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The specific shapes of gender imbalance in scientific authorships: A network approach

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ABSTRACT

Gender differences in collaborative research have received little attention when compared with the growing importance that women hold in academia and research. Unsurprisingly, most of bibliometric databases have a strong lack of directly available information by gender. Although empirical-based network approaches are often used in the study of research collaboration, the studies about the influence of gender dissimilarities on the resulting topological outcomes are still scarce. Here, networks of scientific subjects are used to characterize patterns that might be associated to five categories of authorships which were built based on gender. We find enough evidence that gender imbalance in scientific authorships brings a peculiar trait to the networks induced from papers published in Web of Science (WoS) indexed journals of Economics over the period 2010–2015 and having at least one author affiliated to a Portuguese institution. Our results show the emergence of a specific pattern when the network of co-occurring subjects is induced from a set of papers exclusively authored by men. Such a male-exclusive authorship condition is found to be the solely responsible for the emergence of that particular shape in the network structure. This peculiar trait might facilitate future network analysis of research collaboration and interdisciplinarity.

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1. Introduction

The handiness of powerful computational instruments and recent improvements in multidisciplinary methods are providing researchers an ever-greater opportunity to investigate societies in their complex nature (Banisch, Lima, & Araújo, 2012). Several research outcomes have been showing that men and women differ in characteristics that could be related to their collaboration patterns. Research collaboration is increasing in frequency and scope. It is driven, among other causes, by growing relationship across scientific disciplines, improvement of the efficiency in research resources in projects and development of information and communication technologies (Abramo, Cicero, & D'Angelo, 2015). The motivations (Beaver, 2001), strategies, patterns and impacts on scientific productivity in quantity and quality in research collaboration have received great scholarly attention (Börner, Dall'Asta, Ke, & Vespignani, 2005; Cainelli, Maggioni, Uberti, de, & Felice, 2015; Ductor, 2015). The patterns vary across space (Hoekman, Frenken, & Tijssen, 2010; Stefaniak, 2001), academic ranks (Abramo, D'Angelo, & Murgia, 2014), professional origins (Beaver & Rosen, 1978) and scientific disciplines (Tsai, Corley, & Bozeman, 2016).

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Economic science makes connections with many other scientific disciplines, like Statistics or Social Sciences, like Sociology, History or Management (Krichel & Bakkalbasi, 2006; Pieters & Baumgartner, 2002). Economics shows a growing increase of co-authorship (Barnett, Ault, & Kaserman, 1988; Cainelli et al., 2015; McDowell & Melvin, 1983). On average, a researcher in Economics had less than one co-author in the 1970s, 1.24 co-authors in the 1980s and 1.67 in 1990s (Goyal, van der Leij, & Moraga-Gonzalez, 2006; Tsai et al., 2016).

Gender differences in collaborative research concerning motivations, strategies, patterns and impacts on science performance have received little attention, contrasting with the growing importance that women hold in academia and research. The literature shows mixed results about the gender differences concerning research collaboration strategies (McDowell & Melvin, 1983), impacts (Abramo et al., 2015; Frandsen, Jacobsen, Wallin, Brixen, & Ousager, 2015; Kyvik & Teigen, 1996; McDowell & Melvin, 1983; McDowell & Smith, 1992; Meng, 2016; Rorstad & Aksnes, 2015) and patterns (Abramo, D'Angelo, & Murgia, 2013; Barbezat, 2006; Boschini & Sjogren, 2007; Bozeman & Gaughan, 2011; Cottrell & Parpart, 2006; Kosmulski, 2015; Raasch, Lee, Spaeth, & Herstatt, 2013; Rhoten & Pfirman, 2007; Uhly, Visser, & Zippel, 2015).

Large bibliometric databases like Web of Science (Adriaanse & Rensleigh, 2013; Harzing & Alakangas, 2016; Sugimoto, Lariviere, Ni, Gingras, & Cronin, 2013) are the main sources used to bibliometric analysis. Bibliometric studies and survey analysis are the main methodologies to the study of research collaboration (Barabási et al., 2002). However, that bibliometric databases have a strong weakness concerning the study of the differences by gender; they do not include information separated by male–female and the way to overcome that weakness is to obtain the information from the first name (Naldi, Luzi, Valente, & Parenti, 2004) or the family name of the author (Kosmulski, 2015).

