

**Research priorities may not align with the SDGs. Policy suggestions to steer them<sup>1</sup>**

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## Abstract

Most scientific research is concentrated in a few high-income countries and tends to focus on challenges that are not relevant to SDG challenges in low-income countries. Such unequal distribution of research efforts may be of little support to the SDGs. We show that countries' research priorities do not always align with their SDG challenges, which may hinder their capabilities to address them. Funders, donors and international organisations should seek to steer research priorities, including by consulting with a wider range of stakeholders and improving the assessment of research's (unequal) impact on societies.

## An uneven distribution of science and innovation may not support the SDGs

It is well known that most academic research is produced in high-income countries<sup>1</sup>. These are also the countries that rank highest in relation to the SDG targets (if we exclude SDGs 12 and 13).

Figure 1 maps the number of publications per capita across countries between 2001 and 2019 (top panel) and their SDG Index 2020 (bottom panel). The figure illustrates that most research is published in countries that face the smallest SDG challenges. Not surprisingly, the correlation between research output per capita and a country's ability to achieve the SDGs is positive (Figure A1).

[Figure 1 here]

What is the likelihood that such a large amount of research published in a few high-income countries, which nurture emerging technologies, will address the SDGs challenges of lower-income countries<sup>2</sup>? If they do, what is the likelihood that this research aligns with their national and local SDG and research priorities<sup>3</sup>? In the longer term, to what extent can reliance on foreign research contribute to building research capabilities in low-income countries, which may allow them to prioritise national and local SDGs priorities<sup>4-8</sup>?

Science and technology can contribute to addressing (and creating) societal challenges like those set out in the SDGs<sup>9</sup>, but scientific efforts are unevenly distributed with respect to the societal challenges they seek to address and they engender<sup>10</sup>. While it is likely that different challenges need a different amount and type of research, it is not obvious why the challenges of those most in need tend to be the least prioritised in research funding<sup>11-13</sup>.

In the context of the Global Goals, these least prioritised challenges are likely to coincide with the SDG targets. Examples include: health – where research efforts do not prioritise diseases that are more common in low-income countries<sup>14,15</sup>; agriculture – where research specialisation is only partially aligned with country priorities<sup>16</sup>; and the global production process – that focuses on the consumption patterns of the wealthiest rather than on global social needs<sup>17</sup>. Such imbalances are not solely driven by the economic incentives of private companies, they are also observed in publicly funded research<sup>18</sup>, despite the differing mission of public funders.

It has been argued that inequalities are an obstacle to achieving SDGs<sup>19,20</sup>. Such inequalities in research prioritisation may reproduce those inequalities<sup>21-23</sup>, making it even harder to address the SDGs. The observed concentration of research in few countries and

organizations is a challenge to reduce such inequalities, as low-income countries may need to rely on funder's and donors' capabilities and research agendas.

One possible way, perhaps over-simplistic, to break this vicious cycle, and improve science and innovation's contributions to the SDGs, is to better align research priorities to national and local SDG challenges<sup>24,25</sup>.

### **Do countries' research priorities align with their SDG challenges?**

In the [STRINGS \(Steering Research and Innovation for Global Goals\)](#) project, we analysed countries' research priorities in relation to SDGs since the launch of the UN 2030 Agenda (2015-2019), and whether this prioritisation aligns with their greatest SDG challenges.

To measure countries' research priorities in relation to SDGs we use a relative specialisation index (Balassa) computed using publication data from the Web of Science (WoS). Using the Balassa index, a country is considered to prioritise research related to a given SDG if their research portfolio includes more publications related to this SDG than the world average. To assign scientific publications to a specific SDG, we first built a query with a set of terms strongly associated with the SDG based on searches and text-mining techniques on a wide array of policy reports, grey literature, scientific publications, web forums and official UN sources<sup>26</sup>; we then used those SDG-related queries to search publications in 4013 research areas that are generated by citation relations between all WoS publications<sup>27</sup>. In this way we reduce the limitations of focussing on a specific set of keywords<sup>28</sup>, and include scientific publications that contribute to SDG-related research even when not using SDG specific language.

