Implications of cross-disciplinarity.

Estimating the "paper drain" in Development Studies

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Abstract.

Why does the cross-disciplinary field of "development studies" have relatively low "journal impact indicators" in comparison with other mono-disciplinary fields of study? We argue that a reasonable explanation is the existence of a "paper drain" phenomenon: a certain proportion of the papers dealing with development is eventually published in journals that are assigned to other (non-development) fields.

We conceptualize the paper drain phenomenon and empirically estimate its size for the field of development studies. Running an algorithmic procedure on the Scopus database, we identify six "key development issues" and estimate that the subject category of "development" is approximately publishing 28% of the papers dealings with these issues within the Social Sciences. The remaining 72% are "draining" to other (non-development) categories. We offer some recommendations in order to rise the scientific impact (and influence) of development studies, such as increasing the number of journals covered by the impact indicators.

1. Introduction

"Development studies" is a cross-disciplinary (multi- and interdisciplinary) field of study, and hence not a discipline. The main feature of "cross-disciplinary research" is the

combination of different scientific paradigms (i.e. the set of concepts that define a scientific discipline) form various disciplines that cooperate in order to produce new (relevant) knowledge.

The aim of this paper is to offer a reasonable explanation on why the cross-disciplinary field of development studies has relatively low journal impact indicators in comparison with other mono-disciplinary and/or basic research fields of study. In order to do so we conceptualize a "paper drain" phenomenon, which implies that a certain proportion of the papers dealing with development issues is eventually published in journals that are assigned to other fields of study. The paper drain is reinforced by the extensive use of "journal impact indicators", which do not only measure the level of influence of academic journals, but also assign the journals to different fields of study —the so-called "subject categories". An important consequence of this classification of journals into subject categories is the growing competition across fields of study for attracting potentially influential articles (i.e. papers that may be highly cited), which is a distinctive trait of the so-called "academic capitalism". And this competition for articles is especially acute in the case of development studies, as the object of analysis (in general terms, the process of development) is of common interest for other fields.

In practical terms, we empirically estimate the size of the paper drain for the specific field of development studies and for the period 2007-2016. We run an algorithmic procedure for gathering the ample bibliometric information provided by *Scopus*, which is used to compute one of the main international citation indexes: the *Scimago Journal Rank* (SJR). According to our review of the specialized literature, this is the first attempt to estimate this phenomenon in any cross-disciplinary field of study.

The analysis tries to answer the following three consecutive research questions:

- Firstly, which are the most frequently addressed topics among development journals? Answering to this question will allow us to identify six "key development issues" in terms of their influence and frequency of use across development journals.

- Secondly, are there many influential articles that deal with these six key development issues but are not published in development journals? The estimation of this body of literature will be used as an approximation to the relative size of the paper drain from the development subject category to other non-development categories.

- And thirdly, in which fields of study are finally published these papers that deal with the six key development issues? This information will help us identify the most influential subject categories that deal with development issues.

The paper is structured as follows: after this introduction, the second section briefly explains the main features of cross-disciplinary fields of study, and exemplifies it for the field of "development studies". The third section explains the paper drain and the procedure that we implement in order to estimate its size in the *Scopus'* subject category of "development". The fourth and fifth sections, respectively, describe the main features of the "development" and the "non-development" subject categories, and identify six "key development issues" in terms of their influence and frequency of use (these are "governance", "poverty", "developing world", "sustainable development", "gender" and "inequality"). The sixth section estimates the magnitude of the paper drain in the subject category of development. We conclude summarizing the main results and offering some recommendations in order to increase the scientific impact of development studies.

2. Cross-disciplinary fields of study: the case of development studies

Before understanding what a "non-disciplinary" field of study is, it is necessary to define the concept of "scientific disciplines". The American physicist and historian of Science, Thomas Kuhn, offered a pioneer definition based on the concept of "paradigm". According to Kuhn (1962), a "scientific paradigm" is a set of concepts and practices that define a "scientific discipline" at any particular period. More precisely, in his influential book *The Structure of Scientific Revolutions*, Kuhn (1962: 10) defined a scientific paradigm as "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners". In line with Kuhn, the OECD's (1972: 83) report on *Interdisciplinarity: Problems of Teaching and Research in Universities* defined disciplinarity as "the specialised scientific exploration of a given homogeneous subject matter producing new knowledge and making obsolete old knowledge".[i]

So, in this context, what is cross-disciplinarity? This is a polysemic concept that needs clarification, as there are many related concepts —such as multi-, inter- and trans-disciplinarity— with important differences. These terms are generally conceived in contrast to what Kuhn defined as "normal Science" (i.e. disciplinary knowledge). If a disciplinary research field is understood as a group of researchers that share a paradigm, the generic term of "cross-disciplinary" research should be understood as a combination of different paradigms, form various disciplines, that cooperate in order to produce new knowledge. In this context, the OECD (1972: 136-138) offered a clear distinction of three

levels of cross-disciplinarity in increasing order of interaction between their disciplinary components:

- *Multidisciplinarity* occurs when the solution to a problem makes it necessary to obtain information from two or more disciplines without the disciplines drawn on thereby being changed or enriched. This is the case when research teams are formed with a cross-disciplinary objective and keep their discussions on the level of mutual and cumulative information but without any actual interactions. Its impact in terms of knowledge creation is, therefore, additive.[ii]

- *Interdisciplinarity* occurs when there is cooperation among various disciplines that leads to actual interactions and to certain reciprocity of exchanges resulting in mutual enrichment. Therefore, interdisciplinary researchers are knowledgeable within more than one discipline, and the results of their study of a certain problem are more coherent and integrated. Its impact in terms of knowledge creation is —potentially— multiplicative.[iii]

- *Transdisciplinarity* occurs when the interactions between disciplines derive in a "total system" without any firm boundaries between disciplines. Therefore, transdisciplinarity results in overcoming the original disciplines and founding a new meta-discipline.[iv]

A good example of cross-disciplinarity is the field of "development studies". Its cross-disciplinary character has been regarded as an advantage, as it seems to be the most appropriate research strategy for understanding the multidimensional process of progress of human societies (EADI, 2005; Hulme and Toye, 2006; Sumner and Tribe, 2008; Domínguez, 2012; Potter, 2014; Monks et al. 2017). In this line, the renewed definition

elaborated by the European Association of Development Research and Training Institutes (EADI) conceives development studies as "[…] a multi- and interdisciplinary field of study that seeks to understand social, economic, political, technological, ecological, gender and cultural aspects of societal change at the local, national, regional and global levels, and the interplay between these different levels and the stakeholders involved" (Monks *et al.*, 2017: 13).

In sum, development studies is a cross-disciplinary academic field of study (multi- or inter-disciplinary depending on the level of integration of the different disciplines), and thus not a discipline, as it is characterized by a diversity of paradigms, mainly within the Social Sciences (such as Sociology, Political Science, Economics, Anthropology, International Relations and Geography). Moreover, its cross-disciplinary character is further reinforced by the application of a "problem driven research approach", which requires integrating scientific paradigms from different disciplines.

3. The paper drain

One implication of cross-disciplinarity is the emergence of what we call the "paper drain", which occurs when a certain proportion of papers dealing with the research object of a specific field of study is eventually published in journals that are assigned to other fields of study. This phenomenon is exacerbated by the wide use of "journal impact indicators", which measure the level of influence of academic journals, but also classify journals into different fields of study —the "subject categories".

In order to comprehend the dynamics of papers moving (or draining) from one field into another it is important to understand first which is the logic for defining the boundaries of these fields of study. As Calhoun (2017) points out, in the case of Social Science the distinction between disciplines has been historically forged and the result is, to some extent, arbitrary, as the resulting disciplines have been reinforced with the creation of specific university Faculties and departments, and scientific publications.

In the case of scientific publications, we have tracked back the theoretical foundations of distinguishing between disciplines (or subjects). Back in 1934, the British mathematician and librarian Samuel C. Bradford introduced the concept of "nucleus journals", which are those more closely related to a specific subject —because they are source of many references— and thus provide a clear picture about the distribution of references in a specific field of study. Given a specific topic, the so-called *Bradford's law* determines a quantitative relationship between the references and the scientific journals included in a bibliography (Bradford, 1934). Considering a long period, the law predicts an unequal distribution of the references into three groups: the first one is a small group of journals that collects most of the references in that specific subject; the second is composed of a little collection of journals that accumulates a significant number of citations at a lineal (decreasing) rate; and thirdly, an ample group of journals where references are highly scattered. Therefore, Bradford's law predicts that if journals in a field are sorted by number of articles into three groups, each with about one-third of all articles, then the number of journals in each group will be proportional to $1:n:n^2$ (where n is characteristic of each specific subject). The practical advantage of this law is that knowing this asymptotic behaviour is useful in order to define the boundaries between fields of study and thus to classify them.

