Measuring trade, investment and financial aspects of climate change: Stakes, new indicators and insights from a developing country perspective

by Diana Barrowclough, Rachid Bouhia, Onno Hoffmeister, Daniel Hopp and Anu Peltola

1. Introduction

Climate change is a systemic risk for the world, and even more so for developing countries which generally exhibit greater vulnerability. In 2020, total economic losses from disasters were estimated at US$202 billion globally, up from US$150 billion in 2019, with about US$190 billion resulting from natural catastrophes (UNCTAD, 2021g). Coping with climate disasters and adapting to climate change is challenging especially for many developing countries, in which budgets were already tight in the past and that are faced with alarming and unsustainable debt levels after the COVID-19 pandemic.

Another dilemma for developing countries is that climate change mitigation policies may be seen as counteracting economic growth and international trade, and trade and regulatory policies to reduce emissions can impact heavily on developing countries that have fewer resources and limited policy space to respond. Decoupling emissions from economic growth, and investment in green technology and environmentally sustainable solutions are important. The strive for more climate-friendly and environmentally sustainable economic development can create new opportunities, such as better jobs, new products and processes that do not rely extensively on fossil fuels etc. Innovative businesses can gain market share with new products and technologies that instead of a trade-off, contribute to a transformation towards a new path for sustainable development. To assess these developments, we need more information on the economic and cross-border aspects of climate change.

Given UNCTAD's role as the focal point for trade, investment and development in the United Nations family, it is in a unique position to collect, compile and analyse data and statistics on cross-border trade and investment and finance, including in relation to climate change and environmental concerns. This paper discusses the data needs for policies aiming to enhance economic and financial stability in the face of climate change and highlights useful datasets and indicators of climate investment, financial instruments, debt, climate aspects of cross-border trade in goods and related emissions. The paper considers the statistical response to these policy data needs from the conceptual, analytical and empirical perspectives.

The paper contributes to the efforts of the global statistical community to develop statistics to inform climate policies. The first consideration of the topic took place in 2008 at two conferences held in Oslo and Seoul, and during a programme review on climate change and official statistics, prepared by the Australian Bureau of Statistics for the UN Statistical Commission (UNSC) in 2009. Following these developments, in 2011, the Economic Commission for Europe (UNECE) established a Task Force to improve the use of official statistics as a source for information on the drivers, impacts and mitigation of and adaptation to climate change. The work resulted in the first Recommendations on climate change-related statistics (UNECE, 2014), prepared in a partnership between the statistical and climate communities, including with the UN Framework Convention on Climate Change (UNFCCC).

In August 2021, UNECE (2021) published a new set of 44 indicators covering climate change drivers, emissions, climate change impacts, mitigation and adaptation. UNSC had also asked for the development of a global set, applicable to countries at various stages of development. Currently, a global consultation is under way on the draft global set with 134 indicators of climate change by the UN Statistics Division (UNSD, (2021a). While these include some indicators covering the economic perspective, climate-relevant indicators on debt and trade have been largely missing due to data availability issues. The International Monetary Fund's (IMF, 2021a) 'Climate Change Indicators Dashboard' is an important initiative towards filling data gaps in support of macroeconomic and financial policy analysis to facilitate climate change mitigation and adaptation.

Climate change is a cross-cutting issue with complex dynamics and economic, social and environmental impacts that affect each other and pose considerable challenges to measurement and policy. To date, the economic and cross-border aspects of climate change have not been comprehensively covered by climate indicator sets. The data needs, new sources and proposals to fill gaps, as discussed in this paper, will hopefully feed into further work to improve the evidence base for climate action. Bringing climate indicators together into a dashboard

focusing on macroeconomic and financial aspects can provide crucial support for more targeted and evidence-based climate action. The indicators presented here would inform policy makers of climate investment and funding, the implications of plastics trade, and emissions from transport related to global trade.

The paper consists of four sections discussing diverse but inter-related aspects relating to debt and finance, sustainable investment, global plastics trade and finally transport costs and emissions related to the transport of internationally traded goods. First, we address the need to improve debt statistics to reflect commitments in addressing climate change, take stock of the main climate financing instruments and propose a conceptual framework with an emphasis on developing countries. Second, we review progress with climate and sustainability investment, such as certified green bonds, nature-based swaps and funds, and green lending of dedicated green banks and development banks. Third, the paper shares insights about one element of production and consumption in the global economy, using the new UNCTAD database on trade in plastics. As concerns about plastic pollution and plastic's contribution to rising carbon dioxide (CO_2) emissions will likely lead to a world plastics trade treaty, on top of a series of regulations, we will need to have clear information about the significance of plastic imports and exports to reduce plastic pollution and emissions. Fourth, we discuss possibilities to estimate emissions caused by transport related to international trade in goods using the new UNCTAD Global Transport Costs Database for International Trade. International trade is a key engine for economic development, but also a significant source of greenhouse gas emissions.

The COVID-19 pandemic has revealed alarming debt levels and is affecting the availability of financing for climate action, including increasing concerns that funds will not be directed to climate adaptation, but more often for other purposes with future revenue expectations. The pandemic has had various impacts on modes of transport, flows of traded goods and the related emissions, as well as the demand for plastic products and packaging and their alternatives. This paper concludes with a discussion of potential new indicators and datasets to assess these developments and a discussion of related data gaps and challenges to improve the measurement of financial, investment and trade-related aspects of climate change, thus contributing to IMF's 'Climate Change Indicators Dashboard' initiative.

2. Debt and finance

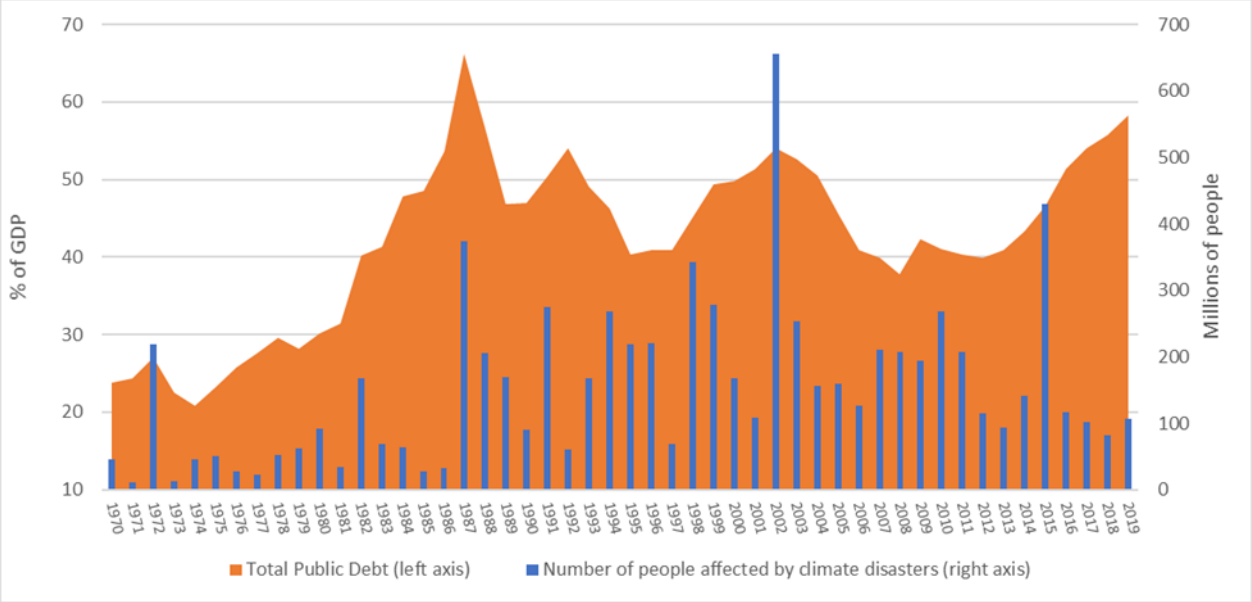
International debt statistics should reflect national commitments in addressing climate change. This section proposes a conceptual framework for climate-relevant debt indicators, with an emphasis on developing countries. In many developing countries, the COVID-19 pandemic has laid bare alarming and unsustainable debt levels, often compounded by previous climate disasters or by financial efforts to address climate change adaptation and mitigation. It is essential and in the common interest to know how much of the debt burden is dedicated to the battle against climate change. The last two decades have seen a significant rise in climate disasters around the globe along with a surge in the diversity and quantity of climate-related financial instruments. Information on the nature and the size of these initiatives is critical to decision-making.

This section is divided into three parts. First, it elaborates on the stakes and needs of decomposing international debt statistics from the policy-making point of view. Second, it takes stock of the main financing instruments towards climate resilience that countries have implemented. Third, it proposes a general conceptual framework for obtaining relevant climate-related debt indicators.

2.1 Need for reshaping international debt statistics for climate change analysis

The pandemic has revealed alarming debt levels in developing countries (World Bank, 2021a; UNCTAD, 2020a, 2020d). While there is an urgent and critical need to support health systems and finance lockdowns in almost all countries, the international community has realized that the policy space to do so is very narrow in developing countries. In fact, sovereign debt had started to grow to excessive levels prior to the onset of the COVID-19 crisis.

Figure 1. Total public debt as a share of gross domestic product and number of people affected by climate disasters in developing countries



Source: Author's calculations based on the on the EM-DAT International Disaster Database and IMF Global Debt Database

As figure 1 shows, at the end of 2019[1], developing countries' total public debt – external and domestic – stood at 59 per cent of their combined gross domestic product (GDP), the second highest level on record. It has increased steadily at an average growth rate of 3 percentage points per year since 2013, in a context of both more recurrent external shocks[2] and rising fragilities in their debt positions (UNCTAD, 2020d), including those related to climate change (Volz, et al., 2020). Figure 1 also exhibits that developing countries have been hit by acute episodes of climate disasters more regularly since the late 1980s.

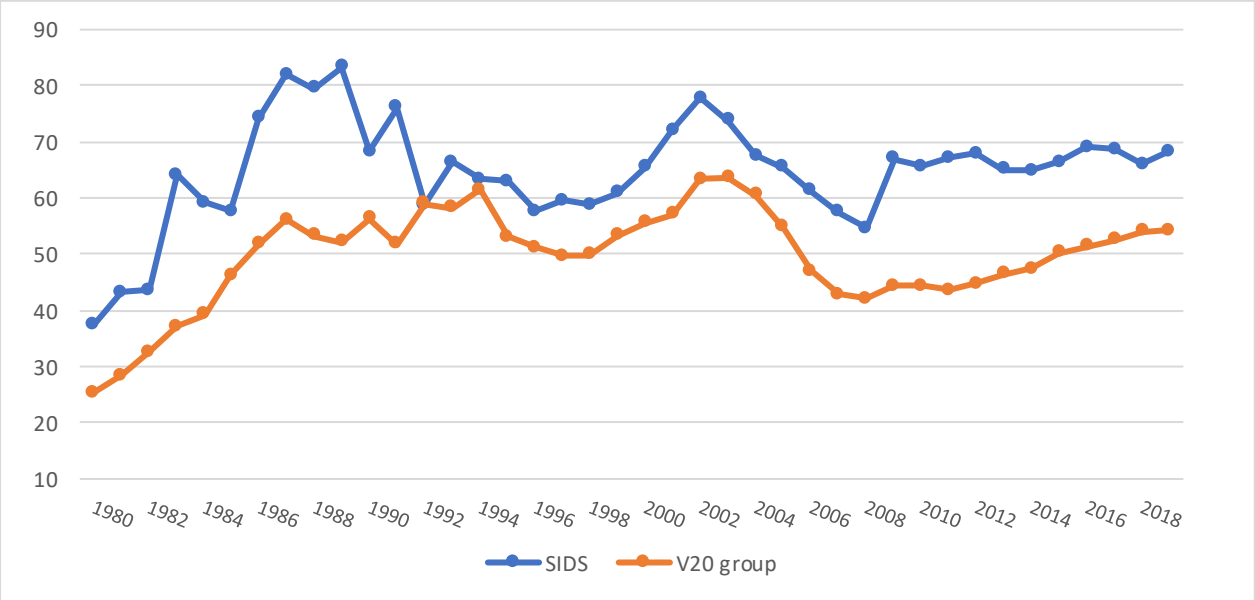
The international community has launched several initiatives to support developing countries in fighting the pandemic and averting sovereign defaults[3]. The G20 Debt Service Suspension Initiative is among the main and earliest measures (Debt Service Suspension Initiative, 2020). It aims to provide debt relief to developing countries, mostly through a temporary suspension of debt-service payments owed to their official bilateral creditors. Not all developing countries are eligible, however: the initiative applies to International Development Association (IDA) borrowing countries and/or least developed countries (LDCs) only. Since it came into effect on 1 May 2020, the initiative has delivered around US$5 billion in relief to 40 eligible countries. The IMF and the World Bank have also, in the meantime, raised concessional[4] finance flows to LDCs, mostly through grants and zero per cent interest rate loans. More recently, the IMF has approved a general allocation of Special Drawing Rights (SDRs) equivalent to US$650 billion to boost global liquidity, re-equilibrate global imbalances and help developing countries cope with the pandemic (IMF, 2021b). Developed countries with strong external positions are specifically invited to channel part of their SDRs to scale up lending for LDCs through the IMF's Poverty Reduction and Growth Trust (PRGT).