To measure the salience of SDGs across countries, we built an index per SDG that combines SDG target indicators from the [UN SDG database](#) and the [SDSN SDG Index](#). For each indicator we compute the distance with respect to countries that are closer to meeting the SDG target. We then computed a country-SDG index normalised between -1 and 1 using principal component analysis. A value closer to 1 indicates that the country is facing a relatively higher challenge with respect to the SDG.

Figure 2 and Figure 3 provide two different examples, from India and Ethiopia. Figure 2 panel (a) plots the main challenges in India between 2010-2017, in relation to other countries. These are SDG 2 (zero hunger), SDG 5 (gender equality), SDG 6 (clean water and sanitation), SDG 9 (industry, infrastructure and innovation), SDG 11 (sustainable cities), SDG 14 (life below water) and SDG 15 (life on land). Figure 2 panel (b) plots the areas in which Indian researchers are specialised, in relation to other countries: SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy) and SDG 12 (responsible consumption and production). At a country level, since 2015, India seems to be focussing on building research capabilities only related to one major challenge, SDG 6.

Figure 3 plots the main challenges (a) and research priorities (b) for Ethiopia. In this case, results suggest that the country is building research capabilities in all its main SDG challenges, with the exception of SDG 7 (affordable and clean energy).

[Figure 2 & Figure 3 here]

We tested the relation between research priorities (2015-2019) and SDG challenges (2008-2017) across all countries, for all SDGs. Table 1 reports the pairwise correlation, suggesting that countries facing a major challenge in relation to SDGs 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), and 6 (clean water and sanitation), tend to prioritise research on those SDGs. This is, for example, the case for research in agriculture (SDG2) and health (SDG3), where historically low-income countries tend to focus their research efforts, in collaboration with foreign funders (Figures 2A and 3A).

[Table 1 here]

However, for all other SDGs, the correlation is either zero or negative. This suggests that countries facing challenges in relation to, for example, education, gender equality, access to energy, responsible consumption and production, and climate action, do not prioritise research that addresses those challenges. This is, for example, the case of SDGs 12 and 13, where high-income countries, which are also the major polluters, do not prioritise research to address these challenges (Figures 4A and 5A).

### **Policy recommendations**

Research on emerging technologies opens great opportunities and challenges. How can we steer research priorities so that both opportunities and challenges prioritise global, national and local SDG priorities across low-income countries?

There are several factors that explain why research prioritisation is less aligned with the societal challenges of the people who are most in need.

R&D priorities emerge as the outcome of the interaction of several, competing and related actors<sup>29</sup>, technologies<sup>30</sup>, socio-economic conditions<sup>31,32</sup>, politics<sup>33</sup> and science communities<sup>34</sup>.

SDGs are also a complex system, constituted by a large set of targets that relate in positive and negative ways<sup>35,36</sup>. This is at odds with research, which instead advances mainly through specialisation<sup>37,38</sup>.

Research and SDG priorities are both global and local, and they differ at multiple levels. Different stakeholders, policy makers, users, citizens and scientists hold different views on which research and SDG targets to prioritise, in which area, and how<sup>39,40</sup>. Those actors differ substantially in their power to influence research funding<sup>41,42</sup> and different societal groups are unequally (or not at all) represented in research funding decision making<sup>43,44</sup>. Path dependency also provides a strong advantage to incumbent technologies and research trajectories<sup>45,46</sup>.

Research evaluation tend to focus on a narrow understanding of research excellence and productivity ([DORA](#)), rather than on its impacts on societies<sup>47,48</sup> partly because due to the above complexities these are not straightforward to assess.

Here, the [STRINGS](#) report will provide evidence and policies to orient research and innovation towards the SDGs, across different contexts.

The above factors suggest a number of opportunities for funders, donors and international organisations to steer research towards the SDGs.

