migration of people and transfer of knowledge. Figure 3.1 illustrates the interaction between the dimensions of "here and now" and "elsewhere", with different types of flows (at the centre of the diagram) affecting both human well-being and the capital resources of other countries.




Source: UNECE, OECD, ESTAT, *Conference of European Statisticians Recommendations on Measuring Sustainable Development*, 2013 (UNECE, OECD, ESTAT, 2013[11])

22. The TFSD report suggested a few indicators that could be used to assess these transboundary flows, although indicators were not included in the report. While the TFSD framework has not been operationalised as it was developed prior to the 2030 Agenda, several countries have referred to it when developing their own frameworks for measuring sustainable development (OECD, 2017[12]). In the Netherlands, the *Sustainability Monitor* covers the three dimensions recommended by the TFSD: here and

now, elsewhere, and later, and includes measures of performance in each of these areas (Statistics Netherlands, 2017[13]). In Finland, the *Development Policy Committee* supports policy making in sectors that impact developing countries. In Switzerland, the *Guidelines on Sustainability Policy* used in the Swiss Sustainable Development Strategy 2016-2019 argue that economic, social and environmental impacts should be considered in both domestic and foreign policy proposals. Both Belgium's *Complementary Indicators to GDP* (Belgium Federal Planning Bureau, 2018[14]) and New Zealand's *Indicators Aotearoa New Zealand* (Statistics New Zealand, 2019[15]) also include indicators relating to the "elsewhere" dimension.

23. In addition to NSOs, other initiatives have tried to measure transboundary impacts. The **SDG Index and Dashboards Report** (Sachs et al., 2019[16]), which assesses countries' performance on SDGs, includes a segment on global responsibilities and international spillovers, which includes 10 indicators of transboundary effects, six of which are trade/consumption-related. Some attempts have also been made to rank or measure countries' impacts on other countries or their contribution to common global goods. The Centre for Global Development's **Commitment to Development Index** (Center For Global Development, 2018[17]), aims to capture the actions of most developed countries aimed at aiding developing countries. The CDI index covers 7 dimensions (aid, finance, technology, environment, trade security and migration), ranking 27 countries using over 100 indicators. The **Good Country Index** proposed by (Anholt, 2020[18]) aims "to measure what each country on earth contributes to the common good of humanity, and what it takes away". The index includes 35 indicators across a range of seven dimensions: Science & Technology, Culture, International Peace & Security, World Order, Planet & Climate, Prosperity & Equality and Health & Wellbeing. Conversely, the **Global Peace Index**, published by the Institute for Economics and Peace, ranks countries according to their level of "peacefulness", considering both internal and external impacts on peace, across three domains: ongoing domestic and international conflict, societal safety, and security and militarisation. These are measured by 23 indicators, normalised on a scale of 1 to 5.

24. Table 3.1 presents the indicators used in these various frameworks, with the indicators that repeat across frameworks identified in italics. Common indicators include Official Development Assistance (financial flow), greenhouse gas emissions (environmental flow), Foreign Direct Investment (financial flow), imports from developing countries (trade flow), refugees (movement of people), and imports of energy and mineral resources (trade & environmental flows).

## Table 3.1. Transboundary indicators included in different frameworks

| Belgium Complementary Indicators to GDP | Netherlands Monitor of Well-being | Indicators Aotearoa New Zealand | TFSD | SDG Index 2019 | Commitment to Development Index | Good Country Index |
|---|---|---|---|---|---|---|
| *Official Development Assistance* | Biomass *imports from LDCS* | Consumption of net greenhouse gas emissions | *Official Development Assistance* | Imported groundwater depletion | Aid: Aid Quantity - *Official Development Assistance*, Aid Quality | Science & Technology: International students, Journal exports, International publications, Nobel prizes, Patents |
| Domestic material consumption | Metal *imports from LDCs* | *Official Development Assistance* | *Imports from developing countries* | Fatal work-related accidents embodied in imports | Finance: Investment, Financial Secrecy | Culture: Creative goods exports, Creative services exports, UNESCO dues in arrears as % of contribution, Freedom of movement, i.e. visa restrictions, Press freedom |
| Primary energy consumption | Non-metallic mineral *imports from LDC* | Remittances to other countries | Migration of human capital | Imported SO2 emissions | Technology: Government support to R&D, Intellectual property rights | International Peace and Security: Peacekeeping troops, Dues in arrears to UN peace keeping budgets, International violent conflict, Arms exports, Internet security |
| *Greenhouse gas emissions* | Fossil *imports from LDC* | International investment position | Land footprint (foreign part) | Net imported emissions of reactive nitrogen | Environment: Global climate, Sustainable fisheries, Biodiversity & global ecosystems | World Order: Charity giving, *Refugees hosted*, *Refugees generated*, Birth rate, UN Treaties signed |
| | *Biomass imports* | *Foreign direct investment* | Water footprint (foreign part) | *Imported CO2 emissions, technology-adjusted* | Trade: Lower income weighted tariffs, Agricultural subsidies, Services trade restrictions (STRI), Logistics performance | Planet and Climate: *Ecological footprint*, Environmental agreements compliance, Hazardous pesticides exports, Renewable energy share, Ozone |
| | *Fossil imports* | Net migration by skill type | *Carbon footprint (foreign part)* | Imported biodiversity threats | Security: Contributions to peacekeeping, Arms exports, Participation in security regimes | Prosperity and Equality: Open trading, UN volunteers abroad, Remittance Cost, *FDI outflows*, *Development assistance* |
| | *Metal imports* | *Net greenhouse gas emissions* | *Imports of energy resources* | Transfers of major conventional weapons (exports) | Migration: International conventions, Integration policies, *Share of asylum seekers*, *Share of refugees*, Foreign students | Health and Wellbeing: Food aid, Pharmaceutical exports, Voluntary excess donations to the WHO, Humanitarian aid donations, International Health Regulations Compliance |
| | *No-metallic mineral imports* | Export of waste (net and gross) | *Imports of mineral resources (excluding coal and peat)* | International concessional public finance, including *official development assistance* | | |

| Belgium Complementary Indicators to GDP | Netherlands Monitor of Well-being | Indicators Aotearoa New Zealand | TFSD | SDG Index 2019 | Commitment to Development Index | Good Country Index |
|---|---|---|---|---|---|---|
| | Private transfers | | Contribution to international institutions | Tax Haven Score | | |
| | *Official Development Assistance (% GNI)* | | Exports of physical capital | Financial Secrecy Score | | |
| | *Total imports from LDC* | | Exports of knowledge capital | | | |
| | | | *Foreign Direct Investment (FDI)* | | | |

Source: (Statistics New Zealand, 2019[15]; Statistics Netherlands, 2017[13]; Belgium Federal Planning Bureau, 2018[14]; Sachs et al., 2019[16]; UNECE, OECD, ESTAT, 2013[11]; Center For Global Development, 2018[17]; Anholt, 2020[18]).

## 3.2. Describing transboundary mechanisms as flows

25. Building on the TFSD's approach, this paper proposes framing the measurement of transboundary impacts in the 2030 Agenda using five types of flows, which act as the conduits to the impacts borne outside country borders. The flows are expanded beyond those recognised by the TFSD to include financial flows, trade flows, knowledge transfers, movements of people and environmental flows, including pollution, waste and use of natural resources. These flows are all the channels by which countries are connected to each other, and can impact on other countries' well-being outcomes or capital resources. The flows are not mutually exclusive, so that a flow of goods can be accompanied by financial and environmental flows, or a movement of people can also imply movement of knowledge and finance, etc. The rest of this section describes these flows and the ways in which these affect other countries or global public goods follows.

### *3.2.1. Financial flows*

26. Flows of financial resources and investments beyond borders are key drivers of global economic growth. Moving financial resources beyond national borders provides investment opportunities to domestic investors, while also complementing domestic savings in recipient countries. Developed countries can also assist developing countries through ODA, as well as through financial flows from different sources, such as philanthropy.

27. The 2015 Addis Ababa Action Agenda (United Nations, 2015[19]) provides the framework for financing sustainable development, identifying different financial flows from philanthropic foundations, public agencies (ODA and OOF), households (remittances) and the private sector (e.g. FDI). In 2016, these cross-border financial flows to developing countries totalled USD 1.7 trillion, more than a third of the amount collected locally in developing countries through domestic taxation (USD 4.3 trillion; see (OECD, 2018[20]). ODA from the 30 members of the OECD's Development Assistance Committee (DAC) totalled USD 153 billion in 2018 (less than one tenth of the total value of these private flows), down 2.7% from 2017 (OECD, 2019[21]). However, financial flows, even when well-intended, can have negative impacts, such as in the case of recipient countries with poor governance structures that receive financial assistance, which can be then misused. Short-term financial flows can also lead to sudden changes in the exchange rate, which will be harmful to importing or exporting industries, depending on the direction of change.

28. Transboundary financial flows can be detrimental to the sustainable development of poorer developing countries when, for example, differences in tax regimes and inadequate recording of trade flows enable tax evasion and generate flows to tax havens. The OECD's Inclusive Framework on Base Erosion and Profit Shifting brings together over 135 countries cooperating to tackle tax avoidance, improve the coherence of international tax rules and ensure a more transparent tax environment (OECD, 2019[22]). Similarly, illicit financial flows, which can stem from corruption, crime and terrorism, can use channels such as cash smuggling and transfers to shell companies and to extract important resources from developing countries. These harmful financial flows require international cooperation, such as the BEPS program, in order to limit their negative impacts the resources available in developing countries to attain the SGDs.

### *3.2.2. Movement of people*

29. People move beyond national borders for many reasons, whether in the hopes of bettering their lives, family reunification, or due to natural disasters, conflicts and threats in their home country. In their movement, people take with them their accumulated economic, social and human capital, in the form of their financial resources, knowledge, ideas and culture (Bernstein et al., 2018[23]; Abramitzky and Boustan, 2017[24]; Borjas, 1994[25]). In 2018, permanent migration flows to OECD countries amounted to approximately 5.3 million[3], 2% more than in 2017, with most of them coming from developing countries (OECD, 2019[26]). While migration, when well-managed, can bring economic and cultural benefits in destination countries to migrants and non-migrants alike (OECD, 2014[27]), it can also pose challenges in terms of integration in host countries. Influxes of workers can put pressure on the labour market which may result in lower wages for certain jobs, and thus affect the residents alongside the migrants. Migration can also have a significant impact on origin countries, both positively and negatively. Remittances, cultural exports[4] and new economic activities established or supported by migrants are examples of the positive effect of migration on the country of origin of these migration flows, while reductions of human capital and lack of support for dependent family members remaining in the home country as examples of negative impacts (Nurse, 2005[28]).

30. People also move across borders for temporary visits, for business or leisure. Even during short term visits, people rely on and consume local resources, and are exposed to new and different experiences, potentially raising their awareness of environmental and cultural values of the countries they visit. Indeed, in some countries tourism is a central driver of the economy. The sector directly contributes 4.4% of GDP, 6.9% of employment and 21.5% of service exports in OECD countries, which account for more than half of global arrivals (OECD, 2020[29]). The tourism sector account for an even larger share of domestic production in several developing counties. However, tourism can also drive extraction and exploitation of local resources and services, and over-use can cause deterioration and indeed destruction of the very things that drive tourism in the first place. Enhancing countries' commitments to promoting sustainable and inclusive tourism, as acknowledged in the 2017 OECD Policy Statement on Tourism Policies for Sustainable and Inclusive Growth, is especially important in the context of the long-term rise in international tourism.

31. Human trafficking is a harmful form of transboundary movement of people across borders. Over 20.9 million people around the world are estimated to be victims of forced labour, generating an estimated USD 150 billion of illegal profits in the private economy worldwide every year (ILO, 2020[30]). Of the total number of people affected by human trafficking, two thirds cross borders. Human trafficking is often linked to organised crime and corruption, and tackling it requires cross-border coordination and cooperation.

[3] According to preliminary data.

[4] Cultural exports from home country to meet demand from migrants living elsewhere can include literature, arts, films and other media; this foreign demand help support the cultural industry of the origin country (Nurse, 2005[28]).

### *3.2.3. Trade flows*

32. Trade of goods and services across borders drives GDP growth and economic opportunities worldwide, but also impacts throughout the global value chain. Many economic benefits are associated with foreign trade: more open economies often grow faster than relatively closed economies, and salaries and working conditions are generally better in companies that trade across borders than in those that do not (OECD[31]). In turn, economies that grow through foreign trade generate higher domestic demand, which drives higher production of goods and services both domestically and worldwide. This domestic production relies on local resources that can include produced and natural capital, as well as labour, human and social capital. Because of these links, use of imported goods and services in one country can affect other countries' through job creation or displacement, employment conditions (whether for better or worse than local alternatives), depletion of natural resources, investment in produced capital and other economic and social impacts.

33. While economies are increasingly interdependent due to Global Value Chains (GVCs), trade flows can also influence wage inequality. Evidence of this effect is often mixed and inconclusive, with some analyses suggesting relatively small effects in raising wage inequality for low-skilled segments of the labour force (Lopez Gonzalez, Kowalski and Achard, 2015[32]). The impact of trade openness on the population depends on both domestic institutions and the economy's capacity to take advantage of the opportunities created and to distribute equitably the benefits associated to it. For example, high reliance on exports of natural resources coupled with weak institutions can result in a "resource curse", leading to poorer outcomes relative to countries at the same level of development but with fewer natural resources (Havro and Santiso, 2008[33]).

### *3.2.4. Environmental flows*

34. Nature knows no borders; animals and plants do not respect border controls, and the same applies to water, air pollution and climate change. Environmental flows across borders include depletion of natural resources, flows of pollution and waste, and trade in environmental goods and services. It is also useful to differentiate between flows affecting global goods (such as $CO_2$ emissions accumulating globally whose impacts are independent of where emissions take place, or marine debris) versus local goods (such as local air pollution, due the presence of small particles which sometimes originate in a neighbouring country (Brunekreef, 2010[34]; Amann, Klimont and Wagner, 2013[35]). For instance, electricity production based on fossil fuels, even if produced and consumed locally, emits greenhouse gasses that exacerbate climate change, a global challenge. Local pollution can also cross borders, such as sulphur emissions or small particles ($PM_{2.5}$) transported across borders in Asia and elsewhere (JAXA Earth Observation Research Center (EORC), 2014[36]).

35. Another channel for the environmental impacts of countries outside their national borders is through the production of traded goods, which may drive natural resource depletion or pollution. Wealthier countries are increasing their imports of semi-finished and finished products and shifting their economic structure toward service economy. These advanced economies look more resource-efficient than before. However, these economies depend on the material resources of other countries and various environmental impacts occur elsewhere when the materials are extracted, processed and transported (Wiedmann et al., 2015[37]).

36. Biodiversity is defined by the 1992 UN Convention on Biological Diversity as the "variability among living organisms from all sources… and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems". Biodiversity is a global public good, as some of the ecosystem services that it provides benefit people and communities beyond borders (e.g. through carbon sequestration, clean water and genetic resources (CBD, 1992[38]). Transboundary impacts on biodiversity can be location dependent, as in the case of shared waters affected by overuse and pollution;

these impacts can also be transboundary as in the case of imports of tropical wood, which may affect the existence of diverse species in forests.

37. Trade in environmental goods and services (i.e. outputs that allow more environmental friendly production activities), as well as in flows in waste and scrap, are also channels for transboundary environmental impacts. OECD countries tend to export more waste than they import. While transboundary movements of waste and scrap can be detrimental to the environment of importing countries (depending primarily on how these are then treated), these trade flows can sometimes be beneficial for these countries, both financially (through the revenues they generate) as well as for expanding environmental infrastructure and technological capabilities for treating domestic waste.

