Scientometrics (2019) 118:849–868
https://doi.org/10.1007/s11192-018-03000-z

A bibliometric visualization of the economics and sociology of wealth inequality: a world apart?

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Received: 20 April 2018 / Published online: 24 January 2019

Abstract

Wealth inequality research is fragmented across different social science disciplines. This article explores the potential of interdisciplinary perspectives by investigating the thematic overlap between economic and sociological approaches to wealth inequality. To do so, we use the *Web of Science* citation database to identify pertinent articles on the topic of wealth inequality in each discipline (1990–2017). On the basis of complete bibliographies of these selected articles, we construct co-citation networks and obtain thematic clusters. What becomes evident is a low thematic overlap: Economists explore the causes of wealth inequality based on mathematical models and study the interplay between inequality and economic growth. Sociologists focus mostly on wealth disparities between ethnic groups. The article identifies, however, a few instances of cross-disciplinary borrowing and the French economist Thomas Piketty as a novel advocate of interdisciplinarity in the field. The prospects of an economics-cum-sociology of wealth inequality are discussed in the conclusion.

Keywords Wealth inequality · Interdisciplinarity · Co-citation networks · VOSviewer · Piketty

Rising disparities in ownership of private assets in the past few decades have become a matter of general concern that increasingly commands the attention of different disciplines: Historians, for example, chronicle the evolution of wealth inequality from the dawn of mankind to modernity (Scheidel 2017); social geographers map the locational habits and trajectories of the super-rich (Forrest et al. 2017); sociologists explore how disparities in family wealth impact opportunities across multiple generations (Hällsten and Pfeffer

Wealth consists of assets that can be "owned and exchanged on some market" (Piketty 2014, p. 46), including, among other things, real estate, financial assets, and physical assets (i.e., cars), but *not* human capital, which cannot be traded. A central characteristic of a stock of wealth is that it can be treated as collateral, e.g., for money loans (Hodgson 2014).

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11192-018-03000-z) contains supplementary material, which is available to authorized users.

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2017); and economists give insights into the extent of the world's money held in tax havens (Zucman 2015).

Most indicative for the increased salience of the topic is the landmark work *Capital in the Twenty-First Century* by the French economist Piketty (2014), which ranked among Amazon's top 100 non-fiction bestsellers for four consecutive months (Brissaud and Chahsiche 2017). Its central argument is that modern societies are again characterized by a form of inheritance-based capitalism ("patrimonial capitalism"), in which a few people can generate a satisfactory income without the pain of work while the many own only very little. Recently Piketty, the leading figure in current wealth inequality research, has argued that only a reconciliation between economics and other social sciences such as sociology can promise new insights into the drivers of wealth inequality (Piketty 2017).

Some sociologists want to take up "Piketty's challenge" (Savage 2014) and do not see the economic topic of wealth as lying beyond their discipline's purview. But how likely is a reconciliation of economics and sociology when it comes to the analysis of wealth inequality? More generally, is fruitful interdisciplinary research on wealth inequality a realistic goal given the past discipline-specific research traditions?[1]

To explore the common ground between economics and sociology, this article examines past research on wealth inequality. By analyzing between 120 and 150 pertinent publications in each discipline, we identify dominant and commonly pursued discipline-specific lines of inquiry with the help of bibliometric visualization techniques and content analysis.

The main insights are as follows: In the last 30 years, economists and sociologists have approached the topic of wealth inequality quite differently. Economists analyzed the causes of rising wealth inequality as well as the role of life-cycle wealth versus inherited wealth using theoretical models that were only partly grounded in empirical evidence. Furthermore, the interplay between the unequal distribution of economic resources and economic growth was at the very center of many central studies in the discipline. In contrast, sociologists were mainly concerned with racial and ethnic wealth disparities.

The main conclusion of this paper is that future interdisciplinary research cannot build on historical experiences. Fundamentally, then, the future of the field as a vibrant interdisciplinary environment depends critically upon the establishment of educational institutions and platforms that foster interdisciplinary dialogue. While the prospects of such a future remain unclear, the French economist Thomas Piketty has already established himself in the field as the only leading figure pursuing an interdisciplinary research agenda.

Innovators and laggards

While wealth was central to many theories in classical economics (Smith 2010) as well as classical sociology (Marx 1981; Veblen 1965), pioneering investigations into disparities in asset ownership were conducted only by economists (and statisticians). Early empirically oriented researchers either conducted government research or were granted access to state-administered data. One of the leading scholars was George K. Holmes, the Chief of Division of Production and Distribution at the United States Department of Agriculture. Holmes extrapolated data on farm and home ownership in 22 states from the 1890 US

[1] I use the term "interdisciplinary" in a strict sense to refer to research that aims at integrating frameworks from different disciplines and to explore research questions which would not arise within the boundaries of a single discipline.

census in order to derive nation-specific estimates on wealth inequality (Holmes 1893). It was at the 88th annual meeting of the American Statistical Association in 1926 that Wilford L. King, an economist at the National Bureau of Economic Research, presented results on wealth inequality that were derived for the first time from records of probated estates—thus, from non-census information (King 1927).

From the 1950s onwards, wealth inequality research gained considerable momentum, with economists applying improved methodologies to partly old data that were extracted in "anthropologist-like fashion from their entombment in census manuscripts, probate records and tax files" (Smith 1980, pp. 1–2). Robert Lampman, adviser to President John F. Kennedy's Council of Economic Advisers, used estate tax returns to estimate the share of top wealth-holders (Lampman 1962). Robert Gallman and Lee C. Soltow, both professors of economics, published studies on wealth inequality, basing their analysis on samples drawn from the censuses of previous years which contained questions about wealth (Gallmann 1969; Soltow 1976).

The first researcher to apply the "estate-multiplier method" (that uses data reported on estate tax returns files for the deceased to estimate the wealth of the living population) was the economist Horst Menderhausen (Menderhausen 1956). With the launching of the Survey of Financial Characteristics of Consumers (SFCC), the research community started to use government-collected household microdata. The 1962 SFCC is also known as the "Projector Survey," after Dorothy Projector, an economist working for the US Bureau of Labor Statistics. The SFCC—which was renamed as the Survey of Consumer Finances (SCF) has become the main data source for wealth research.