In the wake of the COVID-19 pandemic, development finance flows have reached a record high (World Bank, 2021b). However, the crisis has not altered the scope of beneficiary developing countries. The COVID-19 induced measures have not shifted away from the conventional framework which briefly grants access to Official Development Assistance (ODA), concessional finance and debt relief on the sole basis of GDP or gross national income (GNI) per capita (Wilkinson et al., 2021). Most middle-income and high-income countries are, therefore,

[1] Last date for which these data are available at present
[2] For further details on these external shocks since 2013, see Bouhia and Munevar (2019)).
[3] Sovereign default refers to the failure of a government of a sovereign state to pay back its debt in full when due.
[4] Concessional finance is extended on terms substantially more generous than market finance. Concessionality is achieved either through interest rates below those available on the market or by grace periods, or a combination of these.

not eligible to receive concessional finance from multilateral financial institutions. Moreover, evidence suggests that as low-income countries (LICs) approach or join the middle income countries' (MIC) group, donor governments scale down their development cooperation programmes (Jalles d'Orey and Prizon, 2019) .

Figure 2. Total Public debt in small island developing States and the vulnerable 20 Group (Percentage of GDP)



Source: Author's calculations based on the on the EM-DAT International Disaster Database and IMF Global Debt Database

Many developing countries, especially those at the forefront of climate challenges – including small island developing States (SIDS) and the members of the Vulnerable Twenty Group (V20)[5] – have requested that environmental vulnerability be taken into consideration in the access to concessional finance, as climate change has increasingly weighed on their public finances and debt sustainability[6]; (Bishop et al., 2021; Volz, et al., 2020). This request has been more pressing in the wake of the COVID-19 pandemic (UNCTAD, 2021a; V20: The Vulnerable Twenty Group, 2021), as many of these countries have experienced high debt distress (Bouhia and Wilkinson, 2021).

The main approach that has been put forward on the political agenda is the use of environmental vulnerability indices, such as the Multidimensional Vulnerability Index (MVI) by the UN Development Programme (UNDP) (Assa and Meddeb, 2021). The MVI's components on environmental and geographic vulnerability include data on agriculture and fishing, victims of disasters, remoteness, the share of population in low elevation coastal zones and the share of population living in drylands. Environmental vulnerability indices like the MVI could be used for developing additional or exceptional eligibility criteria for concessional finance that align with commitments under the Paris Agreement.

However, environmental indices alone are not sufficient for grasping the economic and financial repercussions of climate change and should be supplemented with climate-related debt statistics. A robust concept of vulnerability should encompass both "exposure" and "resilience" dimensions[7]. Environmental indices inform to

[5] 48 economies including Afghanistan, Bangladesh, Barbados, Bhutan, Burkina Faso, Cambodia, Colombia, Comoros, Costa Rica, Democratic Republic of the Congo, Dominican Republic, Ethiopia, Fiji, The Gambia, Ghana, Grenada, Guatemala, Haïti, Honduras, Kenya, Kiribati, Lebanon, Madagascar, Malawi, Maldives, Marshall Islands, Mongolia, Morocco, Nepal, Niger, Palau, Palestine, Papua New Guinea, Philippines, Rwanda, Saint Lucia, Samoa, Senegal, South Sudan, Sri Lanka, Sudan, Tanzania, Timor-Leste, Tunisia, Tuvalu, Vanuatu, Viet Nam and Yemen.

[6] Figure 2 shows total public debt stocks as a share of GDP for these two groups of countries (not mutually exclusive).

[7] Briguglio et al (2009) and Briguglio(2014) distinguish between economic vulnerability, which is due to inherent features of the economy, and economic resilience, which is policy-induced.

what degrees countries are exposed to climate change but fall short of giving a comprehensive picture. As such, environmental indices measure risk but not actual effects of climate disasters. This has important implications. For example, a country may have relatively low risk but be hit acutely or repeatedly as the vagaries of climate change are yet to be fully understood scientifically. Another weakness of these indices for this context is that they do not provide any information on how well-shielded a country may be.

In fact, the rise in climate disasters in developing countries over the last two decades has also been accompanied by a surge in the diversity and quantity of climate-related financing instruments at the national level, which contribute to the reported increase of debt levels. It is important for all stakeholders to know the share of the debt burden intended to combat climate change. Developing countries would benefit from reporting this share as it would shed new insights on the sustainability of their debt, showing to public and private creditors alike to what extent climate change weighs on their public finances. This may improve, for instance, developing countries' notations by credit rate agencies, who may associate high levels of public debt with bad governance instead of climate considerations, fuelling a vicious cycle over debt sustainability. Volz et al. (2020) show that higher climate risk vulnerability leads to significant increases in the cost of sovereign borrowing. They estimate that premiums on sovereign bond yields amount to around 275 basis points for economies highly exposed to climate risk. They also find that exposure to climate risks is, in contrast, not statistically significant for advanced economies.

Information on the share of climate-related debt would potentially trigger more capital inflows as well as improve countries' eligibility for both concessional finance and debt-relief programmes. These countries could continue to combat climate change in accordance with the provisions of the Paris Agreement, including with ex-ante climate adaptation and mitigation rather than ex-post responses to climate catastrophes, which is less effective and more costly humanly and financially. Official creditors who are interested in fostering climate adaption and mitigation would be able to assess progress in this area, ensure that these actions are not detrimental to other key aspects of economic and social development, and be in a better position to promote ex-ante approaches by reducing moral hazard[8]. Private creditors would be better guided in making targeted investments and more inclined to participate in debt restructuring programmes.

2.2 Main financing instruments towards climate resilience

The previous section discussed how critical it is to distinguish the share of climate action in the overall debt burden, not only from developmental and political perspectives but also for the sake of the fight against climate change. This section examines the specific financing instruments that should be included in this share by exploring the debt-related ramifications of climate change.

The fight against climate change occurs simultaneously on different arenas, requiring a large variety of financing options. Financial resources are needed at different stages, ranging from prevention to preparedness, response and recovery. Moreover, the amounts needed for each of these stages may vary drastically.

The first main category of financing instruments that should be included in the proposed indicators refers to ex-ante climate actions, which are actions undertaken before a particular hazard strikes. These instruments are intended to cover costs and investments related to disaster risk reduction, climate change adaptation and mitigation as well as the various dimensions of countries' disaster risk management plans. More specifically, they allow for the financing of mitigating infrastructures, for instance sea walls, road repaving, etc., the development of regulatory standards to strengthen climate resilience across activity sectors and increase the availability of and access to climate and disaster risk insurance, and the creation and maintenance of early warning systems, safety nets and appropriate social protection systems.

The second category regroups ex-post financing instruments, which address needs after a disaster has struck. They mostly cover the costs associated with emergency response and assistance, economic recovery and support to enterprises, infrastructure reconstruction and the reconstruction of uninsured housing, and logistics and supply chain maintenance.

[8] Martinez-Diaz and Sidner (2021) discusses how the current international framework for concessional and climate finance tend to favour ex-post reaction to climate disasters over ex-ante investment in resilience, preparedness, and loss reduction. See also Clarke and Dercon (2016).

Countries have the option to directly finance both ex-ante and ex-post needs by raising domestic resources through the regular budgetary allocation process (based on domestic taxation), the establishment of contingency and reserve funds or by raising extrabudgetary funds. These instruments should not be included in the proposed indicators as they are debt-neutral from an accounting perspective, although they do generate an opportunity cost. In any case, their contribution to the fight against climate change is very small compared with other sources of financing, especially in developing countries.

A large part of climate action is financed through external finance in developing countries, including an increasing reliance on bonds. Sovereign bonds are often issued to raise funds for construction or project implementation, but they are also increasingly used for climate change mitigation, e.g., investments in renewable energy, and adaptation, e.g., desalinization. Green bonds are the most well-known, but there exists a myriad of other types of bonds which specifically address climate change, such as infrastructure bonds, catastrophe bonds (CAT), blue bonds, impact bonds and resilience bonds.

Developing countries also have different options for external financing from their development partners, such as the Green Climate Fund, the World Bank's IDA and International Bank for Reconstruction and Development (IBRD), regional development banks, bilateral creditors, and United Nations agencies. Although they sometimes come as grants, these financial flows most often take the form of concessional loans. While these instruments are available to fund disaster risk reduction and climate adaptation, political considerations and the set-up of the international financial system tend to incentivize ex-post disaster response rather than investments in disaster risk reduction and adaptation (Martinez-Diaz and Sidner, 2021; Clarke and Dercon, 2016) Commercial debt and secured lending are also available, although these are usually non-concessional (African Legal Support Facility, 2020)

There are also various contingent credit instruments available. The purpose of contingent credit is to disburse quick, pre-arranged, liquid resources to governments after a disaster (Vaughan and Hillier, 2019). The particularity of contingent credit instruments is that the government only begins to make loan repayments after an event has occurred, regardless of the arrangements made ahead of time. Such instruments are provided by the World Bank through different development policy loans with a Catastrophe Deferred Drawdown Option (Cat DDO) for IBRD and IDA-eligible countries, the IMF through the Rapid Credit facility, and to a lesser extent, regional development banks. In addition to contingent credit instruments, there are a variety of disaster response banking instruments, mostly via the World Bank, such as the Crisis Response Window (CRW), the Contingent Emergency Response Component, Immediate Response Mechanism, and the inclusion of so-called "zero components" in project allocations (Vaughan and Hillier, 2019). Funds come as loans, but the World Bank can convert them into grants should damages exceed certain thresholds.

Besides external financing, developing countries can opt for risk transfer instruments. While these products pay out after a climate event takes place, they need to be contracted ahead of time, usually through premium payments. They should be considered in our proposed indicators as many countries finance these premium payments with debt. In theory, these products aim at averting larger indebtedness after a disaster. The most famous category of sovereign risk transfer for natural hazards and climate risk includes the various regional insurance pools that have been created since 2007, such as African Risk Capacity (ARC), Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC), Pacific Catastrophe Risk Insurance Company (PCRIC) and the Southeast Asia Disaster Risk Insurance Facility (SEADRIF). These regional pools have since gained momentum and inspired governments in designing their own domestic pools and replica products. In the same vein, developing countries governments have taken out insurance for public assets like key infrastructure or "natural resource insurance" on their extractive industries, especially when these play a key role in their economies.

2.3 Conceptual framework for climate-relevant debt indicators

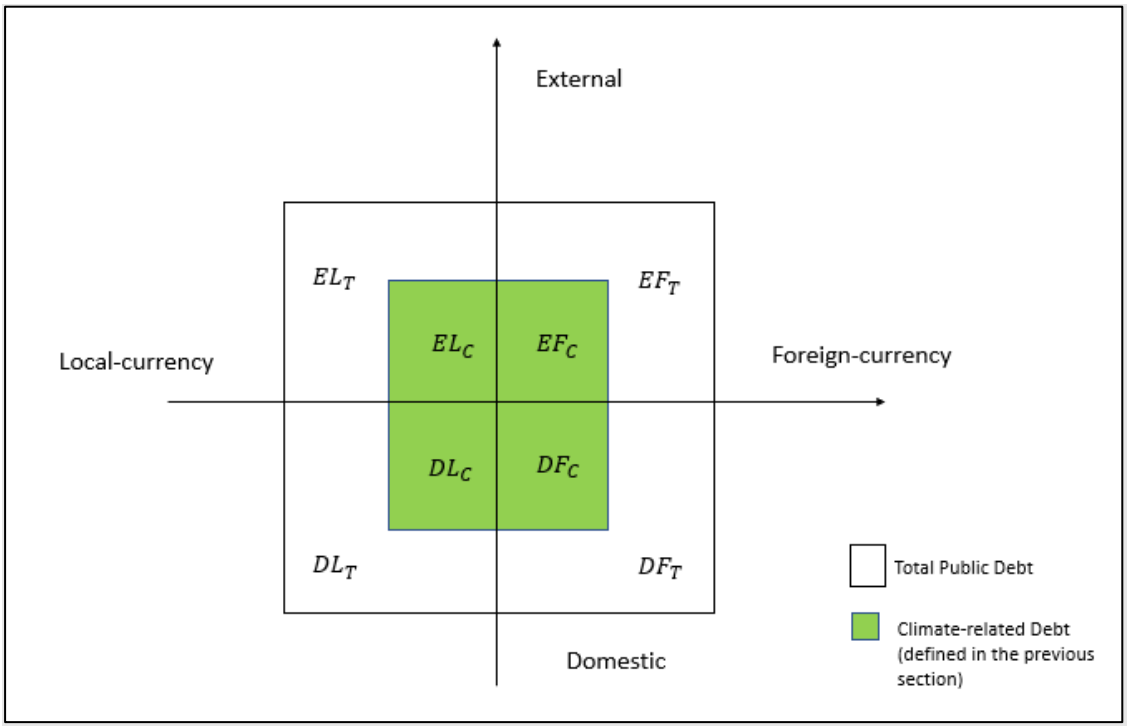
Indicators on the share of the debt burden intended to combat climate change in total public debt would be relevant in measuring both environmental exposure and resilience. They should be broken down by ownership (external versus domestic) and currency composition (foreign versus local), as the decomposition of public debt against these two dimensions reveals much about vulnerability and sustainability.