### *3.2.5. Knowledge transfers*

38. The movement of knowledge and ideas across borders predates globalisation and nation states, and is indeed a fundamental part of human history. Modernisation has made this movement faster and easier through communication technologies and open resources, but has also limited it by granting institutional protection of created knowledge in the form of intellectual property rights. Knowledge shares many of the features of a public good: it is undiminished by consumption and use, and low transaction costs often mean that dissemination of new ideas is easy (Arrow, 1962[39]). Now more than ever, low transaction costs and fast exchanges make knowledge flows essential to economic and social prosperity. Indeed, transboundary knowledge transfers are deemed to have driven cross-country convergence of GDP per capita (Aghion and Jaravel, 2015[40]; Howitt, 2000[41]). Flows of scientific knowledge have been extensively researched, with affiliations, collaborations and networks shown to have positive impacts on academic output and productivity (Halevi, Moed and Bar-Ilan, 2016[42]; Azoulay, Zivin and Wang, 2010[43])

39. In recent years, technological developments have made the transfer of data across borders a central part of the economy. Transboundary e-commerce, which relies on the smooth transfer of data across borders, is expanding, with 45% of EU firms having undertaken cross-border e-commerce sales in 2016, up from 42% in 2010 (OECD, 2019[44]). Cross-border data transfers enable consumers and producers around the world to connect and thus facilitates the trade of goods and services across borders. Data flow is therefore a means for widening consumer choice and the affordability of goods and services, helping SMEs reach global markets. It is also a key element of international production through GVCs (Casalini and López González, 2019[45]). However, data flows also raise privacy issues as data protection legislation can differ between jurisdictions.

### *3.2.6. Wrapping-up*

40. These five transboundary flows are the main channels through which domestic policies and development patterns of individual countries affect both countries “elsewhere” and global public goods. While there are other mechanisms through which transboundary impacts occur, such as policies (tariffs and trade barriers, as an example), or international institutions and agreements that reinforce, regulate and monitor various international transactions and relationships, these are indirect mechanisms, whose effects materialise through the five flows discussed above. Conversely, the direction of these impacts (either positive or negative) depends on much more that the size of these flows. Section 5 will present a methodology to assess how transboundary flows may impact on SDGs and partly shape the success of the 2030 Agenda.

# 4. Assessing the impact of transboundary flows on SDG targets

41. This section takes a deeper look into the linkage between transboundary flows and SDG targets based on a qualitative expert assessment. Identifying the relationship between the flows and the SDGs allows applying the approach for classifying transboundary flows to the SDGs, in order to assess the transboundary impacts within the 2030 Agenda. A questionnaire was prepared by the authors to collect experts' views about the strength of the linkages between flows and SDGs. This questionnaire was disseminated across a varied group of experts, with backgrounds in science and policy. Altogether, 28 experts from across the OECD and the European Commission's Joint Research Centre responded to the questionnaire, providing their assessment of the strength of the relationship between transboundary flows and SDG targets. This section presents the results from this collective assessment.

## 1.1. Design of the qualitative assessment

42. The questionnaire collected expert views about the linkage between the five transboundary flows described above and SDG targets. For each SDG target, the questionnaire asked the following question, while using a scale ranging between -3 and +3:

> *"For each of the five transboundary flows, is there a strong, medium, weak or no relationship between flows and SDGs targets? This relationship shall be understood as a correlation that reflects either a causality from flows to SDGs targets or the other way around. If there are both positive and negative links within each cell, please consider the net effect."*

43. Respondents were selected in an inter-disciplinary way, covering fields such as economics, finance, statistics or the environment. Each respondent was asked the question above for about 30 targets randomly chosen among the 169 existing ones. Responses were merged and each target received on average 4 answers. For each target, average scores were calculated and classified into the seven categories shown in Table 4.1.

**Table 4.1. Assessing the size of relationships between transboundary flows and SDG targets**

| Category | Average score among experts |
|---|---|
| Strong positive relationship | More than 2 |
| Moderate positive relationship | More than 1 and equal or less than 2 |
| Weak positive relationship | More than 0 and equal or less than 1 |
| No linkage | Equal to 0 |
| Weak negative relationship | Less than 0 and equal or more than -1 |
| Moderate negative relationship | Less than -1 and equal or more than -2 |
| Strong negative relationship | Less than -2 |

44. Two caveats applying to this methodology should be mentioned: i) An average of 4 answers per item is not large enough to derive statistical significance; ii) The process departs from the well-known Delphi method in the sense that experts do not have the option of revising their judgement after looking at the results. These limitations naturally arise from the difficulty of assessing the relationship between 169 targets and 5 flows, or 845 correlations, times 4 experts on average. In total, 4x845=3 380 assessments were conducted, implying a time-consuming process.

## 4.1. Main results

45. Scores are averaged across experts and across targets and then displayed by goal in Table 4.2, which provides a bird's eye-view over the perceived strength of transboundary impacts on SDG goals. A first remark is that no average score is above 2, implying that the experts consulted deemed the relationships between the five transboundary flows and the various SDG goals to be, at most, moderate. This finding reflects either dispersion across experts' judgement at the target level (i.e. lack of consensus implying weak correlations) or heterogeneity in correlations across targets within goals (i.e. heterogeneous impacts within goals, with a moderate average correlation at most).

46. In spite of the inherent noisiness of these average scores, it is still interesting to note the moderate relationships (i.e. average scores larger than or equal to 1) for financial flows, environmental flows, and knowledge transfer. The results suggest that, first, financial flows are deemed by experts to be related to a relatively wide range of policy areas, including policies to end poverty (Goal 1), the supply of affordable clean energy (Goal 7), the promotion of economic development (Goal 9), the reduction of inequality (Goal 10) and global partnership (Goal 17). Second, experts considered that environmental flows are associated with Planet Goals 6 (supply of clean water and sanitation) and 13 (action against climate change). Lastly, experts assessed that knowledge transfer displays only a moderate relationship with Goal 4 (opportunities in acquiring quality education).

47. When averaging scores across all goals, financial flows and knowledge transfers display the largest average scores, and are deemed by experts to be the most susceptible of having significant transboundary impacts. Conversely, when summing scores across flows, Goals 7 (access to energy), 9 (industrialisation and innovation) and 17 (global partnerships) are deemed by experts as the most likely of being affected by transboundary flows.

## Table 4.2. Strength of the relationships identified between five transboundary flows and 17 SDG goals: Evidence from an expert assessment

| | | | Flow | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | | Finance | People | Trade | Environ-ment | Know-ledge | |
| People | Goal 1 | End poverty in all its forms everywhere | 1.32 | 0.11 | 0.57 | 0.11 | 0.54 | 0.53 |
| | Goal 2 | End hunger, achieve food security and improved nutrition and promote sustainable agriculture | 0.91 | 0.12 | 0.94 | 0.18 | 0.61 | 0.55 |
| | Goal 3 | Ensure healthy lives and promote well-being for all at all ages | 0.60 | 0.34 | 0.04 | 0.10 | 0.64 | 0.34 |
| | Goal 4 | Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all | 0.72 | 0.69 | 0.13 | 0.05 | 1.10 | 0.54 |
| | Goal 5 | Achieve gender equality and empower all women and girls | 0.40 | 0.63 | 0.28 | 0.00 | 0.83 | 0.43 |
| Planet | Goal 6 | Ensure availability and sustainable management of water and sanitation for all | 0.61 | 0.22 | -0.03 | 1.17 | 0.69 | 0.53 |
| | Goal 12 | Ensure sustainable consumption and production patterns | 0.61 | 0.24 | 0.39 | 0.75 | 0.66 | 0.53 |
| | Goal 13 | Take urgent action to combat climate change and its impacts | 0.78 | 0.22 | 0.13 | 1.00 | 0.70 | 0.57 |
| | Goal 14 | Conserve and sustainably use the oceans, seas and marine resources for sustainable development | 0.51 | 0.07 | 0.47 | 0.74 | 0.42 | 0.44 |
| | Goal 15 | Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss | 0.34 | -0.14 | -0.32 | 0.89 | 0.59 | 0.27 |
| Pros-perity | Goal 7 | Ensure access to affordable, reliable, sustainable and modern energy for all | 1.30 | 0.30 | 0.48 | 0.78 | 0.83 | 0.74 |
| | Goal 8 | Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all | 0.69 | 0.10 | 0.51 | 0.10 | 0.46 | 0.37 |
| | Goal 9 | Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation | 1.10 | 0.57 | 0.80 | 0.10 | 0.90 | 0.69 |
| | Goal 10 | Reduce inequality within and among countries | 1.02 | 0.56 | 0.86 | -0.05 | 0.37 | 0.55 |
| | Goal 11 | Make cities and human settlements inclusive, safe, resilient and sustainable | 0.50 | 0.12 | -0.03 | 0.24 | 0.35 | 0.24 |
| Peace | Goal 16 | Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels | 0.29 | 0.41 | 0.16 | 0.16 | 0.65 | 0.33 |
| Part-nership | Goal 17 | Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development | 1.40 | 0.37 | 0.99 | 0.05 | 0.71 | 0.70 |
| | | Average | 0.77 | 0.29 | 0.37 | 0.37 | 0.65 | |

Note: ■ for values equal or more than 1 in absolute value. ■ for values equal or more than 0.5 and less than 1 in absolute value. Values are equal to average scores calculated across 4.0 expert assessments comprised between -3 and 3.
Source: Authors' calculation

48. A look at the distribution of average scores (Table 4.3) confirms that the consulted experts identified few strong relationships at the target level (about 2.1% across all flows). The most frequent assessment is, by far, the existence of weak relationships (about 57% of all correlations) or no relationship

(about 29%). Moderate positive and moderate negative relationships are identified for 94 targets, and 2 linkages respectively (11% in total). Across the five flows, financial flows record the highest share of moderate or strong relationships (at about 25%), followed by knowledge transfers (15%), people and trade flows (about 8% each). This is somewhat explained by the structure of the 169 SDG targets, of which 62 are "Means of Implementation" targets, mostly referring to the transfer of financial resources and knowledge to developing countries.

### Table 4.3. Composition of the strength of the linkages to SDG targets identified by experts' qualitative assessment

| | Flow | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance | | People | | Trade | | Environment | | Knowledge | |
| | N | (%) | N | (%) | N | (%) | N | (%) | N | (%) |
| Strong (strong positive and strong negative) | 11 | 6.5% | 0 | 0.0% | 4 | 2.4% | 2 | 1.2% | 1 | 0.6% |
| Moderate (moderate positive and moderate negative) | 30 | 17.8% | 13 | 7.7% | 10 | 5.9% | 21 | 12.4% | 24 | 14.2% |
| Weak (weak positive and weak negative) | 105 | 62.1% | 95 | 56.2% | 107 | 63.3% | 77 | 45.6% | 101 | 59.8% |
| None | 23 | 13.6% | 61 | 36.1% | 48 | 28.4% | 69 | 40.8% | 43 | 25.4% |
| Total | 169 | 100.0% | 169 | 100.0% | 169 | 100.0% | 169 | 100.0% | 169 | 100.0% |

Source: Authors' calculation

49. A more detailed examination of experts' assessments at the target level allows identifying a number of strong transboundary impacts (Annex B). Among the 845 correlations between the 5 flows and the 169 SDG targets, there are 18 strong positive relationships (about 2% of all cases), while no strong negative relationship has been singled out. A bird's eye view of Figure B.1 suggests that strong linkages are quite common across SDGs, since 10 out of the 17 Goals display at least one strong relationship with a transboundary flow, while all 17 Goals record at least one moderate linkage to a transboundary flow. This suggests that, according to the experts consulted, transboundary impacts are potentially pervasive across all SDGs.

50. Again, financial flows have the highest number of strong positive relationships (11 out of 18). These relate, for instance, to transferring resources to developing countries through ODA and FDI (Target 10.b) or to the mobilization of additional financial sources (Target 17.3). Notably, financial flows have a strong positive relation with 4 out of the 19 targets under Global Partnership (Goal 17), the highest number of strong relationships under one SDG goal. Second, trade flows have strong positive relationships with 4 targets, namely with efforts to increase exports from developing countries (Target 17.11). Environment flows have strong positive relationships with the targets pertaining to integrated water resources management (Target 6.5) and to sustainable infrastructure and industries (Target 9.4). Knowledge transfers have strong positive linkage with targets on support for research and development of vaccines and medicines and affordable access to essential ones, while people flows are not deemed to have strong positive links with any SDG targets.

51. Conversely, the experts consulted identified 94 moderate positive. For example, financial flows are deemed to be of moderate importance for promoting clean energy research and technology (Target 7.a), with the same applying in the case of flows of people and scholarships to citizens in developing countries (Target 4.b), and of environmental flow and action to prevent the degradation of natural habitats (Target 15.5). Moderate links constitute 11% of all possible relationships. All of the five flows are deemed to have multiple moderate positive relationships, with financial flows recording the largest number (29 relationships), among which 6 pertain to Goal 17, and 3 to Goals 1, 7 and 9. Knowledge transfer displays the second largest number of moderate positive relationships (21), while environment flows, flows of people and trade flows have moderate positive relationships with 17, 12 and 10 targets, respectively.

52. Although the experts consulted never identified strong negative relationships, they highlighted 4 moderate ones: environmental flows with respect to actions against poaching and trafficking of protected species (Target 15.7); financial and trade flows with respect to efforts to reduce illicit financial and arms flows (Target 16.4); and flows of people with respect to ending malnutrition globally (Target 15.7).

53. Overall, the qualitative survey conducted among experts sheds light on the relationship between a given transboundary flow and a given SDG target. Three patterns emerge from the questionnaire results:

- the large majority of linkages are deemed to be weak or non-existing, with only 2% and 11% of all relationships deemed to be strong or moderate, respectively;
- financial flows record a much higher share of strong or moderate linkages than other flows, followed by knowledge transfers; and
- transboundary impacts are quite diffuse across SDGs, with 10 out of the 17 Goals displaying at least one strong relationship with a given transboundary flow, while all of the 17 Goals record at least one moderate linkage to a transboundary flow.

54. Altogether, these patterns suggest that transboundary impacts are deemed by experts to be pervasive across all SDGs, but potential significant impacts limited to a small number of targets.

# 5. Measuring transboundary flows and their impact on SDG targets: an illustration

55. Building on the conceptual framework for measuring transboundary impacts described in Section 3, this section illustrates how each of the five transboundary flows could be measured in specific areas. For this analysis, one specific area is selected to describe each of the five flows. The indicators pertaining to this area have been selected primarily based on the criterion of data availability; this in order to allow coverage of most countries in each world region, including in terms of bilateral data, i.e. data on the origin and destination of each flow, as well as of relevance to the five flows for the different SDGs.