Already from this brief historical overview, it becomes evident that economists were the "innovators" in the field of empirical wealth research. According to Rogers (2003), "innovators" are those researchers who operate under uncertain conditions, since there are no prior models that could tell whether new (research) practices will turn out to be successful. In the field of wealth research, economists (with backgrounds in statistics) were the first to establish estimation methods such as the "estate multiplier method" or various survey modes to gain knowledge about private household balance sheets. While today these methodologies are commonly used, they were highly innovative at the time. Sociologists did not participate in these early methodological endeavors, and much evidence suggests that they were "laggards," using methodological tools only after they had become firmly established in economics. The fact, however, that three literature reviews on wealth inequality have been published in recent years in the high-impact journal *Annual Review of Sociology* indicates that wealth research has found its way into sociology (Keister and Moller 2000; Killewald et al. 2017; Spilerman 2000). As both disciplines have produced a sizeable body of scholarly publications over the years, a cross disciplinary comparison appears meaningful.

Towards a bibliometric analysis of wealth inequality research

Building a Web of Science (WoS) citation database

In any field of scholarship, writers make judgments as to who has written about what. Their judgment is reflected in their citing practices. Even if there are good reasons to argue that citations should not be treated equally, previous studies demonstrate that (co-)citation analysis allows us visualize disciplines. By means of network analysis, one can easily find structure, as key writers show commonalities in how they judge the subject matter

and intellectual style of other writers. Consensus on eminent contributors and works is not gained "by getting the people around a table to agree. [Rather, it] is defined behaviorally, as the citing practices of many writers, and it is gained unobtrusively, [mostly] through access to the citation data of the Institute for Scientific Information (ISI)" (White and McCain 1998, pp. 328–329).

ISI was founded by the linguist Eugene Garfield in 1960. In 1992, ISI was sold to the Thomson Reuters corporation ("*Thomson IS*"). Today, the citation indexing service is maintained by *Clarivate Analytics*. Thomson Reuters had already made its citation databases accessible online: *Web of Science* (previously known as *ISI Web of Knowledge*) includes various indexes, such as the Social Science Citation Index (SSCI, 1980–present).[2] The SSCI contains information from articles published in the most important high-impact scholarly journals in the social sciences. Each registered article is indexed, and the references in each article are extracted, which allows researchers to conduct (co-)citation analysis.

In bibliometric research, the WoS is the standard and most widely used tool for generating citation data.[3] Critics note that the WoS has the following downsides (Yang and Meho 2007):

(1) It covers mainly (English-language) journal articles;
(2) It is limited to citations from journals indexed in the database while ignoring non-indexed journals;
(3) It does not count citations in the monographic literature; and
(4) It contains citing errors—for example, there are inconsistencies in the use of initials between journals.

In the following section, I will show how these deficits can be tackled and how a WoS database was built to generate co-citation networks.

- *Step 1:* Retrieving bibliometric data from the Web of Science

In order to identify key publications in the WoS, one has to settle on one of the two possible topical search strategies:

(a) A broader search, by entering "topic terms" to search the following fields within a record: title, abstract, author keywords and keyword plus,[4] or
(b) A narrow search for keywords and phrases in the titles of registered journal articles.

[2] https://webofknowledge.com/.

[3] Since 2004, two other tools are available (Scopus and Google Scholar). Each of the three available databases provides sufficient stability of coverage to be used for detailed cross-disciplinary comparisons (Harzing and Alakangas 2016), and each has its relative strengths and weaknesses (Mongeon and Paul-Hus 2016). I have chosen the WoS as the main source because of its large coverage of journals and its compatibility with other software tools used in this article.

[4] "Author keywords" refers to the original keywords provided by contributors, while "keyword plus" stands for keywords retrieved from an auto-indexing system that may include important terms not mentioned in the title, the abstract, or the author keywords. "Keyword plus" terms are generated by an automatic computer algorithm and are reported to capture an article's content with great depth and variety (Börner et al. 2003).

One can further refine search results by "WoS categories" and "timespan:" Journals covered by the WoS are assigned to at least one of 252 subject categories, among them being "sociology" and "economics;" the timespan can be selected by indicating the years that should be covered.

I decided to choose the broader search strategy for sociology and a combination of both search procedures for economics (see below). Such an approach allows us to give due consideration to the fact that the term "wealth" is only part of the standard vocabulary of economics. In the case of economics, searching for "wealth AND inequality" as topic terms turns out to be a much too coarse-grained search procedure, delivering more than 900 search results. Searching for "wealth" in the title and for "inequality" as a topical term helped achieve better search results. Additionally, such a mixed approach puts us in a position to compare a similar number of articles for both disciplines.[5]

For economics (Nov. 14, 2017): 263 "hits"

TITLE: (wealth) *AND* TOPIC: (inequality)
Refined by:
WEB OF SCIENCE CATEGORIES: (ECONOMICS) AND DOCUMENT TYPES: (ARTICLE)
Timespan: 1990–2017
Indexes: SSCI

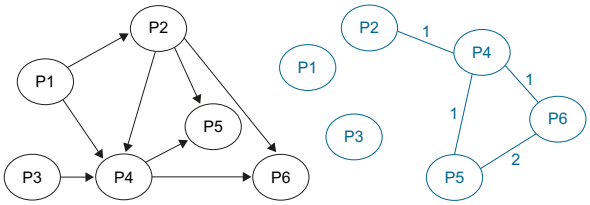
For sociology (Nov. 14, 2017): 274 "hits"

TOPIC: (wealth AND inequality)
Refined by:
WEB OF SCIENCE CATEGORIES: (SOCIOLOGY) AND DOCUMENT TYPES: (ARTICLE)
Timespan: 1990–2017
Indexes: SSCI

- *Step 2:* Extracting bibliographic information

To accomplish our goal of identifying seminal works and dominant research strands in wealth inequality research, we extracted information from the two field-specific publication sets. The WoS allows for the export of a file (in plain text format) that contains key information for each selected record separately—such as, for example, the author's name ("AU") or the document's title ("TI"). The information used here is the exported cited

[5] As with any other possible search strategy, the approach adopted here is not able to harvest all journal articles on wealth inequality. For example, articles in the WoS category 'sociology' that use different terminology such as inequality in asset ownership are overlooked. In the WoS category 'economics', the approach fails to capture all articles that address the issue of wealth inequality but whose title does not contain the word 'wealth'. This bias is, however, remedied by the fact the analysis concentrates on references contained in the selected articles that considerably broaden the scope of literature covered.