The sizable foreign-currency denominated debt of developing countries, which has grown with greater access to international capital markets, has long been identified and discussed as a major threat looming over their

sovereign debt (IMF, 2000). It indeed renders them more vulnerable to swings in international exchange rates and interest rates and, often, to speculative currency attacks. The fallout from these phenomena is more adverse as the devaluation that they often lead to does not trigger inflows in other sectors, e.g., via an increase in exports in the private sector. Under these circumstances, a snowball effect settles in, and debt levels grow dangerously until, in the worst-case scenario, developing countries can no longer service their external debt. It is according to this sequence of events that major waves of sovereign defaults have occurred in the past, especially in the 1980s and 1990s (Reinhart and Roghoff, 2011), and that many developing countries have, more recently, gotten into situations of financial distress (Bouhia and Munevar, 2019).

For several reasons, mostly linked with the current functioning of the world economy, developing countries are somehow doomed to rely on high levels of foreign-currency denominated, this is known as the "original sin" (Eichengreen and Hausmann, 1999). This has long been measured and assessed with external public debt statistics. It makes sense for low-income developing countries, which have limited access to international financial markets and do not have the capacity to borrow externally in their local currencies. This shorthand has shaped current international official debt statistics, mostly represented by *the International Debt Statistics* by the World Bank (World Bank, 2021a) which solely focus on external debt[9]. However, the gap between debt ownership and currency denomination has substantially widened over the last decade, especially among middle- and high-income developing countries (Amstad et al., 2020; Panizza, 2008). Conventional distinctions between external and domestic debt have increasingly blurred in a context of rapid financial integration and open capital accounts. Despite the continuing push of the "original sin", developing countries have managed to increase their public external debt in local-currency, and with foreign exchange liberalization compounded lately by the post global financial crisis (GFC) quantitative-easing policies in advanced economies, have been able to mobilize domestic debt in foreign-currency (Aizenman et al., 2021; Borensztein et al., 2007).

Figure 3. Simplified diagram of the decomposition of total public debt



Public external debt in local-currency and domestic debt in foreign-currency carry their own risks. The latter is exposed to currency risk as described above whereas the former may pose challenges should the country need to restructure this debt, and even more so if it is owned by private creditors, who have been less inclined to participate in restructurings (Bucheit et al., 2018). However, foreign-currency external debt remains the most hazardous category, as it combines all aforementioned risks.

[9] IMF Global Debt Database (Mbaye et al., 2018) and to a lesser extent, the Bank of International Settlements (IMF et al., 2015) do provide data on domestic public debt but for a limited number of countries.

Climate-related debt statistics for developing countries should be examined and delivered against this two-dimensional background. Figure 3 summarizes how the share of climate debt as defined in the previous section is projected onto this two-dimensional space. In other words, **analysing the climate-related exposure and vulnerability of developing countries' public debt ideally requires five main indicators**.

Using the notations of figure 3 referring to each segment of public debt, for any country, region or the world, we define:

Indicator 1: Share of climate-related debt in external and foreign-currency denominated debt

$$In_1 = {EF_c}/{EF_T}$$

Indicator 2: Share of climate-related debt in domestic and foreign-currency denominated debt

$$In_2 = {DF_c}/{DF_T}$$

Indicator 3: Share of climate-related debt in external and local-currency denominated debt

$$In_3 = {EL_c}/{EL_T}$$

Indicator 4: Share of climate-related debt in domestic and local-currency denominated debt

$$In_4 = {DL_c}/{DL_T}$$

Indicator 5: Share of climate-related debt in total debt

$$In_5 = {(EF_c + DF_c + EL_c + DL_c)}/{(EF_T + DF_T + EL_T + DL_T)}$$

These indicators allow for quick identification of which public debt sections the fight against climate change is weighing on, and to what extent it is exacerbating countries' overall debt vulnerability. A relatively high value for indicator 1, for instance, means that the country heavily relies on external and foreign-currency resources to finance its climate action, and that this financing is most likely to interfere with its ability to cope with external shocks. The resulting debt distress should be then tackled with appropriate international and domestic programmes and policies. Indicator 5, which provides the share of climate-related debt in total public debt can be also used as a proxy for measuring public financial commitment to combating climate change, as most financial efforts have so far been financed with debt rather than with other sources of government revenues[10].

3. Climate and sustainability investment

3.1 Need for climate-related investment indicators

Sustainability investment has started to gain ground and there is broad agreement that it should be measured more systematically. It matters because the need to mitigate the threat of global warming is essentially a call for the biggest investment push ever. This is not only because of the scale of transformation required, which must address decades of investment in products and processes that are damaging for the environment, but also because it must simultaneously address other related inequalities and fragilities of today's highly globalized and financialized world in order to be sustainable.

This is a question of more than just massively increasing the scale of investment; we must change its direction as well. Recent Trade and Development Reports (UNCTAD, 2019a, 2021i) called for a wave of new investments to reinvent energy systems and other carbon-emitting sectors in support of climate protection and adaptation, drawing upon lessons learned from the New Deal of the 1930s and the post WWII Marshall Plan. Articulated through the lens of a Green New Deal (see UNCTAD, 2021i)) this comprehensive package of inter-related policies is increasingly on the radar of many countries across the globe. Support for this approach is reinforced by the fact that the investments required for climate adaptation and mitigation can also be a source of jobs and income and address long-standing sources of inequalities. Similarly, according to the World Investment Report 2021 (UNCTAD, 2021g) the sustainable investment market needs to transition from a niche to a mass market that fully integrates sustainability. To be effective, such commitments need to be monitored with sufficient data and statistics.

[10] This overall ratio can also be re-written with other conventional denominators such as GDP or exports (see IMF(2000)).

UNCTAD (2021g) also calls for tackling concerns of "greenwashing" and addressing geographical imbalance of sustainability investment. According to the World Investment Report 2021, effective monitoring cand help accelerate the transition to sustainable investment in support of the efforts by asset owners, financial institutions, exchanges, regulators and policymakers. To this end, UNCTAD launched a Global Sustainable Finance Observatory in October 2021 at its World Investment Forum.

Even before the COVID-19 pandemic, UNCTAD was concerned there was insufficient investment for the structural transformation implied in the SDGs, and the pandemic is exacerbating the SDG investment gap, particularly in LDCs and other structurally weak economies (UNCTAD, 2021g). SDG-relevant greenfield investment in developing regions is 33 per cent lower than before the pandemic, and international project finance is down by 42 per cent. This decline is much larger in developing countries than in developed countries. In recent years, however, the most popular investment areas have related to climate change mitigation, in particular in carbon-efficient assets and renewables, green real estate and infrastructure, and green, social or mixed-sustainability bonds. According to UNCTAD (2021g) investment in renewable energy has picked up even as the pandemic has constricted investment in other sectors.

Yet, considering the increasing gap of financing between the developed and developing world, and particularly the long-standing problems of finding the necessary finance for developmental and public-oriented investments that may not deliver financial profits in the near-term or even in the long-term, but without which transformation will not occur, climate action is a major challenge for developing countries. This section briefly outlines some recent UNCTAD research in this area expanded further in the Trade and Development Report 2021 (UNCTAD, 2021i); as well as remaining gaps in knowledge and information, examined through the lens of how to secure long-term developmental finance for climate change mitigation and adaptation[11].

3.2 Channels of climate funding

There are many mechanisms to channel funding for climate investment that should be sufficiently monitored to increase transparency and help guide policy efforts. We identify the following channels, among many, that could be part of regularly monitored climate indicators, and for many of these statistics are already available:

Official development assistance for climate projects and global climate funds

ODA and global climate funds are the cornerstones of international climate finance to support the most difficult and hard-to-reach areas. They are essential because of the urgency and costs of climate change, and because its nature as a "public bad" demands collective action as individually, neither markets, investors nor governments alone can provide what is needed. Even more importantly, many countries that are worst hit by changing climatic conditions are the least responsible for causing it and have the least resources to withstand it.

However, donor reports of public climate finance to the UNFCCC and Organisation for Economic Co-operation and Development (OECD) show that even though sums are rising, by 2017-2018, they were still only about half the US$100 billion per year by 2020 pledged in Copenhagen in 2009 and Cancun in 2010. Though reported totals of US$63 billion in 2018 show an increase over the previous year, there are signs that effective funds are even less than half the amount reported (Oxfam, 2020). Counting only grant equivalent funds the net financial value to recipient countries fell to levels between US$19bn and US$22.5 billion (ibid). The rest came as loans and other non-grant instruments that could significantly increase the debt burden of recipient countries, many of whom are LDCs and SIDS.

The challenge is particularly acute in the most demanding of climate change contexts, the oceans or blue economy, where needs are immense, spillovers and externalities are truly global, and sources of finance notably scarce (Barrowclough and Vivas, 2020). Finance levels remain far too low and not sufficiently directed to sustainability. According to OECD (2021) in 2019, ODA for the ocean economy decreased from US$3.0 billion in 2018 to US$2.9 billion. Focusing on the blue economy is a new trend and extremely welcome given the importance of the oceans in the climate challenge, and the particularly harsh impact on SIDS. The estimate that in 2019, only 0.8 per cent of gross ODA commitments targeted the sustainable ocean economy, is a great concern

[11] This section draws on UNCTAD's Trade and Development Report 2019 and 2021 in addition to ongoing and related work on the role of public and development banks.

for the achievement of many SDGs and for the ecosystems, wildlife, people and businesses dependent upon clean beaches and waters and sustainable fisheries in the high seas (Ibid).

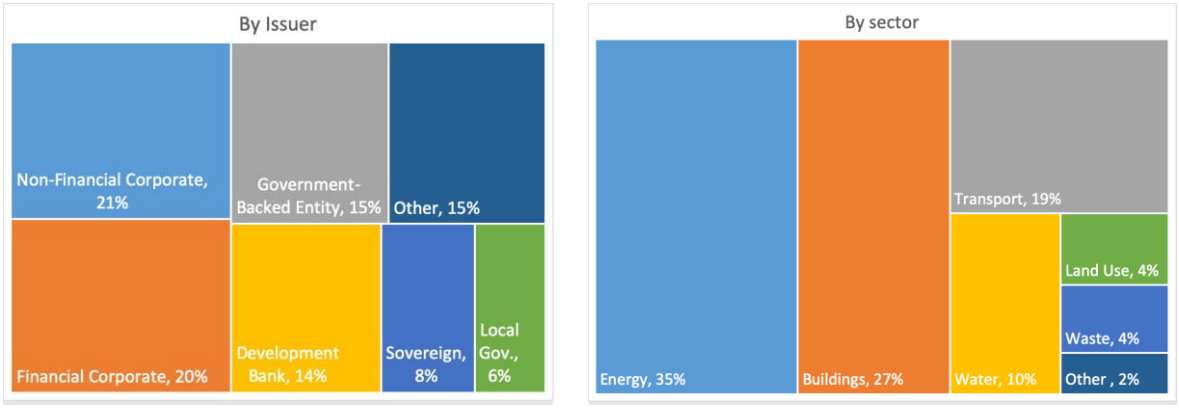
Market based mechanisms – green bonds

Market based mechanisms such as "green bonds" have attracted a great deal of attention, unsurprising given the speed of their rise. These are also included on the IMF climate indicator dashboard (IMF, 2021a). Since the first green bond launched by the European Investment Bank in 2007, estimates for the sector now show strong growth and total green bond issuances of potentially $1 trillion. However, "Certified Climate Bonds"[12] make up a smaller part of green bonds, estimated at US$100 billion. This is large compared to the global funds and official assistance discussed above. Moreover, despite its rapid growth, the green bond market still represents only 5 per cent of the total issuance of bonds in global markets and 4.3 per cent of the amount outstanding in the international capital market. The challenge is how to direct it to purposes productive in the fight against climate change. Do green bonds solve this purpose?

Green bonds are, by their nature, considered to be more suitable for green investments with higher short-term profitability and not for longer-term green projects with low profitability, if any. This may be in part because they are mostly issued by the private sector, even though governments and development banks are significant sources and could be expected to have a different sense of public purpose. More research is needed to examine in detail the distinctions between different bonds from different issuers but given that green bonds can be asset defined after the fact, there is a lingering concern about "greenwashing", that is, the practice of channelling proceeds from green bonds towards activities having negligible or even negative environmental impacts. While some bond label certificates do help to ensure that financed activities are green, existing frameworks are non-binding and lack enforcement mechanisms (Deschryver and de Mariz, 2020; Noor, 2019).

UNCTAD (2021i) along with many others, calls for more research, transparency and consensus building around the different taxonomies. Nonetheless, it also notes that as long as some essential climate-related activities do not generate profit, especially in the short-term, such sources of finance are unlikely to be a solution for developing countries. Better information will be needed on the development impact of these instruments to strengthen their role. This calls for regular reporting of data and statistics, and research on their effectiveness. The IMF climate indicator dashboard does consider green bonds by issuer and the US dollar value of total issuances, and it will be even more useful when this is linked with transparent information about their certification and underlying purposes.

Figure 4. Green bonds: accumulated issuances, 2014-2020
(Billions of current US dollars)



Source: UNCTAD (2021i), UNCTAD's secretariat calculation based on Climate Bond Initiative database.

[12] According to the Climate Bond Initiative (CBI), "rigorous scientific criteria ensure that bonds and loans with Certification, are consistent with the 2 degrees Celsius warming limit in the Paris Agreement".