### Table 5.1. Areas that could be considered for each transboundary flow

| Financial flows | Movement of people | Trade flows | Environmental flows | Knowledge transfers |
|---|---|---|---|---|
| Official development assistance (ODA), flow | Foreign born population, stock | Value-added embodied in trade, flow | $CO_2$ emissions, flow | Patent applications, flow |
| Foreign direct investment (FDI), flow | Refugee population, stock | Total value of export and import, flow | Material footprint, flow | Industrial design applications, flow |
| International remittances, flow | International tourists, flow | Imports from developing countries, flow | Trade of environmentally related goods and services, flow | Charges for the use of intellectual property, flow |
| Other Private transfers, flow | International students, flow | Human rights risks embodied in trade, flow | Red List Index | Trademark applications, flow |
| Transfers from philanthropic institutions, flow | | | Forest area, stock | Government support to R&D, flow |
| | | | Trade in waste and scrap, flow | |

56. Some important caveats immediately follow the choice of specific indicators within each area. Indicators are broad proxies of the underlying variables of interest, and no single indicator captures all interesting aspects of, say, foreign direct investment or imports from developing countries. Therefore, this Section simply intends to provide an illustration of the methodology. For that purpose, the following set of indicators has been selected to describe both inbound and outbound flows for each of the five categories. The indicators were selected according to criteria of general relevance, data availability and country coverage. These indicators are:

- **Financial flows – Net disbursement/receipt of Official Development Assistance.** ODA is one important aspect of the global transfer of financial resources from developed to developing countries. ODA is the main source of development aid, and features prominently in the 2030 Agenda, with 13 of the 169 targets related to it. Detailed country-level data on ODA are available for OECD-DAC member countries and the EU. Data are sourced from OECD databases (2021[46]). The analysis could be replicated with the help of the indicator on Total Official Support

for Sustainable Development (TOSSD, or its forthcoming avatar), when the data becomes available for all countries. But the analysis could also be replicated for other types of financial flows, such as foreign direct investment or short-term capital movements.

- **Movement of people – Stock of the migrant population, by country of origin and destination.** Migration is the most significant form of movement of people across borders. Stock (rather than flow) data are used here, as data coverage is higher than in the case of annual flows of migrants. Additionally, migration typically implies a long-term resettlement of people, and in this sense is different from financial and trade flows, so that the data on the stocks of the migrant population provide a useful summary measure of the flows of migrants that have unfolded over a long period of time. Additionally, data available cover most of the countries and world regions in detail. Migration is the subject of SDG target 10.7. Data on the stock of the migrant population is a given country are sourced from the World Bank (2017[47]). This indicator does not capture more specific forms of migration, such as forced migration. Similar analysis could be applied in the case of other types of movements of people, such as tourism flows.
- **Trade flows – Total domestic value-added embodied in foreign final demand, and total foreign value-added embodied in domestic final demand**. These data can be sourced from the Trade in Value Added database for 2015, which provides detailed country-level data. Value-added is used here as it captures the net value of trade to an economy, excluding the value of intermediate imports that are created elsewhere. Trade-related SDG targets are concentrated under Goal 17, in targets 17.10, 17.11, and 17.12. Data are sourced from a range of OECD databases (2021[48]). While this analysis considers the total size of these trade flows, it could be extended to specific types of goods, such as imports of food stables and necessities, which will increase domestic supply but also displace local producers or shift consumption patterns in directions that increase health risks of the local population (e.g. through higher consumption and fat- and sugar-rich stables, thereby raising obesity risks).
- **Environmental flows – $CO_2$ emissions from domestic production, and $CO_2$ emissions from domestic final demand.** These two measures show two facets of a country's contribution to climate change, one of the greatest environmental challenges of our time. The climate system is a global common good, so countries' impacts on it are different from other transboundary impacts that occur only through flows across borders, as countries affect this global public good through their own emissions, as well as through consumption of products produced elsewhere through processes that generate $CO_2$ emissions, i.e. demand-based emissions. For the purpose of this analysis, rather than using incoming and outgoing flows, we use domestic $CO_2$ emissions from production and (net) imported $CO_2$ emissions. SDG 13 is dedicated entirely to climate change, and includes 5 targets. Data on $CO_2$ emissions from domestic production and from domestic demand are available for most countries and world regions from the *OECD database* (OECD, 2019[49]).
- **Knowledge transfers – Patent applications in a given country by both residents and by non-residents** are used below as proxies for knowledge creation. Patents are a legal tool providing intellectual property rights to the inventor, and excluding others from using this invention. For that reason, it is an imperfect measure of knowledge transfers as it precisely limits knowledge diffusion. It has also the disadvantage that an innovation can be counted multiple times if it is patented in several countries. However, there is not any better proxy indicator capable of capturing the full breadth of innovation, and the number of patent applications is widely used in the economic literature to proxy research and development activities, and as such, knowledge creation (Kalutkiewicz and Ehman, 2014[50]). As intellectual property rights are typically time-bound, we use data on patent applications (sourced from the *World Bank database* (World Bank[51])) as a measure of the domestic production of knowledge by residents, which contributes to global knowledge creation. Likewise, the number of patent applications in a country deposited by non-residents involves an implicit import of knowledge, which also contributes to the creation of knowledge as a global public good. As in the case of other flows, knowledge transfers can also take other forms,

as in the case of scholarships awarded to foreign students, incentives for high-skilled migrants to return to their home country, or licences granted to developing countries for the local production of generic medicines or vaccines, with the direction of impacts depending on the specific type of knowledge transfer considered.

57. The analysis of these indicators is presented at the global level, with country-level data aggregated into 11 world regions: i) Australia and New Zealand; ii) Central Asia; iii) China; iv) East Asia; v) Europe; vi) Japan and Korea; vii) Latin America and the Caribbean; viii) Middle East and North Africa (MENA); ix) South Asia; x) Sub-Saharan Africa; and xi) the United States and Canada. This country grouping (based on the work by Morrisson and Murtin (2013[52]), is based on both the geographical location of countries and their level of economic development. Table 5.2 presents the number of countries, total population and total GDP of each of the 11 world regions. The analysis of transboundary flows at this regional level allows for a high-level global assessment of the size of transboundary flows, i.e. which region disproportionally affects, through the flows originating from it, both other regions and global public goods.

### Table 5.2. Summary indicators for the 11 world regions used in the paper

| | Number of countries and economies | Total population in 2018 (Millions) | Total GDP in 2018 (Billions USD) |
|---|---|---|---|
| Europe | 45 | 545 | 20 041 |
| Australia-New Zealand | 2 | 30 | 1 639 |
| Japan-Korea | 2 | 178 | 6 591 |
| China | 3 | 1 401 | 14 026 |
| East Asia | 13 | 684 | 2 989 |
| South Asia | 8 | 1 814 | 3 453 |
| Central Asia | 13 | 374 | 2 994 |
| Middle East and North Africa | 21 | 449 | 3 033 |
| Sub-Saharan Africa | 48 | 1 075 | 1 697 |
| United States-Canada | 2 | 364 | 22 258 |
| Latin America | 19 | 589 | 4 961 |

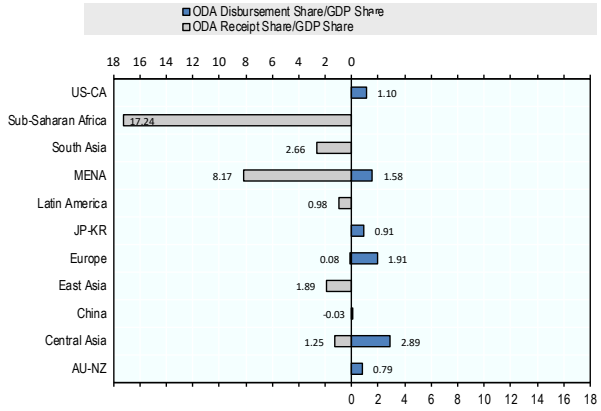
Source: Grouped and calculated by authors based on *World Band Database* (World Bank[51])

## 5.1. Measuring transboundary flows relative to regional size

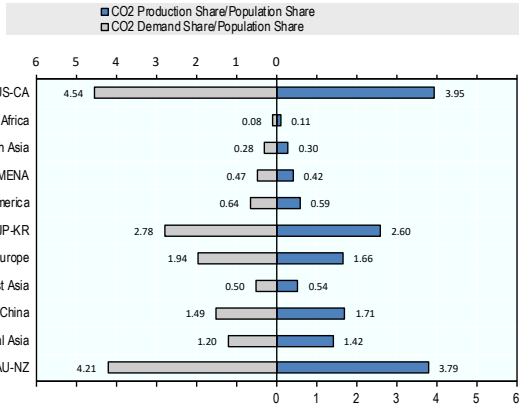
58. This Section, based on the available data for the five flows described above, assessed the relative magnitude of transboundary flows for each of the 11 world regions relative to their size. The five panels of Figure 5.1 describe the ratios of each region's share in global flows (both incoming and outgoing) relative to its share in global GDP or population (depending on the indicator considered). Ratios higher than one imply that the region is dominant in this transboundary flow relative to its size.

## Figure 5.1. Ratios of transboundary flows relative to size, by world region

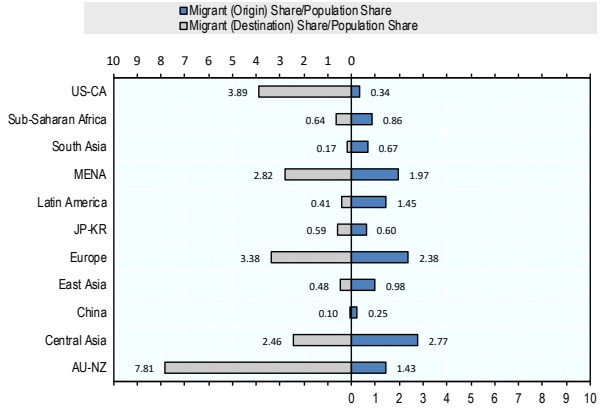
A. The ratio of each region's share of ODA disbursement/receipt and GDP share



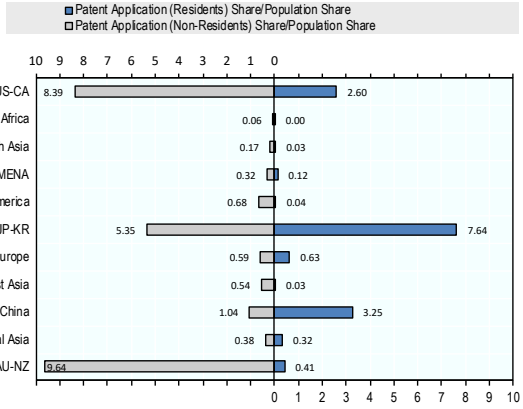

D. The ratio of each region's share of CO2 production/demand and population share



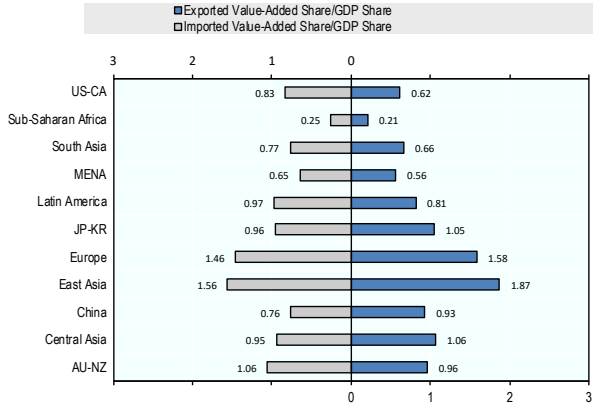

B. The ratio of each region's share of migration (origin/destination) and population share




E. The ratio of each region's share of patent application (residents/non-residents) and population share




C. The ratio of each region's share of exported/imported value-added and GDP share




Note: Each indicator is aggregated at the regional level for both incoming and outgoing flows. For each transboundary flow, the ratio is computed as the share of each region in the total flow, divided by the share of the same region in world population or GDP (depending the nature of the flow considered). Panel A shows incoming and outflowing ODA, Panel B shows stocks of migration by origin and destination, Panel C shows imported and exported value-added, Panel D shows production and demand-based $CO_2$ emissions, and Panel E shows patent applications by resident and non-residents. Panels A, B and C include intra-regional flow and exclude the flow to/from unspecified places.

Source: Authors' calculation based on the following data sources: Net ODA disbursement (OECD, 2021[46]); value-added embodied in a country imports and exports (OECD, 2021[48]); Bilateral migrant stocks (World Bank, 2017[47]); Production-based $CO_2$ emissions and $CO_2$ emissions embodied in final demand, (OECD, 2019[49]); Patent applications by residents and non-residents in 2017 (World Bank, 2020[51])

59. Transboundary **financial** flows (Panel A, Figure 5.1) are expressed as the ratio of the share of global ODA attributed to each world region relative to their share of global GDP. For ODA outflows (disbursements), regions with a ratio greater than one are Central Asia, Europe, MENA, and United States-Canada, meaning that their share in global ODA disbursements exceeds their economic size. For ODA recipients, the regions with a ratio above one are Sub-Saharan Africa, MENA, South Asia, East Asia and Central Asia. Central Asia and MENA are both large payers and recipients of ODA, whereas Sub-Saharan Africa is by far the largest recipient region relative to its size, with a ratio above 17.

60. Transboundary movements of **people** (Panel B, Figure 5.1) are measured by the share of incoming and outgoing migrants relative to population size of each region. Dominant emigration regions, with a ratio larger than one in outflow of migrants, are Central Asia, Europe, MENA, Latin America and Australia-New Zealand, meaning that their share of outgoing migration is greater than their share in global population. Conversely, the regions with a relatively higher inflow of migrants compared to their population share are Australia-New Zealand, United States-Canada, Europe, MENA and Central Asia. Large outflows of migrants are not necessarily orthogonal to inflows, with some regions (MENA, Europe, Australia-New Zealand and Central Asia) featuring high levels of both incoming and outgoing migration relative to their population share. Among these regions, only Central Asia has more outflow than inflow of migrants.

61. Transboundary **trade** flows (Panel C, Figure 5.1) are measured by ratio of the shares of both exported and imported value-added relative to the GDP share of the same region. Trade flow ratios are relatively symmetrical compared to the other ratios, meaning that regions featuring relatively high imports compared to GDP also have relatively high exports. This is the case of East Asia and Europe, which have higher shares of both export and import of value-added relative to GDP. On the other side, South Asia, MENA and Sub-Saharan Africa have relatively low share of value-added embodied in their imports and exports compared to their share of global GDP. However, the absolute size of trade flows should also be considered when assessing the transboundary impacts of regions, as presented in the next sub-section.

62. Transboundary **environmental** flows are represented here by $CO_2$ emissions of different world regions (Panel D, Figure 5.1), both from domestic production and from final demand, relative to their share in global population. As in the case of trade flows, environmental flows are also fairly symmetrical, with inflows ($CO_2$ emissions imported from abroad) and outflows ($CO_2$ emissions stemming from domestic production) following similar patterns. Regions with a high share of $CO_2$ emissions relative to their share of global population are United States-Canada, Australia-New Zealand, Japan-Korea, China, Europe and Central Asia. This means that, when considering the size of their population, these regions are responsible for both producing and consuming (embodied in goods and services) a disproportionate share of global $CO_2$ emissions. In particular, China and Central Asia produce more $CO_2$ than they consume, indicating that part of the impacts of these two regions on the climate system is driven by foreign demand, as well as by domestic policies and circumstances (e.g. production technologies, environmental regulations) that translate in a high $CO_2$-intensity of their economic production.

63. Lastly, transboundary **knowledge** transfers are measured here by the number of patent applications by residents and non-residents in each country, relative to the share of different regions in global population (Panel E, Figure 5.1). Residents' patent applications in Japan-Korea, China and United States-Canada are greater than their share of population, suggesting that these regions are contributing considerably to the accumulation of knowledge. Likewise, non-resident patent applications in Australia-New Zealand, United States-Canada and Japan-Korea are also high. These findings may be interpreted as pointing towards greater contributions to knowledge of these regions, although policies and institutions concerning intellectual property protection should also be considered as explaining factors here.