Prioritisation needs to reflect the views of different communities across different contexts, especially those that may benefit from or suffer the negative consequences of research and innovation. For instance, in STRINGS we are running a large Delphi survey across contexts and stakeholders, to capture the breadth of views on what research and innovation areas may contribute to SDGs in the future. Such exercises could be done in a systematic way at different levels.

Research funders may need to prioritise open and transdisciplinary research to maximise impact on the SDGs ([Arza and Colonna, 2020](#)), which also requires a different system of incentives for researchers and research evaluation<sup>49</sup>. This should also improve our understanding of the synergies and trade-offs between different research trajectories.

Funding may need to consider the role of research in generating capabilities for local actors to address challenges, and how it relates to existing, often not well mapped knowledge<sup>50</sup>, rather than focusing exclusively on the cure to the challenges ([Chataway and Ciarli, 2020](#)).

Policy needs to facilitate plural perspectives and pathways<sup>51</sup> in steering research towards the SDGs. It should recognise and nurture the multiple ways in which different perspectives characterise the SDGs and what research is closely related to them, in positive and negative ways ([Ràfols, 2020](#)), and which direction should be prioritised. Rigorous, transparent and more democratic global, national and local dialogue between different interest groups and stakeholders is central to aligning research priorities with challenges ([Arora and Stirling, 2021](#)).

All the above suggests that policymakers do not have an easy task to improve how research is prioritised to better contribute to the SDGs. But complexity is a feature of both the research and the SDGs systems, and should be taken on board, better understood, and leveraged, rather than oversimplified<sup>52</sup>. “The link between knowledge and action is not automatic, and needs to be cultivated, supported and steered to where it is most needed. Science can inform policy, but policies can (and should) direct science towards the greater (and more equal) good” ([Assa, 2020](#)).