Nature-based swaps and funds

Keeping fossil fuels in the ground or not felling trees in the rainforest has sometimes been suggested as ways to meet the goals of the Paris Agreement, prompting a revisit of the concept of debt for nature swaps used in previous decades. These are a form of debt conversion, where an existing debt contract is exchanged for a new one on more favourable terms, and where the increment released is destined to support a specific environmental project, such as restoring a coral reef or training park staff – or even, maybe one day, leaving fossil fuels unexploited. This could be something of a win-win in the sense that the countries get the funds needed, or at least a reduction in their debt, and emission-creating activities are halted or reduced. Recipient countries that use the opportunity to diversify could even be protected from the volatile swings in commodity prices that will happen regardless as investors pull their funds out of "sunk assets".

The current interest in debt for nature swaps rests in part on their use in the 1980s and 1990sCompared to other sources of finance, the amounts cited are small, ranging from US$2.6 billion to US$6 billion over the three decades since their inception in 1987, according to some estimates, although recent examples such as the Seychelles Sovereign Debt swap of US$21.6 million in 2016, or the US debt-for nature swaps with Indonesia (in 2011 and 2014), are frequently cited. While actual activity has declined since the earlier decades for various reasons (UNCTAD, 2021i), some country proposals have been more ambitious, including Commonwealth Secretariat proposals for debt swaps to finance climate change adaptation and mitigation for small states. Other recent examples range from Bhutan to Fiji and South Korea. Some of the obstacles previously associated with their use, such as high transactions costs and complex implementation could potentially be mitigated under recently launched coordinating regional initiatives, such as ECLAC's (2018) Debt for Climate Adaptation Initiative for the Caribbean and ESCWA's (2021) Debt Swap Mechanism for the Western Asia region.

Nature performance bonds

Nature Performance Bonds are another nature-based approach of recapitalizing sovereign debt. They complement traditional debt instruments with a performance scheme focused on measurable economic, nature and climate outcomes. Once again, however, these are most likely to be used for revenue-earning-mitigation purposes and not adaptation, and, in addition, concerns have been raised that the arrangements being proposed limit the policy space of developing countries (UNCTAD, 2021i).

Dedicated green banks

Moving beyond market-based instruments, Dedicated Green Banks are considered to offer significant – probably the most - potential. Nearly all the public banks established since 2010 have "green" in their title or mandate and, given the special credit-creating and credit-guiding characteristics of banks in general and public banks in particular, should be able to make investment choices with a long-term and patient profile (UNCTAD, 2019a). By some estimates, they have lent about US$24.5 billion since their inception (Whitney et al., 2020); however this is likely to be an underestimate as it does not include established banks with a green desk or with green lending within their normal activities. Some of these, especially the new public banks that emerged after the 2007-2008 crisis, including the Asian Infrastructure Investment Bank, began very quickly lending to green projects.

Many governments have expressed an interest in establishing a green bank, as in the case of current discussions in the United States, United Kingdom and elsewhere. Others are looking to establish a green facility within an existing bank and to boost existing green credential. All of these banks will require improved the kinds of climate-related information discussed in this paper, in order to achieve this.

Similarly central banks all around the world have been gradually adapting their operations, and in some cases their mandates, to better reflect the financial risks related to climate change and reduce the threat of a "Minsky climate moment" (see UNCTAD, 2019b; Carney, 2015; Campiglio et al., 2017). A global Network for Greening the Financial System with more than 80 central banks and financial institutions as members is exploring ways central banks can be green leaders of the financial system and also green investors. These include integrating climate risks into prudential and monetary frameworks and insisting on regular climate stress tests and disclosure across the financial system – of which will rely on new statistical investigations and indicators.

However, mitigating risk is the minimum needed to encourage productive investment in assisting countries to adapt to climate change and reduce emissions overall. Others have also argued that central banks need to align their current COVID-19 responses to avoid locking-in to a high carbon recovery as they attempt to maintain financial stability (Dikau et al., 2020). Some central banks have gone further by putting in place macro prudent policies and positively guiding capital in a more carbon-sensitive way. The European Central Bank (ECB) recently agreed to include climate change considerations in monetary policy, as has the Bank of England and many others across the world. A number of developing countries have already been very active in this new direction for several years (Campiglio et al., 2017; Dikau et al., 2020; Dikau and Volz, 2019; UNCTAD, 2019b). The People's Bank of China, in particular, has long used financial policies and directed credit to support green industrial policies, but banks in much smaller economies have also been experimental and innovative in terms of capital creation and direction (including the central banks of Bangladesh, Fiji, Lebanon and many others).

Research carried out by UNCTAD with Lund University and the Graduate Institute in Switzerland finds that governments around the world have reduced sharply their financing flows to the fossil fuel and petrochemical industries since the Copenhagen and Paris Agreements, but some US$38 billion in financial flows are still active today. Of this, central banks provided US$26 billion over the years from the Copenhagen Accord in 2009 to today (Barrowclough and Finkill, (forthcoming))[13]. Other writers have long argued for a revisiting of the role of central bank collateral and bond schemes (e.g., Dikau and Volz, 2019).

Multilateral development banks

Multilateral Development Banks are well positioned to support investment in climate change adaptation and mitigation, as their remit usually specifically authorizes them to provide finance for the long-term at lower rates and on more advantageous terms. To date, development banks have provided most of the concessional loans and grant-based finance employed. Not all Multilateral Development Banks (MDBs) and Regional Development Banks (RDBs) have been consistent in this regard, but their role is critical given current predictions and worsening conditions (IPCC, 2021a).

This type of public financing needs to increase in areas that so far have been under-resourced, especially in regional projects where many climate projects are considered less feasible for private or revenue-seeking purposes. Partly compensating for the limitations of under-capitalized national banks, MDBs have been steadily increasing their climate finance activities in the years since the Paris Agreement. Many pledged to re-direct their financing decisions and investment portfolios to be consistent with climate change adaptation and mitigation goals. The 12 largest MDBs committed to five Voluntary Principles for Mainstreaming Climate Change and by October 2020 as many as 48 institutions had followed suit.

Nonetheless, the goal of scaling up is yet to be achieved. In 2019, nine MDBs announced their target to increase collective global climate investment to at least US$65 billion per year by 2025 (ADB, 2019). They plan also to increase co-financing to US$110 billion, of which less than half is anticipated to be mobilized by private direct sources. While there has been a sizeable increase since 2015, there is still a long way to go.

Securing adequate finance is not just about the amount of money lent, but also its purpose within the broad spectrum of climate related activities, and as with the discussion about green bonds above, it is here that more transparency and accuracy in statistical indicators will be needed. This is especially important for least developed and lower income countries that find it more difficult to attract finances from other sources.. Currently UNCTAD is continuing research on their role, aiming to help support MDBs to secure the additional finance and the clarity of mandate that can help them contribute effectively to the goals of addressing climate change. Improving data on the terms and conditions of loans (concessional etc), the purpose and impact of development lending will help to support this aim.

[13] This does not include equity, where State ownership remains significant even though it is a small part of the total.

4. Plastics trade and climate change

4.1 Need for statistics on plastic trade

As many governments around the world are grappling to reduce pollution from plastic, in addition to making the transition to net-zero carbon emissions, there is a growing interest in policy levers that can support these efforts (Barrowclough and Deere Birkbeck, 2020). This underlines the need to consider plastics across their entire lifecycle and not just the final product of waste. Plastic production, consumption and waste account for a significant proportion of the entire carbon footprint – as much as 10 per cent according to some estimates. The lack of information about plastic production and consumption hampers policy action. To this end, UNCTAD, in collaboration with the Graduate Institute of Geneva, began research to identify information sources, through the lens of plastics trade. Since the launch of this process, more than 80 countries have indicated support for a global treaty in trade in plastic. It will be more important than ever for governments to know about plastic products entering and leaving their economies, and how dependent they are on plastic trade.

Plastics are almost entirely derived from fossil fuel feedstocks with increasing worries that if current production does not reduce, CO_2 emissions across the plastics value chain will increase by 50 per cent by 2030 (WWF, 2019). Countries that have pledged to achieve net-zero carbon emissions, or even just lower carbon emissions, need to consider that plastics account for a significant share of total oil consumption and the annual carbon budget. At the same time, alternatives to plastics are offering significant economic potential to countries that can enter these new markets. Some developing countries already have comparative advantages in new products and processes. Trade is an important transmission mechanism in both these areas, though its role has not been well understood.

To meet the need for better information about plastic, UNCTAD has created a new database measuring, for the first time, trade in plastics across their lifecycle; from their inception from fossil fuel feedstocks, through intermediate and final plastic products, and eventually to waste. The database will provide statistics on plastics trade for governments, civil societies, industry stakeholders and others around the globe interested in understanding plastics trade to seek ways to address the challenges. The database will be available to all users as part of the UNCTAD Statistics Portal. It will help identify plastic trade flows and key trends in plastic production, consumption and trade that are not easy to discover otherwise. The findings are important for many countries who have depended on plastic as a means of diversifying their economies and adding value to exports, and who are seeking solutions to plastics' problematic contribution to contamination of waterways, oceans and the air, as well as to CO_2 emissions and climate change.

4.2 Why plastic?

In recent years, plastic use has been viewed as increasingly problematic. At the same time, plastics have become important across all industries due to their physical characteristics and low price. This is a systemic issue due to plastic's cross-sector production and use. Moreover, demand for plastic is set to continue while production is forecast to expand four-fold in the next 20 years under "business as usual" scenarios; this regardless of the problems of dealing with plastics pollution of oceans and waterways, plastic-related additives in food-chains and water supplies that become toxic, and concerns about the role of plastics and their fossil fuel inputs to CO_2 emissions and climate change. Plastic-related green-house gas emissions may account for more than 15 per cent of the global annual carbon budget. As concerns about climate change have grown, there have been a flurry of policy actions to reduce its excessive use. In order to go about this in effective and ultimately sustainable ways, policymakers need to have a correct understanding of the inward and outward flows of plastic products across borders.

Developing countries are key players in the global plastics economy, alongside advanced economies, accounting for around half of plastics output globally. They are key suppliers of feedstocks used in plastics manufacturing and the main destination for exports of plastic waste from advanced economies. About one in every three jobs in manufacturing of plastic products is now concentrated in developing countries, and plastic has been an important part of many countries' strategies for economic diversification and value-added. Hence, the transition to new pathways will involve shocks and costs that many countries are not currently able to withstand. Some countries suffer from the adverse effects of plastics pollution without having contributed to the problem – SIDS

in particular. Some developing countries are taking measures to regulate and reduce plastics imports, and some are actively seeking new markets for plastics alternatives (UNCTAD, 2020b).

At the same time, global efforts are advancing to regulate plastics use and trade. Already more than 100 countries are calling for a new global treaty next year on plastic pollution, accompanied by a growing number of business and civil society groups. The G7 declared earlier this year plans to bolster action not only to tackle climate change, but also plastics pollution. Simultaneously, countries are working to implement the Basel Convention's new plastic waste amendments, which seek to tackle plastic pollution by better regulating trade in plastic waste. World Trade Organisation members are advancing an informal dialogue on plastics pollution and environmentally sustainable plastics trade. UNCTAD is working with developing countries keen to advance research and production of alternatives to plastic as a new export market. Global processes such as the Copenhagen Agreement and the UN Climate Change conference have plastic in their sights. Given the scale of global trade in plastics revealed in the new database, the need to better connect international policymaking on trade and the environment relevant to plastic pollution is clear.

4.3 Methodology for compiling statistics on plastics trade

In order to capture the breadth of trade across the lifecycle of plastics as well as inputs into plastics, the data are derived from the United Nations International Trade Statistics Database, the UN Comtrade, as reported by national statistical authorities. In order to identify plastic-relevant entries in UN Comtrade, a detailed examination of the official World Customs Organisation's "Harmonised Commodity Description and Coding Systems" (HS), which compiles data on a far broader set of plastics-related inputs and products than commonly used[14], was carried out. An essential first step involved scientists with expertise in the chemical industry and plastics. With their help, UNCTAD identified the HS codes for various categories of feedstocks, precursors and additives which are the raw inputs into the plastics value chain. This granular process involved detailed micro-analysis, HS code by HS code, of all traded products to identify those traded inputs used in plastics production. UNCTAD and Graduate Institute professionals needed to work closely with chemistry and other scientific experts in order to identify the individual product lines and codes.

The new database includes all flows of HS Chapter 39, "Plastics and articles thereof" (non-hidden) plastics, plastics flows outside Chapter 39 (semi-hidden), as well as input flows such as resin pellets and fibres that are part of plastics feedstocks and additives. The database also captures the breadth of trade across the industrial lifecycle, categorising trade from inputs to primary forms of production, including resin pellets, a very important category as this is what enters the production of an immense range of all final products, then, through phases of production to final products and waste.

The efforts to generate a statistical database that included bilateral flows for all countries globally across hundreds of HS codes, and a time series of 20 years, is extremely intensive and makes a huge database. The database functionalities allow easy browsing of this huge dataset by interested users. Continued efforts of statisticians and customs experts across countries to standardise the national application of HS codes and harmonise recording practices will be important.