64. Beyond individual flows and the associated proxy indicators, it is also important to identify world regions having greater transboundary impacts relative to their size across *all* five flows for the variables examined in this study. Regions with relatively higher transboundary ratios are Europe, Central Asia, United States-Canada and MENA, meaning that their transboundary ratios are above one across several indicators. In particular, Europe and Central Asia have relatively high ratios in 7 of the 10 indicators, while the United States-Canada and MENA regions record a high ratio in 6 of the 10 indicators. Conversely, Sub-Saharan Africa, South Asia and Latin America all record relatively low transboundary ratios, with 9 out of 10 indicators below 1. This suggests that Europe, Central Asia, United States-Canada and MENA have higher transboundary impacts as measured by these flows and indicators, compared to their relative size. Similarly, Sub-Saharan Africa, South Asia and Latin America all record lower transboundary impacts, implying more limited impacts on other countries and global public goods in the areas and variables of focus for the 2030 Agenda.

## 5.2. Mapping the global network of transboundary flows in absolute terms

65. This sub-section examines transboundary flows from the 11 world regions in absolute terms, i.e. emphasizing their global impact. For financial, trade and people flows, the analysis looks at bilateral flows between the 11 regions, based on bilateral flow databases.

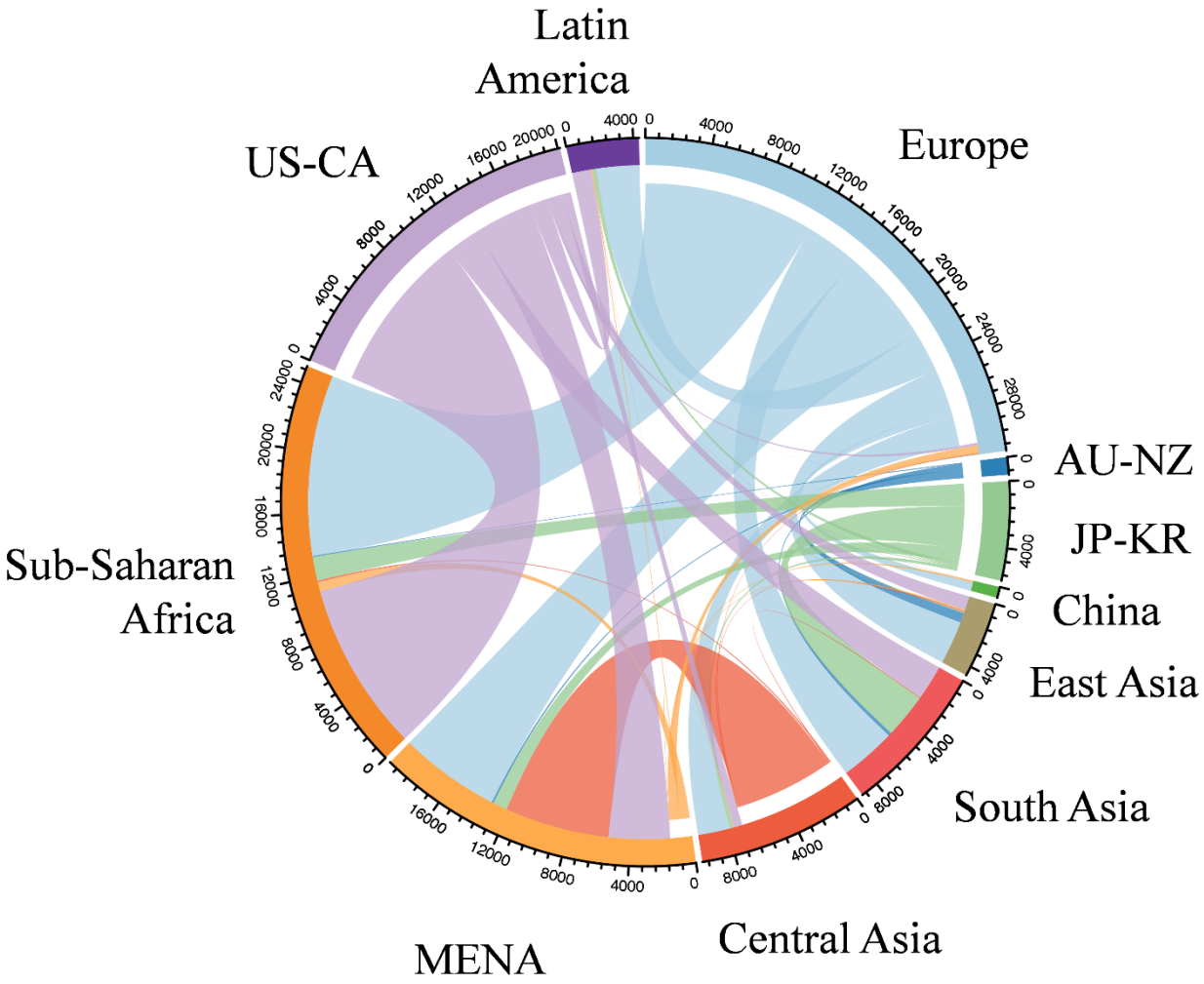
### *5.2.1. Financial transboundary flow*

66. As in the previous section, ODA data are used to illustrate how financial transboundary flows might affect countries' abilities to meet their SDG commitments, as well as progress in delivering the planetary goals of the 2030 Agenda.

67. Figure 5.2 describes the amount of ODA originating in each world region and flowing to other regions in 2018 (see Annex C for details). Focusing on the absolute value of total outbound ODA, Europe, the United States-Canada, and Central Asia are the largest donor regions, with Europe being the largest donor, with 30 billion current US dollars disbursed in 2018. European ODA flows mainly to Sub-Saharan Africa and MENA, which account for 39% and 22% of its total ODA outflow (respectively). United States-Canada is the second largest ODA donor region, with 20 billion current US dollars disbursed in 2018, 55% of which flows to Sub-Saharan Africa. Central Asia is the third largest donor, with 7 billion current US dollars disbursed in 2018, most of which is directed to MENA.

68. The largest ODA recipient regions in 2018 were Sub-Saharan Africa, MENA and South Asia. Sub-Saharan Africa is the largest recipient region, with inflows mostly originating from Europe and United States-Canada, with a total of 25 billion current US dollars received. MENA is the second largest destination, with 18 billion current US dollars, mostly received from Europe and Central Asia. South Asia is the third largest recipient, with about 9 billion current US dollars, most of which come from Europe, Japan-Korea and United States-Canada.

## Figure 5.2. Europe is the largest region of origin of ODA, while Sub-Saharan Africa is the largest recipient of ODA

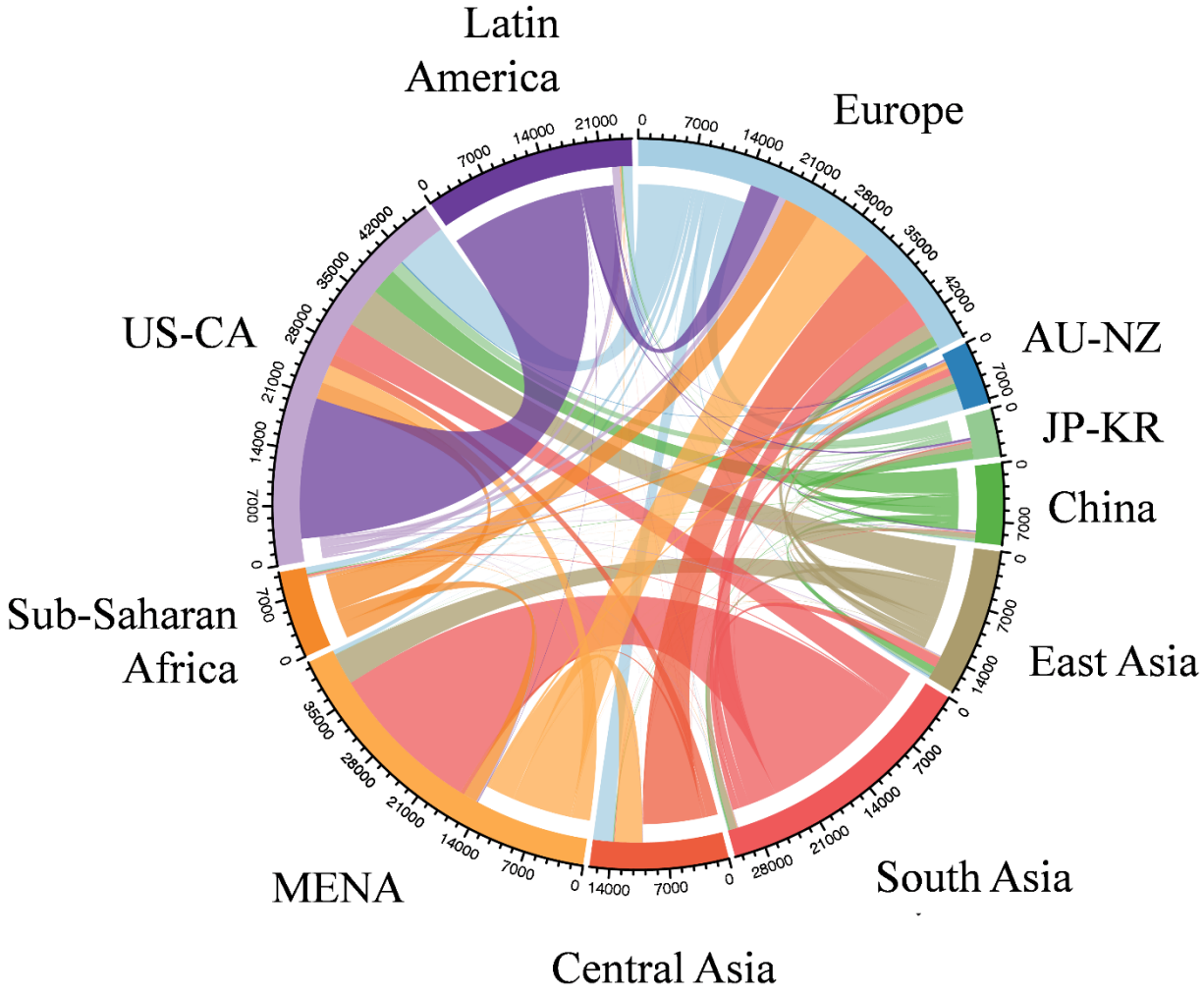



Note: The figure shows the flows of bilateral net ODA disbursement in 2018 from the 11 regions, excluding any possible intra-regional flow, flows to unspecified places and negative flows (net ODA has negative value when repayments or recoveries on grants are greater than amounts disbursed in a given year). The lines connoting the flow of net ODA show the origin and destination of each flow, differentiating origin by colour. The width of the coloured line depicts the size of the flow. The scale on the circumference of the circle shows the absolute size of the flows in millions current US dollars.
Source: Authors' calculation based on OECD (2021[46]).

### *5.2.2. Movement of people*

69. In 2017, 266 million people worldwide – approximately 3.5% of the world population – were living in countries they were not born in or had foreign citizenship.[5] Based on this definition, the stock of migrants, as measured in 2017, can be used as a proxy for measuring the (cumulative) movement of people across the 11 world regions. This measure is used here as it is less volatile than the flow of migrants in a given year, which is subject to several idiosyncratic factors and is prone to large measurement errors.

**Figure 5.3. South Asia is the region with the largest outflow of migrants, while the United States and Canada is the largest regions of destination of migrants**




Note: The figure shows the flows of bilateral estimated migrant stocks in 2017 from the 11 regions, not including intra-regional flow and the flow to unspecified places. The lines connoting the flow of estimated migrants show the origin and destination of each flow, differentiating origin by colour. The width of the coloured line depicts the size of the flow. The scale on the circumference of the circle shows the absolute size of the flows in thousand people.
Source: Authors' calculation based on the World Bank (2017[47]).

[5] In *International Migration Report 2013* (United Nations, Department of Economic and Social Affairs, Population Division, 2013[54]), migrants are defined as "people living in a country or area other than the one in which they were born or, in the absence of such data, the number of people of foreign citizenship".

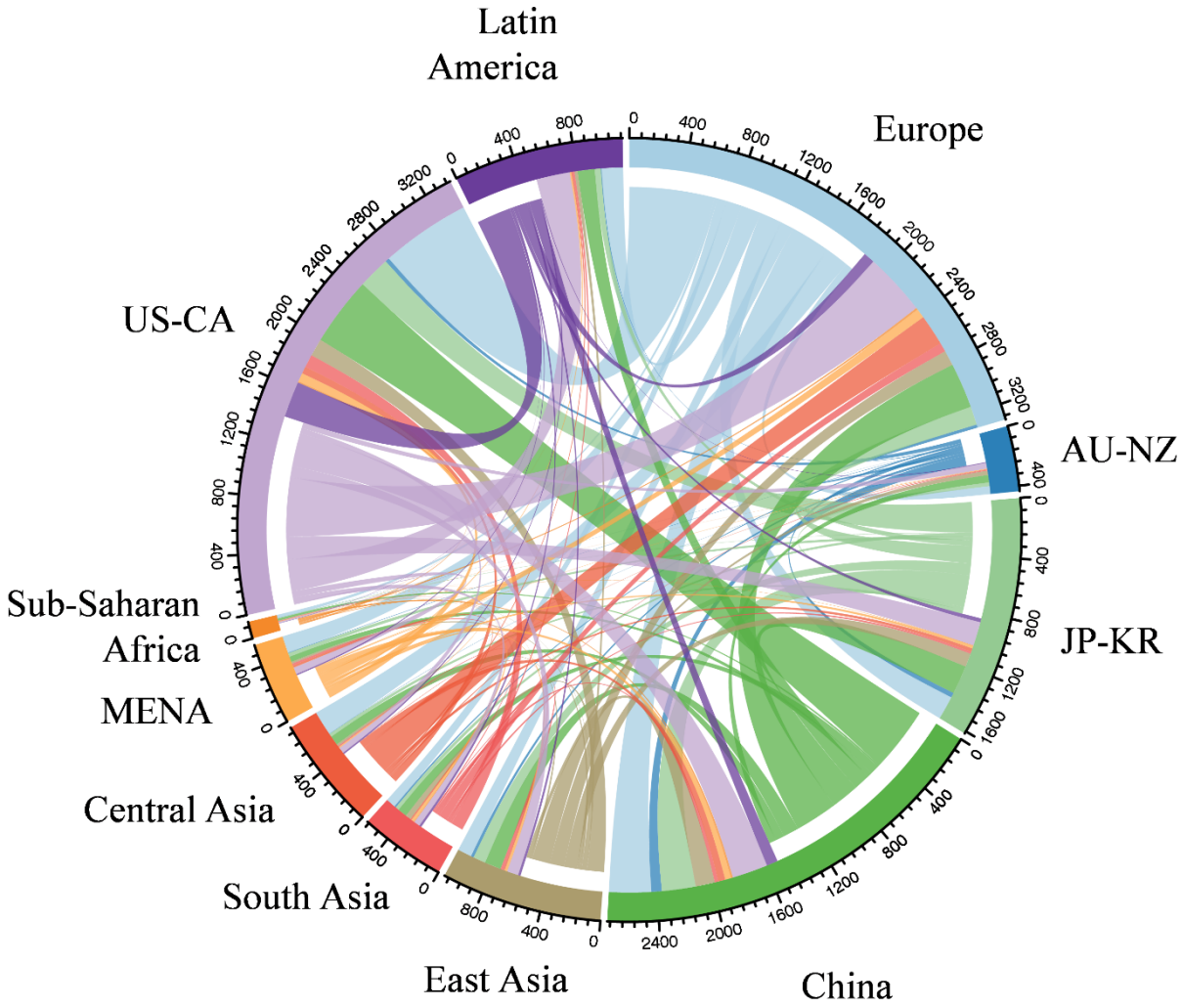
70. Figure 5.3 describes the movement of people between world regions (see Annex C for details). Emigration from South Asia and Latin America is the largest among the 11 regions, with some 30 million people from South Asia having emigrated mostly to MENA countries, and 22 million emigrants from Latin America having mostly moved to the United States-Canada. Meanwhile, United States-Canada, Europe and MENA are the three world regions with the highest stock of incoming migration, with 44.6 million migrants living in the United States-Canada, 32 million in Europe (mostly from MENA and Central Asia), and almost 27 million people in MENA (mostly from South Asia). South Asia and Sub-Saharan Africa have the lowest numbers of incoming migrants, and Australia-New Zealand has the lowest number of emigrants among the 11 regions.