	P1	P2	P3	P4	P5	P6
P1		0	0	0	0	0
P2	0		0	1	0	0
P3	0	0		0	0	0
P4	0	1	0		1	1
P5	0	0	0	1		2
P6	0	0	0	1	2	

Fig. 1 Directed citation network (in black), corresponding undirected co-citation network of publications (in blue), and a matrix representation of co-citations. (Color figure online)

references ("CR"). It is on the basis of these exported references ("CR") that we are able to construct co-citation connections.

- *Step 3:* Constructing co-citation networks

Scientific literature is intellectually organized in terms of specialties; these structures are reproduced by making references to the authors, concepts, and texts embedded in specialized literatures (Leydesdorff 2011). Co-citation analysis is used to detect these *thematic structures*. In co-citation analysis, two articles are considered to be similar if they are cited by the same documents. A fundamental assumption of co-citation analysis is that the more two articles are cited together, the more likely it is that their content is related (Zupic and Čater 2015). The main aim is to detect subgroups of publications that are frequently cited together because of similarities in intellectual content. A further assumption is that co-citation analysis might also be able to identify *epistemic communities*—that is, a group of scholars with similar *epistemological styles,* which Michèle Lamont defines as "preferences for particular ways of understanding how to build knowledge, as well as beliefs in the very possibility of proving those theories" (Lamont 2009, p. 54). In such communities, we are likely not only to find similar research topics but also researchers with similar theoretical aspirations and belief systems who might possibly apply the same methodologies in their work.

Figure 1 shows how (undirected) co-citation networks are generated on the basis of directed citation networks. The figure reveals, among other things, that Papers 5 and 6 are both cited by Papers 2 and 4; thus, both documents are linked by an edge of the strength 2 (see matrix representation).

We construct co-citation networks with the help of the software *VOSviewer,* which integrates well with WoS data.[6] Publication matching is primarily done based on the digital object identifier (DOI). If DOI data is not available, matching is done in the case of journal articles based on the author's surname, publication year, volume number, and the starting (and not the ending) page number (van Eck and Waltman 2014). In case of monographs, author's surname, publication date, and book title are used.

Here are three examples of matches that VOSviewer is able to identify as such:

[6] VOS stands for "visualization of similarities." The software VOSviewer is freely available here: www.vosviewer.com. VOSviewer is a mapping and clustering program for network data developed by Ludo Waltman and Nees Jan van Eck, based at the Centre for Science and Technology Studies at the University of Leiden.

Massey Douglas S., 1993, AM APARTHEID SEGREGA
Massey Douglas S., 1993, AM APARTHEID

Wolff E. N., 1995, TOP HEAVY STUDY INCR
Wolff E. N., 1995, TOP HEAVY INCREASING

Piketty T, 2003, Q J ECON, V118, P1, DOI 10.1162/00335530360535135
Piketty T, 2003, Q J ECON, V118, P1, DOI 10.1162/00335530360535135

However, there are variants of reference entries that VOS viewer treats as though they were different:

Conley Dalton, 1999, BEING BLACK LIVING R
Conley Dalton, 2009, BEING BLACK LIVING R

Saez E., 2014, NBER WORKING PAPERS, V20625
Saez E., 2014, 20625 NBER

Spilerman S., 1993, SOCIAL THEORY SOCIAL, P165
Spilerman S., 1993, SOCIAL THEORY SOCIAL

In these and other cases, it was necessary to employ data pre-processing of the exported WoS data—that is, harmonization of reference entries.

WoS data accuracy is troubled as well by incorrect and missing references. In the first case, a reference is displaced by another one that has some similarities (e.g., name of the first author and perhaps first page number) but is in essence a completely different reference. Bibliometricians refer to these WoS references that are not to be found in the original articles as "phantom citations" (García-Pérez 2010). I was able to identify some phantom citations and replaced them with correct reference entries.

More vexing are references that are, for some reason, omitted in the WoS data. Unfortunately, it is impossible to systematically correct for this last type of error, which is well documented in the literature (Franceschini et al. 2015).

The (potential) error-proneness of the matching process of several thousand publications must be judged in the light of three crucial advantages inherent to the adopted approach: First, the sample is extended from a few hundred to several thousand publications. Second, by considering entire bibliographies taken from representative articles on wealth inequality, monographic literature is considered as well—which appears crucial, as previous research revealed that sociologists "attend to and cite leading books at even higher rates than they cite leading articles" (Sullivan 1994, p. 171). Third, the bibliographic information used is not necessarily limited to English-language literature.

Visualizing co-citation networks

To visually explore co-citation networks, clustering techniques are often used in combination with multidimensional scaling (MDS) (Börner et al. 2003). Here, however, we use an alternative to MDS, the "VOS mapping technique," as it produces substantially better structured maps (van Eck and Waltman 2010). The construction of a VOS map is basically a process that consists of three steps: normalization, mapping, and clustering.

- *Normalization* In co-citation networks, popular nodes representing highly cited publications may differ greatly in terms of connections from less popular publications. To reduce differences between nodes in the number of edges, *VOSviewer* applies (by default) normalization. More information on this applied "association strength normalization" can be found in van Eck and Waltman (2009).
- *Mapping* The aim of VOS is to provide a low-dimensional Euclidean space in which the objects 1, …, n are located in such a way that the distance between any pair of objects i and j reflects their similarity s_{ij}. Objects that have a high similarity should be located close to each other, whereas objects that have a low similarity should be located far from each other. The VOS mapping technique minimizes the function:

$$V(x_1, \ldots, x_n) = \sum_{i<j} s_{ij} \left\| x_i - x_j \right\|^2$$

  where the vector $x_i = (x_{i1}, x_{i2})$ denotes the location of item i in a two-dimensional map, n the number of nodes in the network, and $\left\| x_i - x_j \right\|$ denotes the Euclidean distances between nodes i and j (van Eck and Waltman 2010).
- *Clustering* In co-citation networks, VOSviewer (by default) assigns nodes in a network to clusters—that is, to sets of closely related nodes. The VOSviewer clustering technique was developed by Waltman et al. (2010). Nodes are assigned to a cluster by maximizing the function

$$V(c_i, \ldots, c_n) = \sum_{i<j} \delta(c_i, c_j)(s_{ij} - \gamma)$$

  where c_i denotes the cluster to which node i is assigned; $\delta(c_i, c_j)$ a function that equals 1 if $c_i = c_j$ and 0 otherwise; and γ a resolution parameter that determines the level of detail of clustering. The higher the value of γ, the larger the number of clusters that will be obtained. Publications that are assigned to the same clusters are likely to have a theme in common.