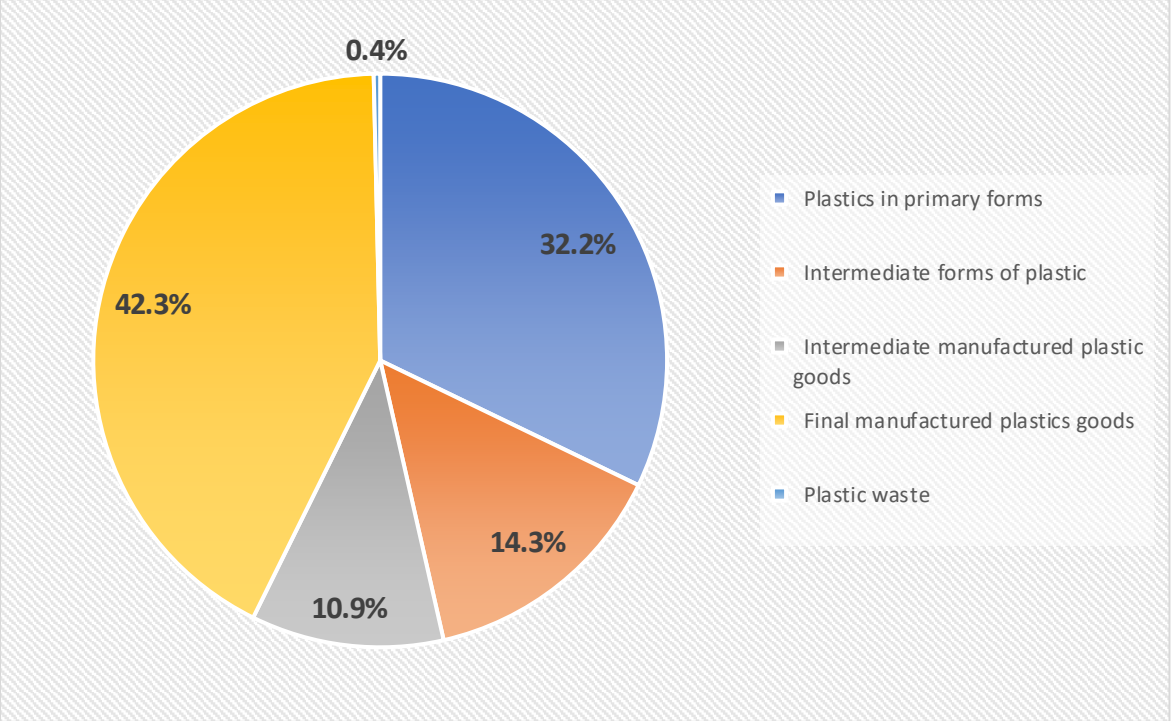
4.4 Findings from the UNCTAD plastics database

The new database shows that the value of plastics trade is immense, much larger than previously thought. Exports of primary, intermediate and final forms of plastic summed up to more than US$1 trillion in 2018 and 336 million metric tonnes. This represents 5 per cent of the total value of global trade and is 40 per cent higher than previous estimates, which did not use the granular and life-cycle approach. In volume terms, this was 30 per cent higher than previously thought. The actual amount of plastics traded is likely greater than this, given that much embedded plastic trade remains hidden.

[14] For a more detailed discussion of the methodology used please see Barrowclough D, Deere Birkbeck C and Christen J (2020). *Global trade in plastics: insights from the first life-cycle trade database*. UNCTAD Research Paper No 53, United Nations: Geneva; particularly pages 8-13.

The data show that plastics trade is extremely significant in the early, intermediate and final phases of plastics production and use. To focus attention on trade in waste is missing the vast majority of what is actually happening (figure 5). While it may be extremely important for the countries that are recipients of waste exports, waste trade accounted for below US$4 billion out of the total US$1 trillion. Moreover, some categories – such as packaging, worth at least US$55 billion, and synthetic clothes, worth US$200 billion – are both an indicator of the complexity of the problem as well as an indicator of where some developing countries could find new markets making alternatives.

Figure 5. Share of plastics trade across the lifecycle - plastic waste trade is just the tip of the iceberg, 2018



The new data for 2020 also show that plastics trade is multi-faceted and multi-directional. Virtually all countries are touched in some way, either as importers or exporters, and many are both. Some countries are not only present but prominent in all phases of the supply chain, such as China, Germany and the United States of America (table 1).

Table 1. Top ten exporters of plastics by category, 2020

Rank	ASSOCIATED PLASTICS		GLOBAL PLASTICS					SPOTLIGHT ON SELECTED PLASTICS		
	Feedstocks	Additives used in plastics	Plastics in primary forms	Intermediate forms of plastic	Intermediate manufactured plastic goods	Final manufactured plastics goods	Plastic waste	Plastic packaging	Synthetic textiles	Synthetic rubber
1	Korea, Rep of	USA	USA	China	China	China	Japan	China	China	Korea, Rep of
2	USA	China	Korea, Rep of	Germany	Germany	Germany	Germany	USA	Viet Nam	Thailand
3	Japan	Germany	Germany	Japan	USA	USA	USA	Germany	Germany	Japan
4	Netherlands	Singapore	China	USA	Italy	Poland	Netherlands	France	Korea, Rep of	USA
5	India	Korea, Rep of	Netherlands	Korea, Rep of	Korea, Rep of	Italy	China	Mexico	Turkey	Viet Nam
6	Germany	Indonesia	Japan	Italy	Taiwan, Prov. of China	France	United Kingdom	Netherlands	USA	Germany
7	Taiwan, Prov. of China	Belgium	Taiwan, Prov. of China	Taiwan, Prov. of China	Turkey	Thailand	Belgium	Canada	Taiwan, Prov. of China	Taiwan, Prov. of China
8	Belgium	Taiwan, Prov. of China	Belgium	Belgium	Japan	Netherlands	France	Italy	Italy	Malaysia
9	Singapore	France	Singapore	Netherlands	India	Viet Nam	Mexico	Korea, Rep of	India	China
10	Thailand	Malaysia	Thailand	Turkey	Spain	Malaysia	Austria	Spain	Spain	Singapore
11	United Kingdom	Netherlands	France	France	Viet Nam	Japan	Poland	Poland	Japan	Belgium
12	Canada	Italy	Italy	Canada	France	Spain	Thailand	Thailand	Hong Kong SAR	France
13	Malaysia	India	Malaysia	United Kingdom	Poland	Korea, Rep of	Italy	United Kingdom	Netherlands	Poland
14	France	Canada	Spain	Poland	Hong Kong SAR	Mexico	Canada	Viet Nam	Indonesia	Indonesia
15	Spain	Japan	Canada	India	Czechia	Czechia	Philippines	Turkey	France	Italy

Some developing countries also feature prominently, such as Vietnam (plastics packaging and textiles), Thailand, Indonesia and India for intermediate manufactured goods, much of which is linked to their role in trade in

synthetic textiles. Even countries whose role is too small to make it into the top ten or even the top 100 are involved. For instance, SIDS who export agricultural products wrapped in plastic as a way to boost exports and meet phytosanitary standards in northern supermarkets. It is worth mentioning that SIDS are deeply impacted by plastics pollution of the oceans, despite contributing little to the problem.

4.5 Data limitations and ongoing research questions

The database is still in its early stages and will be subject to further consultations with experts and a review of data sources. Despite the previously semi-hidden plastic trade collected from across HS codes, much remains hidden because plastics that are embedded in other products cannot be included. Similarly, plastic packaging in pre-packaged products or used in transport and distribution are not included, meaning that the official Comtrade statistics which rely on the HS give only a partial picture of how much and what types of plastics move across borders.

One way in which the database is already supporting new policy-related research is through its identification of potential market opportunities for countries that can provide products that offer some of the benefits of plastics, without the negatives (e.g., Barrowclough and Vivas, 2020). The database is highlighting trade in some points during the life-cycle where non-plastic substitutes and alternatives can already be found. This includes synthetic textiles, for which alternatives include textiles made from cotton, wool, and vegetable fibres, and packaging, where many substitutes and alternatives based on plant cellulose or milk-based wrappings, among others, are already entering markets. UNCTAD is already working closely with developing countries on this topic (UNCTAD, 2020b). At the earliest stage of the plastic production cycle, there are also bio-based alternatives to fossil fuel-based virgin plastic feedstocks, although the overall environmental credentials of such 'bio-plastics' are a matter of considerable debate (Robbins, 2020).

While much remains to be done, the main message thus far is that plastics are intensely traded products, and as such, trade policies and trade regulation could be helpful and effective levers for reducing plastic pollution. For this reason, there is a great deal of interest in the topic at present, though there has been much less discussion about what is needed to support developing countries who will be impacted by these changes, potentially much more so than advanced countries, with less resources available to counter the blow. The new database provides the possibility to monitor changes in plastic flows over the lifecycle of plastics production, and countries' participation in the global plastics industry.

5. CO_2 emissions from transport related to international trade

5.1 Need for statistics on emissions from transport related to international trade

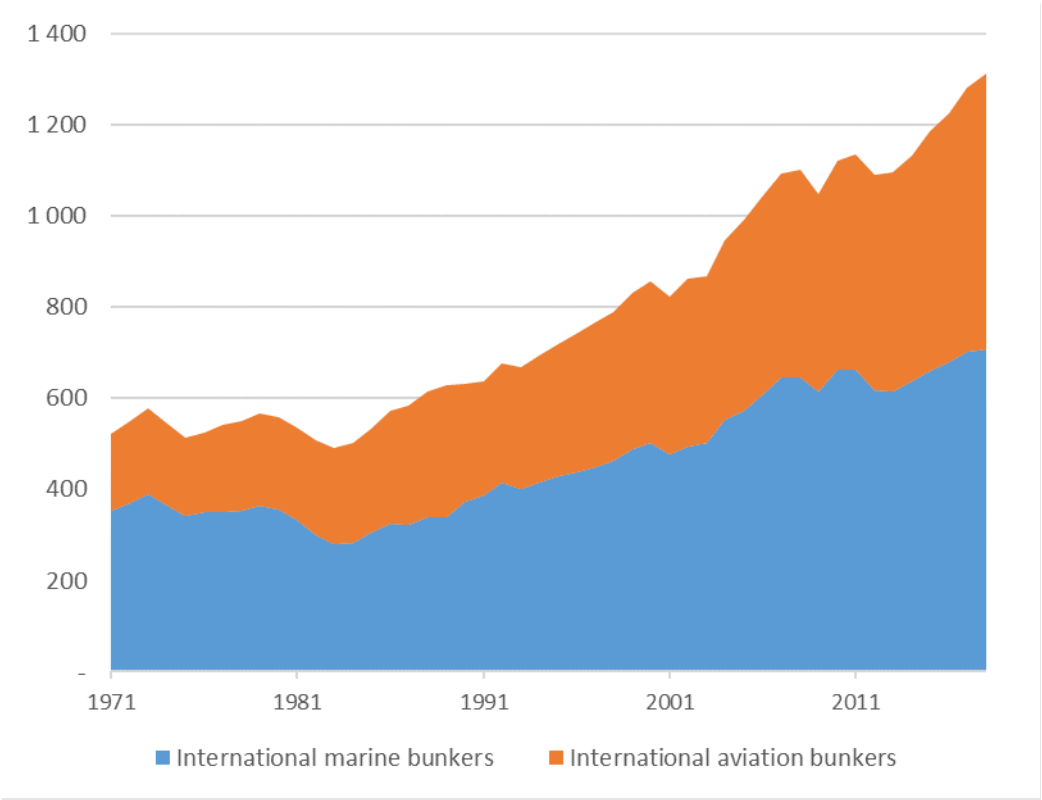
The beneficial effect of international trade on economic development is well understood and has been widely studied in literature. Better understanding and monitoring of the trade-offs between the promotion of trade and reduction of greenhouse gas emissions is key for the development of green policy, especially with a view of "flexing the link" (Schipper and Marie-Lilliu, 1999) between international trade, related transport and greenhouse gas emissions, for example through the use of biofuels or application of new carbon-neutral technologies.

The 2021 Economic Development in Africa Report discusses the adverse impact of transport costs on regional trade (UNCTAD, 2021b). The recent surge of freight rates after the COVID-19 pandemic in particular has raised concerns and put the topic into the focus of the international trade news (UNCTAD, 2021c). Much less is known, however, about the environmental costs, in the form of greenhouse gas emissions, which transport related to international trade is responsible for, and about the economic impact which policies targeting an internalization of those environmental externalities would have. Below, we show how new data on international transport related to trade available on UNCTADstat (UNCTAD, 2021d), and under further development by UNCTAD, can be used to shed light on these questions.

5.2 Trends in CO_2 emissions from transport and strategies for their limitation

Transport represents the end-use category of fossil fuels in which CO_2 emissions have grown fastest over the last decades (Sims R et al., 2014; Rodrigue, 2020). In 2018, fuel combustion in transport emitted 8.3 billion tons of CO_2. It was thereby responsible for around one quarter (24.6 per cent) of total CO_2 emissions worldwide (IEA, 2020). Between 1971 and 2018, CO_2 emissions from international maritime transport doubled, from 353 to 708 Mio. tons, and CO_2 emissions from international aviation more than tripled, from 169 to 604 million tons (see figure 6).

Figure 6. World CO_2 emissions from fuel combustion in international air and maritime transport (Million tons of CO_2)



Source: IEA (2020).