### *5.2.3. Trade flow*

71. The total of value-added export worldwide amounted to USD 13 894 billion in 2015. Figure 5.4 describes trade flows from and to each region (see details in Annex C). In terms of export of value-added, the largest exporting regions are, in decreasing order of importance, Europe, China and United States-Canada. European exports in value added terms amount to 1 817 billion in current US dollars, of which almost 35% is imported by United States-Canada. The next largest exporter, in value added terms, is China, with exports worth 1 511 billion current US dollars, one-third of which goes to the United States-Canada, and a further 20% to Europe. United States-Canada is the third largest exporting region, with valued added worth 1 348 billion in current US dollars, about a half of which is imported by Europe and Latin America. About half of the export of value-added from Latin American flows to United States-Canada, whereas more than a half of the value-added of Central Asia is exported to Europe.

72. In terms of the import of value-added, the three largest regions are the United States-Canada, Europe and China, with 2 002, 1 490, and 1 228 billion in current US dollars, respectively. Imports of value-added to United States-Canada are mostly coming from Europe, China, Europe, Latin America and Japan-Korea, while imports of value-added to Europe are mostly coming from United States-Canada, China and Central Asia. In China, value added imported mainly comes from Europe, United States-Canada, Japan – Korea and East Asia.

**Figure 5.4. Europe is the largest exporting region in value-added terms, while United States-Canada is the largest importing region**

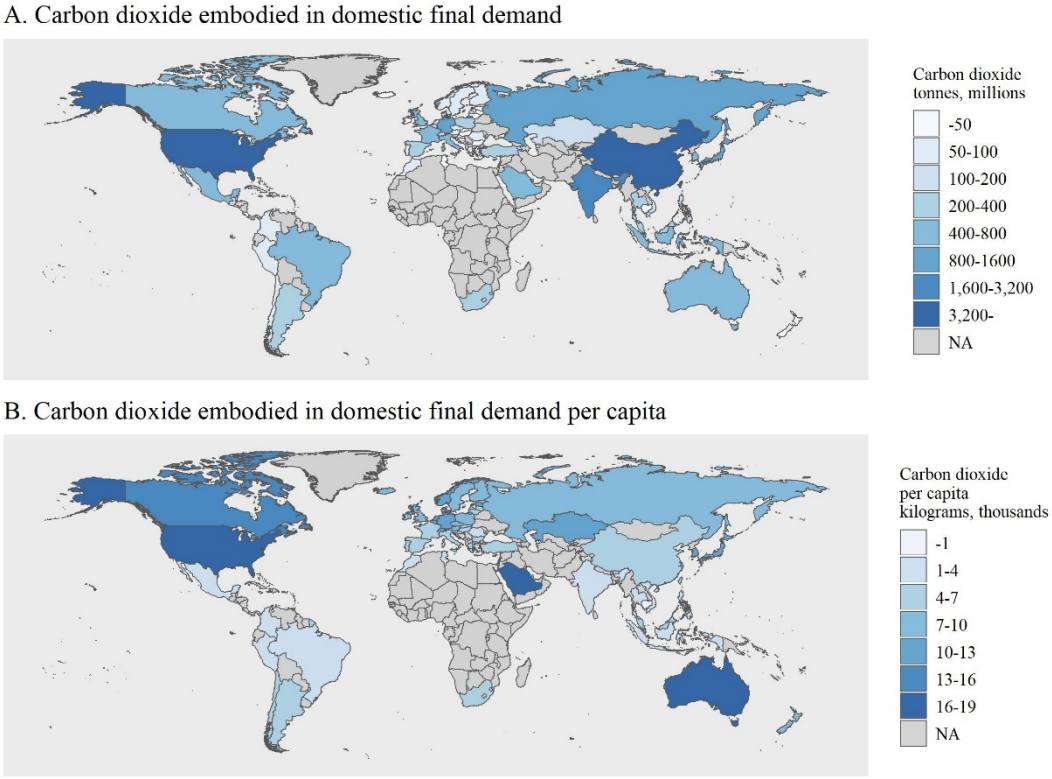



Note: The figure shows the flows of total export of value-added in 2015 from the 11 regions, not including intra-regional flow and the flow to unspecified places. The lines connoting the flow of estimated migrants show the origin and destination of each flow, differentiating origin by colour. The width of the coloured line depicts the size of the flow. The scale on the circumference of the circle shows the absolute size of the flows in billion current US dollars.
Source: Authors' calculation based on OECD (2021[48]).

### *5.2.4. Environmental transboundary flow*

73. As explained in Section 3.2, data on $CO_2$ emission are used below to illustrate the potential importance of environmental transboundary flows. Figure 5.5 shows $CO_2$ emissions embodied in the domestic final demand of various countries around the globe.[6]

## Figure 5.5. $CO_2$ emissions embodied in domestic final demand




Note: Panel A shows $CO_2$ emissions embodied in domestic final demand in 2015 by country. Darker shades of blue indicate more embodied $CO_2$ emissions. Similarly, Panel B shows the $CO_2$ emissions embodied in domestic final demand in 2015 per capita, and darker blue indicates more embodied $CO_2$ emissions per capita. Grey indicates when data are not available. See the legends for detailed correspondence of the colours and intervals.
Source: Authors' calculation based on OECD (2019[49]) and the World Bank (2020[51]).

74. Panel A in Figure 5.5 depicts the $CO_2$ emissions of each country associated with the consumption of goods and services produced domestically and embodied in the imports of each country or economy. The largest amount of $CO_2$ emissions embedded in final demand is recorded in China with 7 978 million tonnes of $CO_2$ (8 082 million tonnes including Hong Kong). The United States is the second largest consumer of carbon dioxide, with 5 795 million tonnes of $CO_2$, while India stands as the third largest consumer with 1 919 million tonnes of $CO_2$.

75. Panel B in Figure 5.5 shows $CO_2$ emissions from domestic final demand per person. With 18.8 tonnes of $CO_2$ per person, Saudi Arabia is responsible for the largest amount of $CO_2$ embodied in final demand per capita. The United States is coming second, with 18.1 tonnes of $CO_2$ per person, then followed by Australia (17.9 tonnes of $CO_2$ per person).

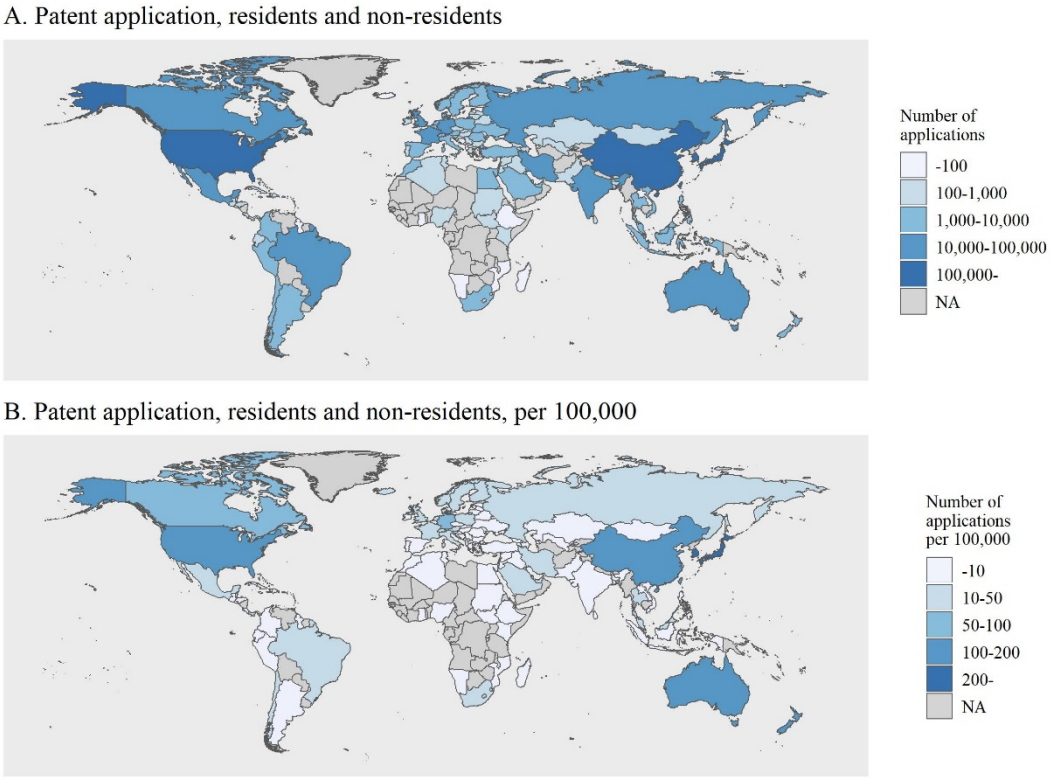
[6] See Annex D for detailed statistical table.

76. As these $CO_2$ emissions disrupt the global climate system, with effects that are independent of where emissions took place, no breakdown by 'destination' of the flows is presented.

### *5.2.5. Knowledge transfer*

77. As argued above, the number of patent applications submitted by residents of each country (whether in the same country or abroad) can be used as a (partial) proxy for the generation of knowledge of each country. Figure 5.6 describes the total number of patent applications by residents and non-residents, in each country.[7] The four countries with more than 100 000 patent applications in total are China, the United States, Japan and Korea. China (with 1 557 988 applications when including Hong Kong) actually records about 2.4 times more applications than United States-Canada combined (United States: 597 141, Canada: 36 161) and about 3 times more than Japan-Korea (Japan: 313 567, Korea: 209 992). As a whole, sixteen economies including Germany, India and France receive between 10 000 and 100 000 patent applications each year.

## Figure 5.6. Patent application by residents and non-residents




Note: Patent application by residents and non-residents in 2017 and population in 2017. Panel A shows patent application by residents and non-residents in 2017 by country, and darker blue indicates more patent applications by residents and non-residents. Similarly, Panel B shows patent application by residents and non-residents per 100 000 people in each country, with darker blue indicating higher numbers of patent applications. Grey indicates where data are not available. See the legends for detailed correspondence of the colours and intervals.
Source: Authors' calculation based on the World Bank (2020[51]).

78. Panel B in Figure 5.6 illustrates the total number of patent applications submitted by both residents and non-residents per 100 000 people in each country or economy. Korea, Japan, Hong Kong and

[7] See Annex D for detailed statistical table.

Singapore record more than 200 applications per 100 000 people. Likewise, the United States, New Zealand, Australia and China display between 100 and 200 patent applications per 100 000 residents.

79. As in the case of $CO_2$ emissions, generation of knowledge (as proxied by the number of total applications for copyright protection) is here considered as contributing to the generation of a global public good; hence a breakdown by "destination" of the flows is not meaningful in this case.

### *5.2.6. Transboundary flows between and within regions*

80. While the previous sections have highlighted transboundary flows between world regions, in some cases these reflect large cross-border flows within each region, i.e. between the many countries and jurisdictions belonging to each region. The distinction is important in the case of transboundary flows of financial resources, goods and services, and people, as flows within each region do not affect the rest of the world. This is different to the case of knowledge and $CO_2$ emissions, which affect global goods regardless of where they are produced, so that interregional flows are just as important as local flows.

81. Table 5.3 describes the total volume of outflows together with their decomposition into between and within-region components for finance, people and trade. A focus on outflows is especially important in the context of documenting the origin of transboundary impacts. A similar analysis for inflows is presented in Table A C.1.

82. Most of financial flows take place between regions, rather than within them. The main exception are the MENA countries, where a small number of high-income countries transfers about 4 billion current US dollars of ODA to other MENA countries.

83. Regarding the movement of people, there are three types of situation:

- Regions where at least two thirds of total emigration concern destinations outside of the region. (This is the situation of China that, for the purpose of this analysis, has been merged with the jurisdictions of Hong Kong and Macau), East Asia, Japan-Korea, Latin America, South Asia and United States-Canada.
- Regions where about half of emigration flows goes outside the region and another half stays within the region (Australia-New Zealand; and MENA).
- Regions where a large majority of emigration flows remains within the region, which includes Central Asia, Europe and Sub-Saharan Africa.

84. Finally, the large majority of trade exports is between regions, with the noticeable exception of Europe (where 56% of European exports are directed towards other European countries).

85. Overall, the data presented in Table 5.3 do not alter the global picture of cross-region flows depicted in the previous sections, as well as the ranking of regions. Europe and United States-Canada largely dominate in terms of ODA flows. When accounting for intra-regional migration, Europe now slightly exceeds South Asia. Europe confirms its status of first exporting region in the world even after taking into account intra-European trade.

### Table 5.3. Structure of the transboundary outflow

| Region name | Financial flow | | | Movements of people | | | Trade flows | | | Environmental flows | Knowledge transfers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Billion current US dollar) | | | (1 000 people) | | | (Billion current US dollar) | | | (Billion tonnes) | (1 000 applications) |
| | Total | Between (%) | Within (%) | Total | Between (%) | Within (%) | Total | Between (%) | Within (%) | Total | Total |
| Australia-New Zealand | 1.1 | 100.0% | - | 1 361 | 50.5% | 49.5% | 217 | 95.1% | 4.9% | 0.4 | 3.8 |
| Central Asia | 7.4 | 96.0% | 4.0% | 33 395 | 30.1% | 69.9% | 438 | 91.9% | 8.1% | 2.1 | 36.4 |
| China | - | - | - | 11 211 | 73.0% | 27.0% | 1,566 | 96.5% | 3.5% | 9.4 | 1 394.1 |
| East Asia | - | - | - | 21 566 | 65.9% | 34.1% | 687 | 86.4% | 13.6% | 1.4 | 6.3 |
| Europe | 30.6 | 98.1% | 1.9% | 42 055 | 34.3% | 65.7% | 4,146 | 43.8% | 56.2% | 3.6 | 105.1 |
| Japan-Korea | 5.0 | 100.0% | - | 3 454 | 82.1% | 17.9% | 896 | 94.3% | 5.7% | 1.8 | 416.2 |
| Latin America | - | - | - | 27 540 | 81.2% | 18.8% | 570 | 89.5% | 10.5% | 1.3 | 8.1 |
| MENA | 4.4 | 0.9% | 99.1% | 28 195 | 51.5% | 48.5% | 257 | 98.9% | 1.1% | 0.7 | 16.9 |
| South Asia | - | - | - | 39 161 | 77.4% | 22.6% | 264 | 100.0% | 0.0% | 2.0 | 17.0 |
| Sub-Saharan Africa | - | - | - | 29 120 | 30.5% | 69.5% | 51 | 100.0% | 0.0% | 0.4 | 1.5 |
| United States-Canada | 20.1 | 100.0% | - | 3 968 | 72.3% | 27.7% | 1 808 | 76.5% | 23.5% | 5.6 | 289.4 |

Note: Financial flow in this table shows ODA disbursements in 2018; movement of people shows migrant stock estimate by origin in 2017; trade flow shows domestic value added embodied in foreign final demand in 2015; environmental flow shows $CO_2$ emissions based on production in 2015; knowledge transfer shows patent applications by residents in 2017.
Source: Calculated by authors.