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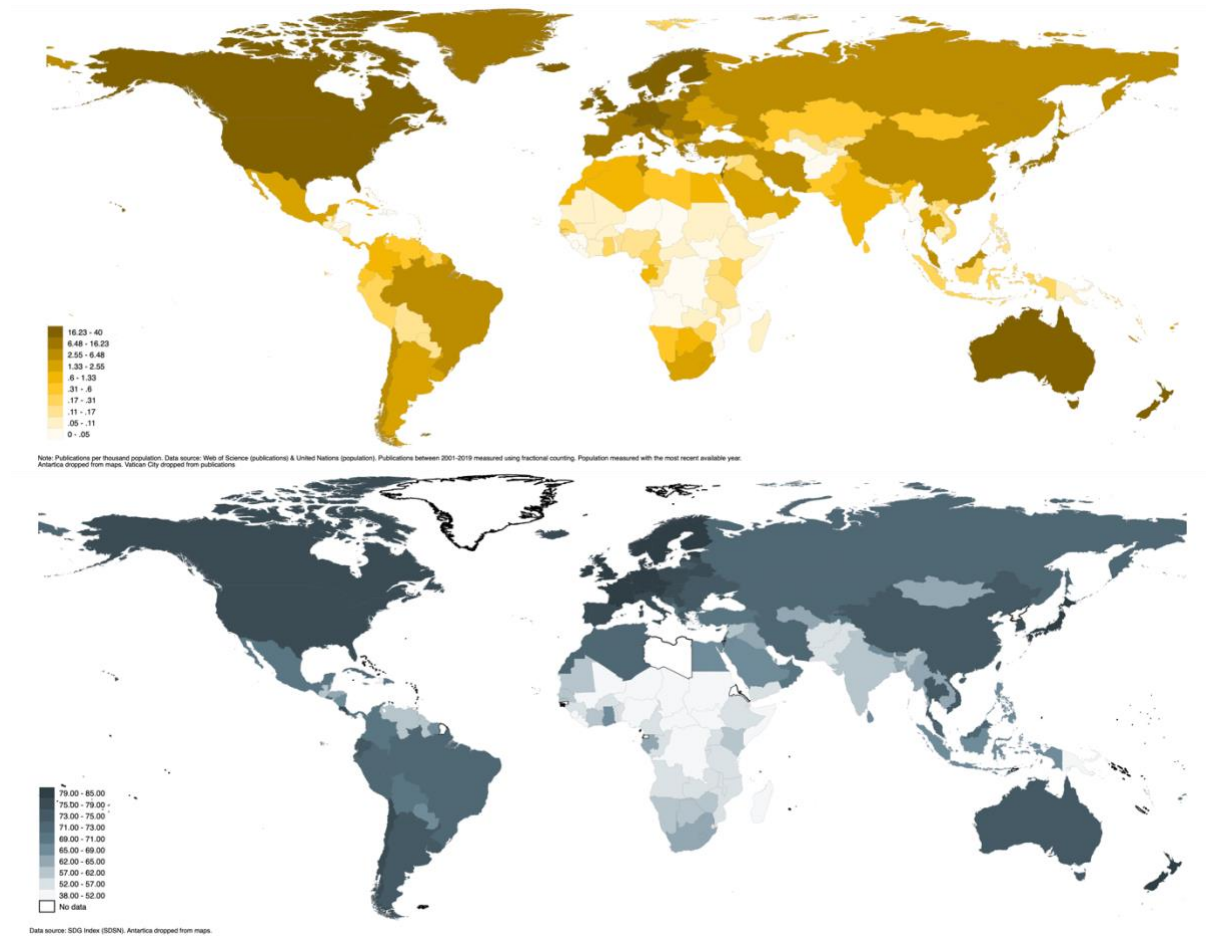
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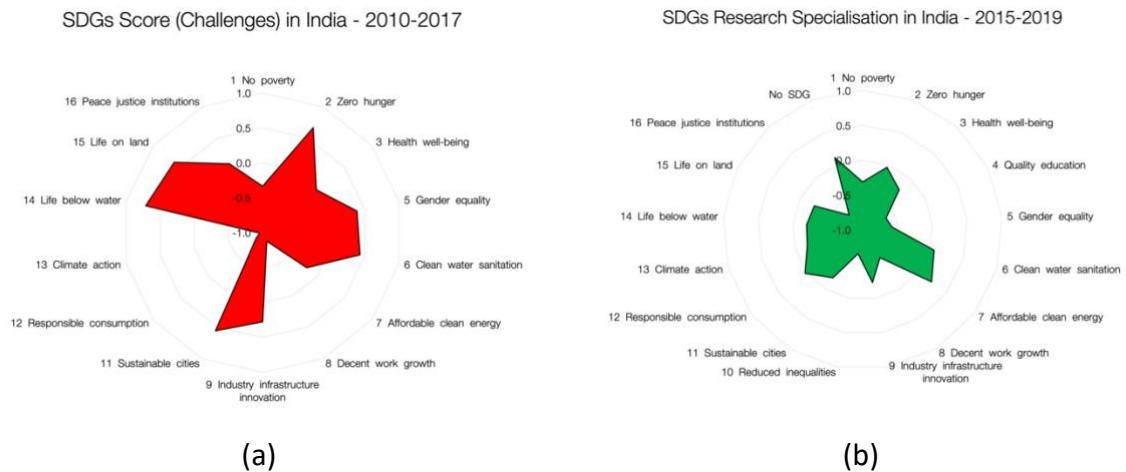
## Figures and Tables (text)

### Figure 1: Publications and the SDG Index



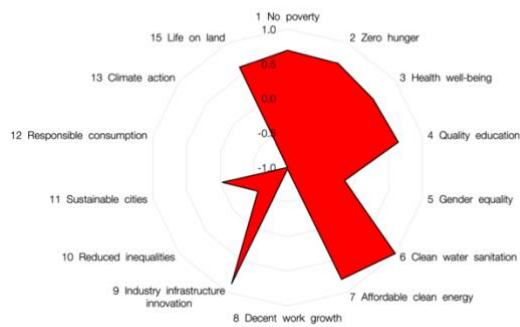
**Notes.** Top panel: number of publications per capita (using fractional counting for publications co-authored across different countries). Bottom panel: SDG Index 2020