The Kyoto Protocol calls for developed countries to limit or reduce emissions of greenhouse gases in the transport sector (Article 2.1.a) and in international aviation and shipping (Article 2.2). The reduction of emissions from transport by rail and road, usually taking place on national territories, is assigned by the Kyoto Protocol directly to national member states for regulation. At the climate conference in Paris, 2015, (COP21), signature countries agreed to develop plans about Nationally Determined Contributions (NDCs) with the goal of limiting global warming. By 2017, 193 NDCs were submitted to the UNFCCC, among which 60 per cent mentioned the implementation of transport mitigation measures to some extent; only ren per cent defined specific transport mitigation targets (OECD and ITF, 2018).

In the area of international aviation and shipping, the Kyoto Protocol assigns a coordination role to the International Civil Airline Organization (ICAO) and the International Maritime Organization (IMO). In 2009, the international airline industry committed itself to improve fuel efficiency each year by at least 1.5 per cent until 2020, to achieve carbon-neutral growth after that year, and by 2050 to reduce net emissions to half of their levels of 2005 (IATA, 2020). In 2010, the ICAO agreed, at the 37th session of its Assembly, on the targets of a two per cent annual efficiency increase and of constant emissions in the period from 2020 to 2050. In 2019, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was set up as a bundle of measures to achieve these targets. From 2027 onwards, participation in CORSIA will be obligatory for all ICAO member states that contribute more than 0.5 per cent to global aviation activities, except least developed countries, Small Island Developing States and landlocked developing countries.

In 2018, the IMO adopted its Initial Strategy on the Reduction of Greenhouse Gas Emissions from Ships, which sets out the following goals: to reduce carbon intensity of international shipping by at least 40 per cent compared with 2008 levels by 2030, pursuing efforts towards 70 per cent by 2050; to reduce annual greenhouse gas emissions by at least 50 per cent by 2050 compared to 2008 levels, whilst pursuing efforts at phasing them out (IMO, 2018, 2021). Earlier, IMO had adopted measures aimed at reducing greenhouse gas emissions, such as the Energy Efficiency Design Index, a mandatory standard that defines energy efficiency for new ships, and the Ship Energy Efficiency Management Plan.

However, measuring the CO_2 emissions caused by transport of international goods as part of trade is difficult. In the greenhouse gas inventories compiled by the UNFCCC, based on the data submissions from signature countries, from the ICAO and the IMO, transport by rail and road cannot be differentiated into national and international, and the distinction of transport by air and sea into national and international is not always possible in practice. Furthermore, passenger transport is not distinguished from freight transport (OECD et al., 2004; IPCC, 2006). This also applies to the CO_2 balances from the IEA (2020).

5.3 A new data source for international transport and trade

UNCTAD and the World Bank, in collaboration with the IMO and with support from the World Bank's Blue Economy Program (PROBLUE), have been developing a novel database which is well suited to address the shortages in data outlined above. The Global Transport Cost Dataset for International Trade (GTCDIT) provides data on bilateral international merchandise trade, in value and quantity, detailed by commodity group (at 6-digit HS level), alongside the associated transport costs All these variables are broken down by five modes of transport (MoT): air, sea, rail, road and others. In this first version, all data refer to the reference year 2016. A beta version of the dataset was launched in December 2020, and it is publicly available on UNCTADstat (UNCTAD, 2021d).

The compilation of GTCDIT data has been made possible by the availability of new variables in a recent upgrade of the UN Comtrade database, known as UN Comtrade Plus (UNSD, 2021b), as a result of a change in official reporting guidelines for international merchandise trade statistics in 2010 (UNSD, 2010). In these new guidelines, countries are encouraged to report their bilateral trade at commodity levels distinguishing between different modes of transport and recording both the cost, insurance and freight (CIF) and free on board (FOB) value for each flow. At the time when the project was launched, data coverage in the new variables above was relatively low. These data gaps have been filled by econometric models that learned from the reported data to break down trade by MoT and to predict transport costs and the unit value. As most of the included data, especially the breakdowns by mode, have been estimated, the database in its current form should be treated as primarily synthetic. A main challenge that has not yet been overcome is taking into account modal shift. Goods may be reloaded from one mode to another before their arrival at the final destination. But in the source data the breakdown by mode of transport is based on the mode by which goods entered (for imports) or left (for exports) the country.

GTCDIT provides the most extensive coverage of any public transport costs dataset so far. It covers around 105 importing countries and over 200 exporting countries, thus capturing around 95 per cent of global merchandise trade in terms of imports. As data coverage in UN Comtrade Plus increases in the coming years, and more research can be carried out, UNCTAD intends to successively enhance GTCDIT in precision and scope.

The information in GTCDIT provides new opportunities for the calculation of indicators measuring CO_2 emissions caused by transport related to international trade in goods worldwide, as well as the expected economic impact of an internalization of these costs in the transport price. We propose in particular the indicators: "CO_2 emissions from transport for international trade in goods" and the "carbon intensity of importation and exportation of goods".

5.4 Measuring CO_2 emissions from transport for international merchandise trade

Following Schipper and Marie-Liliu (1999), CO_2 emissions from transport (E) can be decomposed multiplicatively into the following components: activity, modal structure and carbon intensity. In the case of freight transport, activity is represented by the transport volume, the product of the quantity (q) of the traded goods and the distance (d) over which they are transported. The modal structure is represented by the proportions in which trade is distributed over different modes (m); and carbon intensity (β) by the average CO_2 emissions per unit of transport volume.

Emissions (E) can thus be calculated as

$$E = \sum_m q_m a_m \beta_m = Q \sum_m \frac{q_m}{Q} a_m \beta_m \quad \text{with} \quad Q = \sum_m q_m \tag{1}$$

where q_m/Q *represent modal shares.* Carbon intensity can in principle be further split up into other factors, such as number of trips, vehicle capacity, vehicle capacity utilization, fuel intensity and carbon-intensity, to enable a more differentiated assessment.[15]

GTCDIT provides observations on the quantities and distances traded between individual origin (o) and destination countries (d), differentiated by more than 5000 commodity groups (p), at the 6-digits level of the Harmonized System classification and broken down by mode of transport (m): air, sea, rail, road and others. Therefore, country d*'s* emissions from imports can be derived as:

$$E_d^{Imp} = \sum_o \sum_p \sum_m q_{o,d,p,m} a_{o,d,p,m} \beta_{o,d,p,m} \tag{2}$$

and country o's emissions from exports as

$$E_o^{Exp} = \sum_d \sum_p \sum_m q_{o,d,p,m} a_{o,d,p,m} \beta_{o,d,p,m} \tag{3}$$

The information that needs to be added externally consists in the coefficient *r*, the carbon intensity. Secondary data on carbon intensity can be found in the transport literature. For example, EEA (2013), Sims *et al.* (2014) and Rodrigue (2020) present emission coefficients, measuring average CO_2 emissions per ton-km, for different modes of freight transport. IPCC (2021b) maintains an online database of emission factors, also split into subfactors, such as fuel intensity, fuel consumption per vehicle, and carbon intensity of fuel, collected from different studies.

Dividing E by the value of imports (exports) (Y), yields the *carbon intensity of imports (exports)* which depicts the amount of CO_2 emission attributable to one dollar of imports (exports) on average:

$$R = \frac{E}{Y} \tag{4}$$

It is interesting to see the role which the unit value plays for the carbon intensity of imports (exports). Not differentiating by trading partners, product or mode of transport, equation (4) can be written as

$$R = \frac{q a \beta}{Y} = \frac{a \beta}{\frac{Y}{q}} \tag{5}$$

The term on the right has the unit value (Y/q) in the denominator. The carbon intensity of imports (exports) is equal to the product of distance and carbon intensity of transport, deflated by the price. The higher the traded goods' value per kg the lower emissions, because less transport capacity is needed to realize imports (exports) of a given value.

[15] Note that the relationship assumed in the model (1) is linear. Emissions are considered to increase proportional to transport distance, quantity and carbon intensity, thus abstracting from fixed costs caused for example by the starting and landing of airplanes.

5.5 Possible uses

Measuring the contribution of international trade to CO_2 emissions

The indicator *E* in equation 2 (3) is useful in and of itself, as it indicates how much a country's imports (exports) contribute to global warming. Dividing it by the global emissions from transport related to international goods trade, measured for example as the sum of all countries' emissions from imports, indicates the individual country's weight in global-trade-related emissions. Dividing *E* by the total CO_2 emitted by the country, as recorded for example in the greenhouse gas Inventories from the UNFCCC (2021) and in the CO_2 balances from the IEA (2020), we obtain a measure of the contribution of a country's imports (exports) to its total emissions.

The indicator *R* has the advantage that it is unit free, thus independent from overall import and export demand and less driven by the size of the individual economy. As it has the FOB value in the denominator, it can be directly compared with the ad-valorem freight rate, the ratio of transport cost over the FOB value, so that the ecological costs can be contrasted with the monetary costs

Assessing the impact of the carbon price on the transport bill

The application of the indicators above is not limited to the measurement of the amount of CO_2 emissions caused by transport related to international trade in goods. They can also be used to assess the degree to which a country's trade bill and, accordingly, its current account, would be affected if the environmental costs of transport related emissions were internalized in the price to be paid for transport. Such internalization of environmental costs is the logic behind, for example, the carbon tax. It can also be achieved by carbon offsetting schemes, such as CORSIA recently introduced in the aviation sector (see above).

The volume of emissions is equivalent to the amount which transport costs (*C*) would grow in response to an increase of the carbon price (*r*) by 1 dollar, assuming the carbon price is included in these costs, before any behavioral adjustment. If we split total transport costs up into an emission-independent component (*B*) and an emission-independent component, so that

(5) $$C = B + Er$$

then the marginal effect of a change in the carbon tax is

(6) $$\frac{\partial C}{\partial r} = E$$

Correspondingly, the carbon intensity of imports (exports) measures the *marginal effect of a change in the carbon tax on the overall ad-valorem freight rate* (*C/Y*):

(7) $$\frac{\partial\left(\frac{C}{Y}\right)}{\partial r} = \frac{E}{Y}$$

On that basis, other derived indicators may be calculated, such as the marginal effect of the carbon-price on the terms of trade or on the purchasing power of exports. These measures may also be expressed as elasticities, the percentage change in response to a one per cent increase of the carbon tax, or semi-elasticities, the percentage change in response to an increase of the carbon price by one dollar.

Conducting analyses by individual flow

The high level of detail in GTCDIT database allows the analysis of the effects above for individual trade flows, i.e., trade in a particular product group, with an individual trading partner, or via a specific MoT. The marginal effects of a carbon price change are likely to be different in each flow. They therefore induce changes in the relative CIF prices, which are likely to lead to changes in demand, as traders will substitute imports for which the price has increased most with other imports, or even with the acquisition of goods from the domestic market.

The disaggregated analysis of the marginal impact of the carbon price on transport costs allows a straightforward assessment of the first-round changes in relative CIF prices, for example in the context of a micro-simulation model.

It is worth noting that the effects of the individual trade flows on emissions and, correspondingly, the effects of a carbon-price change on these individual flows, add up to the total respective effect (see equations 2 and 3). Furthermore, as

$$(8) \qquad R = \sum_i \sum_j \sum_m \frac{Y_{i,j,m}}{Y} R_{i,j,m}$$

the overall marginal effect of a change in the carbon tax on the overall ad-valorem freight rate represents a weighted average of the effects measured in individual flows, where the weights consist of the import (export) value shares of each flow. These types of additive decompositions can help policy makers and analysts identifying the segments of trade that contribute most to the total trade-related emissions from transport and in which transport costs are therefore most exposed to changes in the carbon price. They also reveal the segments of trade in which innovations targeted at raising energy efficiency or use of biofuels will pay-off most.

6. Conclusion – new indicators and further work

6.1 Potential new climate-relevant indicators

In recent years, official statisticians have put increasing efforts into developing the use of statistical data in support of scientific data and analysis on climate and emissions. When combined, these data enable the analysis of the drivers of climate change and emissions, the impacts and efforts related to mitigation of climate change and the necessary adaptation to the changes. As a starting point, climate indicator sets have focused on identifying indicators that are most commonly produced by countries or for which data would be available. This practical approach is leading to an increased availability of evidence for better and more targeted climate action.

The UNECE and UNSD-led international work streams have improved the evidence base for climate policy with sets of statistics and indicators. The UNECE (2021) set of 44 indicators includes mainly environmental indicators, but also some that consider economic aspects of climate change, such as energy use and supply, energy intensity and greenhouse gas emission intensity of production, carbon footprint, direct economic losses from hydro-meteorological disasters in relation to GDP, direct agricultural losses, energy and transport-related taxes and adaptation expenditure in GDP.

The draft global set with 134 indicators of climate change by the UNSD (2021a), includes several economic indicators, in addition to the above, also on the reduction in tourist arrivals following climate-related hazardous events, balance of food trade, dependency on imported energy, climate change mitigation expenditure in GDP, external funding mobilized for climate change mitigation, average trading carbon price, climate change funds received, and insurance premium increases due to climate change. Some of these, once collected and reported, could also complement the IMF indicator dashboard. To date, these indicator sets have been missing relevant debt and trade indicators.

The debt indicators proposed in this paper (section 2) can contribute to reassessing debt sustainability in developing countries considering financial requirements arising from the SDGs and the 2030 Agenda, besides enabling a better mitigation of and adaptation to the effects of climate change. The conceptual framework for climate-relevant debt indicators suggests the collection of data and compilation of indicators to analyse the share of climate-related debt in external (or domestic) debt that is foreign-currency (or local-currency) denominated as well as the share of climate-related debt in total debt. These could separate debt for ex-ante actions to prevent negative impacts of climate change and for ex-post actions as a response to climate catastrophes. There is a high policy demand for these indicators globally, while data are not readily available.