Results

A thematically clustered map of wealth inequality research in sociology

Figure 1 displays the co-citation network for sociology. Considered are cited references that have at least five co-citation links. It turns out that 110 out of 12,251 cited references identified by *VOSviewer* fulfill this selection criterion. Therefore, the network contains 110 vertices, with each vertex standing for a single publication.

Publications are visualized by circles and labels. The size of the publication's circle and label depends on the total strength of links of a given publication. To avoid overlapping labels, some labels may not be visible. The labels used contain only the first author and the publication date. The label "Oliver (1995)," for example, stands for the monograph *Black Wealth/White Wealth* published by Melvin L. Oliver and Thomas M. Shapiro in 1995. All labels and their corresponding full publication titles are to be found in the Online Appendix.

The color of an item is determined by the cluster to which the publication belongs. The distance between two publications indicates the strength of their relatedness in terms of

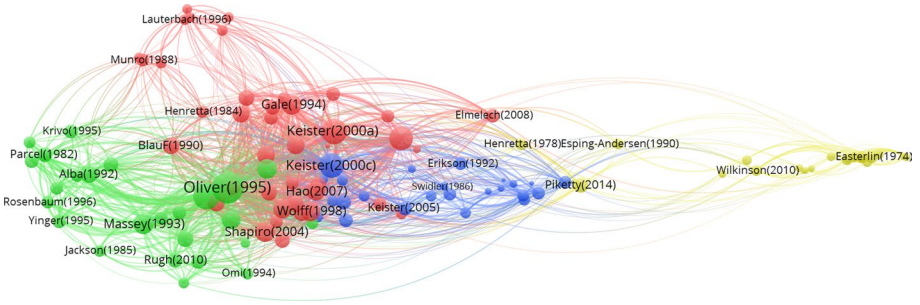


Fig. 2 Visualization of the sociology of wealth inequality (co-citation network) *Notes*: Number of vertices: 110; min. cluster size: 15; resolution parameter: 2.0; max. lines: 1300. (Color figure online)

co-citation links. The closer two publications are located to each other, the more often these publications tend to be listed in the investigated bibliographies. "Easterlin (1974)," for example, tends to be cited in the same bibliographies as 'Wilkinson (2010)," but is never mentioned together with "Lauterbach (1996)." In contrast, publications in the center of the co-citation network, such as "Oliver (1995)" or "Keister (2000c)" tend to have co-citation links with many and thematically different publications. The same holds for clusters as well. Cluster 2 (in green) is located closer to Cluster 1 (in red) than to Cluster 3 (in blue-purple) because of the greater number of co-citation links between Clusters 2 and 1.

The left part of the map in Fig. 2 represents what can be referred to as literature on the racial wealth gap best represented by such works as "Conley (1999)," "Massey (1993)," or "Oliver (1995)." While this literature documents wealth disparities between different ethnic groups, the literature at the right part of the map is mostly contributed by economists

Table 1 Summary of the four thematic clusters in sociology

Cluster No. (no. of publications)	Main topics	Representative publications (see also Appendix A)	Color
1 (40)	Inheritance, intergenerational wealth transfers , inheritance of housing	Beckert (2008) Inherited Wealth Gale (1994) Intergenerational Transfers and the Accumulation of Wealth Modigliani (1988) The Role of Intergenerational Transfers and Life Cycle Saving	
2 (25)	Black-white wealth gap , ethnic inequality , race differences, residential segregation	Conley (1999) Being Black, Living in the Red Massey (1993) American Apartheid Oliver (1995) Black Wealth/White Wealth	
3 (24)	Theories of inequality, top incomes, pioneering studies	Becker (1964) Human Capital Bourdieu (1984) Distinction Piketty (2006) The Evolution of Top Incomes	
4 (21)	Divided societies, income and happiness , unhealthy societies	Easterlin (1974) Does Economic Growth Improve the Human Lot? Stiglitz (2012) The Price of Inequality Piketty (2014) Capital in the Twenty-First Century	

such as Easterlin or Stiglitz and is concerned with social inequality as a societal macro trend affecting the social conditions of the many.

There are two other subfields. A significant number of sociologists specialized in research on the importance of intergenerational transmission of wealth (e.g., "Beckert (2008)"). Finally, classical studies (e.g., "Bourdieu (1984)") on inequality and more theoretical contributions that investigate cumulative advantage processes as well as mechanisms underlying inequality (e.g., "Becker (1964)") constitute a field on their own. Interestingly, Piketty's contributions on the topic of the evolution of incomes (e.g., "Piketty (2006)") belong to the very same sociological cluster. An overview of all four clusters is given in Table 1.

It is worth noting that the structure of the network is partly determined not only by content but also by exogenous factors such as common language and publication date. "Lauterbach (1996)," for example, is only loosely related to other publications in Cluster 1 because the article mainly refers to other German literature that is clearly underrepresented in the data set analyzed. Only recently published contributions such as Piketty's *Capital in the Twenty-First Century* ("Piketty (2014)") are more likely to have fewer co-citation links than work from earlier time periods. That is most likely the main reason why "Piketty (2006)" is more central to the network than "Piketty (2014)." As can be seen from Fig. 2, "Piketty (2014)" is mapped with Cluster 3 but (mistakenly) assigned to Cluster 4. Apparently, VOSviewer has difficulties allocating the right place to recent publications in a two-dimensional space, especially if these contributions additionally cross-cut different research domains, as "Piketty (2014)" does.