## 5.3. An overview of transboundary impacts

86. Based on the analysis presented in the previous sections, this section summarises the nature of transboundary impacts of each world region. Two different logics are at play: a region-centric viewpoint would state that transboundary impacts are large when a region records large transboundary flows *relative* to the size of its economy or population; whereas a global perspective would simply focus on the absolute size of transboundary flows. Both relative and absolute impacts are assessed in Table 5.4 for each world region on a 4-point scale: negligible, small, moderate or large. For all types of flows, and for both relative and absolute measures, Table 5.4 reports on flows by country of origin (rather than by destination country, or by the sum of the two) in order to reflect the likely impact of origin countries on destination countries.

87. At a global level, China and the United States-Canada display the largest impacts, as each region records the highest score in 3 types of transboundary flows (trade, environment and knowledge for the former; finance, trade and environment for the latter). Europe has large transboundary impacts in two flows (finance and trade), while Japan-Korea have large impact for knowledge, and Latin America and South Asia have large impacts in terms of people. This implies that about half of all the global transboundary impacts considered in this section stem from two regions, namely China and the United States-Canada. One region, namely Sub-Saharan Africa, displays only negligible or small transboundary impacts, although

this result should be nuanced as two proxy indicators, namely $CO_2$ emissions and patent applications, display a lot of missing data.

88. Relative to the size of population or the economy, Central Asia stands out as the region displaying the highest number of large transboundary impacts (finance, people, trade and environment), followed by China (trade, environment and knowledge), Europe (finance, people and environment), Australia-New Zealand (people, trade and environment) and Japan-Korea (trade, environment and knowledge). Conversely, South Asia and Sub-Saharan Africa record only tiny or small transboundary impacts.

### Table 5.4. Overview of transboundary impacts

| Region Name | Financial flow | | Movement of people | | Trade flow | | Environmental flow | | Knowledge transfer | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rel. | Abs. | Rel. | Abs. | Rel. | Abs. | Rel. | Abs. | Rel. | Abs. |
| Australia-New Zealand | Small | Negligible | Large | Tiny | Large | Tiny | Large | Tiny | Tiny | Tiny |
| Central Asia | Large | Moderate | Large | Small | Large | Small | Large | Small | Tiny | Tiny |
| China | Tiny | Tiny | Tiny | Small | Large | Large | Large | Large | Large | Large |
| East Asia | Tiny | Tiny | Large | Moderate | Large | Small | Tiny | Tiny | Tiny | Tiny |
| Europe | Large | Large | Large | Moderate | Small | Large | Large | Moderate | Tiny | Tiny |
| Japan-Korea | Moderate | Small | Small | Tiny | Large | Moderate | Large | Small | Large | Large |
| Latin America | Tiny | Tiny | Large | Large | Moderate | Small | Tiny | Small | Tiny | Tiny |
| MENA | Tiny | Tiny | Large | Moderate | Tiny | Tiny | Tiny | Tiny | Tiny | Tiny |
| South Asia | Tiny | Tiny | Small | Large | Small | Tiny | Tiny | Small | Tiny | Tiny |
| Sub-Saharan Africa | Tiny | Tiny | Tiny | Small | Tiny | Tiny | Tiny | Tiny | Tiny | Tiny |
| United States-Canada | Moderate | Large | Tiny | Tiny | Tiny | Large | Large | Large | Large | Moderate |

Note: The magnitude of the transboundary relative interconnectivity is assessed as follows: *Large,* i.e. transboundary flows relative to size greater than or equal to 1.2; *Moderate*, i.e. transboundary flows relative to size greater than or equal to 1.0 and less than 1.2; *Small,* i.e. transboundary flows relative to size greater than or equal to 0.8 and less than 1.0; and *Tiny,* i.e. transboundary flows relative to size less than 0.8. The magnitude of the transboundary absolute interconnectivity is assessed as follows: *Large,* i.e. share of the flow greater than or equal to 15%; *Moderate,* i.e. share of the flow greater than or equal to 10% and less than 15%; *Small,* i.e. share of the flow greater than or equal to 5% and less than 10%; and *Tiny,* i.e. share of the flow less than 5%. Transboundary flows refer to ODA disbursement, migrant stock by country of origin, domestic value-added embodied in foreign final demand, $CO_2$ emissions embodied in domestic final demand and patent application by residents. ODA disbursement, migrant stock by origin countries and domestic value-added embodied in foreign final demand do not include intra-regional flows and the flows to unspecified places.
Source: Calculated by authors.

89. Table 5.4 highlights strong transboundary relationships dominated by China, the United States-Canada and Europe at a global level. These regions have the highest potential of impacting SDGs in destination countries (e.g. Europe and United States-Canada via financial flows) or on common global goods (e.g. China and United States-Canada via $CO_2$ emissions). When the assessment is conducted in relative terms and normalised by population size or GDP, the picture becomes more nuanced as 7 regions out of 11 record at least two large transboundary impacts.

90. This illustration of the data analysis of the transboundary flows presented in this section offers an operationalisation of the conceptual framing of transboundary impacts. The operationalisation is only illustrative as each of the five types of flows encompass a variety of items (e.g. transboundary environmental flows go well beyond emissions of $CO_2$). As a first step, more research could be conducted with different proxy indicators for each item. Then, the analysis could be extended to different areas pertaining to each type of flows (e.g. to FDI, or tourist flows). Finally, , the approach could be used to present a more granular picture at the country level. Better understanding of the dynamics of transboundary impacts worldwide is essential for the successful implementation of the SDGs, and better measurement and data analysis can contribute to this objective.

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# Annex A. **Regional classification**

## Table A A.1. Regional classification: countries and economies

| | | | | |
|---|---|---|---|---|
| **AUS-NZL** | | | | |
| Australia | New Zealand | | | |
| **Central Asia** | | | | |
| Armenia | Azerbaijan | Belarus | Georgia | Kazakhstan |
| Kyrgyzstan | Moldova | Russia | Tajikistan | Turkey |
| Turkmenistan | Ukraine | Uzbekistan | | |
| **China** | | | | |
| China (People's Republic of) | Hong Kong (China) | Macau (China) | | |
| **East Asia** | | | | |
| Brunei Darussalam | Cambodia | Indonesia | Democratic People's Republic of Korea | Lao People's Democratic Republic |
| Malaysia | Mongolia | Myanmar | Philippines | Singapore |
| Thailand | Timor-Leste | Vietnam | | |
| **Europe** | | | | |
| Albania | Andorra | Austria | Belgium | Bosnia and Herzegovina |
| Bulgaria | Channel Islands | Croatia | Cyprus | Czech Republic |
| Denmark | Estonia | Faroe Islands | Finland | France |
| Germany | Gibraltar | Greece | Greenland | Hungary |
| Iceland | Ireland | Isle of Man | Italy | Kosovo |
| Latvia | Liechtenstein | Lithuania | Luxembourg | Monaco |
| Montenegro | Netherlands | North Macedonia | Norway | Poland |
| Portugal | Romania | San Marino | Serbia | Slovak Republic |
| Slovenia | Spain | Sweden | Switzerland | United Kingdom |
| **JPN-KOR** | | | | |
| Japan | Korea | | | |
| **Latin America** | | | | |
| Argentina | Belize | Bolivia | Brazil | Chile |
| Colombia | Costa Rica | Ecuador | El Salvador | Guatemala |
| Guyana | Mexico | Nicaragua | Panama | Paraguay |
| Peru | Suriname | Uruguay | Venezuela | |
| **MENA** | | | | |
| Algeria | Bahrain | Djibouti | Egypt | Iran |
| Iraq | Israel | Jordan | Kuwait | Lebanon |
| Libya | Malta | Morocco | Oman | Qatar |
| Saudi Arabia | Syrian Arab Republic | Tunisia | United Arab Emirates | West Bank and Gaza Strip |
| Yemen | | | | |
| **South Asia** | | | | |
| Afghanistan | Bangladesh | Bhutan | India | Maldives |
| Nepal | Pakistan | Sri Lanka | | |
| **Sub-Saharan Africa** | | | | |
| Angola | Benin | Botswana | Burkina Faso | Burundi |

| | | | | |
|---|---|---|---|---|
| Cabo Verde | Cameroon | Central African Republic | Chad | Comoros |
| Democratic Republic of the Congo | Congo | Côte d'Ivoire | Equatorial Guinea | Eritrea |
| Eswatini | Ethiopia | Gabon | Gambia | Ghana |
| Guinea | Guinea-Bissau | Kenya | Lesotho | Liberia |
| Madagascar | Malawi | Mali | Mauritania | Mauritius |
| Mozambique | Namibia | Niger | Nigeria | Rwanda |
| Sao Tome and Principe | Senegal | Seychelles | Sierra Leone | Somalia |
| South Africa | South Sudan | Sudan | Tanzania | Togo |
| Uganda | Zambia | Zimbabwe | | |
| | | **USA-CAN** | | |
| Canada | United States | | | |

# Annex B. **Detailed analysis of relationships between flows and SDG targets**

## Figure A B.1. Strength of the relationships between the five transboundary flows and the 169 SDG targets: evidence from expert assessment

| | Target | Flow | | | | |
|---|---|---|---|---|---|---|
| | | Finance | People | Trade | Environment | Knowledge |
| Goal 1 | 1.1 | 1.33 | -0.67 | 1.33 | 0.00 | 0.33 |
| | 1.2 | 1.33 | 0.33 | 0.67 | 0.00 | 0.00 |
| | 1.3 | 0.00 | -0.33 | 0.00 | 0.00 | 0.00 |
| | 1.4 | 1.25 | 0.75 | 0.75 | -0.25 | 0.75 |
| | 1.5 | 0.75 | -1.00 | 0.00 | 0.50 | 0.50 |
| | 1.a | 2.71 | 0.57 | 0.86 | 0.43 | 1.00 |
| | 1.b | 0.50 | 0.50 | 0.25 | -0.25 | 0.50 |
| Goal 2 | 2.1 | 0.50 | 0.25 | 0.50 | 0.25 | 0.25 |
| | 2.2 | 1.50 | -1.25 | 1.00 | 0.00 | 1.00 |
| | 2.3 | 0.50 | 0.50 | 1.00 | 0.25 | 0.50 |
| | 2.4 | 0.00 | 0.00 | 0.50 | 1.00 | 0.00 |
| | 2.5 | 0.50 | 0.50 | 0.50 | 1.25 | 1.25 |
| | 2.a | 2.25 | 0.00 | 0.50 | -0.25 | 0.75 |
| | 2.b | 0.50 | 0.50 | 1.50 | 0.00 | 0.00 |
| | 2.c | 1.00 | 0.29 | 1.43 | -0.29 | 0.71 |
| Goal 3 | 3.1 | 0.43 | 0.71 | 0.14 | 0.00 | 0.57 |
| | 3.2 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 3.3 | 1.33 | -0.67 | 0.00 | 0.33 | -0.33 |
| | 3.4 | 0.75 | 1.00 | 0.00 | 0.25 | 1.25 |
| | 3.5 | 0.00 | 0.00 | -0.33 | 0.00 | 0.00 |
| | 3.6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 3.7 | 0.50 | 0.00 | 0.00 | 0.00 | 0.50 |
| | 3.8 | 0.80 | 0.00 | 0.00 | 0.00 | 0.40 |
| | 3.9 | 0.00 | -0.20 | -0.40 | 0.60 | 0.80 |
| | 3.a | 0.00 | 1.00 | 0.00 | 0.00 | 0.25 |
| | 3.b | 1.50 | 0.75 | 0.50 | 0.00 | 2.25 |
| | 3.c | 1.00 | -0.33 | 0.00 | 0.33 | 0.33 |
| | 3.d | 1.00 | 1.25 | 0.50 | -0.25 | 1.50 |
| Goal 4 | 4.1 | 0.33 | 0.00 | 0.00 | 0.00 | 1.00 |
| | 4.2 | 1.25 | 0.75 | -0.75 | 0.00 | 1.00 |
| | 4.3 | 0.50 | 0.75 | 0.25 | 0.25 | 1.00 |
| | 4.4 | 1.00 | 1.25 | 0.50 | 0.00 | 1.00 |
| | 4.5 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4.6 | 0.71 | 0.86 | 0.57 | 0.00 | 1.71 |
| | 4.7 | 0.67 | 0.33 | 0.00 | 0.33 | 0.67 |
| | 4.a | 0.75 | 0.00 | 0.25 | 0.00 | 1.00 |
| | 4.b | 1.00 | 2.00 | 0.00 | 0.00 | 1.67 |
| | 4.c | 0.50 | 0.75 | 0.00 | 0.00 | 1.25 |
| Goal 5 | 5.1 | 0.40 | 0.20 | 0.00 | 0.00 | 0.60 |
| | 5.2 | -0.25 | -1.00 | -0.50 | 0.00 | 0.50 |
| | 5.3 | 0.57 | 1.43 | 0.43 | 0.00 | 1.14 |
| | 5.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5.5 | 0.71 | 1.57 | 0.57 | 0.00 | 1.43 |
| | 5.6 | 0.67 | 0.33 | 0.33 | 0.00 | 0.67 |
| | 5.a | 0.25 | 0.75 | 0.25 | 0.00 | 0.50 |
| | 5.b | 0.00 | 0.00 | 0.00 | 0.00 | 0.67 |
| | 5.c | 0.75 | 0.75 | 1.00 | 0.00 | 1.00 |