### Figure 2: Alignment of research & SDG challenges (India)



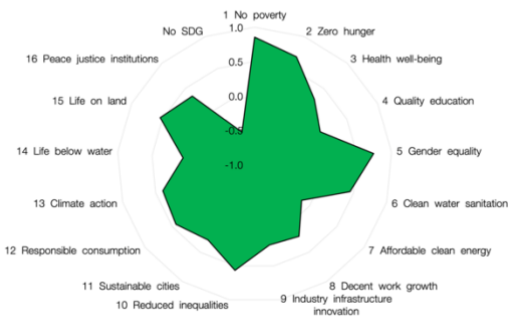
**Figure 3: Alignment of research & SDG challenges (Ethiopia)**

SDGs Score (Challenges) in Ethiopia - 2010-2017



(a)

SDGs Research Specialisation in Ethiopia - 2015-2019



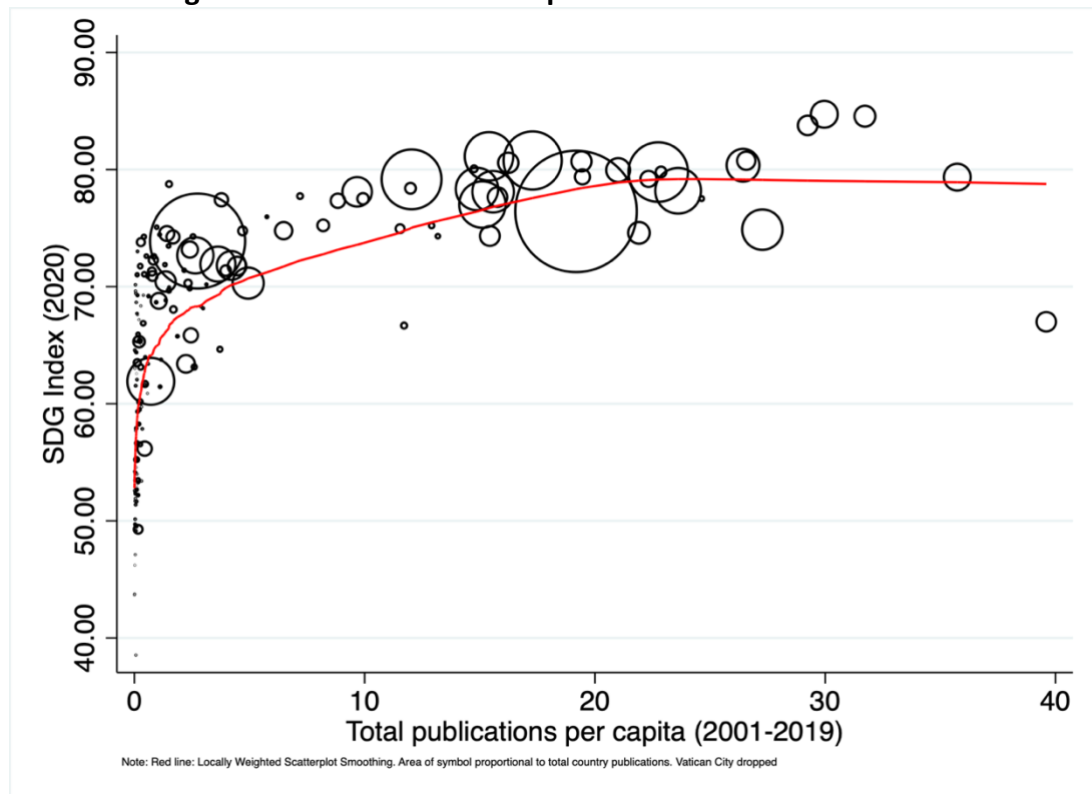
(b)