A thematically clustered map of wealth inequality research in economics

Figure 3 shows the result of a combined mapping and clustering of cited references in economics that have a total strength of five—which applies to 146 out of the 7344 references

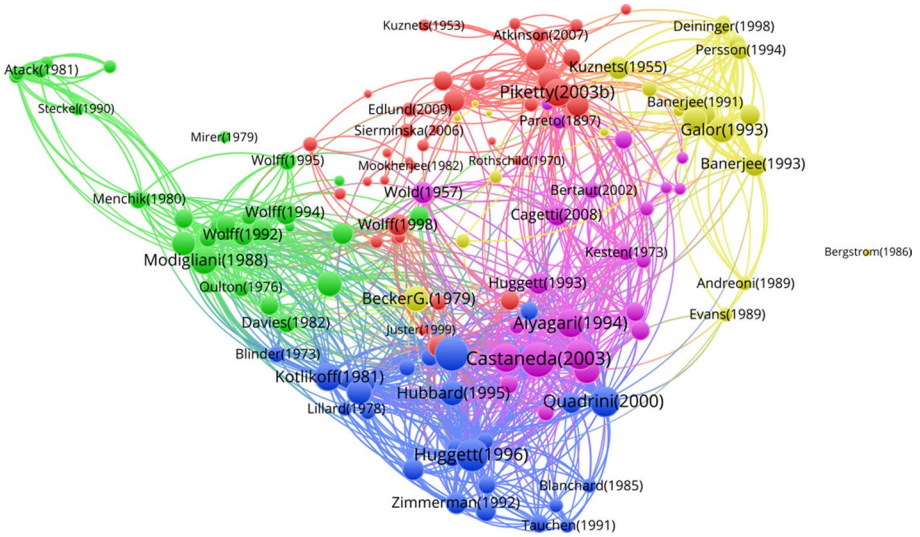


Fig. 3 Visualization of the economics of wealth inequality (co-citation network). *Notes*: Number of vertices: 146; min. cluster size: 20; resolution parameter: 2.0; max. lines: 1300. (Color figure online)

Table 2 Summary of the five thematic clusters in economics

Cluster No. (No. of publications)	Keywords	Representative publications (see also Appendix B)	Color
1 (37)	Top wealth holders , 1% , time series analysis	Atkinson (1978) Distribution of Personal Wealth in Britain Lampman (1962) The Share of Top Wealth-Holders in National Wealth Piketty (2003b) Income Inequality in the United States, 1913-1998	
2 (32)	Empirically grounded models, inheritance, bequests, life cycle saving	Harbury (1979) Inheritance and Wealth Inequality in Britain Davies(1982) The Relative Impact of Inheritance Modigliani (1988) The Role of Intergenerational Transfers and Life Cycle Saving	
3 (28)	Quantitative macro -models, life cycle wealth, precautionary saving, wealth transfers	Hubbard (1995) Precautionary Saving and Social Insurance Huggett(1996) Wealth Distribution in Life-Cycle Economies Quadrini (1997) Understanding the US Distribution of Wealth	
4 (26)	Economic growth, politics , models of economic development, macroeconomics	Alesina (1994) Distributive Politics and Economic Growth Banerjee(1993) Occupational Choice and the Process of Development Galor (1993) Income Distribution and Macroeconomics	
5(23)	Quantitative models of wealth inequality , saving behavior, rates of return	Castañeda(2003) Accounting for the US Earnings and Wealth Inequality Krusell(1998) Income and Wealth Heterogeneity in the Macroeconomy Quadrini(2000) Entrepreneurship, Saving and Social Mobility	

identified by *VOSviewer*. What catches the eye immediately are the different overall structures of the two co-citation networks (Figs. 1, 2):

While for sociology, we almost see a "citation island" of economic work ("Easterlin (1974)") that relates only loosely to other clusters, only a few selected publications ("Atack (1981)," "Steckel (1990)") occupy distant network positions in economics—which is mostly explained by this rather isolated work's particular interest in past episodes (e.g., wealth inequality before the American Civil War).

Anthony Atkinson and Thomas Piketty turn out to be the leading figures in contributions that measure inequality by mainly focusing on the top of the affluence distribution (Cluster 1 in Table 2). A major topic in this research stream, therefore, is the "top one percent share" measure of wealth inequality.[7]

A second cluster gravitates around Franco Modigliani's seminal contribution ("Modigliani (1988)") on the relative magnitude of the two main sources of wealth: life-cycle savings and inter vivos transfers/bequests. Like the bulk of contributions in this cluster, Modigliani discusses the role of intergenerational transfers.[8]

[7] It should be noted that the work of both scholars builds on collective efforts involving many other scholars, including Emmanuel Saez, Gabriel Zucman, and Facundo Alvaredo. In *Capital in the Twenty-First Century,* Piketty (2014) therefore warns the reader that the book is not to be considered a one-man opus.

[8] Franco Modigliani, the "father" of the life-cycle hypothesis, showed that over 80% of net worth in the USA can be explained by life-cycle saving (Modigliani 1988). More recent research, however, estimates that inherited wealth makes up more than 70% of private total wealth in France today.

The third cluster consists of highly associated publications that share similar topics with the second cluster (see Table 2). Representative for this research are models that link parents and children by (voluntary and accidental) bequests and by transmission of earnings ability ("overlapping-generational model"). These stylized mathematical models that focus on few causes and seek to show how their effects function in the system are then mapped against reality.[9] In contrast, most authors in Cluster 2 tend to rely much more on inferences from (survey) data on savings and inheritance.

In the fourth cluster, research is mainly concerned with the trade-off between macroeconomic trends and the unequal distribution of material resources (see Table 2). "Galor (1993)," for example, reports evidence that cross-country differences in macroeconomic adjustment to aggregate shocks can be attributed to differences in wealth distributions across countries.

Publications in the fifth cluster are not concerned with top wealth shares (Cluster 1), empirical evidence on inheritance (Cluster 2), life-cycle models of savings (Cluster 3), or the relationship between economic growth and inequality (Cluster 4), but with macro models of wealth inequality. The "model builders" that belong to Cluster 5 try to come up with theory-based mathematical frameworks on the determinants of real wealth inequality (e.g., entrepreneurship, intergenerational links, rate of return, heterogeneity in savings rates, public policies). A typical workhorse model is the "Bewley model," in which people ("agents") save in order to self-insure against earnings shocks to smooth their consumption.

As already observed in Fig. 2, publications that cross-cut different research domains are positioned between the various clusters. Obvious examples in Fig. 3 are "BeckerG. (1979)" and "Kuznets (1955)."

Validating cluster results using computer-aided content analysis

Different researchers employ different vocabulary in academic writing. It is likely that we will find a higher word similarity between the work of social scientists writing on the same topic than between scientists with different research specializations. Text analysis is thus another appropriate tool to identify distinct research domains (Griffiths and Steyvers 2004).