| | Target | Flow | | | | |
|---|---|---|---|---|---|---|
| | | Finance | People | Trade | Environment | Knowledge |
| Goal 6 | 6.1 | 0.60 | -0.80 | -0.20 | 1.40 | 0.80 |
| | 6.2 | 1.00 | 0.25 | 0.00 | 0.75 | 0.50 |
| | 6.3 | 0.43 | 0.43 | -0.14 | 0.86 | 1.29 |
| | 6.4 | 0.00 | 0.00 | 0.00 | 0.67 | 0.00 |
| | 6.5 | 0.25 | 0.50 | 0.25 | 2.25 | 0.25 |
| | 6.6 | 0.50 | 0.25 | 0.00 | 1.50 | 0.25 |
| | 6.a | 1.75 | 1.00 | 0.00 | 1.00 | 1.50 |
| | 6.b | 0.40 | 0.20 | 0.00 | 1.00 | 0.40 |
| Goal 7 | 7.1 | 1.25 | 0.00 | 0.00 | 0.00 | 0.50 |
| | 7.2 | 1.00 | 0.50 | 0.25 | 1.50 | 0.50 |
| | 7.3 | 0.50 | 0.50 | 0.50 | 0.50 | 0.75 |
| | 7.a | 2.00 | 0.43 | 1.00 | 1.43 | 1.14 |
| | 7.b | 1.25 | 0.00 | 0.25 | 0.00 | 1.00 |
| Goal 8 | 8.1 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| | 8.2 | 0.50 | 0.00 | 0.50 | 0.00 | 0.00 |
| | 8.3 | 1.00 | 0.33 | 0.33 | 0.33 | 0.67 |
| | 8.4 | 0.50 | 0.00 | -1.00 | 1.75 | 0.75 |
| | 8.5 | 0.50 | 0.00 | 0.50 | 0.00 | 0.00 |
| | 8.6 | 0.50 | 0.00 | 0.75 | 0.00 | 0.75 |
| | 8.7 | -0.25 | -0.50 | -0.25 | 0.00 | 0.75 |
| | 8.8 | 0.67 | -0.33 | 0.00 | 0.00 | 0.67 |
| Goal 9 | 8.9 | 0.33 | 0.00 | 0.67 | -0.33 | 0.00 |
| | 8.1 | 1.33 | 0.00 | 1.00 | 0.00 | 0.00 |
| | 8.a | 1.60 | 0.40 | 2.40 | -0.60 | 0.40 |
| | 8.b | 0.50 | 1.00 | 0.00 | 0.00 | 0.75 |
| | 9.1 | 1.33 | 0.33 | 0.67 | 0.00 | 0.00 |
| | 9.2 | 0.33 | 0.00 | 1.00 | -0.33 | 0.00 |
| | 9.3 | 1.25 | 0.75 | 0.75 | -0.50 | 0.25 |
| | 9.4 | 0.25 | 0.25 | 0.50 | 2.25 | 0.75 |
| | 9.5 | 1.25 | 1.00 | 1.25 | -0.25 | 1.50 |
| | 9.a | 2.50 | 1.25 | 0.75 | -0.75 | 1.00 |
| | 9.b | 1.00 | 0.00 | 0.50 | -0.25 | 1.50 |
| | 9.c | 0.75 | 0.75 | 1.00 | 0.50 | 1.75 |
| Goal 10 | 10.1 | 1.25 | 0.25 | 1.50 | -0.75 | 0.50 |
| | 10.2 | 0.86 | 1.14 | 0.71 | 0.33 | 1.00 |
| | 10.3 | 0.20 | 0.80 | 0.20 | 0.00 | 0.20 |
| | 10.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 10.5 | 1.00 | 0.00 | 0.33 | 0.00 | 0.00 |
| | 10.6 | 0.50 | 0.25 | 0.75 | 0.00 | 0.75 |
| | 10.7 | 0.75 | 1.25 | 0.25 | 0.25 | 0.00 |
| | 10.a | 1.14 | 0.29 | 2.57 | -0.29 | 0.43 |
| | 10.b | 3.00 | 0.00 | 0.50 | 0.00 | 0.00 |
| | 10.c | 2.50 | 0.75 | 0.25 | 0.00 | 0.00 |

| | Target | Flow | | | | |
|---|---|---|---|---|---|---|
| | | Finance | People | Trade | Environment | Knowledge |
| Goal 11 | 11.1 | 0.33 | -0.67 | 0.00 | 0.00 | 0.00 |
| | 11.2 | 0.33 | 0.33 | 0.00 | 0.00 | 0.00 |
| | 11.3 | 0.00 | -0.67 | 0.00 | 0.33 | 0.00 |
| | 11.4 | 0.25 | 0.50 | 0.00 | 0.50 | 1.25 |
| | 11.5 | 0.50 | -0.25 | 0.00 | 0.50 | 0.00 |
| | 11.6 | 0.33 | -0.33 | -1.00 | -0.33 | 0.00 |
| | 11.7 | 0.50 | 0.75 | 0.00 | 0.25 | 0.50 |
| | 11.a | 0.25 | 0.00 | 0.25 | 0.50 | 0.00 |
| | 11.b | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 |
| | 11.c | 2.00 | 1.00 | 0.25 | 0.25 | 1.00 |
| Goal 12 | 12.1 | 0.60 | -0.20 | 0.40 | 0.60 | 0.20 |
| | 12.2 | 0.50 | 0.00 | -0.25 | 1.00 | 0.75 |
| | 12.3 | 0.50 | 0.25 | 1.00 | 1.00 | 1.25 |
| | 12.4 | 0.00 | 0.00 | -0.50 | 0.50 | 0.00 |
| | 12.5 | 0.67 | 0.00 | -0.33 | 0.00 | 0.33 |
| | 12.6 | 0.75 | 0.00 | 1.00 | 1.50 | 0.50 |
| | 12.7 | 0.33 | 0.00 | 0.67 | 0.00 | 0.00 |
| | 12.8 | 0.25 | 0.00 | 0.00 | 0.50 | 1.00 |
| | 12.a | 1.75 | 0.50 | 1.25 | 1.33 | 1.50 |
| | 12.b | 0.50 | 1.00 | 0.25 | 0.25 | 0.25 |
| | 12.c | 0.50 | 1.00 | 0.25 | 1.25 | 1.00 |
| Goal 13 | 13.1 | 0.60 | 0.40 | 0.60 | 0.60 | 0.60 |
| | 13.2 | -0.50 | -0.25 | -0.50 | 1.50 | 0.75 |
| | 13.3 | 0.40 | 0.60 | 0.00 | 0.60 | 1.00 |
| | 13.a | 2.40 | 0.00 | 0.20 | 1.00 | 0.20 |
| | 13.b | 0.75 | 0.25 | 0.25 | 1.50 | 1.00 |
| Goal 14 | 14.1 | 0.33 | 0.00 | 0.33 | 1.67 | 0.00 |
| | 14.2 | 0.25 | -0.25 | -0.50 | 0.50 | 0.75 |
| | 14.3 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| | 14.4 | 0.00 | 0.00 | 0.00 | 0.33 | 1.00 |
| | 14.5 | -0.67 | -0.67 | -0.67 | 0.00 | -0.67 |
| | 14.6 | 0.00 | 0.00 | 0.40 | 1.00 | 1.00 |
| | 14.7 | 1.14 | 0.00 | 0.86 | 0.57 | 0.43 |
| | 14.a | 0.75 | 0.25 | 0.75 | 1.75 | 2.00 |
| | 14.b | 1.13 | 0.25 | 1.00 | -0.25 | 0.38 |
| | 14.c | 0.50 | 0.25 | 0.00 | 1.50 | 0.25 |
| Goal 15 | 15.1 | 0.20 | -0.60 | -0.60 | 1.00 | 0.20 |
| | 15.2 | -1.00 | 1.00 | -0.67 | 1.33 | 1.00 |
| | 15.3 | -0.33 | -0.67 | -0.67 | 0.33 | 0.33 |
| | 15.4 | -0.25 | 0.00 | -0.25 | 1.25 | 1.00 |
| | 15.5 | 0.50 | -0.75 | -1.00 | 2.00 | 0.50 |
| | 15.6 | 0.00 | 0.00 | 0.33 | 0.67 | 1.00 |
| | 15.7 | 0.00 | -0.67 | -0.67 | -1.33 | 0.00 |
| | 15.8 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 |
| | 15.9 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| | 15.a | 2.25 | 0.00 | -0.25 | 2.00 | 1.00 |
| | 15.b | 0.86 | 0.14 | 0.29 | 1.29 | 1.00 |
| | 15.c | 0.67 | 0.00 | -0.67 | -1.00 | 0.00 |

| | Target | Flow | | | | |
|---|---|---|---|---|---|---|
| | | Finance | People | Trade | Environment | Knowledge |
| Goal 16 | 16.1 | 0.33 | -0.67 | 0.67 | 0.33 | 0.33 |
| | 16.2 | -0.25 | -1.00 | -0.50 | 0.00 | 0.75 |
| | 16.3 | 0.50 | 1.50 | 0.50 | 0.50 | 0.25 |
| | 16.4 | -1.25 | 0.00 | -1.25 | 0.00 | 0.25 |
| | 16.5 | 0.33 | 0.00 | 0.33 | 0.00 | 0.00 |
| | 16.6 | 1.40 | 1.20 | 0.80 | 0.60 | 0.40 |
| | 16.7 | 0.14 | 0.57 | 0.00 | 0.14 | 1.14 |
| | 16.8 | 0.50 | 0.25 | 0.50 | 0.25 | 0.25 |
| | 16.9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 16.1 | 0.25 | 0.50 | 0.25 | 0.25 | 1.00 |
| | 16.a | 0.86 | 1.14 | 0.43 | -0.14 | 1.71 |
| | 16.b | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Goal 17 | 17.1 | 2.29 | 1.14 | 1.00 | -0.43 | 0.71 |
| | 17.2 | 2.50 | 0.25 | 1.00 | 0.50 | 0.75 |
| | 17.3 | 3.00 | 0.50 | 1.00 | 0.00 | 0.50 |
| | 17.4 | 2.25 | 0.00 | 0.50 | 0.00 | 0.25 |
| | 17.5 | 2.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| | 17.6 | 1.00 | 0.00 | 0.33 | 0.00 | 2.00 |
| | 17.7 | 0.33 | 0.00 | 0.00 | 1.67 | 2.00 |
| | 17.8 | 0.67 | 0.00 | 0.00 | 0.00 | 1.67 |
| | 17.9 | 1.33 | 0.00 | 0.33 | 0.00 | 0.67 |
| | 17.1 | 0.75 | 0.00 | 1.50 | 0.00 | 0.75 |
| | 17.11 | 1.75 | 0.75 | 2.75 | -0.75 | 0.50 |
| | 17.12 | 0.86 | 0.57 | 2.43 | -0.43 | 0.71 |
| | 17.13 | 1.20 | 0.80 | 1.20 | 0.80 | 0.00 |
| | 17.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 17.15 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 17.16 | 2.00 | 0.50 | 1.25 | 0.25 | 1.25 |
| | 17.17 | 1.50 | 0.75 | 1.00 | 0.25 | 0.50 |
| | 17.18 | 0.33 | 0.00 | 0.00 | 0.00 | 1.00 |
| | 17.19 | 1.00 | 0.00 | 0.67 | 0.00 | 0.67 |

Strong Positive
Moderate Positive
Weak Positive
Strong Negative
Moderate Negative
Weak Negative

Source: Authors' calculation.

# Annex C. **Detailed bilateral flows**

## Table A C.1. Structure of the transboundary inflow

| Region name | | Financial flow | | | Movement of people | | | Trade flow | | | Environ-mental flow | Knowledge transfer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (Billion current US dollar) | | | (1 000 people) | | | (Billion current US dollar) | | | (Billion tonnes) | (1 000 appli-cations) |
| | | TOTAL | BET-WEEN (%) | WITHIN (%) | TOTAL | BET-WEEN (%) | WITHIN (%) | TOTAL | BET-WEEN (%) | WITHIN (%) | TOTAL | TOTAL |
| 1 | Australia-New Zealand | | | | 7 461 | 91.0% | 9.0% | 239 | 95.6% | 4.4% | 0.5 | 32.4 |
| 2 | Central Asia | 3.2 | 90.9% | 9.1% | 29 613 | 21.2% | 78.8% | 390 | 90.9% | 9.1% | 1.7 | 15.9 |
| 3 | China | -0.3 | 100.0% | | 4 488 | 32.5% | 67.5% | 1 283 | 95.7% | 4.3% | 8.1 | 163.9 |
| 4 | East Asia | 4.6 | 100.0% | | 10 541 | 30.2% | 69.8% | 572 | 83.7% | 16.3% | 1.3 | 41.6 |
| 5 | Europe | 1.4 | 56.5% | 43.5% | 59 702 | 53.7% | 46.3% | 3 819 | 39.0% | 61.0% | 4.1 | 36.4 |
| 6 | Japan-Korea | | | | 3 437 | 82.0% | 18.0% | 821 | 93.8% | 6.2% | 1.9 | 107.4 |
| 7 | Latin America | 4.4 | 100.0% | | 7 754 | 33.2% | 66.8% | 682 | 91.2% | 8.8% | 1.4 | 45.3 |
| 8 | MENA | 22.7 | 80.9% | 19.1% | 40 452 | 66.2% | 33.8% | 297 | 99.1% | 0.9% | 0.8 | 15.9 |
| 9 | South Asia | 7.7 | 100.0% | | 10 180 | 13.2% | 86.8% | 309 | 100.0 % | 0.0% | 1.9 | 34.9 |
| 10 | Sub-Saharan Africa | 25.0 | 100.0% | | 21 644 | 6.5% | 93.5% | 62 | 100.0 % | 0.0% | 0.3 | 7.1 |
| 11 | United States-Canada | | | | 45 754 | 97.6% | 2.4% | 2 426 | 82.5% | 17.5% | 6.3 | 343.9 |

Note: Financial flow in this table shows ODA receipt in 2018; movement of people shows migrant stock estimate by destination in 2017; trade flow shows foreign value added embodied in domestic final demand in 2015; environmental flow shows $CO_2$ emissions embodied in domestic final demand in 2015; knowledge transfer shows patent applications by non-residents in 2017.
Source: Calculated by authors.

## Table A C.2. Financial flow: ODA

Net ODA disbursement by region in 2018 (million current US dollar)

| Origin | Destination | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AU-NZ | Central Asia | China | East Asia | Europe | JP-KR | Latin America | MENA | South Asia | Sub-Saharan Africa | US-CA |
| AU-NZ | - | 0 | 5 | 631 | 0 | - | 5 | 121 | 220 | 71 | - |
| Central Asia | - | 292 | 0 | 75 | 56 | - | 10 | 6 781 | 57 | 106 | - |
| China | - | - | - | - | - | - | - | - | - | - | - |
| East Asia | - | - | - | - | - | - | - | - | - | - | - |
| Europe | - | 2 059 | 533 | 2 808 | 593 | - | 2 764 | 6 528 | 3 638 | 11 719 | - |
| JP-KR | - | 228 | -939 | 58 | 45 | - | 260 | 928 | 2 882 | 1 547 | - |
| Latin America | - | - | - | - | - | - | - | - | - | - | - |
| MENA | - | 38 | 106 | 98 | 497 | - | 70 | 4 328 | -1 373 | 604 | - |
| South Asia | - | - | - | - | - | - | - | - | - | - | - |
| Sub-Saharan Africa | - | - | - | - | - | - | - | - | - | - | - |
| US-CA | - | 570 | 20 | 898 | 173 | - | 1 248 | 3 970 | 2 276 | 10 979 | - |

Source: Authors' calculation based on OECD (2021[46]).

## Table A C.3. Movement of people: migration stock

Migrant stock by region in 2017 (thousand people)

| Origin | Destination | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AU-NZ | Central Asia | China | East Asia | Europe | JP-KR | Latin America | MENA | South Asia | Sub-Saharan Africa | US-CA |
| AU-NZ | 674 | 6 | 28 | 82 | 340 | 26 | 8 | 11 | 1 | 21 | 164 |
| Central Asia | 99 | 23 332 | 22 | 15 | 7 827 | 43 | 29 | 512 | 30 | 21 | 1 465 |
| China | 731 | 74 | 3 031 | 959 | 1 220 | 1 398 | 129 | 31 | 210 | 106 | 3 323 |
| East Asia | 1 068 | 60 | 635 | 7 353 | 1 720 | 703 | 14 | 4 037 | 885 | 12 | 5 080 |
| Europe | 2 602 | 2 475 | 98 | 257 | 27 627 | 64 | 1 149 | 555 | 67 | 804 | 6 358 |
| JP-KR | 206 | 45 | 308 | 310 | 259 | 618 | 115 | 4 | 17 | 8 | 1 567 |
| Latin America | 152 | 5 | 145 | 13 | 3 783 | 282 | 5 183 | 68 | 15 | 19 | 17 874 |
| MENA | 399 | 3 499 | 11 | 64 | 7 875 | 8 | 81 | 13 682 | 65 | 140 | 2 371 |
| South Asia | 887 | 71 | 76 | 1 321 | 3 672 | 123 | 15 | 19 601 | 8 833 | 203 | 4 359 |
| Sub-Saharan Africa | 454 | 15 | 15 | 19 | 4 439 | 9 | 47 | 1 784 | 5 | 20 238 | 2 095 |
| US-CA | 189 | 32 | 120 | 147 | 941 | 164 | 985 | 168 | 53 | 71 | 1 100 |

Note: This table does not include the flow to unspecified places.
Source: Authors' calculation based on the World Bank (2017[47]).