Bradford's law is important to our research because the definition of boundaries across fields of study is precisely what determines the possibility that some papers move from one field into another (i.e. the paper drain). In a more updated terminology, the classification of "subject categories" (what Bradford identified as nucleus journals) is essential for building a journal impact factor, which is the most widely used scientometric indicator. The impact factor represents the average number of times that the papers published in a particular journal are referenced (cited) by other papers.[v] Despite its advantages in terms of measuring academic "influence", one major technical critique is that impact factors vary ostensibly across different fields of study, and hence they are not directly comparable. As Cross (2014: 6) clearly warns, it is only at the level of subject categories that journals should be ranked according to their impact factors.

An important consequence of this classification of journals into subject categories is the growing competition across fields of study for attracting potentially influential articles (i.e. papers that may be highly cited), which is a distinctive trait of the so-called "academic capitalism".[vi] And this competition for articles is especially acute in the case of cross-disciplinary fields of study, as their object of analysis is of common interest for other fields. This is the case of development studies where, because of this competitive process, some papers dealing with development issues are draining to other fields of study than development.

There are a number of reasons why development researchers may send their papers to "non-development" journals, thus contributing to the paper drain.

Firstly, the professional incentive that many academics have to publish their papers in journals with very high ranks in the international impact indicators (especially in those journals located in the two first quartiles of the rankings). This incentive is reinforced by the national accreditation systems across the world, which heavily rely on impact indicators for the evaluation of the research quality.

Secondly, the fact that the main international impact indicators have a particularly low coverage of journals in the development subject category in comparison with other categories (Tezanos and Trueba, 2019). This means that many papers eventually drain from development to other categories with wider coverages because there is actually very little room for publishing in the very few development journals that are ranked in the first and second quartiles.

Thirdly —and derived from the previous argument—, the scarce supply of high impact development journals means that the chances of acceptance of a paper are lower in the development subject category than in other categories with greater supply of journals.

In order to estimate the magnitude of the paper drain in the development subject category we have two available bibliometric databases, provided by the two main (and competing) international citation indexes in Social Sciences: the *Social Science Citation Index* (SSCI) produced by Clarivate Analytics, and the *Scimago Journal Rank* (SJR) produced by Elsevier. On the one hand, the SSCI provides bibliographic information developed from the *Web of Science*, which includes over 3,000 Social Sciences journals (which are grouped in 55 "subject areas" and 177 "subject categories"). On the other hand, the SJR provides indicators developed from the information contained in the *Scopus* database,

which includes over 22,000 journals (not only Social Sciences) that are grouped in 27 major thematic areas (subject area) and 313 subject categories.[vii]

We choose to analyse the *Scopus* database because of two main reasons:

Firstly, because it offers a wider coverage of development journals than the *Web of Science*.[viii] In fact, whereas the 2016 edition of the SJR's subject category of "development" included 195 journals, the SSCI's category of "planning and development" only had 55 journals[ix]. We therefore empirically assess the cross-disciplinary field of development studies using the *Scopus'* subject category of "development" as a proxy.

Secondly, because the *Scopus* database is open and, therefore, we can retrieve the data directly from the website. However, the *Scopus* database limits the data download and the quantity of detail with an immediate accessibility. For this reason, the information collection has required different scripts of data capture in order to build a complete database. These scripts are based on automatic robot navigation, employing macros of the *i-macros* software (Progress Software Corporation, 2021) and javascript language, which allows us to cover the entire database and export it to a set of files in a more useful csv format. From these csv files we extract the most relevant fields of research and we use different scripts (mostly in bash and python language) to re-organize the ample information in a set of new files.

This procedure allows us to download all the articles published by the 195 development journals between 2007 and 2016. We focus our analysis on the following 11 bibliographic

items: journal title, article title, year, abstract, author keywords, index keywords, citations, Digital Object Identifier (DOI), *Scopus'* Electronic Identifier Document (EID), and International Standard Serial Number (ISSN). Although *Scopus* collects different types of publications, we limit our analysis to "articles", which results in a sample of 57,593 items.

Once the data is collected and processed for the period (2007-2016), the analysis is performed in the following three consecutive steps:

Firstly, we carry out a descriptive analysis of the 57,593 articles that were published in the 195 journals included in the development subject category. This allows us to identify distinctive characteristics for the quantification of impact indicators, and to detect six "key development issues" in terms of their influence and frequency of use. To achieve this, we identify the most frequently used words in the articles' titles, author keywords, index keywords and abstracts. Similar approaches have been used in the informetric literature in order to study the structure and relations between cross-disciplinary fields of study (see Bordons et al., 2004)[x]. Although there are over 18,500 words that are repeated more than once, we were able to identify six "key development issues" which were especially influential.

Secondly, we analyse the 252,404 articles that deal with the above-mentioned six key development issues but were published in journals included in "non-development" subject categories. This body of literature is an approximation of what may constitute the paper drain of the development subject category.

And, thirdly, we identify in which fields of study were finally published those papers that deal with the six key development issues and estimate the percentage of papers that may be draining from the development subject category into other subject categories.

Before closing this section, it is worth highlighting two limitations of the *Scopus* database:

On the one hand, the subject categories for a journal are assigned by *Scopus'* Content Selection and Advisory Board (CSAB) during the title evaluation process, and a journal can simultaneously appear in several subject categories.[xi] Nevertheless, journals' editors are able to add or remove subject categories after the CASB decision (although they need *Scopus'* approval for these changes). As we will see later on, we have detected a certain level of "laxity" in the categories allocation process that is coordinated by *Scopus*, as we have found several journals in the development category that only sporadically deal with development issues.

And, on the other hand, despite being an extensive and complete record, the *Scopus* database has some errors due to the disappearance of some journals during the analysed period, the change of some journals' titles or adscription areas, the presence of articles with inadequate or insufficient information, and the existence of problems in the processing of data. We have minimized these errors by carefully detecting and deleting the inconsistencies; consequently, the weight of the errors is within reasonable limits.

In any case, as Bordons et al. (2004) argue, the SJR is one the most useful indicators for studying cross-disciplinarity and the boundaries of the areas; and, therefore, it is also useful for analysing the paper allocation across different subject categories.

4. Main issues of the "development" subject category

Figure 1 illustrates the evolution of the number of development articles that were published between 2007 and 2016. This number has steadily grown until 2013, and it has stabilized since then. Overall, this field has experienced a 3.5% cumulative annual growth during this period. The maximum number was reached in 2013, with almost 6,500 articles. Despite this growth, the development subject category is still a minor component of Social Sciences, as it actually accounts for 5% of the papers included in this subject area.

Figure 2 represents the citations and the citations per article by year of publication of the papers included in the subject category of "development" between 2007 and 2016. In both cases the series decrease overtime in a practically linear way. These downward tendencies are logical as "younger" papers have had less time to be cited. Even though this figure does not allow us to identify the optimal "citation window" in development studies (i.e. the period during which citations are counted), it clearly shows that development papers tend to be cited over long periods and this fact involves a clear disadvantage with the computation of impact indicators, which use very short citation windows[xii]. In fact, as Tezanos and Trueba (2019) show, short citation windows are not beneficial for Social Sciences' fields of study. In the particular case of development studies —according to these authors' calculations—, even with the five-year citation window of the SSCI, over two thirds of citation are still neglected in development studies.

Figure 3 shows the top-20 journals in the development subject category according to the number of citations received during the period 2007-2016. Although the citations are not concentrated in a single journal, the top-5 journals received 28.6% of the total citations of this subject category[xiii].

It is striking that, among the 20 most cited journals in the development category, some of these journals only sporadically deal with development issues (such as *Nanomedicine* and *Social Neuroscience*). As mentioned before, journals can simultaneously appear in several *Scopus'* subject categories and journals' editors are able to add subject categories to those previously allocated by *Scopus*. This implies that some journals may choose to appear in the development category if it involves being allocated in an impact quartile that is higher than their position in other subject categories[xiv]. This laxity in the process of allocating journals to subject categories is an important limitation of the *Scopus* database that should be bore in mind when interpreting these data and it is also a factor that reinforces the paper drain phenomenon.

Next, we identify the articles that received the highest number of citations (**Table 1).** A striking result is that most of the articles were published more than three years ago. This means that many papers are receiving citations outside the SJR's three-year citation window and thus not all citations are contributing to increase the journals' impact indicators[xv]. This mismatch between the long citation history of development articles and the short citation window of the impact indicators may also stimulate journals' editors to favour papers with —potentially— more immediate citations (i.e. those which may contribute to the journal's impact indicator) against those articles with potentially longer periods of citation.

A relevant question for our analysis is: which are the most frequently addressed issues in the development subject category? In order to address this question, we identify the most frequently used words in the articles' titles, author keywords, index keywords and abstracts. Although there are over 18,500 words that are repeated more than once, we were able to identify six "key development issues" which were especially influential.

Three caveats of this procedure should be considered:

Firstly, these key issues are generic and thus they are not exclusively used in development studies. To minimise this problem, we discarded those words that were too generic and weakly related to development studies (such as "article", "China", "paper" and "research").