In the following section, we will examine the distinctiveness of each cluster's semantic profile by applying purely descriptive word frequency counts.[10] Considered are English-language journal articles (of similar length) only. If a given journal article is included in the JSTOR archive, we made use of the "JSTOR Data for Research"[11] service, which generates *n*-grams (contiguous sequences of n words) from archived texts. All other articles had to be converted from a pdf to an ASCII (text) format before conducting text analysis with *Yoshikoder*.[12]

[9] Models in economics are different from physical models used by architects since they do not attempt to describe the real world but rather a hypothetical world. One can thus think of economic models as "theoretical cases" (Gilboa et al. 2014), which help us understand economic problems by drawing analogies between the model and the problem.

[10] Most of the specialized literature identifies research domains through the use of "topic models," which are essentially algorithms applied to massive collections of documents. Here, however, we are dealing with too few texts to apply Dirichlet allocation, which is at the very base of every topic model.

[11] https://www.jstor.org/dfr/.

[12] The conversion was performed with *Yoshikoder Converter*. *Yoshikoder* was developed by Will Lowe as part of the Identity Project at Harvard´s *Weatherhead Center for International Affairs*. The website can be found at: http://www.yoshikoder.org.

What is counted is the number of times a given word (1-g) such as "inheritance" appears in the texts belonging to a given cluster. We assume here that such a simple approach, which treats text as "bags of words" and thus ignores where in the text words occur, is able to reveal the overall topic contained in already clustered texts.

The most recurrent words which are likely to be indicative of topics are listed in descending order in Tables 3 and 4. The especially high frequency of terms such as "family," "children," "inheritance," or "bequests" suggests that Cluster 1 in sociology is mainly concerned with the transmission of wealth from parents to children. Interestingly, the word "housing" is even more characteristic of Cluster 2 than words such as "race" or "ethnic"—which can be explained by the fact that the white-black wealth (or other ethnic wealth disparities) are closely intertwined with topics such as residential segregation or housing inequality (see, for example, "Massey (1993)").

The neglect of (sociological) books leads to a list of keywords for Cluster 3 that features, among other things, word combinations such as "top income" or "top 1 percent" (as several articles by Piketty are contained in the very same cluster). One has to treat these results with caution, as the inclusion of sociological books contained in the cluster would certainly reveal different keywords. As expected, words and word combinations such as "health," "happiness," "subjective well-being," and "life satisfaction" dominate Cluster 4.

On a more general level, one can conclude that while word frequency analysis confirms the fractal divisions detected by network analysis, no cluster is monothematic. Text analysis reveals, for example, that different research streams such as articles on the happiness-wealth and the health-wealth nexus are clustered together. The many commonalities of these specialized literatures are, however, self-evident.

While content analysis clearly characterizes Cluster 1 in economics as containing work based on time series data and visualizing the changing top shares of income and wealth, the results show fewer differences in keywords between Cluster 2 and Cluster 3, as expected. The obvious reason is that both thematic clusters feature research on the role of life-cycle and inherited wealth. However, the different usage of word combinations such as "utility function" or "parameter value" hint at substantially different methodological approaches pursued in both clusters. Research contained in Cluster 3 uses economic models to uncover, for example, the significance of inherited wealth. These models are supposed to mimic reality, and parameters are typically calibrated based on key assumptions. A second step tests whether these models can produce aggregate wealth statistics observed in the real world. In contrast, research in Cluster 2 is marked by a different epistemological preference: Conclusions are derived inductively from empirical evidence. "Wolff (1994)" in Cluster 2, for example, reports results on trends in household wealth without reference to any economic model.

The outstanding salience of co-occurrences such as "economic growth," "human capital," "growth rate," or "political instability" characterize Cluster 4 as featuring texts that discuss politico-economic differences between countries and how these relate to the distribution of wealth. Cluster 5 contains fewer unique keywords. What becomes evident is that this cluster of texts, which use models to explore the underlying causes of wealth inequality, is substantially less concerned with top wealth shares (Cluster 1), the role of life-cycle and inherited wealth (Clusters 2 and 3), and the trade-off between economic growth/development and inequality (Cluster 4). In essence, research in Cluster 5 features various models that are supposed to unearth the underlying forces (i.e., heterogeneity in rates of return) that drive wealth inequality.

In general, one can thus conclude that the simplest of all text-mining algorithms proves the distinctiveness of all thematic clusters.

Table 3 The 30 most frequent terms in the sociology of wealth inequality

Cluster 1	Cluster 2	Cluster 3	Cluster 4
28 journal articles	*16 journal articles*	*15 journal articles*	*13 journal articles*
min. pages: 4	*min. pages: 9*	*min. pages: 5*	*min. pages: 12*
max. pages: 46	*max. pages: 38*	*max. pages: 68*	*max. pages: 49*
total pages: 623	*total pages: 321*	*total pages: 403*	*total pages: 327*
JSTOR n-grams: 18	*JSTOR n-grams: 14*	*JSTOR n-grams: 12*	*JSTOR n-grams: 7*
1-g			
wealth	**housing**	inequality	income
income	**racial**	income	**happiness**
age	**hispanic**	wealth	**well-**
social	home	family	**being**
net	**black**	**top**	economic
transfers	**blacks**	size	social
household	income	**financial**	**life**
percent	differences	distribution	utility
worth	social	social	data
assets	**whites**	resources	people
children	**white**	**data**	**health**
family	equity	model	countries
data	wealth	families	individual
economic	race	effect	**satisfaction**
market	characteristics	children	level
inheritance	groups	wage	relative
effect	ownership	economic	status
inequality	ethnic	**states**	inequality
table	hispanics	**united**	time
parents	households	labor	subjective
years	percent	countries	individuals
white	household	time	consumption
education	effect	**process**	average
bequests	**homeownership**	transfers	country
black	data	capital	research
differences	inequality	number	effect
inheritances	status	research	states
capital	**segregation**	**tax**	growth
value	research	educational	economics
cycle	minority	**effects**	evidence
Most frequent co-occurrences			
net worth	**home ownership**	United States	**subjective well-being**
family structure	housing equity	**top income**	**life satisfaction**
top income	housing market	family structure	income inequality
income inequality	housing appreciation	income inequality	life cycle
wealth accumulation	**ethnic groups**	**top incomes**	utility function
household wealth	**residential segregation**	financial troubles	economic growth
wealth ownership	**racial differences**	capital gains	job satisfaction
top incomes	household income	capital income	
intergenerational transfers	wealth inequality	**top 1 percent**	
household income	housing inequality	**educational attainment**	
financial assets	racial and ethnic groups		
top 1 percent	wealth accumulation		
capital income			
family wealth			
parental wealth			
parental resources			
tax data			