## Table A C.4. Trade flow: trade in value-added

Total export/import of value-added by region in 2015 (billion current US dollar)

| Origin | Destination | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AU-NZ | Central Asia | China | East Asia | Europe | JP-KR | Latin America | MENA | South Asia | Sub-Saharan Africa | US-CA |
| AU-NZ | 10.6 | 2.6 | 74.2 | 20.7 | 22.9 | 34.9 | 5.5 | 4.0 | 11.2 | 1.2 | 29.5 |
| Central Asia | 3.4 | 35.6 | 51.7 | 10.4 | 222.8 | 24.1 | 10.1 | 15.9 | 10.6 | 1.5 | 51.6 |
| China | 53.2 | 67.2 | 54.7 | 119.0 | 325.6 | 207.1 | 122.3 | 39.1 | 67.6 | 14.2 | 495.8 |
| East Asia | 30.7 | 15.0 | 137.8 | 93.2 | 109.1 | 96.9 | 22.3 | 13.7 | 38.9 | 3.5 | 126.4 |
| Europe | 56.9 | 176.2 | 302.3 | 101.0 | 2 329.2 | 169.4 | 153.2 | 121.3 | 69.4 | 22.3 | 644.7 |
| JP-KR | 26.4 | 22.5 | 243.4 | 88.7 | 133.0 | 50.8 | 43.8 | 26.6 | 26.2 | 3.8 | 231.2 |
| Latin America | 5.0 | 10.8 | 81.4 | 17.1 | 81.2 | 27.7 | 59.8 | 9.1 | 16.1 | 2.4 | 259.1 |
| MENA | 3.9 | 7.4 | 42.8 | 17.3 | 67.8 | 19.9 | 9.3 | 2.8 | 20.3 | 2.5 | 62.6 |
| South Asia | 6.2 | 8.8 | 25.8 | 20.3 | 64.8 | 15.7 | 13.2 | 13.4 | - | 3.3 | 92.8 |
| Sub-Saharan Africa | 1.2 | 1.6 | 13.0 | 2.1 | 13.4 | 3.0 | 1.6 | 1.5 | 5.0 | - | 8.6 |
| US-CA | 41.8 | 41.8 | 256.2 | 82.0 | 449.4 | 171.5 | 240.6 | 49.4 | 43.4 | 7.6 | 424.1 |

Note: This table does not include the flow to unspecified places.
Source: Authors' calculation based on OECD (2021[48]).

# Annex D. **Details of carbon dioxide emissions**

### Table A D.1. Carbon dioxide embodied in domestic final demand (tonnes, millions), carbon dioxide embodied in domestic final demand per capita (kilograms, thousands) and population, by country or economy

| Country | Carbon dioxide embodied in domestic final demand (2015) | Carbon dioxide embodied in domestic final demand per capita (2015) | Population (2015) |
|---|---|---|---|
| Argentina | 216.03 | 5.01 | 43 131 966 |
| Australia | 426.40 | 17.90 | 23 815 995 |
| Austria | 83.44 | 9.65 | 8 642 699 |
| Belgium | 117.83 | 10.45 | 11 274 196 |
| Brazil | 475.39 | 2.32 | 204 471 769 |
| Brunei Darussalam | 6.39 | 15.40 | 414 907 |
| Bulgaria | 34.76 | 4.84 | 7 177 991 |
| Cambodia | 12.60 | 0.81 | 15 521 436 |
| Canada | 547.86 | 15.35 | 35 702 908 |
| Chile | 89.24 | 4.97 | 17 969 353 |
| China (People's Republic of) | 7 977.94 | 5.82 | 1 371 220 000 |
| Colombia | 97.38 | 2.05 | 47 520 667 |
| Costa Rica | 13.55 | 2.79 | 4 847 804 |
| Croatia | 17.13 | 4.07 | 4 203 604 |
| Cyprus | 7.93 | 6.83 | 1 160 985 |
| Czech Republic | 91.85 | 8.71 | 10 546 059 |
| Denmark | 59.38 | 10.45 | 5 683 483 |
| Estonia | 13.29 | 10.10 | 1 315 407 |
| Finland | 52.29 | 9.54 | 5 479 531 |
| France | 445.01 | 6.68 | 66 593 366 |
| Germany | 853.44 | 10.45 | 81 686 611 |
| Greece | 72.95 | 6.74 | 10 820 883 |
| Hong Kong (China) | 104.31 | 14.31 | 7 291 300 |
| Hungary | 48.26 | 4.90 | 9 843 028 |
| Iceland | 2.88 | 8.71 | 330 815 |
| India | 1 918.81 | 1.46 | 1 310 152 403 |
| Indonesia | 484.59 | 1.88 | 258 383 256 |
| Ireland | 46.67 | 9.93 | 4 701 957 |
| Israel | 88.27 | 10.53 | 8 380 100 |
| Italy | 423.01 | 6.97 | 60 730 582 |
| Japan | 1 361.02 | 10.70 | 127 141 000 |
| Kazakhstan | 180.19 | 10.27 | 17 542 806 |
| Korea | 584.82 | 11.46 | 51 014 947 |
| Latvia | 9.23 | 4.67 | 1 977 527 |
| Lithuania | 14.21 | 4.89 | 2 904 910 |
| Luxembourg | 9.15 | 16.06 | 569 604 |
| Malaysia | 209.46 | 6.92 | 30 270 962 |
| Malta | 2.60 | 5.84 | 445 053 |

| Country | Carbon dioxide embodied in domestic final demand (2015) | Carbon dioxide embodied in domestic final demand per capita (2015) | Population (2015) |
|---|---|---|---|
| Mexico | 485.49 | 3.98 | 121 858 258 |
| Morocco | 66.59 | 1.92 | 34 663 603 |
| Netherlands | 179.24 | 10.58 | 16 939 923 |
| New Zealand | 42.83 | 9.32 | 4 595 700 |
| Norway | 59.57 | 11.48 | 5 188 607 |
| Peru | 63.64 | 2.09 | 30 470 734 |
| Philippines | 135.20 | 1.32 | 102 113 212 |
| Poland | 273.84 | 7.21 | 37 986 412 |
| Portugal | 51.67 | 4.99 | 10 358 076 |
| Romania | 72.51 | 3.66 | 19 815 481 |
| Russia | 1 167.53 | 8.10 | 144 096 870 |
| Saudi Arabia | 595.05 | 18.76 | 31 717 667 |
| Singapore | 70.50 | 12.74 | 5 535 002 |
| Slovak Republic | 30.65 | 5.65 | 5 423 801 |
| Slovenia | 14.00 | 6.78 | 2 063 531 |
| South Africa | 313.45 | 5.66 | 55 386 367 |
| Spain | 293.82 | 6.33 | 46 444 832 |
| Sweden | 70.20 | 7.16 | 9 799 186 |
| Switzerland | 94.16 | 11.37 | 8 282 396 |
| Thailand | 235.39 | 3.43 | 68 714 511 |
| Tunisia | 29.14 | 2.61 | 11 179 949 |
| Turkey | 374.95 | 4.77 | 78 529 409 |
| United Kingdom | 575.80 | 8.84 | 65 128 861 |
| United States | 5 794.51 | 18.07 | 320 742 673 |
| Viet Nam | 152.46 | 1.65 | 92 677 076 |

Source: Authors' calculation based on OECD (2019[49]) and the World Bank (2020[51]).

# Annex E. **Details of patent application by residents and non-residents**

**Table A E.1. Patent application by residents and non-residents, patent application by residents and non-residents (per 100 000) and population, by country or economy**

| Countries and economies | Patent application, residents and non-residents (2018) | Patent application, residents and non-residents, per 100 000 (2018) | Population (2015) | Countries and economies | Patent application, residents and non-residents (2018) | Patent application, residents and non-residents, per 100 000 (2018) | Population (2015) |
|---|---|---|---|---|---|---|---|
| Albania | 18 | 0.63 | 2 866 376 | Madagascar | 46 | 0.18 | 26 262 368 |
| Algeria | 673 | 1.59 | 42 228 429 | Malaysia | 7 295 | 23.14 | 31 528 585 |
| Andorra | 11 | 14.28 | 77 006 | Mauritius | 29 | 2.29 | 1 265 303 |
| Antigua and Barbuda | 10 | 10.39 | 96 286 | Mexico | 16 424 | 13.02 | 126 190 788 |
| Argentina | 3 667 | 8.24 | 44 494 502 | Moldova | 113 | 3.19 | 3 545 883 |
| Armenia | 105 | 3.56 | 2 951 776 | Monaco | 15 | 38.78 | 38 682 |
| Australia | 29 957 | 119.86 | 24 992 369 | Mongolia | 161 | 5.08 | 3 170 208 |
| Austria | 2 207 | 24.95 | 8 847 037 | Morocco | 2 537 | 7.04 | 36 029 138 |
| Azerbaijan | 171 | 1.72 | 9 942 334 | Mozambique | 47 | 0.16 | 29 495 962 |
| Bahrain | 230 | 14.65 | 1 569 439 | Namibia | 36 | 1.47 | 2 448 255 |
| Bangladesh | 368 | 0.23 | 161 356 039 | Netherlands | 2 505 | 14.54 | 17 231 017 |
| Belarus | 547 | 5.77 | 9 485 386 | New Zealand | 6 238 | 127.68 | 4 885 500 |
| Belgium | 1 110 | 9.72 | 11 422 068 | Nigeria | 338 | 0.17 | 195 874 740 |
| Bosnia and Herzegovina | 96 | 2.89 | 3 323 929 | Norway | 1 674 | 31.50 | 5 314 336 |
| Brazil | 24 857 | 11.87 | 209 469 333 | Pakistan | 892 | 0.42 | 212 215 030 |
| Brunei Darussalam | 121 | 28.21 | 428 962 | Panama | 497 | 11.90 | 4 176 873 |

| Countries and economies | Patent application, residents and non-residents (2018) | Patent application, residents and non-residents, per 100 000 (2018) | Population (2015) | Countries and economies | Patent application, residents and non-residents (2018) | Patent application, residents and non-residents, per 100 000 (2018) | Population (2015) |
|---|---|---|---|---|---|---|---|
| Bulgaria | 198 | 2.82 | 7 024 216 | Peru | 1 222 | 3.82 | 31 989 256 |
| Canada | 36 161 | 97.58 | 37 058 856 | Philippines | 4 300 | 4.03 | 106 651 922 |
| Chile | 3 100 | 16.55 | 18 729 160 | Poland | 4 322 | 11.38 | 37 978 548 |
| China (People's Republic of) | 1 542 002 | 110.72 | 1 392 730 000 | Portugal | 690 | 6.71 | 10 281 762 |
| Colombia | 2 223 | 4.48 | 49 648 685 | Serbia | 174 | 2.49 | 6 982 084 |
| Costa Rica | 498 | 9.96 | 4 999 441 | Romania | 1 147 | 5.89 | 19 473 936 |
| Croatia | 136 | 3.33 | 4 089 400 | Russia | 37 957 | 26.27 | 144 478 050 |
| Cuba | 155 | 1.37 | 11 338 138 | Rwanda | 7 | 0.06 | 12 301 939 |
| Czech Republic | 732 | 6.89 | 10 625 695 | San Marino | 695 | 2,057.13 | 33 785 |
| Denmark | 1 501 | 25.89 | 5 797 446 | Saudi Arabia | 3,399 | 10.09 | 33 699 947 |
| Dominican Republic | 228 | 2.15 | 10 627 165 | Singapore | 11 845 | 210.07 | 5 638 676 |
| Ecuador | 405 | 2.37 | 17 084 357 | Slovak Republic | 231 | 4.24 | 5 447 011 |
| Egypt | 2 255 | 2.29 | 98 423 595 | Slovenia | 278 | 13.45 | 2 067 372 |
| El Salvador | 139 | 2.16 | 6 420 744 | South Africa | 6 915 | 11.97 | 57 779 622 |
| Estonia | 30 | 2.27 | 1 320 884 | Spain | 1 674 | 3.58 | 46 723 749 |
| Ethiopia | 62 | 0.06 | 109 224 559 | Sri Lanka | 603 | 2.78 | 21 670 000 |
| Finland | 1 487 | 26.95 | 5 518 050 | Sudan | 380 | 0.91 | 41 801 533 |
| France | 16 222 | 24.22 | 66 987 244 | Sweden | 2 280 | 22.39 | 10 183 175 |
| Georgia | 260 | 6.97 | 3 731 000 | Switzerland | 1 615 | 18.96 | 8 516 543 |
| Germany | 67 898 | 81.88 | 82 927 922 | Syrian Arab Republic | 148 | 0.88 | 16 906 283 |
| Ghana | 52 | 0.17 | 29 767 108 | Thailand | 8 149 | 11.74 | 69 428 524 |
| Greece | 579 | 5.40 | 10 727 668 | Trinidad and Tobago | 139 | 10.00 | 1 389 858 |
| Guatemala | 234 | 1.36 | 17 247 807 | Tunisia | 451 | 3.90 | 11 565 204 |
| Guyana | 20 | 2.57 | 779 004 | Turkey | 7 466 | 9.07 | 82 319 724 |
| Honduras | 156 | 1.63 | 9 587 522 | Ukraine | 3 968 | 8.89 | 44 622 516 |
| Hong Kong (China) | 15 986 | 214.55 | 7 451 000 | United Arab Emirates | 1 783 | 18.51 | 9 630 959 |
| Hungary | 443 | 4.53 | 9 768 785 | United Kingdom | 20 941 | 31.50 | 66 488 991 |
| Iceland | 66 | 18.67 | 353 574 | United States | 597 141 | 182.52 | 327 167 434 |

| Countries and economies | Patent application, residents and non-residents (2018) | Patent application, residents and non-residents, per 100 000 (2018) | Population (2015) |
|---|---|---|---|
| India | 50 055 | 3.70 | 1 352 617 328 |
| Indonesia | 9 754 | 3.64 | 267 663 435 |
| Iran | 12 823 | 15.68 | 81 800 269 |
| Iraq | 730 | 1.90 | 38 433 600 |
| Ireland | 108 | 2.23 | 4 853 506 |
| Israel | 7 363 | 82.88 | 8 883 800 |
| Italy | 9 821 | 16.25 | 60 431 283 |
| Jamaica | 79 | 2.69 | 2 934 855 |
| Japan | 313 567 | 247.82 | 126 529 100 |
| Jordan | 133 | 1.34 | 9 956 011 |
| Kazakhstan | 982 | 5.37 | 18 276 499 |
| Kenya | 286 | 0.56 | 51 393 010 |
| Korea | 209 992 | 406.68 | 51 635 256 |
| Kuwait | 257 | 6.21 | 4 137 309 |
| Lao People's Democratic Republic | 59 | 0.84 | 7 061 507 |
| Latvia | 110 | 5.71 | 1 926 542 |
| Lithuania | 105 | 3.76 | 2 789 533 |
| Luxembourg | 395 | 65.00 | 607 728 |
| Macau (China) | 55 | 8.71 | 631636 |
| Uzbekistan | 650 | 1.97 | 32 955 400 |
| Viet Nam | 6 071 | 6.35 | 95 540 395 |

Source: Authors' calculation based on the World Bank (2020[51]).