**Table 1: Pairwise correlation of SDG challenges (2008-2017) versus SDG research priorities (2015-2019) in all SDGs**

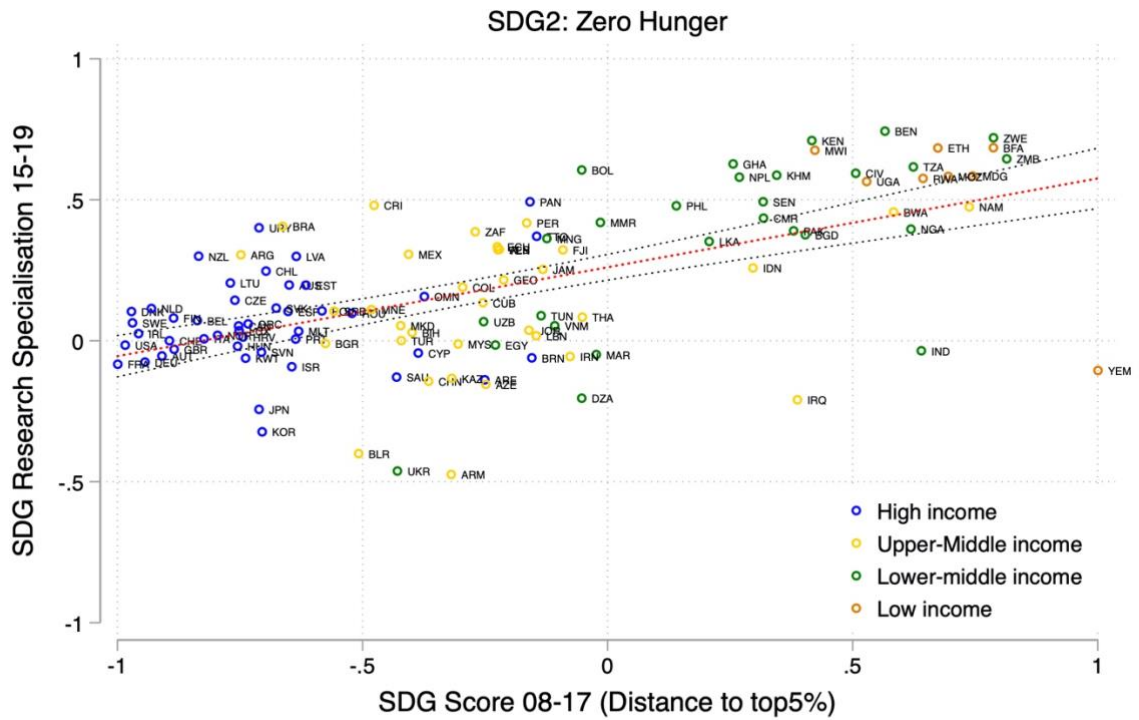
	Score_SDG1	Score_SDG2	Score_SDG3	Score_SDG4	Score_SDG5	Score_SDG6	Score_SDG7	Score_SDG8	Score_SDG9	Score_SDG10	Score_SDG11	Score_SDG12	Score_SDG13	Score_SDG14	Score_SDG15	Score_SDG16
Research specialisation SDG1	0.65	0.71	0.59	0.08	0.63	0.56	-0.32	0.16	0.07	0.43	0.28	0.37	0.45	0.23	0.49	0.35
Research specialisation SDG2	0.49	0.60	0.28	-0.01	0.43	0.67	-0.04	0.07	0.03	0.21	0.26	0.39	0.36	0.17	0.36	0.16
Research specialisation SDG3	0.52	0.64	0.36	-0.05	0.46	0.61	-0.22	0.08	-0.04	0.26	0.16	0.31	0.34	0.16	0.40	0.23
Research specialisation SDG4	0.36	0.57	0.30	-0.27	0.31	0.57	-0.12	-0.08	-0.10	0.04	0.06	0.24	0.24	0.06	0.25	-0.01
Research specialisation SDG5	-0.24	-0.06	-0.09	-0.33	-0.20	0.22	0.30	-0.33	-0.17	-0.39	-0.07	-0.03	-0.32	-0.34	-0.39	-0.43
Research specialisation SDG6	0.56	0.70	0.42	-0.08	0.48	0.64	-0.26	0.08	-0.03	0.28	0.20	0.35	0.44	0.25	0.50	0.21
Research specialisation SDG7	0.69	0.74	0.56	0.12	0.66	0.60	-0.29	0.28	0.13	0.49	0.34	0.42	0.53	0.35	0.57	0.41
Research specialisation SDG8	-0.49	-0.54	-0.27	0.10	-0.37	-0.47	0.20	-0.09	-0.01	-0.26	-0.13	-0.28	-0.30	-0.14	-0.39	-0.18
Research specialisation SDG9	0.35	0.55	0.04	-0.02	0.24	0.59	-0.12	0.06	-0.05	0.09	0.17	0.22	0.39	0.23	0.37	0.08
Research specialisation SDG10	0.40	0.55	0.28	0.20	0.31	0.47	-0.15	0.12	0.00	0.23	0.10	0.27	0.48	0.44	0.50	0.21
Research specialisation SDG11	0.32	0.46	0.29	-0.22	0.28	0.52	-0.08	-0.07	-0.07	0.06	0.15	0.21	0.14	-0.01	0.17	-0.01
Research specialisation SDG12	-0.50	-0.61	-0.34	0.13	-0.42	-0.51	0.21	-0.06	0.02	-0.22	-0.14	-0.32	-0.31	-0.14	-0.37	-0.17
Research specialisation SDG13	-0.39	-0.60	-0.26	0.18	-0.30	-0.51	0.23	0.02	0.10	-0.11	-0.03	-0.26	-0.30	-0.16	-0.40	-0.07
Research specialisation SDG14	0.02	0.14	-0.20	-0.13	-0.10	0.37	0.14	-0.16	-0.15	-0.20	-0.03	0.03	-0.01	-0.02	-0.02	-0.24
Research specialisation SDG15	-0.10	-0.02	-0.20	-0.25	-0.07	0.14	0.12	-0.34	-0.39	-0.23	-0.19	-0.18	-0.15	-0.14	-0.16	-0.16
Research specialisation SDG16	0.29	0.45	0.02	-0.19	0.07	0.48	-0.11	-0.12	-0.18	-0.07	-0.08	0.14	0.26	0.23	0.35	-0.09