1-g and co-occurrences are listed in descending order. The table ignores all extremely common terms such as "the," "of," and "to" that are not useful for content analysis, as well as all numbers. Co-occurrences contain one or several of the 30 most frequent terms

Table 4 The 30 most frequent terms in the economics of wealth inequality

Cluster 1 *27 journal articles* *min. pages: 7* *max. pages: 67* *total pages: 839* *JSTOR n-grams: 19*	Cluster 2 *27 journal articles* *min. pages: 4* *max. pages: 48* *total pages: 500* *JSTOR n-grams: 20*	Cluster 3 *27 journal articles* *min. pages: 4* *max. pages: 54* *total pages: 688* *JSTOR n-grams: 18*	Cluster 4 *24 journal articles* *min. pages: 11* *max. pages: 51* *total pages: 662* *JSTOR n-grams: 21*	Cluster 5 *21 journal articles* *min. pages: 4* *max. pages: 41* *total pages: 544* *JSTOR n-grams: 13*
1-g				
wealth	**wealth**	income	income	wealth
income	age	**wealth**	**growth**	income
percent	earnings	consumption	inequality	model
top	income	*model*	capital	distribution
tax	percent	earnings	wealth	**equity**
wage	inequality	age	distribution	rate
inequality	distribution	**life**	rate	capital
data	**life**	rate	**health**	earnings
changes	data	growth	economic	**private**
distribution	*table*	data	*model*	data
saving	**children**	*function*	**countries**	percent
age	**inheritance**	**cycle**	economy	households
estate	economic	**transfer**	human	time
share	estate	time	data	economy
table	**transfers**	**saving**	**investment**	value
period	rate	*equation*	saving	**returns**
wages	**bequests**	**households**	effect	consumption
capital	*sample*	estimates	level	return
relative	**cycle**	distribution	poor	growth
time	*model*	household	results	**tax**
economic	year	tax	**credit**	aggregate
risk	real	interest	time	age
rate	years	capital	higher	labor
years	**family**	economic	high	function
total	capital	period	rates	period
consumption	results	year	period	household
shares	value	value	*equilibrium*	economic
net	growth	net	average	**public**
series	time	stock	social	law
high	estates	effect	individual	**firms**
Most frequent co-occurrences				
top income	**life cycle**	**life cycle**	**human capital**	**wealth inequality**
capital gains	real estate	interest rate	income distribution	wealth distribution
net worth	household wealth	**growth rate**	income inequality	saving rate
capital income	**inherited wealth**	wealth distribution	**economic growth**	**private equity**
household wealth	personal wealth	labor income	saving rate	time preference
saving rate	wealth inequality	net worth	**growth rate**	interest rate
top wealth	**intergenerational transfer**	human capital	capital accumulation	discount rate
wealth distribution	wealth inequality	**precautionary saving**	**physical capital**	life cycle
wealth inequality	wealth transfer	net worth	wealth distribution	**estate tax**
tax data	human capital	**intergenerational transfer**	interest rate	income distribution
top 1 percent	age group	wealth inequality	social security	**public equity**
income inequality	family size	*Euler equation*	**political instability**	labor income
top wealth share	wealth distribution	discount rate		capital income
	social security	*utility function*		growth rate
	wealth accumulation	*parameter value*		**income tax**
		time preference		net worth
				power law

Table 4 (continued)

1-g and co-occurrences are listed in descending order. The table ignores all extremely common terms such as "the," "of," and "to" that are not useful for content analysis, as well as all numbers. Terms in bold are interpreted to indicate the topic associated with a cluster; terms in italics hint at the underlying methodologies. Co-occurrences contain one or several of the 30 most frequent terms

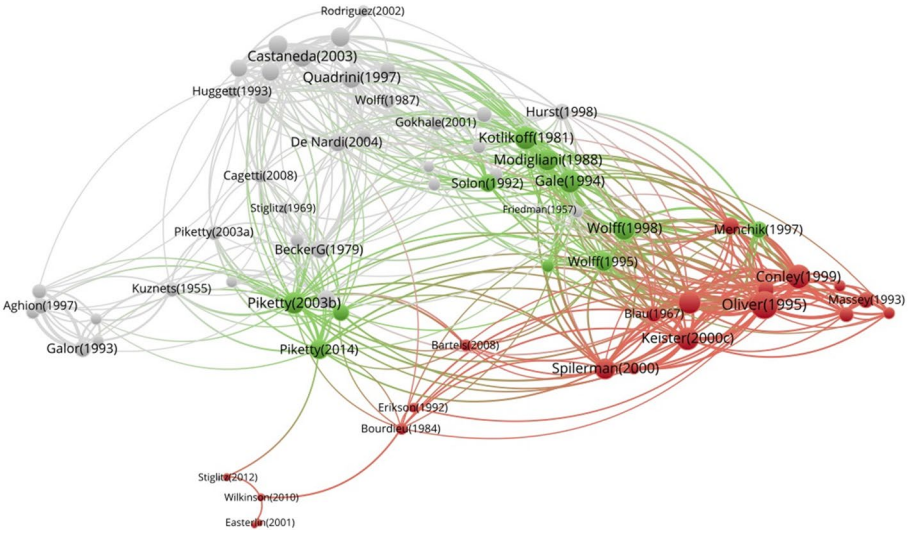


Fig. 4 A joint visualization of the economics and sociology of wealth inequality (co-citation network). *Notes*: Number of vertices: 70; max. lines: 500; literature in grey appears only in the co-citation network of economics (see Fig. 3), literature in red appears only in the co-citation network of sociology (see Fig. 2), and literature in green is part of both disciplinary co-citation networks (see Figs. 2, Fig. 3). (Color figure online)

The joint co-citation network: who bridges gaps in the social fabric of wealth inequality research?

The analysis has so far revealed different research paradigms and a few communalities between economics and sociology. We will continue by examining in detail whose research connects the otherwise mostly disconnected discipline-specific literatures. Scholars acting as intermediaries between research traditions are crucial in enabling knowledge transmission between disciplines, which is a necessary condition for any (future) interdisciplinary endeavor to address the complex problem of wealth inequality.