The present paper seeks to build upon the previous analysis about gender aspects in research collaboration which literature was recently surveyed in Abramo et al. (2013). Here, we intend to contribute to at least two points of the literature: the differences of research collaboration and interdisciplinary participation by gender. Focusing in Economics, a scientific subject strongly connected to other scientific domains (Pieters & Baumgartner, 2002) and constructing five categories of articles in a gender authorship perspective, this study addresses both issues: research collaboration and interdisciplinarity.

Applying a network approach and using as unit of analysis articles indexed in the Web of Science (WoS) this analysis maps the research collaboration by gender within dozen of scientific subjects, all associated with Economics.

Web of Science (WoS) and Scopus are the two major bibliographic databases (Wang & Waltman, 2016). WoS covers multiple types of scientific outputs. For example, the Social Sciences Citation Index (SSCI), for the period 2010–2015 and the Web of Science Subject 'Economics' includes 14 Document Types from which the Articles, Meeting Abstracts and Book Review correspond respectively to 76.7%, 13% and 5.9% of the total. It has been demonstrated that, in general, books are more important in Social Sciences and, in particular, in Art and Humanities than they are in Science (Chi, 2016). It is possible to extend bibliometric studies by using Library Catalog databases to focus on scholarly books in Economics, applying innovative methodologies (Torres-Salinas & Moed, 2009). Our research only includes articles published in English and in journals indexed to ISI-Thomson Reuters. While we recognize that it ignores books, non-English-language journals, local journals, monographs, confidential documents and 'grey' publications, there is a trend in Social Sciences towards publication in journals and away from monographs and similar documents (Norris & Oppenheim, 2007). In addition, concerning the non-English language journals included in the WoS Subject (WC) 'Economics' and based on a detailed analysis of each journal's language policy, Henshall (2012) shows that they account for a tiny proportion of the total. The latest updates in JCR reveal that this tiny proportion is further decreasing (Journal Citation Reports, years from 2010 to 2015). By using only one kind of scientific output (articles in English), our research follows previous literature that uses homogeneous information (Ruiz-Castillo & Waltman, 2015). The advantage of using articles published in ISI indexed journals instead of using other kinds of scientific outputs like books is that the selection process for journals included in Web of Science is public and relies on explicit publishing standards (Testa, 2016).

The choice of network approaches to study research collaboration in economics (Pieters & Baumgartner, 2002) has been extensively embraced. It often relies on the discovery of patterns of collaborations within researcher communities, aiming to find the influence of individual researchers in the networks using citation analysis. Beaver and Rosen (1978), in the first complete theory of scientific collaboration, list and discuss the causes for that collaboration.

Our unit of analysis is the article, not the journal. We define a multidisciplinary article as an article in the bibliographic database that includes Economics as WoS subject and at least one other WoS subject. (The list of co-occurrences with Economics in our database is presented in Table 1.) This multidisciplinary classification is completely independent from the thirteen WoS multidisciplinary categories (for example listed in Wang & Waltman, 2016:361, Table A1). The analysis of the accuracy and comparability across bibliometric databases of the Scientific Subject classifications is a relevant and crucial field of research (Leydesdorff & Bornmann, 2016; Wang & Waltman, 2016). We are aware of that important discussion, but in the current research we adopt the definition of a multidisciplinary article presented above assuming as given, and without discussing, the WoS Subjects (WCs).

They stress that it is necessary, when scientists deal with research questions, that cross disciplinary bounds. They also identify a large variation in collaboration by discipline, which is being further investigated in more recently published studies (Abramo et al., 2013; Bozeman & Gaughan, 2011).

Its well known that the adoption of a network approach allows the modeling of social structures from a bottom-up perspective, as resulting from the interaction (or likeness) of individual characteristics (Banisch et al., 2012). Moreover, as the individual characterization might be driven by multiple aggregate concerns, the network approaches allow for simultaneously considering that multiplicity of individual aspects and the consequences of the aggregate structures themselves on

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