Secondly, there are many words which revolve around the same issue (some of them are synonyms or mere variations in writing) so we simplified the database by grouping similar words into a common concept (see **Table 2**).

And thirdly, the frequency distribution of the keywords has a heavy tail. In particular, most of the keywords only have a single repetition (67.26%), or two repetitions or less (78.89%). This distribution raises two obvious problems: on the one hand, with a low number of repetitions we cannot ensure that these words are meaningful and, even if they were clearly related to development issues, they would be too specific for our analysis. Furthermore, the inclusion of all the words related to development (irrespectively of their frequencies of use) would increase the statistical error of the analysis[xvi]. Therefore, the

resulting list of "key development issues" is just a sample of the wider universe of issues that are debated in the development subject category.

In order to minimize the three above-mentioned difficulties, we run the following process, using the ranking of words (which we previously debug by deleting those words with low repetitions and excessively generic meanings): we assign each word (starting with the most used one) to a "thematic group" (what we call a "key development issue"); and for those words that do not fit any thematic group, we create a new group. This procedure is iterated until the top of the distribution is left.

Our statistical aim is, therefore, to select the key development issues from the top of the words' distribution (i.e. those with higher frequencies of use). These terms are those that appear most frequently in the literature associated with the development category, which ensures that these papers are closely linked to development studies. We limited the selection of terms in order to reduce the noise as much as possible and in order to eventually identify the existence of a paper drain phenomenon without ambiguity.

As a result of this procedure, we identify six key development issues: "governance", "poverty", "developing world", "sustainable development", "gender" and "inequality". These key issues are listed in **Table 2** with their corresponding associated words. A striking result is that some issues have a long list of related words (governance, poverty and gender), while others are identified with just a few words (inequality and sustainable development).

5. Main features of the "non-development" subject categories that deal with development issues

For the period 2007-2016, we identify 252,404 articles in the *Scopus* database that deal with the six key development issues but were published in other subject categories than development. In particular, we focus our attention on these articles' "titles", "abstracts", "author keywords" and "index keywords". Among these articles, 19% deal with issues related to governance, 15% with poverty, 24% with developing world, 18% with sustainable development, 20% with gender and 4% with inequality. This body of literature constitutes an approximation of what may constitute the paper drain of the development subject category.

In a time perspective, the number of development papers published in non-development subject categories is growing faster than the number of papers of the development subject category, thus increasing the gap over time (**Figure 4**).

Moreover, in terms of the evolution of the number of citations and citations per article (**Figure 5**), the trends of the "development" and "non-development" subject categories (for the six key development issues) are similar. Nevertheless, non-development journals have —on average— higher citations per article than development journals, which implies that if development journals increased their capacity to attract some of these "outside" articles, their impact indicators would significantly increase (and the paper drain would be minimized).

So, more in detail, which are the journals dealing with development issues that receive the highest number of citations? **Table 3** and **Table 4** identify these journals, distinguishing between development and non-development subject categories.

On the one hand, **Table 3** shows the top-10 largest non-development journals for the six key development issues. Some journals appear in several key development issues' rankings, and some of them —considering the journals' editorial aims and scope— could also be included in the subject category of development (such as *Ecology and Society*, *Social Indicators Research* and *Journal of Poverty*), thus increasing the number of citations, the impact indicators and the coverage of this field.[xvii]

On the other hand, **Table 4** shows the top-10 largest development journals for the six key development issues. Again, many journals simultaneously appear in several key development issues' rankings, which reveals that there are not strong editorial specializations on just one issue. Moreover, a handful of journals are located in the first places of the different ranks (such as *World Development*, *Third World Quarterly* and *Development in practice*), which highlights their importance in terms of the production of articles.

Moreover, focusing on those articles that are indexed in non-development subject categories and deal with the six key development issues, it is worth exploring which could have been published in development journals. For this aim, we used sampling techniques in order to build a simple random sample with a 90% confidence level, which requires a minimum sample size of 271 articles. We decided to work with a slightly larger sample (300 articles) in order to minimize other sources of error. Our qualitative analysis of the titles and abstracts of these 300 papers revealed that, approximately, 49.67% could have been published in development journals, whereas the remaining 50.33% are papers dealing with very specific topics (most of them related to medicine, computer science and other engineering disciplines) that do not seem suitable for the multidisciplinary audience of development journals. These estimations allow us to correct the initial figure of 252,404 development articles published in non-development,

which should be reduced to, approximately, 125,369 articles potentially draining from the development category.

6. Estimating the size of the paper drain in development studies

The final question of this three-step analysis is: in which fields of study are finally published those papers that deal with the six key development issues? Answering to this question will allow us to compute a rough estimate of the paper drain that affects the development subject category. To do so, we consider the journals' adscriptions to the *Scopus* classification of subject areas and subject categories.

Figure 6 synthesizes the main results of the analysis. On the one hand, the left panel shows that the areas that most frequently publish articles that deal with development issues are Social Science (for governance, gender and inequality issues), Medicine (for poverty and developing world) and Environmental Science (for sustainable development).[xviii] However, other areas (such as Psychology, Engineering, Economics, Econometrics and Finance) also attract significant percentages of development articles. On the other hand, the right panel of **Figure 6** focuses on the subject area of Social Science, where the "development" subject category attracts (for the six analysed key issues) less than 25% of the articles.

More in detail, **Table 5** shows the distribution of development papers across the different subject categories of Social Sciences. "Inequality", "developing countries" and "poverty" are the most concentrated issues in the development category (in fact, there are no other categories that attract higher proportions of these three issues), whereas "gender", "governance" and "sustainable development" are more scattered across other subject categories (in fact, development is not the most attractive category for these topics.

Finally, in aggregate terms, which would be the estimated percentage of papers draining from the development category to other subject categories? For this purpose, we use the estimations reported in Figure 7 in order to compute the average for the six key development issues. Considering the previous estimation of an approximately 50.33% error (which renders a total of 125,369 articles potentially "publishable" in development journals), we estimate that the development category would be only publishing 28% of the papers dealings with these issues within the Social Sciences. Hence, there is —roughly— an 72% paper drain to other (non-development) categories.

7. Conclusions and recommendations

The aim of this paper is to explain why the cross-disciplinary field of development studies has relatively low journal impact indicators in comparison with other mono-disciplinary fields of study. We argue that a reasonable explanation is the existence of a "paper drain" phenomenon, which implies that a certain proportion of the papers dealing with development is eventually published in journals that are assigned to other fields. The paper drain is exacerbated by the widespread use of "journal impact indicators", which both measure the level of influence of academic journals, and also allocate the journals to different "subject categories". An important consequence of this classification of journals into fields of study is the increasing competition for attracting papers that may be highly cited; and this competition is especially intense in the case of cross-disciplinary fields of study, as their objects of analysis are of common interest for other fields.

We analyse the ample data provided by *Scopus* for the computation of the SJR. This data allows us to empirically assess the paper drain in the subject category of "development", which is our proxy for analysing the more complex field of development studies. However, as the *Scopus* database limits the data download and the quantity of detail, we implement different scripts of data capture (based on automatic robot navigation according to macros and javascript) in order to build a complete database.

We carried out the analysis for the period 2007-2016 in order to answer to the three research questions that have articulated this paper:

Firstly, which are the most frequently addressed topics among development journals? We analyse the 57,593 articles published in the 195 journals included in the development subject category and reach two main results:

i.   "Development" is a growing cross-disciplinary subject category, in terms of the variety of analysed topics, the number of published papers and their influence (citations).
ii.   Running an algorithmic procedure, we identify six "key development issues" in terms of their influence and frequency of use in the development journals; these are "governance", "poverty", "developing world", "sustainable development", "gender" and "inequality".

Secondly, are there many influential articles that deal with these six key development issues but are not published in "development journals"? This body of literature constitutes an approximation of what we consider to be the "paper drain" of the development subject category. Three main results stand out from this analysis:

iii. Non-development journals have —on average— higher citations per article than development journals, which implies that if development journals increased their capacity to attract some of these "outside" articles, their impact indicators would significantly increase (and the paper drain would be diminished).

iv. Some of these non-development journals —considering their editorial aims and scopes— could also be included in the subject category of development (such as *Ecology and Society*, *Social Indicators Research* and *Journal of Poverty*, among some others), thus increasing the number of citations, the impact indicators and the coverage of this field.

v. The qualitative analysis of a representative sample of those articles that deal with the six key development issues but were published in non-development journals reveals that, approximately, 49.67% of the papers could have been published in development journals. The reaming 50.33% are papers dealing with very specific topics (most of them related to medicine, computer science and other engineering disciplines) that do not seem suitable for the multidisciplinary audience of development journals.