The IMF indicator dashboard provides a sustainable investment indicator that looks at CO_2 emissions in gross fixed capital formation capturing emissions resulting from investment in specific industries or in the demand for goods and services. An indicator of green bonds, also discussed in this paper, is included with data on total issuances and by issuer. The picture could be complemented by information on additional instruments,

discussed in this paper (section 3), like nature-based swaps and funds and green lending of dedicated green banks and development banks, and with particular attention given to the identification, ex-ante of the green purposes for which finance is being raised and ex-poste monitoring of the impact. However, this would require efforts to address data gaps. According to the World Bank, for instance, 31 per cent of funds in mixed-sustainability bonds (with social and environmental objectives) had climate co-benefits. The World Investment Report 2021 (UNCTAD, 2021g) lists as the most popular investment areas related to climate change mitigation, carbon-efficient assets, renewables, green real estate and infrastructure, and green, social or mixed-sustainability bonds. It will be challenging to separate climate-specific instruments from more generic environmental or SDG-targeted investment. UNCTAD estimates that in total, sustainability-dedicated investments amounted to US$3.2 trillion in 2020, and notes that the rapid expansion of sustainable investment market indicates some potential to help fill gaps in financing for the 2030 Agenda (ibid). However, given the concerns expressed by market experts such as the Climate Bonds Initiative and others (Fancy, 2021) much more transparency is needed to judge the true depth of "green" in these instruments. This gap is already starting to be recognised and hopefully, the work and recommendations of the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD, 2017) and the Climate Disclosure Standards Board (CDSB, 2018) will contribute to better data availability from the private sector in the future.

The new UNCTADstat (UNCTAD, 2021d) trade in plastics database (section 4) provides the possibility to calculate various indicators of plastics trade over the lifecycle, the value and volume of plastics trade by type of product or by trading partner, as well as country level indicators on plastics share of total exports or imports and rankings of top exporters or importers of different plastic products. It would also be possible to calculate comparative advantage in plastics trade indicators, or turning the perspective – the comparative dependence on a sector that is likely to become more problematic in the future. These are a first step towards the much bigger task of ascertaining the underlying carbon intensity of production and trade of plastics. This is a much bigger issue for the global economy, of which plastic is just one small piece. Even with plastic however, the task is difficult as important gaps remain in understanding. For starters, a great deal of trade in plastics remains 'hidden' and the HS codes for plastics trade need to be revised to meet the new needs of climate sensitivity. Codes that were designed for the purpose of attributing customs duties are – unsurprisingly - not fully fit for the purpose of attributing carbon emissions. The data does however already give a useful complementary view to the data on trade in environmental goods as share of total imports and exports, as well as the comparative advantage in these goods, included on the IMF indicator dashboard, and could be more useful in the future as revisions evolve.

Some notable further work linked to environmental goods is led by UNCTAD's BioTrade Initiative which fosters sustainable trade as an incentive for biodiversity conservation and economic and social welfare improvement (UNCTAD, 2020b). The Initiative will soon release its trade and biodiversity database on UNCTADstat (UNCTAD, 2021d), providing valuable insights on trade in biodiversity-based products. Similarly, a database on oceans economy is being developed to provide information on the degree on which countries depend on international trade in goods and service in sectors such as sustainable fisheries and aquaculture, renewable marine energy, marine bioprospecting, maritime transport, and marine and coastal tourism (UNCTAD, 2021e).

The IMF indicator dashboard includes an indicator of CO_2 emissions from production emissions associated with each country's imports, exports and domestic demand. These assess emissions embodied in domestic demand and production, and exports and imports. The new indicators of CO_2 emissions from transport for international trade in goods and the carbon intensity of importation and exportation of goods (section 5), calculated from the UNCTADstat GTCDIT data (UNCTAD, 2021d), complements the picture by adding the viewpoint of emissions from transport of traded goods to the emissions from production of those goods.

Table 3 summarizes the novel indicators mentioned throughout this paper which could aid in quantifying trade, investment and financial aspects of climate change. They are classified according to categories defined by the IPCC (2001, 2008) and applied by UNECE (2021) and UNSD (2021a) in their climate indicators sets: drivers, emissions, impacts, mitigation, adaptation and vulnerability. Vulnerability is a category added in the global indicator set, while emissions have been merged there with drivers. We also indicate the category as used by the IMF (2021a) in its indicator dashboard: economic activity and climate, cross-border, financial, physical and transition risks, and government policy.

Table 3. Suggested indicators to measure trade, investment and financial aspects of climate change

Indicator	Available data/source	IPCC category	IMF category
Share of climate-related debt in external and foreign-currency denominated debt	Not available	Vulnerability	Financial
Share of climate-related debt in domestic and foreign-currency denominated debt	Not available	Vulnerability	Financial
Share of climate-related debt in external and local-currency denominated debt	Not available	Vulnerability	Financial
Share of climate-related debt in domestic and local-currency denominated debt	Not available	Vulnerability	Financial
Share of climate-related debt in total debt	Not available	Vulnerability	Financial
The value of certified green lending and grants for climate action (by country/sector/issuer)	Not available	Mitigation/ Adaptation	Financial
The value of certified climate-related investment (by type/country/sector/donor)	Not available	Mitigation/ Adaptation	Cross-border
Trade in plastics by value/volume and product type	UNCTADstat	Drivers	Cross-border
Plastics trade lifecycle (primary, intermediate, final, waste)	UNCTADstat	Drivers	Cross-border
Trade in plastics by trading partner and product type and share of total exports/imports	UNCTADstat	Drivers	Cross-border
CO_2 emissions from transport for international trade in goods	UNCTADstat	Emissions	Cross-border
Carbon intensity of importation and exportation of goods	UNCTADstat	Emissions	Cross-border

The share of climate-related debt, if separated for ex-ante and ex-post purposes, could also be classified under mitigation (ex-ante) and adaptation (ex-post). The upcoming biotrade and oceans economy indicators follow a similar methodology as the trade in plastics dataset. Therefore, the indicators of biotrade and oceans economy will also be available by type of product, industry and trading partner. Biotrade indicators could be seen as part of the mitigation category, in as far as they provide a more environmentally friendly option. High dependency on the oceans economy could be seen as a source of vulnerability, while the related government intervention to reduce that vulnerability would fall under adaptation to reduce the vulnerability of natural and human systems against potential climate change effects. There is also potential for the development of derived indicators using these data in combination with other data sources, e.g., to calculate elasticities to changes in carbon taxes, and, in particular, to calculate the impact on developing countries of the various carbon-reducing policy reforms currently under debate.

6.2 Further work to improve the evidence base for climate policy

This paper is by no means a comprehensive overview of all UNCTAD's work as it relates to climate change information. It has rather highlighted a range of diverse and yet inter-related existing and upcoming data sources, to identify new uses and potential new indicators that UNCTAD is investigating as part of its ongoing work to ensure policymakers have full and transparent information available with which to guide debate and decision-making.

Further work will include publishing the trade and biodiversity database and the database on oceans economy on UNCTADstat (UNCTAD, 2021d). Furthermore, UNCTAD is a co-custodian of SDG indicator 12.6.1 on enterprise sustainability reporting. In this context, a core set of indicators for sustainable development reporting for businesses has been agreed. While this work will contribute to better availability of information from the business sector, the analysis finds that environmental and social indicators continue to be more difficult for companies to report (UNCTAD, 2021f).

Other examples of relevant work includes the UNCTAD Trade and Environment Review, which uses high resolution climate data to project the trade performance of developing countries in the context of climate change (UNCTAD, 2021c); and the 2020 Trade and Development Report (UNCTAD, 2020c), which forecasts macroeconomic and global environmental variables in response to two different COVID-19 recovery processes.

It finds that in a robust recovery scenario, a decisive climate change mitigation strategy that shifts production towards renewable energy and energy efficiency is vital in order for countries to achieve net employment growth – a goal which for some feels more urgent than climate change. Showing that the two can be mutually compatible is an important contribution. Analytical work on the effectiveness and impacts of climate mechanisms also adds to the evidence base, such as a recent analysis of the implications of the carbon border adjustment mechanism for developing countries (UNCTAD, 2021h).

Our guiding hope in all this work is that with correct data and information - including especially the impact on development - then appropriate responses can be put in place and sustainable policies are more likely to be supported, at the global as well as the national level. The four elements featured in this paper relate to separate but inter-related aspects of an integrated whole – bringing together selected features of finance, debt, production and trade. While much of the data are national, and many countries already have national policy frameworks and goals relating to climate change, global governance will – as always – be essential as national efforts cannot solve these challenges alone.

Global governance needs more transparency to be effective and to lead to desired outcomes when it comes to countries with high level of debts, for example. It must recognize that countries where a relatively large share is dedicated to climate resilience, are disadvantaged as to concessional finance and debt relief programmes. Access to these measures do not acknowledge their environmental vulnerability. Alternative sources of financing, such as through private international markets, are further restricted, in part due to the downgrading by credit ratings agencies, on top of the other risks relating to exchange rate exposure and the costs of repayment. There is a risk that countries are less capable of allocating sufficient financial resources to combatting climate change, especially in the wake of new emergencies related to the pandemic. Quantitative insights on pre-existing climate commitments financed through sovereign debt are also a prerequisite for the ongoing discussions on large-scale debt for climate swaps. The share of debt used for climate resilience provides an additional proxy to measure the intensity of the global fight against climate change.

Transparency is also going to be vital when it comes to transforming productive sectors of the global economy, in the effort to find lower carbon and less pollution products and processes. Taking just the one sector of plastic has given a hint as to the complexity of this. The size and scale of global trade in plastics, and indeed the extent to which trade is an essential transmission route for plastic, is astonishing. It also indicates that trade policy can be used as an effective lever to regulate the industry, as is already happening. Importantly, the multi-faceted and complex nature of the trade patterns revealed indicate that different impacts on different countries will have to be taken into account if the process of transition is to be just and transformation sustainable (see UNCTAD, 2019b). Developing countries in particular will need support to adjust and find new paths. The importance of having the correct statistical data to support policy design and decision making in these many interlinked elements is clear. UNCTAD will continue work to increase the quality of data on plastics trade. Proposals on refining the HS codes as part of the regular update process have been put forward to reveal better the extent of plastics used in different products and packaging. This will be an important step towards greater understanding of the challenges that are involved in transforming the plastics economy.

Improving transparency with respect to the costs of transport will be equally revealing. The quality of the UNCTADstat (UNCTAD, 2021d) data on transport costs for international trade is likely to increase in the next years. As more data will become available in UN Comtrade Plus, the primary data coverage will grow, and the models used for data editing and filling of data gaps will be further enhanced. One such avenue is to record in more detail (than currently possible) the actual routes on which goods travel. In that regard, combining the UN Comtrade Plus data with individual transaction data available for example in transport registers or collected through automatic identification systems (IAS) seems to be a promising option which UNCTAD intends to explore further. A similar bottom-up approach to the measurement of CO_2 emissions from the maritime sector, based on IAS data, is already used by the IMO (2021). Serkan *et al.* (2021) show how satellite-based vessel tracking data can be used for measuring external trade, using the case of the Pacific Island countries. While AIS data provide detailed information about the vehicles used and the routes they traveled, they usually cannot tell us much about the characteristics and volumes of the goods loaded. They may also not show the total of the actual international trade carried out. For these reasons, combining AIS data with the aggregated data on international trade, broken down by mode of transport, from UN Comtrade Plus would provide considerable value added.

To conclude, the indicators presented here aim to inform policy makers of a range of different elements in the climate policy puzzle, including climate investment, financing and debt, the implications of plastics trade, and

emissions from transport related to global trade; contributing to progress towards the SDGs and a more sustainable and inclusive path of growth in developing countries. However, as discussed above, substantial work remains to be done to properly grasp all the complex aspects of climate change as it relates to trade, investment, financing and debt, and to leverage those fields' impacts in the global efforts.

References

ADB (2019). Joint Report on Multilateral Development Banks' Climate Finance. Available at https://publications.iadb.org/publications/english/document/2019-Joint-Report-on-Multilateral-Development-Banks-Climate-Finance.pdf (accessed 23 October 2021).

African Legal Support Facility (2020). Understanding sovereign debt – options and opportunities for Africa - Allen & Overy. (accessed 11 October 2021).

Aizenman J, Jinjarak Y, Park D and Zheng H (2021). Good-bye original sin, hello risk on-off, financial fragility, and crises? *Journal of International Money and Finance*. 117102442.

Amstad M, Packer F and Shek J (2020). Does sovereign risk in local and foreign currency differ? *Journal of International Money and Finance*. 101102099.

Assa J and Meddeb R (2021). Towards a Multidimensional Vulnerability Index. UNDP Discussion Paper. (accessed 11 October 2021).

Barrowclough D and Deere Birkbeck C (2020). Transforming the global plastics economy: The political economy and governance of plastics production and pollution. Working Paper No. 142. GEG Working Paper. (accessed 22 October 2021).

Barrowclough D and Finkill G ((forthcoming)). Banks, Bonds and the petrochemicals/plastics industry; Greening the Path from Copenhagen Agreement, Covid and Beyond. UNCTAD Research Paper No 69 (forthcoming).

