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Nemo solus satis sapit: trends of research collaborations in Vietnamese social sciences, using 2008-2017 Scopus data

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Nemo solus satis sapit – no one can be wise enough on his own. This is particularly true when it comes to collaborations in scientific research, which are essential for the exchange of knowledge, sharing of workloads, and improvement of output quality. Concerns over this issue in Vietnam, a developing country with limited academic resources, led to an in-depth study on Vietnamese social science research, in which data from 410 Vietnamese authors who had international publications recorded in Google Scholar and Scopus during 2008 2017 were collected for analysis. The results showed that more than 90% of scientists had worked with colleagues to publish, and they had collaborated 13 times on average during the time limit of the data sample. These collaborations, both domestic and international, provided authors with significant advantages, boosting their performance (β au.vn = 0.134, $p < 0.001$, β au. fr = 0.052 , $p < 0.001$). On the other hand, academic independence, principally measured by the number of publications the authors wrote alone, also affects the volume of their output. The modest number of publications by Vietnamese authors, along with the striking 75% ratio of authors who had never published alone and the rather unimpressive percentage (56.6%) of corresponding or first authors lead us to believe that Vietnamese social scientists relied heavily on collaborative work and are severely lacking in the fundamental skills required to be a scholar meeting international standards. This problem should be examined through the lens of educational policies, especially those concerning higher education and research training.

Keywords: Scientific collaborations, higher education, research institutions, research policy, productivity

JEL Codes: I23, O32

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ABSTRACT

Nemo solus satis sapit – no one can be wise enough on his own. This is particularly true when it comes to collaborations in scientific research, which are essential for the exchange of knowledge, sharing of workloads, and improvement of output quality. Concerns over this issue in Vietnam, a developing country with limited academic resources, led to an in-depth study on Vietnamese social science research, in which data from 410 Vietnamese authors who had international publications recorded in Google Scholar and Scopus during 2008-2017 were collected for analysis. The results showed that more than 90% of scientists had worked with colleagues to publish, and they had collaborated 13 times on average during the time limit of the data sample. These collaborations, both domestic and international, provided authors with significant advantages, boosting their performance ($\beta_{au.vn} = 0.134$, $p < 0.001$, $\beta_{au.fr} = 0.052$, $p < 0.001$). On the other hand, academic independence, principally measured by the number of publications the authors wrote alone, also affects the volume of their output. The modest number of publications by Vietnamese authors, along with the striking 75% ratio of authors who had never published alone and the rather unimpressive percentage (56.6%) of corresponding or first authors lead us to believe that Vietnamese social scientists relied heavily on collaborative work and are severely lacking in the fundamental skills required to be a scholar meeting international standards. This problem should be examined through the lens of educational policies, especially those concerning higher education and research training.

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INTRODUCTION

It has long been recognized that scientific research prospered in some places more than others, namely at universities on a national scale and in developed countries on a global scale (Hayati and Ebrahimy 2009; Schøtt 1987). This is not a surprise, as the scholar is often required to devote time and energy to research in order to secure an academic position in today's competitive scientific world; it is not uncommon that the demand for higher quality output calls for collaboration. Collaborations, in turn, become a boost for the individual scientists, completing both their personal and inter-personal development in the scientific community. In fact, Fonseca et al. (1997) and Ynalvez and Shrum (2011) proved that bursts of productivity mainly occurred under the influence of human relationships in their working environments. This argument is further complemented by Lee and Bozeman (2005),

explaining that collaboration strategy had a significant, positive effect on scientific output. Moreover, there is evidence that lack of collaboration in research was correlated to significant gender inequalities in scientific publishing (Kyvik and Teigen 1996), in the sense that female scientists collaborated less frequently with others and also have fewer publications on average. Geography, politics, language, faculty and discipline all also played a strong role in determining who collaborated with whom in the scientific community (Abramo et al. 2009; Frame and Carpenter 1979; Liang and Zhu 2002; Newman 2001; Newman 2004; Landry et al. 1996; Luukkonen et al. 1992). Scientists tend to prefer collaborating with people whose locations were not too far from theirs (Landry et al.1996; Liang and Zhu 2002; Ponomariov and Boardman 2010).