Thirdly, in which fields of study are finally published those papers that deal with the six key development issues? The estimations offer three additional results:

vi. The subject areas that most frequently publish articles that deal with development issues are Social Science (for governance, gender and inequality issues), Medicine (for poverty and developing world) and Environmental Science (for sustainable development). However, other areas (such as Psychology, Engineering, Economics, Econometrics and Finance) also attract significant percentages of development articles.

vii. In terms of the distribution of development papers across the different Social Sciences subject categories, "inequality", "developing countries" and "poverty" are the most

concentrated issues in the development category (in fact, there are no other categories that attract higher proportions of these three issues), whereas "gender", "governance" and "sustainable development" are more scattered across other Social Science subject categories (in fact, development is not the most attractive category for these topics).

viii. In aggregate terms, we estimate that approximately 80 % of the papers dealing with development issues within the Social Sciences are "draining" from the development subject category to other categories (i.e. development journals are only publishing the reaming 20% of development papers).

We acknowledge the limitations of the *Scopus* database that we used in our analysis, especially its "laxity" in allocating journals into the development subject category. Nevertheless, this is —to date— the first attempt to empirically estimate the paper drain phenomenon in a cross-disciplinary field of study, and it opens future lines of research such as qualitative analysis on the reasons that motivate development researchers to send their papers for publication in non-development journals.

It is also worth reflecting that the increasing use of journal impact indicators for evaluating the "quality" of the papers published in these journals comes at a price. As Hicks et al. (2015: 429) warns us in the *Leiden Manifesto for research metrics* "data are increasingly used to govern science […] We risk damaging the system with the very tools designed to improve it, as evaluation is increasingly implemented by organizations without knowledge of, or advice on, good practice and interpretation". Thus, with this paper we do not advocate for merely finding the way to improve the impact factors of development studies journals. On the contrary, we alert of the consequences of relying on a journal evaluation system that is not well designed to evaluate cross-disciplinary fields of study, and that is characterized by an artificial scarcity of

indexed journals (when there are many development journals that perfectly fit in this category but find many obstacles in order to be indexed).

All in all, this analysis provides evidence that may be useful for guiding future actions that do not only seek to increase the scientific impact (and influence) of the cross-disciplinary field of development studies, but specially to improve its cross-disciplinary and plural character. In particular, the following four actions may be useful for EADI and other national development studies associations:

Firstly, request that Clarivate Analytics and Elsevier (the providers of the two main journal impact indicators) increase the number of development journals that are currently covered in the impact indicators (thus making room for the publication of more articles in this subject category).

Secondly, try to convince the editors of those journals that clearly contribute to the development debate but are not currently included in the development subject category (such as *Ecology and Society*, *Social Indicators Research* and *Journal of Poverty*, among some others) to apply for the inclusion of their journals in the development category.

Thirdly, improve the capacity of development journals to "attract" influential articles that may be eventually published in non-development journals with higher impact indicators.

And fourthly, warn Scopus that its laxity in allocating journals into subject categories results in the fact that there are several highly influential journals included in the development

category that only sporadically deal with development issues and that do not have a cross-disciplinary research approach.

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[i] See also OECD's (1972: 83-86) seven criteria to characterise a specific discipline, regarding its: i) material field; ii) the subject matter; iii) the level of theoretical integration; iv) the methods; v) the analytical tools; vi) its applications in fields of practice; and vii) the historical contingencies.

[ii] For example, let us think on a multidisciplinary research project on development that ends up producing a report with different sections, where a group of Economists wrote the section on economic issues, a group of Political Scientists wrote the section on political issues, and so on.

[iii] In contrast with the previous example, in the case of an interdisciplinarity piece of research each chapter of the report would be written by either a group of scientists with different disciplinary backgrounds or either a researcher with more than one disciplinary background.

[iv] Transdisciplinarity implies that development studies, instead of being a field of study, becomes a new discipline on itself.

[v] Impact factors were originally conceptualized in the 1960s by the American structural linguist Eugene Garfield as an indicator for evaluating the "quality" of scientific journals (Garfield and Sher, 1963; Garfield, 1979).

[vi] According to Münch (2020), "academic capitalism" is a "unique hybrid that unites the scientific search for truth and the economic maximization of profits". Hence, the theory of academic capitalism explains how universities are changing and adapting in response to two relevant external pressures: on the one hand, the advent of a global knowledge economy in which universities globally compete to produce and "sell" knowledge. And, on the other hand, the increasing pressure on universities for raising funds and generating profits.

vii See Tezanos and Trueba (2019) for a descriptive analysis of the scientific impact of development studies in these two leading citation indexes, as well as an explanation of the main differences of these indexes in terms of accessibility, methodology, definition of the subject category of development, coverage and citation windows.

viii See González-Pereira *et al*. (2010) for a detailed explanation on the methodology of the SJR's impact indicator.

ix Moreover, as Tezanos and Trueba (2019) explain, until 2018 the SSCI used a "hybrid" subject category of "planning & development", which implied that journals working on development and those working on planning were mixed in a single category. In particular, Tezanos and Trueba (2019) identify that among the 55 journals included in "planning & development" there were only 29 development journals.

x See Bordons et al. (2004) for a detailed analysis of pros and cons of four different bibliometric approaches for studying cross-disciplinary research that have been used in the scientific literature. These are: i) collaboration amongst authors from different disciplines; ii) presence of keywords or classification codes from different disciplines in academic publications; iii) interdisciplinary nature of publication journals; and iv) knowledge and scholars transfers between disciplines. Our piece of research contributes to the second approach (analysis of keywords and classification codes from different disciplines in academic journals), which its main limitation is that "[….] its validity depends on the adequate coverage of the database used, the frequent update of the classification system, and the expertise of the indexers" (Bordons et al., 2004: 442).

xi See further info at https://www.elsevier.com/solutions/scopus/content/content-policy-and-selection

xii In particular, the SJR uses a three-year citation window, and the SSCI uses both a two-year and a five-year citation windows.

xiii In fact, the 15 most cited journals concentrate 50.1% of the aggregate citations.

xiv For example, *Nanomedicine* is located in the first quartile in the development category, but on the second quartile of both "Bioengineering" and "Nanoscience and Nanotechnology". And *Social Neuroscience*, also located in the first quartile of Development, falls to the second quartile in "Behavioural Neuroscience".

xv It should be noted that we are aggregating citations for a 10-years period, whereas the SJR impact indicator uses a three-year citation window.

xvi Although the effect of including low-frequency words is small, the inclusion of a high number of low-frequency words significantly increases the error of the analysis.

xvii As previously explained, journals' editors decide in which SJR's subject categories they want their journals to be included, and they can simultaneously appear in several subject categories.

[xviii] It should be born in mind that these figures are rough estimations, as the errors in the identification of the paper drain are not evenly distributed across the different subject categories. In particular, according to our estimations, in the case of Medicine, the error term rises to 70%.

Figure 1. Papers included in the development subject category
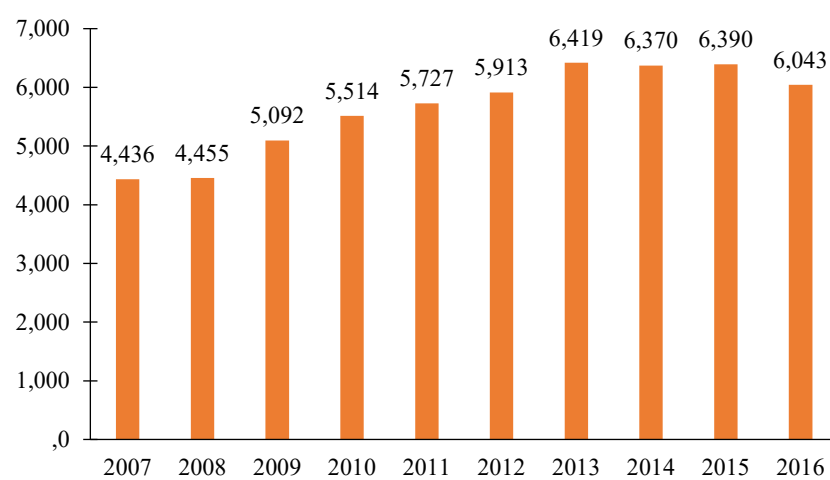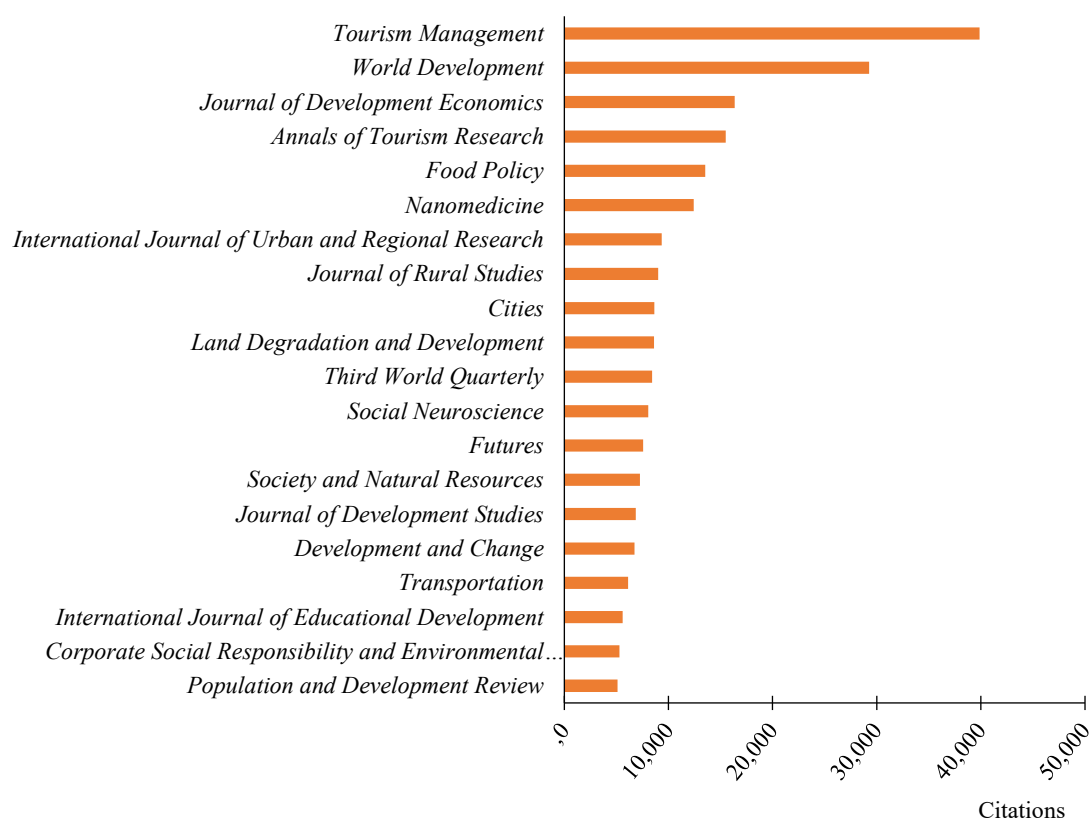
by year of publication

