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The relationship among research productivity, research collaboration, and their determinants

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ABSTRACT

This work provides an in-depth analysis of the relation between the different types of collaboration and research productivity, showing how both are influenced by some personal and organizational variables. By applying different cross-lagged panel models, we are able to analyze the relationship among research productivity, collaboration and their determinants. In particular, we show that only collaboration at intramural and domestic level has a positive effect on research productivity. Differently, all the forms of collaboration are positively affected by research productivity. The results can favor the reexamination of the theories related to these issues, and inform policies that would be more suited to their management.

1. Introduction

The scientific literature on the determinants of a researcher's performance (Cole & Zuckerman, 1984; Costas, Van Leeuwen, & Bordons, 2010; Gonzalez-Brambila & Veloso, 2007; Harris & Kaine, 1994) has shown how this depends on numerous personal and organizational variables. These variables influence the level of competencies, the resources and time available, and the individual's motivation and reputation, which are at the basis of the performance. The continuing decline in the share of single-authored publications (Uddin, Hossain, Abbasi & Rasmussen, 2012) has often been associated with the growth in research performance (Gonzalez-Brambila, Veloso, & Krackhardt, 2013; He, Geng, & Campbell-Hunt, 2009). In particular, as research collaboration increases, the number of publications (Ductor, 2015; Lee & Bozeman, 2005) and citations also increases (Bidault & Hildebrand, 2014; Li, Liao, & Yen, 2013).

The link between research collaboration and performance would at this point seem accepted in the literature (He et al., 2009; Lee & Bozeman, 2005), however in fact there has not been full clarification of the causal nexus between collaboration and research performance. First of all, only few papers have specifically analyzed the different forms of collaborations (intra-university, domestic, and international), which feature notably different efficacies and costs (He et al., 2009; Smeby & Try, 2005). Secondly, even fewer papers have tested the impact of research performance on the ability to activate collaborations,

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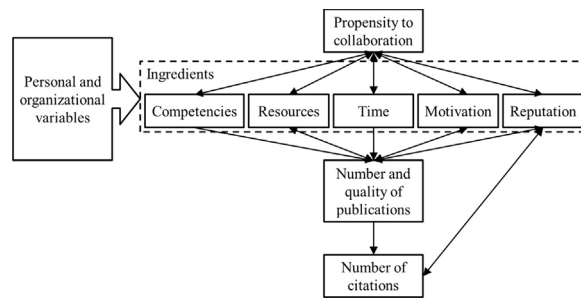
Fig. 1. A systematic view of the determinants of research productivity.

while most of the literature has considered only the opposite causal mechanism (He et al., 2009; Landry & Amara, 1998). Finally, although in a different manner, both research collaboration and performance are influenced by the same personal and organizational variables (Lee & Bozeman, 2005). Besides, some of these variables, firstly academic rank, could in turn be influenced by research performance and collaboration (Lissoni, Mairesse, Montobbio, & Pezzoni, 2011; Pezzoni, Sterzi, & Lissoni, 2012). The presence of such opposite and interrelated causal mechanism requires the use of statistical methods that are able to deal with the endogeneity among the variables under analysis.

In this study we adopt a structural equation modelling approach to estimate different cross lagged panel models. Although these models do not provide a definitive answer to the causal relationship among research productivity, research collaboration, and some of their determinants, such as gender, cohort, and academic rank, they allow us to measure the strength of the different relationships among these variables. We can then evaluate the impact of different forms of propensity to collaborate on research productivity, and vice versa. Besides, we are also able to evaluate how the determinants affect research collaboration and productivity in indirect way, thanks to the mediation of other variables.

Compared to the preceding studies on this topic (He et al., 2009; Lee & Bozeman, 2005), the present work is distinguished also for the breadth and exhaustiveness of the field of observation, that is a large share of the population of the professors of Italian universities in the areas of the sciences and economics (16,823 in all). Another notable element of the present paper is in the indicator of research performance, given that we measure research productivity by means of the (fractional) total impact, meaning the sum of the field-normalized citations received by the publications of each professor (Abramo & D'Angelo, 2014).

The next section of the paper draws from an analysis of the literature to indicate an expected framework of links between collaboration, academic rank, research productivity and the other personal and organizational variables under consideration. Section 3 describes the dataset and the methodology used. Section 4 presents the empirical results, while the implications of the findings are discussed in Section 5.

2. Literature review

To understand how the research productivity of a scientist can be influenced by their research collaboration, it is appropriate to begin from the factors that determine high research performance, measurable in terms of the number of publications and their impact (Fig. 1).

Above all, the advancement of scientific knowledge demands that the researcher be equipped with the appropriate competencies, beginning from knowledge about the problem under analysis, which permits the individual to carry out original and appropriate analyses, up to the necessary competencies in methodologies and reporting the findings in publication. The increasing multidisciplinarity and complexity that characterizes current scientific research often results in contexts where a single scientist does not possess all the necessary competencies for the achievement of scientific advancement (Beaver, 2001; Katz & Martin, 1997). Collaboration permits overcoming these shortcomings by means of involving scientists who are specialized in the missing competencies. Moreover, collaboration facilitates the generation and selection of original ideas, thanks to the synergies that can be obtained from scientists with complementary backgrounds, or even from different disciplines (Katz & Martin, 1997; Rigby & Edler, 2005). This process is especially favored by international collaborations, because they involve scientists gifted with complementary competencies, and mindsets that are often sharply differentiated (Burt, 1992). Over a longer time horizon, collaboration permits overcoming the individual's gaps in competencies, through the activation of learning processes including learning of tacit knowledge (Beaver, 2001; He et al., 2009). The involvement of multiple authors also permit a more efficient use of time and limits the need to the resort to external advisors, for example for third party checking of research processes and outcomes (Barnett, Ault, & Kaserman, 1988).

In many cases, the achievement of scientific projects requires not only competencies, but also equipment and various other resources. Collaboration can ensure the access to unique or costly resources, through the involvement of research groups already equipped with these assets (Beaver & Rosen, 1978) or through developing multiple research projects, each one featuring an adequate critical mass of scientists (Beaver, 2001). It is no accident that the greatest resort to collaboration,