## Figures and Tables (Annex)

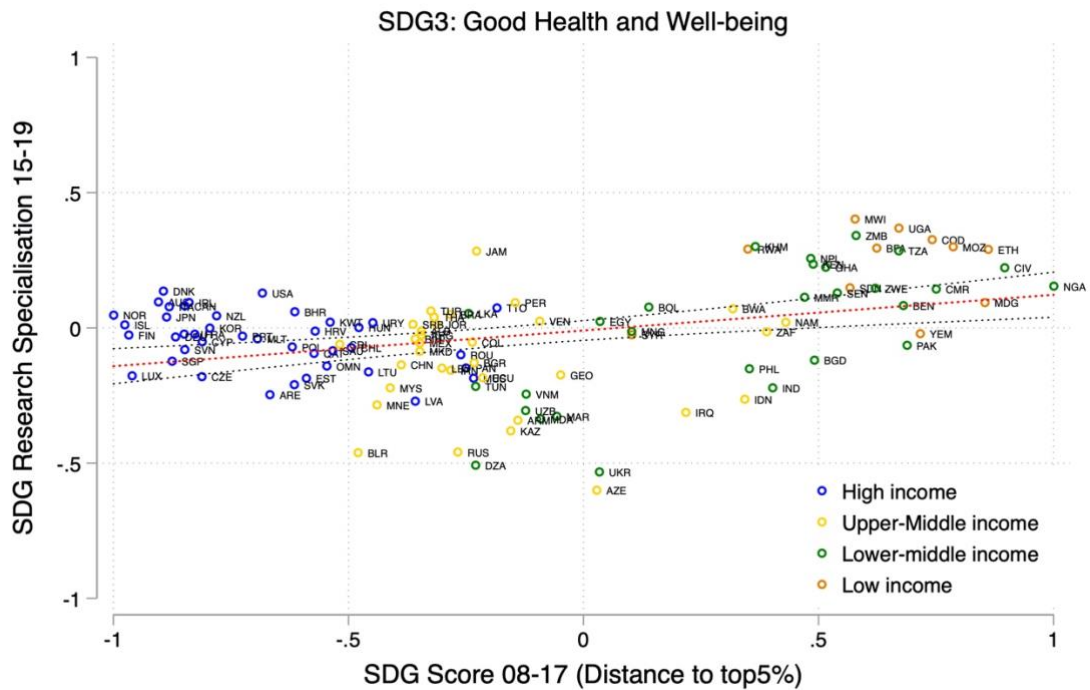
Figure 1A: Relation between publication and the SDG index