Figure 2. Citations and citations per article in the development subject category by year of

publication
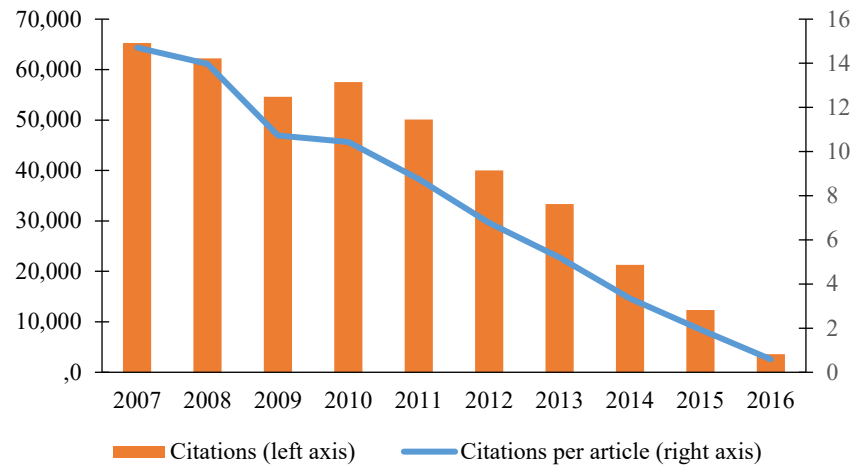
Source: authors calculations using data from Elsevier Science Publishers (2017).

Figure 3. Top-20 journals in the development subject category by citations (2007-2016)

Source: authors calculations using data from Elsevier Science Publishers (2017).

Figure 4. Number of development papers published in the development subject category and other subject categories by key development issues (2007-2016)
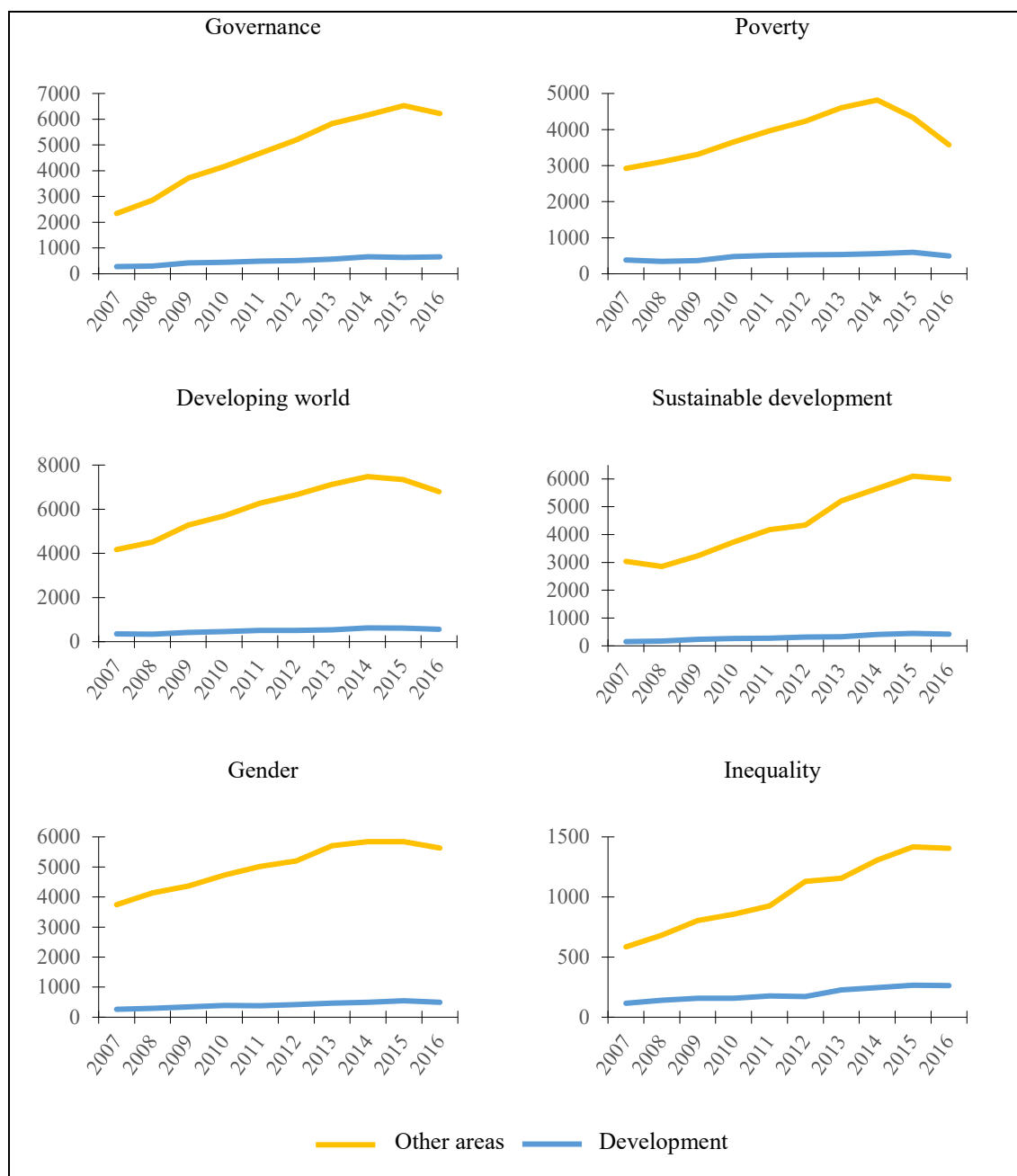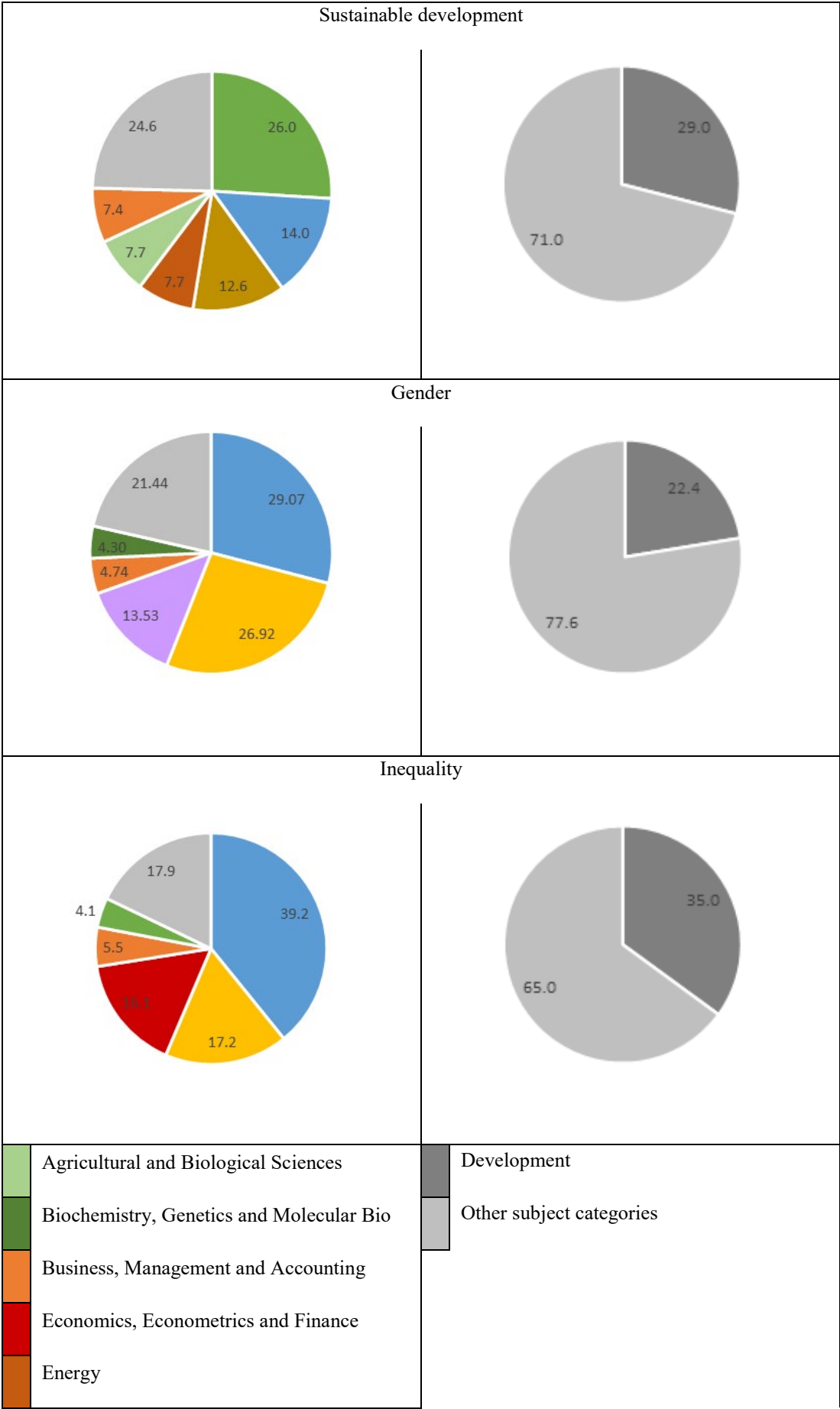
Figure 5. Citations and citations per article in the "development" subject category and other