To do so, we merged both literatures which yielded a total of 18,977 references and extracted publications with 10 or more co-citation links which left us with a total of 70 publications. All co-citations between these publications are depicted in Fig. 4. As expected, the network separates into the economic literature on the left and in the center

and the sociology literature on the right. Literature which appears in the co-citation network for both disciplines (see Figs. 2, 3) functions as a linchpin. Interestingly, we see three different 'bridges' between both disciplines.

First, the work of the economist Edward N. Wolff made the most inroads into sociology. Wolff contributed to different topics such as the historical evolution of wealth trends, wealth top shares and the role of inherited wealth that are all of utmost interest to sociologists. What is more, his quantitative analyses of the *Survey of Consumer Finances* (SCF) do not rely on model assumptions and can be understood by non-economists. Thus, both the wide thematic scope and his intellectual style make Wolff´s work attractive to sociologists.

Second, the debate on the quantitative importance of bequests in wealth accumulation sparked by economists such as Laurence J. Kotlikoff, Franco Modigliani and continued by others such as William G. Gale became a cornerstone in the sociology literature. The many cross-links to this type of economic literature indicates that sociologists imported methodological insights on how to best measure inherited wealth from economics.

Third, Piketty´s work appears to contain significant resources for sociologists. The sociologist Savage (2014) identified three reasons for the Piketty´s outstanding reception in sociology.[13] His repertoire of assembling vast data into a powerful visual template, his historical orientation, and finally his conceptualization of a 'elite' class ("the top 1 percent") chime closely with dominant research paradigms in contemporary sociology.

In line with previous work on interdisciplinary citation patterns (Fourcade et al. 2015), we find sociologists citing economists rather than the other way around. Clearly, work originating from sociologists is rarely, if at all, taken up by economists, which in turn makes interdisciplinary learning one-sided. The reasons for the limited reception of sociological work in economics appear to be not only due to different research interests but are also attributable to different methodological standards. The sociological literature does not build on the mathematical models that are the 'golden standard' in economics, making knowledge transfer from sociology to economics more difficult.

Conclusion

At least since Schumpeter's death in 1950, the isolation of economics from the other social sciences has grown considerably (Swedberg 1991). Some social scientists react to the prevailing division of labor ("economists study the economy, sociologists the society minus the economy") by launching new paradigms such as "socio-economics" (Etzioni 1988, 2003), "economic sociology" (Aspers and Dodd 2015; Smelser and Swedberg 1994), or "institutional economics" (Hodgson 2000). Most recently, the French economist Thomas Piketty has called for a reconciliation between economics and the social sciences in wealth inequality research (Piketty 2017). Piketty criticizes the current state of (mathematical) economics for relying on models that are ill-suited to capture (historical) real-world trends in wealth inequality and bemoans the neglect of the political and social foundations of economics. In fact, one of his main conclusions in *Capital in the Twenty-First Century* is that "one should be wary of any economic determinism in regard to inequalities of wealth […]. The history of the distribution of wealth

[13] It appears noteworthy that Piketty distances himself from mathematical versions of the discipline in favour of more interdisciplinary framings: "I see economics as a subdiscipline of the social sciences, alongside history, sociology, anthropology, and political science" (Piketty 2014, p. 573).

has always been deeply political, and it cannot be reduced to purely economics mechanisms" (Piketty 2014, p. 20).

While Piketty's seminal study on the evolution of wealth inequality provided an impetus for many scholars to think about how different social science disciplines could potentially enrich the study of wealth disparities in the future (see the 2014 "Piketty Symposium" in the *British Journal of Sociology*, Vol. 65(4)), this article looked backwards. It investigated whether any thematic proximity exists in wealth inequality research between economics and sociology as a similar thematic spectrum appears to be a necessary requirement for successful inter-disciplinary approaches.

Based on co-citation mapping techniques, different research domains were identified for each discipline. It has become apparent that what applies to poverty research holds true for research on wealth inequality as well: "If we ask academics why poor [rich] people are poor [rich] …different disciplines will answer …in their own unique ways: each with certain kinds of data, certain methods, certain habits of thinking about the problem" (Abbott 2001, p. 142).

In sociology, there is a strong and lasting research tradition of investigating racial and ethnic wealth disparities, and insights are mostly gained by inference from survey data. In economics, model-based theories on the causes of (overall) wealth inequality, the impact of (overall) wealth inequality on economic growth, and the role of life-cycle versus inherited wealth were identified as being key to the economics of wealth inequality. While cross-linkages and intellectual debates between the different camps of economists are easy to observe (De Nardi et al. 2015), cross-disciplinary dialogue between economics and sociology was in the past clearly the exception rather than the rule.

The analysis also showed that the 'wall of silence' between the two disciplines was broken several times. Sociologists incorporated economists´ methods to accurately assess the role of inherited wealth, cited economists´ analyses on top wealth shares and on the long-term evolution of wealth inequality. It is revealing that the imported economics literature is not based on complex mathematics and thus easily accessible to non-economists. These rare examples of dialogue across disciplinary boundaries point to cross-disciplinary rather than interdisciplinary research (Hulme and Toye 2006): Researchers did not primarily aim at a deep integration of two or more disciplinary approaches but based their studies on the results or methods of two disciplines.

The only significant representative of interdisciplinary research in the field is the French economist Thomas Piketty. One might think of him as an "institutional entrepreneur" (DiMaggio 1988) who is able to engage diverse groups in a meaning-making project. According to Godechot (2017), Piketty´s time series results on top wealth shares will increasingly serve sociologists as a "dependent variable" that is to be explained through social factors rather than economic processes.

While the future of economics-cum-sociology approaches in the field of wealth inequality research remains to be seen, this research reveals that future interdisciplinary endeavors cannot build on past ones. An interdisciplinary future thus requires substantially intensified "inter-disciplinary encounters" (Bridle et al. 2013), graduate programs that do not prioritize specialization but interactions across disciplines (Schmidt et al. 2012), and funding agencies that promote interdisciplinary research (König and Gorman 2016), otherwise the existing professional incentives to stay within disciplinary confines will help perpetuating the current situation in which disciplines simply borrow from each other without engaging in real dialogue.

Acknowledgements Open access funding provided by Max Planck Society.

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