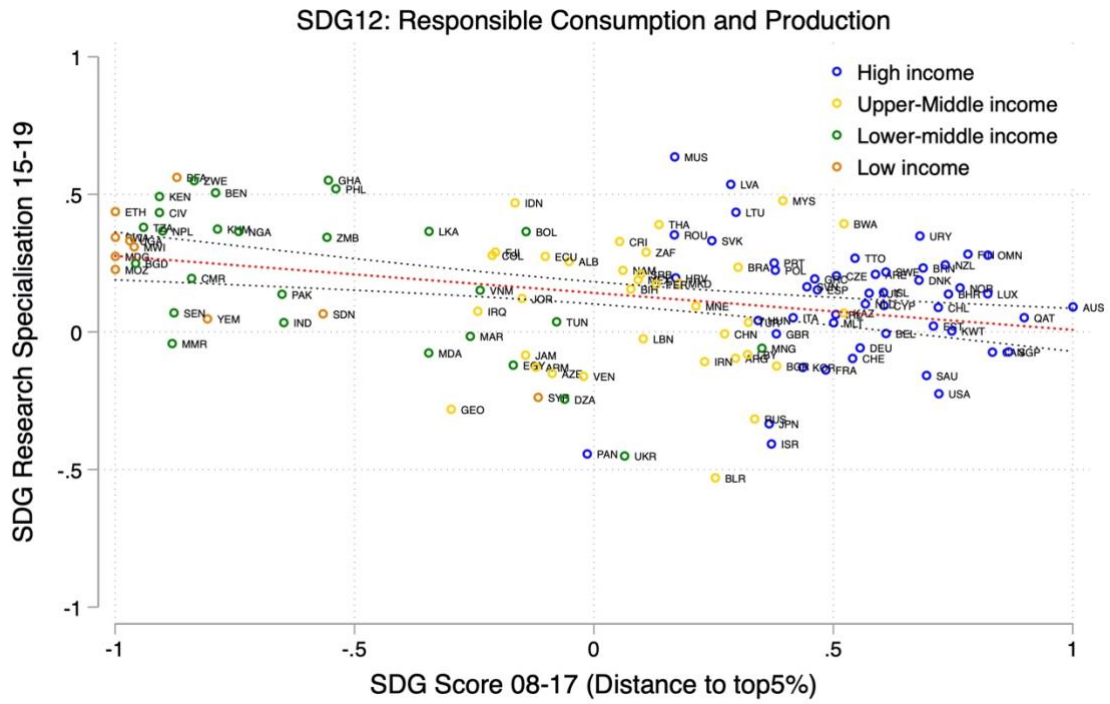
**Figure 2A: Relation between the severity of the challenges and research specialisation (SDG2)**



**Figure 3A: Relation between the severity of the challenges and research specialisation (SDG3)**



**Figure 4A: Relation between the severity of the challenges and research specialisation (SDG12)**



**Figure 5A: Relation between the severity of the challenges and research specialisation (SDG13)**