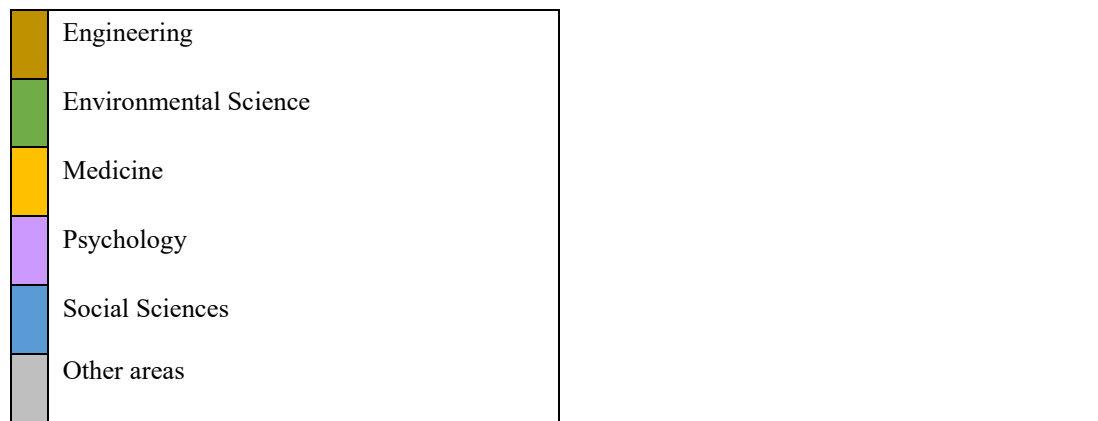subject categories by "key development issues" (2007-2016)
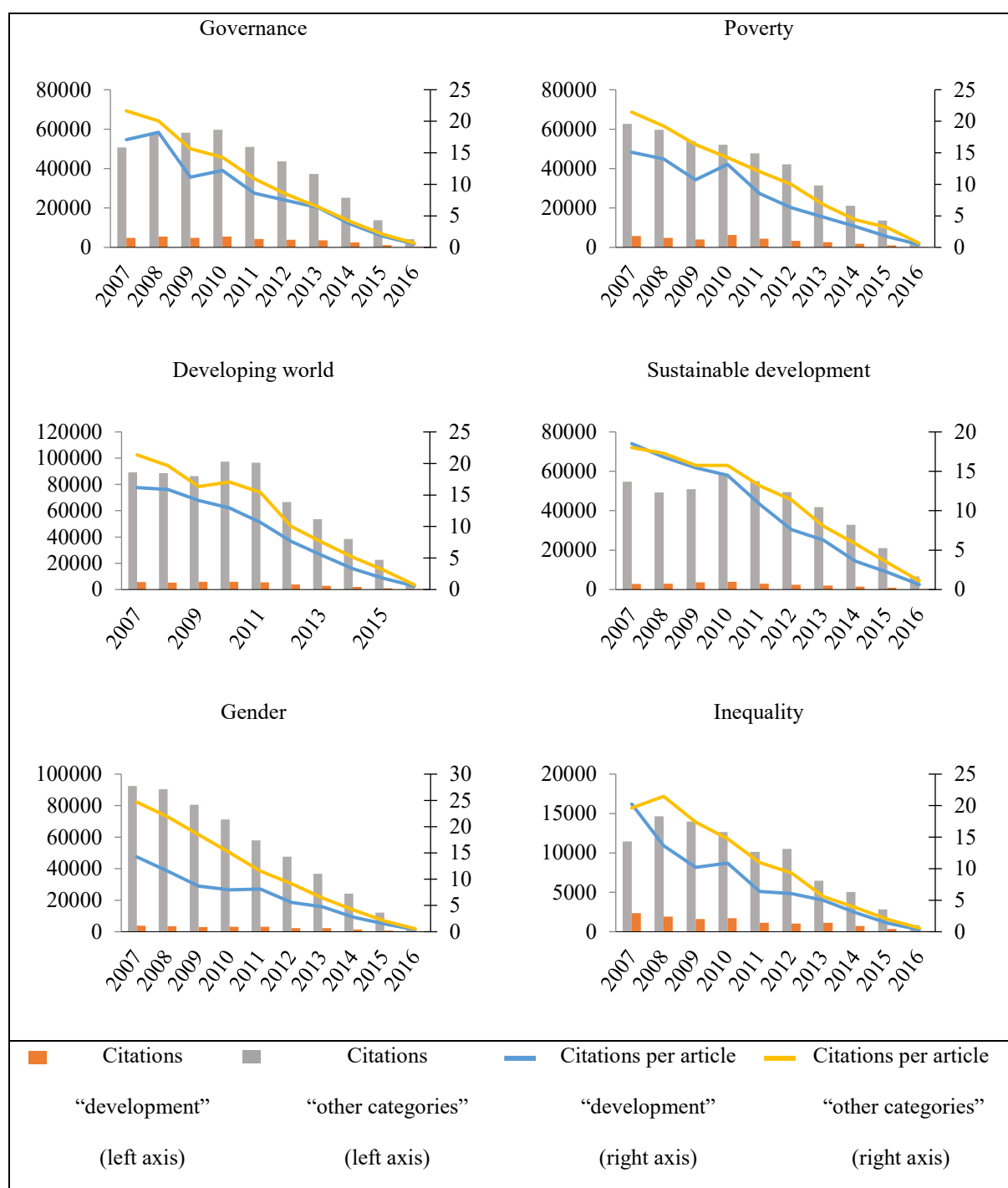
Figure 6. Percentage of papers dealing with development issues across subject areas (left panel) and within Social Science (right panel). 2007-2016

Subject areas	Social Sciences
Governance	

Sustainable development

Gender

Inequality

Legend:
- Agricultural and Biological Sciences
- Biochemistry, Genetics and Molecular Bio
- Business, Management and Accounting
- Economics, Econometrics and Finance
- Energy
- Development
- Other subject categories