Barrowclough D and Vivas D (2020). Plastic Production and Trade in Small States and SIDS: The Shift Towards a Circular Economy. International Trade Worling Paper 2021/01. Commonwealth Secretariat, London. Available at https://unctad.org/node/32567 (accessed 25 October 2021).

Bishop M et al. (2021). Towards sustained development in Small Island Developing States. ODI Working paper. London, 46.

Borensztein E, Levy Yeyati E and Panizza UG (2007). Living with Debt — Inter-American Development Bank. Bank Report on Economic and Social Progress in Latin America. Inter-American Development Bank. (accessed 11 October 2021).

Bouhia R and Munevar D (2019). *External Shocks and Financial Stress Post the Global Financial Crisis: UNCTAD Financial Conditions Indicators and Financial Vulnerabilities in Emerging Markets*. UNCTAD.

Bouhia R and Wilkinson E (2021). Small-Island Developing States need urgent support to avoid debt defaults. Available at https://odi.org/en/insights/small-island-developing-states-need-urgent-support-to-avoid-debt-defaults/ (accessed 11 October 2021).

Briguglio L (2014). A vulnerability and resilience framework for small states.

Briguglio L, Cordina G, Farrugia N and Vella S (2009). Economic Vulnerability and Resilience: Concepts and Measurements. *Oxford Development Studies*. 37(3):229–247.

Bucheit L, Chabert G, DeLong C and Zettelmeyer J (2018). The Sovereign Debt Restructuring Process. IMF Report.

Campiglio E, Godin A, Kemp-Benedict E and Matikainen S (2017). The Tightening Links Between Financial Systems and the Low-Carbon Transition. In: Arestis P, and Sawyer M, eds. *Economic Policies since the Global Financial Crisis*. International Papers in Political EconomySpringer International Publishing. Cham: 313–356.

Carney M (2015). Speach by Governor of the Bank of England and Chairman of the Financial Stability Board, at Lloyd's of London. Breaking the tragedy of the horizon - climate change and financial stability. Available at https://www.bis.org/review/r151009a.htm (accessed 23 October 2021).

CDSB (2018). Framework for reporting environmental and climate change information. Available at https://www.cdsb.net/what-we-do/reporting-frameworks/environmental-information-natural-capital (accessed 24 October 2021).

Clarke DJ and Dercon S (2016). *Dull Disasters?: How Planning Ahead Will Make a Difference*. World Bank. Washington, DC.

Debt Service Suspension Initiative (2020). World Bank. Available at https://www.worldbank.org/en/topic/debt/brief/covid-19-debt-service-suspension-initiative (accessed 12 October 2021).

Deschryver P and de Mariz F (2020). What Future for the Green Bond Market? How Can Policymakers, Companies, and Investors Unlock the Potential of the Green Bond Market? *Journal of Risk and Financial Management*. 13(3):61, Multidisciplinary Digital Publishing Institute.

Dikau S, Robins N and Volz U (2020). A Toolbox of Sustainable Crisis Response Measures for Central Banks and Supervisors. Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science and SOAS Centre for Sustainable Finance, SOAS University of London. Available at https://greencentralbanking.com/research/sustainable-crisis-response-measures-central-banks-supervisors/ (accessed 23 October 2021).

Dikau S and Volz U (2019). Central bank mandates, sustainability objectives and the promotion of green finance. Working Papers 222, Department of Economics, SOAS, University of London, the United Kingdom. Available at https://www.sciencedirect.com/science/article/pii/S092180092100080X (accessed 23 October 2021).

ECLAC (2018). ECLAC debt for climate adaptation initiative across the Caribbean. Available at (accessed 23 October 2021).

EEA (2013). Specific CO2 emissions per tonne-km and per mode of transport in Europe, 1995-2011. Available at https://www.eea.europa.eu/data-and-maps/figures/specific-co2-emissions-per-tonne-2 (accessed 22 October 2021).

Eichengreen B and Hausmann R (1999). Exchange Rates and Financial Fragility. Working Paper No. 7418. National Bureau of Economic Research. (accessed 11 October 2021).

ESCWA (2021). Climate/SDGs Debt Swap Mechanism. Available at https://archive.unescwa.org/publications/climate-sdgs-debt-swap-mechanism (accessed 23 October 2021).

Fancy T (2021). Medium. Available at https://medium.com/@sosofancy/the-secret-diary-of-a-sustainable-investor-part-3-3c238cb0dcbf (accessed 25 October 2021).

IATA (2020). Carbon offsetting for international aviation. Available at https://www.iata.org/en/programs/environment/climate-change (accessed 22 October 2021).

IEA (2020). CO2 Emissions from Fuel Combustion. Available at https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion-highlights (accessed 22 October 2021).

IMF (2000). Debt- and Reserve-Related Indicators of External Vulnerability. Technical Report. (accessed 12 October 2021).

IMF (2021a). Available at https://climatedata.imf.org/ (accessed 22 October 2021).

IMF (2021b). IMF Governors Approve a Historic US$650 Billion SDR Allocation of Special Drawing Rights. Available at https://www.imf.org/en/News/Articles/2021/07/30/pr21235-imf-governors-approve-a-historic-us-650-billion-sdr-allocation-of-special-drawing-rights (accessed 12 October 2021).

IMF, BIS and ECB (2015). *Handbook on Securities Statistics*. Washington, D.C.: International Monetary Fund.

IMO (2018). Initial IMO Strategy on the reduction of GHG emissions from ships. Resolution MEPC.304(72). Available at (accessed 22 October 2021).

IMO (2021). IMO's work to cut GHG emissions from ships. Available at https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx (accessed 22 October 2021).

IPCC (2001). Third Assessment Report. Climate Change 2001: Synthesis Report. Available at https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_TAR_full_report.pdf (accessed 23 October 2021).

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 3. Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/ (accessed 22 October 2021).

IPCC (2008). Fourth Assessment Report. Climate Change 2007: Synthesis Report. Available at https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf (accessed 23 October 2021).

IPCC (2021a). Sixth Assessment Report. AR6 Climate Change 2021: The Physical Science Basis. Available at https://www.ipcc.ch/assessment-report/ar6/ (accessed 23 October 2021).

IPCC (2021b). Emission factor database. Available at https://www.ipcc-nggip.iges.or.jp/EFDB/main.php (accessed 22 October 2021).

Jalles d'Orey MA and Prizon A (2019). Exit from aid: an analysis of donor experiences. ODI Working Paper. (accessed 12 October 2021).

Martinez-Diaz L and Sidner L (2021). Confronting Simultaneous Climate, Public Health, and Economic Shocks in Developing Countries. Available at https://www.wri.org/insights/confronting-simultaneous-climate-public-health-and-economic-shocks-developing-countries (accessed 11 October 2021).

Mbaye S, Moreno Badia M and Chae K (2018). Global Debt Database: Methodology and Sources. Working Paper No. 18/111. (accessed 11 October 2021).

Noor R (2019). Global Overview and Market Analysis of Green Bond. Available at https://climate.mit.edu/posts/global-overview-and-market-analysis-green-bond (accessed 23 October 2021).

OECD (2021). Development co-operation for a sustainable ocean economy 2021. Available at https://www.oecd.org/ocean/topics/developing-countries-and-the-ocean-economy/development-co-operation-sustainable-ocean-economy-2019.pdf.

OECD, IEA, and Eurostat (2004). Energy Statistics Manual. Available at https://www.iea.org/reports/energy-statistics-manual-2 (accessed 22 October 2021).

OECD and ITF (2018). ITF. Available at https://www.itf-oecd.org/transport-co2-paris-climate-agreement-ndcs (accessed 22 October 2021).

Oxfam (2020). Climate Finance Shadow Report 2020: Assessing progress towards the $100 billion commitment. Available at https://policy-practice.oxfam.org/resources/climate-finance-shadow-report-2020-assessing-progress-towards-the-100-billion-c-621066/ (accessed 23 October 2021).

Panizza UG (2008). Domestic and External Public Debt in Developing Countries. UNCTAD Discussion Paper No. 188. UNCTAD. Geneva. (accessed 11 October 2021).

Reinhart CM and Roghoff KS (2011). *This Time Is Different: Eight Centuries of Financial Folly*.

Robbins J (2020). Why Bioplastics Will Not Solve the World's Plastics Problem. Available at https://e360.yale.edu/features/why-bioplastics-will-not-solve-the-worlds-plastics-problem (accessed 22 October 2021).

Rodrigue J (2020). The Geography of Transport Systems. Available at https://transportgeography.org/ (accessed 22 October 2021).

Schipper L and Marie-Lilliu C (1999). Transportation and CO2 emissions : flexing the link - a path for the World Banlk. *undefined*.

Sims R et al. (2014). Transport, in Climate Change 2014, Mitigation of Climate Change. Contribution of working group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Working paper. Cambridge University Press. Cambridge (United Kingdom) and New York (USA. (accessed 24 October 2021).

TCFD (2017). Recommendations of the Task Force on Climate-related Financial Disclosures. Final Report-. Available at https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf (accessed 24 October 2021).

UNCTAD (2019a). *Trade and Development Report 2019: Financing a Global Green New Deal*. United Nations publication. Sales No. E.19.II.D.15. New York and Geneva.

UNCTAD (2019b). Trade and Development Report 2019: Financing A Global Green New Deal.

UNCTAD (2020a). SDG Pulse 2020. No. A/RES/71/313. United Nations.

UNCTAD (2020b). BioTrade Initiative. Available at https://unctad.org/topic/trade-and-environment/biotrade (accessed 10 June 2020).

UNCTAD (2020c). *Trade and Development Report 2020: From Global Pandemic to Prosperity for All: Avoiding Another Lost Decade*. United Nations publication. Sales No. E.20.II.D.30. New York and Geneva.

UNCTAD (2020d). External debt sustainability and development : July. Available at https://digitallibrary.un.org/record/3880639 (accessed 12 October 2021).

UNCTAD (2021a). Report of the Intergovernmental Group of Experts on Financing for Development on its fourth session. No. TD/B/EFD/4/3. 3. United Nations. Geneva.

UNCTAD (2021b). Economic Development in Africa Report 2021.

UNCTAD (2021c). Trade and Environment Review 2021 Trade-Climate Readiness for Developing Countries. No. UNCTAD/DITC/TED/2020/. UNCTAD.

UNCTAD (2021d). UNCTADstat: Statistical Database. Available at https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx (accessed 24 May 2021).

UNCTAD (2021e). Towards a harmonized international trade classification for the development of sustainable ocean-based economies.

UNCTAD (2021f). Practical implementation of core indicators for sustainable development reporting. No. UNCTAD/DIAE/ED/2020/2. UNCTAD.

UNCTAD (2021g). World Investment Report 2021: Investing in Sustainable Recovery. UNCTAD/WIR/2021.

UNCTAD (2021h). A European Union Carbon Border Adjustment Mechanism: Implications for developing countries. No. UNCTAD/OSG/INF/2021/2). UNCTAD.

UNCTAD (2021i). Trade and Development Report 2021: From Recovery to Resilience: The Development Dimension. UNCTAD/TDR/2021.

UNECE (2014). Available at https://unece.org/info/Statistics/pub/21901 (accessed 18 October 2021).

UNECE (2021). Available at https://unece.org/statistics/publications/CES-set-of-core-climate-change-related-indicators (accessed 18 October 2021).

UNFCCC (2021). National Inventory Submissions 2021. Available at https://unfccc.int/ghg-inventories-annex-i-parties/2021 (accessed 22 October 2021).

UNSD (2010). International Merchandise Trade Statistics: Compilers Manual, Revision 1. Available at https://unstats.un.org/unsd/trade/imts/methodology.asp (accessed 22 October 2021).

UNSD (2021a). Global Consultation on Climate Change Statistics and Indicators. Available at https://unstats.un.org/unsd/envstats/ClimateChange_globalconsultation.cshtml (accessed 23 October 2021).

UNSD (2021b). UN Comtrade Plus. International Trade Statistics Database. Available at https://comtrade.un.org/ (accessed 22 October 2021).

V20: The Vulnerable Twenty Group (2021). Statement of HPM to IPCC Report 2021. Available at https://www.v-20.org/our-voice/statements/chair/statement-of-hpm-to-ipcc-report-2021 (accessed 12 October 2021).

Vaughan A and Hillier D (2019). Ensuring impact: the role of civil society organisations in strengthening World Bank disaster risk financing - World. (accessed 12 October 2021).

Volz, U et al. (2020). *Climate Change and Sovereign Risk*. SOAS University of London.

Whitney A et al. (2020). State of Green Banks 2020. Rocky Mountain Institute. (accessed 12 August 2021).

Wilkinson E et al. (2021). Sustaining development in Small Island Developing States: a reform agenda. ODI Policy Brief. (accessed 12 October 2021).

World Bank (2021a). International Debt Statistics 2022. 207.

World Bank (2021b). World Bank. Available at https://www.worldbank.org/en/news/press-release/2021/07/19/world-bank-group-s-157-billion-pandemic-surge-is-largest-crisis-response-in-its-history (accessed 12 October 2021).

WWF (2019). Solving plastic pollution through accountability. Available at https://wwf.panda.org/wwf_news/?344071/Accountability-can-reverse-plastic-pollution-crisis-says-WWF-report (accessed 22 October 2021).