



Do more distant collaborations have more citation impact?



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ABSTRACT

Internationally co-authored papers are known to have more citation impact than nationally co-authored paper, on average. However, the question of whether there are systematic differences between pairs of collaborating countries in terms of the citation impact of their joint output, has remained unanswered. On the basis of all scientific papers published in 2000 and co-authored by two or more European countries, we show that citation impact increases with the geographical distance between the collaborating countries.

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1. Introduction

International collaboration is a salient feature of present-day scientific research. Especially since the 1990s, a rapid rise occurred in internationally co-authored papers (Doré, Ojasoo, & Okubo, 1996; Georghiou, 1998; Glänzel, 2001). The increase was dramatic: the share of internationally co-authored publications doubled between 1990 and 2000 (Wagner & Leydesdorff, 2005). The number of internationally co-authored articles grew at a rate faster than traditional nationally-co-authored articles (NSB, 2002). This trend continued after 2000 (Hoekman, Frenken, & Tijssen, 2010). While there are large differences among fields in the number of international co-authorships (Heimeriks, 2013; Hoekman et al., 2010), an increase can be seen across all fields of science at more or less the same rate (Hoekman et al., 2010; Wagner & Leydesdorff, 2005).

A striking feature of internationally co-authored papers is the tendency of their citation impact to be systematically higher than that of nationally co-authored papers (Frenken, Hardeman, & Hoekman, 2009; Narin, Stevens, & Whitlow, 1991). This pattern suggests that, on average, scientists will have more impact by international partnering as opposed to national partnering. Though the citation premium for internationally co-authored papers is well known, it is unlikely that all pairs of countries equally gain from collaboration. Our question is: what explains the variation in the citations (if any) received by internationally co-authored papers? Using data for over 33,000 papers concerning all collaborations in Europe in 2000, our main result holds that citation impact increases with the geographical distance between the collaborating countries.

2. International co-authorship and its citation impact

Since the study by Narin et al. (1991) on international scientific collaboration, several studies have noted the citation premium enjoyed by internationally co-authored papers compared to nationally co-authored ones. They found that

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co-publications involving affiliations to several European countries were twice as heavily cited as papers reporting a single EC country affiliation. This finding has been confirmed by later studies such as the ones by [Frenken, Hölzl, and De Vor \(2005\)](#), [Frenken, Ponds and Van Oort \(2010\)](#), [Persson, Glänzel, and Danell \(2004\)](#), (for a review, see [Frenken et al., 2009](#)).

The difference in citation impact between nationally and internationally co-authored papers suggests that scientists have something to gain by covering distance. One type of explanation of the citation premium enjoyed by internationally co-authored papers points to the content and the quality of the underlying research: international research projects may be, on average, more creative and important than nationally co-authored ones. Recombining resources from centers located in different national systems and traditions can be expected to lead to more unique outcomes. That is, breakthrough innovations often stem from recombining ideas that previously have been remained unconnected ([Fleming, 2001](#)). Indeed, the higher expenses for international projects compared to national projects need to be legitimized by better prospects in terms of research output.

There is, however, good reason to believe that quality provides only a partial explanation for the citation premium. A second explanation, which does not necessarily exclude the first one, holds that the output of international projects diffuses more widely than nationally co-authored papers. Since research tends to be more cited in the countries where authors originate from ([Pasterkamp, Rotmans, Kleijn, & Borst, 2007](#)), one expects internationally co-authored papers to be cited more than nationally co-authored papers.

The question we pose here is a different one: rather than investigating the citation differences between nationally and internationally co-authored papers, we are interested in explaining differences in citation impact among internationally co-authored papers. We expect that the citation impact of papers will be systematically different for different pairs of collaborating countries. In particular, we expect that collaboration between more distant countries will have greater impact than collaboration between closer countries.

The reasoning underlying our hypothesis is based on the geographical nature of scientific collaboration. In international collaborations, it is known that scientists tend to collaborate with colleagues nearby ([Hoekman, Frenken, & Van Oort, 2009](#); [Hoekman et al., 2010](#); [Maggioni & Uberti, 2009](#); [Scherngell & Barber, 2009](#)). Even if present-day research collaboration is supported by advanced ICTs, frequent travel to have face-to-face interaction will remain necessary. Hence, most international research projects occur between neighboring countries. As a consequence, the networks in which ideas and competencies are being shared and developed, will be much tighter between scientists nearby than farther apart. This would mean that projects recombining resources from centers located farther apart can be expected to lead to more novel and unique outcomes than projects in which nearby colleagues collaborate ([Boschma, 2005](#)). A second reason why geographical distance can lead to more citation impact relates to the diffusion of results. Distant researchers have less overlap in their personal networks than researchers located in closer vicinity ([Breschi & Lissoni, 2009](#)). Hence, results are expected to diffuse more widely.

We test this hypothesis on all internationally co-authored papers in Europe published in 2000. To probe the effect of geographical distance on the citation impact of international research collaborations, this effect needs to be carefully isolated from other impact determinants. Hence, in the following, we take into account several control variables, including the number of authors and countries involved, whether collaborating countries share language and institutions, dummies for scientific disciplines, and an interdisciplinarity indicator. Most importantly, we also employ country dummies as each country has a different baseline expectation regarding citation impact. Since the mean citation rate of countries is known to differ systematically ([May, 1997](#); [Rousseau & Rousseau, 1998](#)), collaborations between highly cited countries will automatically result in higher citation impact. The usage of country dummies that control for these national variations allows one to isolate the hypothesized effect of geographical distance on citation impact in a precise manner.

3. Methodology

We used Elsevier's Scopus database and selected all publications from 2000 which report affiliation addresses from at least two different European countries. As we are interested in European collaborations only, we left out single authored papers as well as papers reporting any non-European addresses in addition to the European ones. This procedure resulted in a total of 33,524 papers.

The dependent variable is the total number of citations a paper received before the end of 2009. This number ranges from 0 to 1503, with a mean of 23.331 citations. Given the skewed distribution of the dependent (integer) variable, Ordinary Least Squares regression is inappropriate. Instead, dealing with citations as count data, the options were Poisson regression and Negative Binomial regression (on this, see [Frenken et al., 2005](#); [Hausman et al., 1984](#); [Maurseth & Verspagen, 2002](#)). Given the extreme skewness of our dependent variable (i.e., over dispersion), the Negative Binomial regression technique is the most appropriate.

Our main independent variable concerns the distance between the two collaborating countries. Many indicate the distance between two countries by computing the kilometer distance between the two capital cities ([Baldwin & Taglioni, 2006](#)). However, in many instances, capital cities are not centrally located; hence, the distances between capitals provide an imprecise measure of the distance between countries. Instead, we follow [Head and Mayer \(2002\)](#) and [Mayer and Zignago \(2011\)](#) who measure the distance between two countries as the weighted average of the bilateral distances between the biggest cities of those two countries, where the weights reflect the share of each city of the pair in the overall population of the

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