Engineering

Environmental Science

Medicine

Psychology

Social Sciences

Other areas
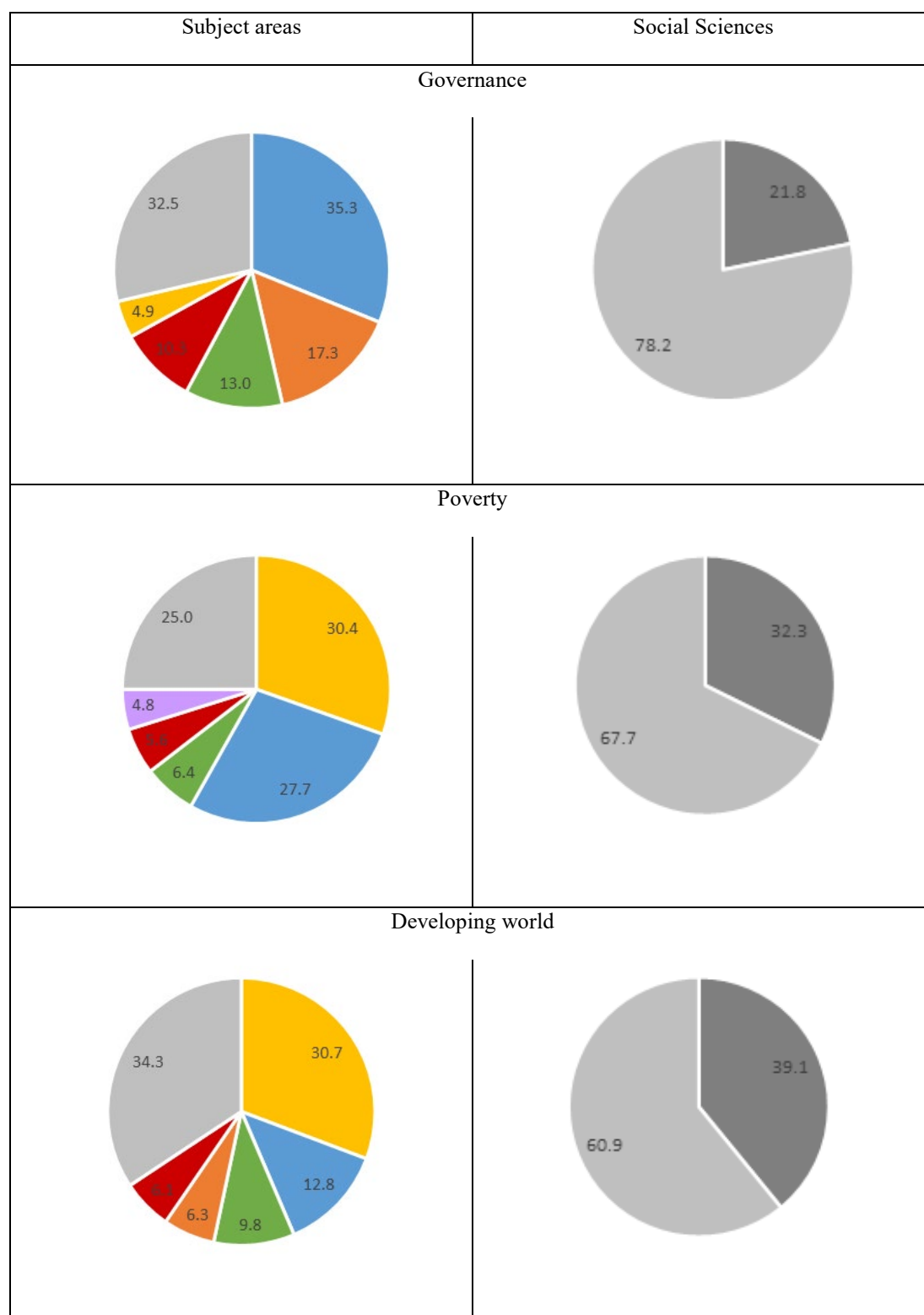
Source: authors' calculations using data from Elsevier Science Publishers (2017). The subject areas included in the *Scopus* database are: Agricultural and Biological Sciences, Arts and Humanities, Biochemistry, Genetics and Molecular Biology, Business, Management and Accounting, Chemical Engineering, Chemistry, Computer Science, Decision Sciences, Dentistry, Earth and Planetary Sciences, Economics, Econometrics and Finance, Energy, Engineering, Environmental, Science, Health Professions, Immunology and Microbiology, Materials Science, Mathematics, Medicine, Multidisciplinary, Neuroscience, Nursing, Pharmacology, Toxicology and Pharmaceutics, Physics and Astronomy, Psychology, Social Sciences and Veterinary.

Table 1. Top-20 articles in the development subject category

by citations (2007-2016)

Ranking	Title	Year	Journal	Citations
1	Progress in information technology and tourism management: 20 years on and 10 years after the Internet-The state of eTourism research	2008	*Tourism Management*	703
2	Travel and the built environment	2010	*Journal of the American Planning Association*	698
3	How corporate social responsibility is defined: An analysis of 37 definitions	2008	*Corporate Social Responsibility and Environmental Management*	579
4	Electronic word-of-mouth in hospitality and tourism management	2008	*Tourism Management*	559
5	Role of social media in online travel information search	2010	*Tourism Management*	555
6	Event tourism: Definition, evolution, and research	2008	*Tourism Management*	468
7	How destination image and evaluative factors affect behavioral intentions?	2007	*Tourism Management*	429
8	Examining the structural relationships of destination image, tourist satisfaction and destination loyalty: An integrated approach	2008	*Tourism Management*	404
9	Farmers' adoption of conservation agriculture: A review and synthesis of recent research	2007	*Food Policy*	381
10	Tourism demand modelling and forecasting-A review of recent research	2008	*Tourism Management*	375
11	Hyperthermic effects of gold nanorods on tumor cells	2007	*Nanomedicine*	362
12	China's (uneven) progress against poverty	2007	*Journal of Development Economics*	341

13	A new data set of educational attainment in the world, 1950-2010	2013	*Journal of Development Economics*	322
14	Graphene in biomedicine: Opportunities and challenges	2011	*Nanomedicine*	308
15	Tried and tested: The impact of online hotel reviews on consumer consideration	2009	*Tourism Management*	287
16	Experience quality, perceived value, satisfaction and behavioral intentions for heritage tourists	2010	*Tourism Management*	280
17	Political connections, financing and firm performance: Evidence from Chinese private firms	2008	*Journal of Development Economics*	266
18	A review of innovation research in tourism	2010	*Tourism Management*	262
19	Is China Abolishing the hukuo system?	2008	*China Quarterly*	243
20	Application of the Theory of Planned Behavior to green hotel choice: Testing the effect of environmental friendly activities	2010	*Tourism Management*	243

Source: authors calculations using data from Elsevier Science Publishers (2017).

Table 2. Selected "key issues of development" and their associated keywords

Key issues	Keywords			
Governance	Democratic governance	Governance and public policy	Governance principles	Quality of governance
	Economic governance	Governance approach	Governance reform	Regional governance
	Environmental governance	Governance approaches	Governance structures	Rural governance
	Fiscal governance	Governance arrangements	Governance/regimes	Subnational governance
	Food safety governance	Governance discourse	Inclusive governance	Sustainable governance
	Food security governance	Governance effectiveness	Local governance	Territorial water governance
	Global economic governance	Governance evaluation	Local governance institutions	Transnational business governance
	Global governance	Governance indicators	Natural resource governance	Urban governance
	Global governance structure	Governance instruments	Natural resources governance	Water governance
	Global health governance	Governance law and justice	New urban governance	Water governance structures
	Global water governance	Governance mechanisms	Organizational governance	
	Good governance	Governance models	Participatory governance	
	Governance	Governance of forest	Participatory local governance	
Poverty	Absolute poverty	Fuel poverty	Poverty determinant	Poverty targeting
	Anti-poverty expenditures	Global poverty	Poverty dynamics	Poverty transition
	Antipoverty programs	Growth-poverty linkage	Poverty elimination	Poverty trap

Anti-poverty strategy	Index of poverty	Poverty eradication	Programs to combat poverty
Business and poverty	Measurement and analysis of poverty	Poverty estimates	Regional poverty lines
Capabilities and income poverty	Microfinance and poverty	Poverty geography	Relative poverty
Child poverty	Model for poverty reduction	Poverty in developed countries	Rural poverty
Chronic poverty	Monetary poverty	Poverty indexes	Rural poverty reduction
Consumption poverty	Multidimensional poverty	Poverty indices	Structural poverty
Depth of poverty	Multidimensional poverty index	Poverty lines	Subjective poverty
Energy poverty	Non-monetary poverty	Poverty measurement	Urban poverty
Extension of poverty	Poverty	Poverty mitigation	Urbanization of poverty
Extreme poverty	Poverty alleviation	Poverty penalty	
Feminization of poverty	Poverty and inequality	Poverty profiles	
Fighting poverty	Poverty areas	Poverty reduction	
Food poverty	Poverty deconcentration	Poverty survey	

Gender	Domestic gender relations	Gender equality policies	Gender sensitivity
	Gender	Gender equity	Gender socialization
	Gender analysis	Gender gap	Gender stereotypes
	Gender and development	Gender goals	Gender structure

Gender and development (gad)	Gender identities	Gender studies
Gender and development organization	Gender ideology	Gender study
Gender and diversity	Gender in international development agendas	Gender symbolism
Gender and diversity – disability	Gender index	Gender transformation
Gender and employment	Gender inequality	Gender work
Gender and environment	Gender issue	Gender-based programmes
Gender and feminism	Gender issues	Gender-based violence (gbv)
Gender and generational analyses	Gender justice	Gender-class intersection
Gender and social capital	Gender mainstreaming	Gender-discrimination
Gender and social protection	Gender mainstreaming and leadership trajectory	Gendered cultures of science
Gender approaches	Gender marginalizing	Gendered division of labor
Gender attitudes	Gender parity	Gendered moral rationalities
Gender bias	Gender parity dynamics	Gendered parenting
Gender cooperation	Gender performativity	Gendered productivity
Gender difference	Gender planning	Gendered space
Gender differences	Gender policy	Gendered welfare regimes
Gender discrimination	Gender power relations	Gender-friendly mhm facilities
Gender disparities	Gender regime	Gender-mainstreaming

	Gender disparity	Gender relations	Gender-responsive budgeting
	Gender diversity	Gender research	Gender-responsive public services
	Gender division of labor	Gender role	Genderscapes
	Gender divisions of labour	Gender role attitudes	Gender-sensitive community groups
	Gender effects	Gender role orientation	Gender-sensitive evaluation
	Gender empowerment	Gender roles	Incorporation of the gender perspective
	Gender equality	Gender segregation	Sacred gender
	Gender equality models	Gender sensitive	

Developing world	Developing countries
	Developing country
	Developing economies
	Developing economy
	Developing nations
	Developing regions
	Developing world
	Developing/emerging economies
	The developing countries
Sustainable development	Environmental sustainability
	Strategic sustainable development
	Sustainable development
	Sustainable growth
Inequality	Economic inequality
	Global inequality
	Income inequality
	Inequality
	Inequality of opportunity

	Inherent social inequality
	Interregional inequality
	Overall inequality
	Regional inequality
	Rural-urban inequality
	Social and economic inequality
	Social inequality
	Socioeconomic inequality in health
	Spatial inequality
	Urban-rural inequality
	Wage inequality
	Wealth inequality
	World inequality

Source: authors elaboration using data from Elsevier Science Publishers (2017).

Table 3. Top-10 "non-development" journals according to number of articles dealing with each key development issue (2007-2016)

Journal	Number of articles	Citations/article
Governance		
Corporate ownership and control	705	0.7
Marine policy	377	13.3
Corporate governance	338	20.2
Ecology and society	322	21.1
Journal of business ethics	298	16.7
Geoforum	233	15.2
Energy policy	227	16.9
Environmental science and policy	220	17.4
Land use policy	210	9.8
Journal of corporate finance	202	22.0
Poverty		
Social science and medicine	463	24.4
Bmc public health	364	13.1

Plos one	356	10.5
Mediterranean journal of social sciences	241	0.4
American journal of public health	226	26.0
Social indicators research	187	5.0
Journal of health care for the poor and underserved	185	8.7
Health and place	182	18.0
Maternal and child health journal	174	10.7
Pediatrics	169	31.7
Developing world		
Plos one	868	12.8
Energy policy	359	22.8
Bmc public health	347	13.1
The lancet	310	103.1
Vaccine	265	17.1
Social science and medicine	261	23.0
Asian pacific journal of cancer prevention	227	6.5
Mediterranean journal of social sciences	179	0.4
Tropical medicine and international health	174	16.5
Bulletin of the world health organization	173	37.2

Sustainable development		
Journal of cleaner production	1391	18.0
Energy policy	574	25.8
Wit transactions on ecology and the environment	533	0.4
Shengtai xuebao/ acta ecologica sinica	454	2.4
Ecological indicators	361	16.8
Energy	350	22.6
Journal of environmental management	326	25.4
Renewable and sustainable energy reviews	301	16.9
Ecological economics	281	24.1
Applied energy	255	21.0
Gender		
Plos one	605	11.6
Sex roles	601	12.4
Social science and medicine	385	23.3
Gender, place and culture	274	7.5
Gender, work and organization	235	13.3
Archives of sexual behavior	232	18.3
Bmc public health	229	12.5

Personality and individual differences	195	11.4
Gender and history	162	4.3
Culture, health and sexuality	156	9.3
Inequality		
Social science and medicine	212	25.3
Plos one	109	8.2
Bmc public health	92	11.8
Journal of epidemiology and community health	84	20.6
European journal of public health	83	13.5
International journal for equity in health	81	7.7
Economic modelling	77	5.8
Journal of economic inequality	74	7.2
Social indicators research	58	6.6
Social science research	54	9.0

Source: authors calculations using data from Elsevier Science Publishers (2017).

Table 4. Top-10 "development" journals according to number of articles dealing with each key development issue (2007-2016)

Journal	Articles	Citations/article
Governance		
Development in practice	239	4.0
World development	161	19.4
Third World Quarterly	149	8.1
Corporate social responsibility and environmental management	143	20.6
International journal of urban and regional research	139	16.2
Local government studies	124	5.0
Public administration and development	113	7.1
Extractive industries and society	107	2.2
Cities	97	9.1
Society and natural resources	93	8.6
Poverty		
World development	334	20.2
Food security	181	7.2
Development in practice	158	3.4
Journal of international development	157	7.0

Journal of development studies	153	10.5
IDS bulletin	142	6.0
Journal of development effectiveness	99	3.2
Development Southern Africa	91	4.9
Climate and development	88	6.2
Third World Quarterly	87	11.2
Developing world		
World development	325	20.7
Journal of development economics	192	18.3
Food security	167	7.4
Developing economies	150	3.3
Third World Quarterly	144	9.0
Journal of water sanitation and hygiene for development	144	2.4
Journal of development studies	142	8.7
Journal of international development	114	5.3
Climate and development	114	4.5
Food policy	98	22.2
Sustainable development		
Sustainable development	252	14.8

Corporate social responsibility and environmental management	178	19.6
Climate and development	116	5.6
Food security	105	5.4
International journal of climate change strategies and management	91	1.7
Journal of sustainable development	89	1.2
Agroecology and sustainable food systems	88	2.3
Extractive industries and society	81	2.5
Mountain research and development	78	5.7
Futures	69	11.5
Gender		
Women's studies international forum	373	4.9
Gender and development	210	5.0
Development in practice	178	3.4
World development	169	11.9
Gender, technology and development	120	3.3
Social neuroscience	111	12.8
ID bulletin	108	3.7
International journal of educational development	103	6.1
Comparative studies of South Asia, Africa and the Middle East	102	2.1

Development	84	3.5
Inequality		
World development	60	27.9
Journal of development economics	52	8.0
Journal of development studies	51	5.2
Journal of international development	44	1.7
Investigaciones regionales	42	7.7
Housing, theory and society	40	10.7
International journal of educational development	37	2.7
Gender and development	37	0.9
Perspectives on global development and technology	36	8.8
Third World Quarterly	36	4.7

Source: authors calculations using data from Elsevier Science Publishers (2017).

Table 5. Distribution of development papers across the different subject categories of Social Sciences. 2007-2016

Subject categories	Governance	Poverty	Developing world	Sustainable development	Gender	Inequality
Anthropology	1.4	2.2	1.0	0.6	2.4	2.3
Archaeology	0.1	0.2	0.1	0.1	0.2	0.5
Communication	0.9	0.6	0.9	0.4	1.9	0.9
Cultural Studies	2.2	2.7	1.2	1.0	4.6	2.6
Demography	0.5	2.0	1.4	0.5	2.7	1.9
Development	21.8	32.3	39.1	29.0	22.4	35.0
Education	4.0	6.9	6.0	5.6	10.8	5.7
Gender Studies	0.4	1.1	0.4	0.1	11.6	0.9
General Social Sciences	4.3	5.9	4.6	4.6	4.6	6.4
Geography, Planning and Development	15.9	8.9	12.0	32.2	4.6	7.5
Health (social science)	1.6	8.2	5.2	1.1	5.8	4.9
Human Factors and Ergonomics	0.2	0.2	0.7	1.6	0.4	0.2
Law	7.8	2.2	4.8	3.8	3.6	1.7
Library and Information Sciences	1.1	0.4	2.3	0.7	0.6	0.4
Life-span and Life-course Studies	0.1	0.8	0.2	0.1	1.3	0.5
Linguistics and Language	0.2	0.7	0.2	0.1	1.6	0.6

Political Science and International Relations	8.8	3.0	5.1	2.1	2.0	3.8
Public Administration	6.4	1.6	1.9	1.0	0.7	1.0
Safety Research	0.9	0.3	0.9	0.3	0.2	0.2
Social Sciences (miscellaneous)	1.7	3.6	1.8	1.3	4.3	3.6
Sociology and Political Science	16.7	13.8	7.8	8.0	12.9	17.1
Transportation	0.6	0.2	1.3	2.4	0.3	0.3
Urban Studies	2.5	2.2	1.3	3.2	0.5	1.8

Source: authors' calculations using data from Elsevier Science Publishers (2017).