On the other hand, while countries with a developed science base seemed to have a smaller proportion of international co-authorship (Frame and Carpenter 1979), nations with a less developed scientific infrastructure have a higher tendency for international co-authorship collaboration, mainly as a means of cost sharing (Luukkonen et al. 1992). In addition, basic research appeared to stimulate collaboration more than applied research (Frame and Carpenter 1979; Newman 2001). And in some cases, it was found that collaboration between researchers and industry had significantly more impact on productivity than collaborations between researchers and their peers or researchers and other institutions (Landry et al.1996). This might be due to the fact that collaborative research projects were not essentially meant for producing knowledge or gaining academic recognition, but for acquiring professional opportunities and extrinsic rewards (Ynalvez and Shrum 2011). In short, collaborations made up an essential part of scientific research and academic work, related to diverse matters from personal and professional development to social and economic inequalities.

Scientific collaborations occur at various levels, namely international, inter-institutional, and inter-individual collaboration (Katz and Martin 1997). Thus, the relations between scientific output and collaborations were also performed on two scales: individually, and between groups (Pravdić and Oluić-Vuković 1986). A large number of papers have already presented the benefits of collaborations on an individual scale by demonstrating a positive correlation between scientific output and collaboration practices (Bordons et al. 1996; Hampton et al. 2011; Landry et al. 1996; Lee and Bozeman 2005; Pao 1992). However, there were just as many cases, especially in developing countries, suggesting that collaboration was not associated with any general increment in productivity (Duque et al. 2005). This also applied generally for research collaborations between groups (Bordons et al. 1996; Hampton and Parker 2011; Pao 1992). This inconsistency between previous results could be because collaborations that were formed to capitalize on funding opportunities were not effective in enhancing researcher productivity in the short run, but may instead be important promoter in the longer run (Defazio et al. 2009).

International collaboration is increasing among countries in the same region as well as around the world (Bote at al. 2013; He 2009; Narváez-Berthelemot et al. 1992), not only enhancing productivity but also increasing scientists' collaborative propensity and visibility (Abramo et al. 2009; Bordons et al. 1996). The ratio of the number of international links and international papers turned out to be roughly proportional to the ratio of full publication counts (Glänzel and de Lange 2002). And international co-authorship, on average, resulted in publications with higher citation rates than purely domestic papers (Glänzel 2001). However, this type of collaboration had no effect in some specific fields (Leimu and Koricheva 2005), or did not significantly influence the benefits that the host countries derived from collaboration, but did seem to positively influence the benefits obtained by the countries they collaborated with (Bote at al. 2013). Cross-country collaboration was also not as globalized as one would have imagined, with several countries collaborating with one another much more than with others. In China, for example, scientific collaborations were limited to just about 20 countries for nearly 95% of their international co-authored papers, of which 40% were published with American co-workers (Wang et al. 2013).

Previous results also indicated that there was a positive and meaningful correlation between qualitative and quantitative criteria in the scholarly scientific publications (Hayati and Ebrahimy 2009). However, the quality of publications could be also boosted when the number of authors involved increases (Figg et al. 2006; Smart and Bayer 1986). Smart and Bayer (1986) found that the acceptance rate of articles, which were collaboratively authored tended to be higher than that for single-authored papers. Furthermore, the number of times an article was cited correlated significantly with the number of authors and the number of institutions (Figg et al. 2006). Those who were open to collaborations and those who seemed to adequately manage those collaborations produced in higher quality, which resulted in higher impact (Figg et al. 2006).

The empirical context of Vietnam

For decades now, academic publication in Vietnamese social sciences has been dismal as far as research quality and international recognition are concerned (Vuong et al. 2013). In Vietnam, sheer total scientific output increases by 17% per year, 77% of which were associated with international collaborations, with the United States and Japan being the leading collaborators (Manh 2015; Nguyen et al. 2017). It is also noteworthy that these research collaborations were mainly led by foreign authors (Manh 2015), and that papers with an overseas corresponding author had higher citation rates than papers with a domestic corresponding author (Nguyen et al. 2017), meaning that foreign research workers were more appreciated, both qualitatively and quantitatively. Furthermore, in Southeast Asia, Vietnam ranked fourth in scientific publications, only accounting for 0.6% of the regional total

(Nguyen and Pham 2011), despite being ranked fourth and third among six favored emerging markets countries, called CIVETS, in terms of total publications and citations, respectively (Yi et al. 2013). Yet the data also indicated that Vietnam was in a phase of rapid growth regarding the build-up of research capacity (Nguyen et al. 2017). These conflicting empirical findings called for a thorough examination.

In this research, we examined the relationship between collaboration among scientists and the number of their publications. Analyses were conducted to test the two following hypotheses:

- **Hypothesis 1**: The number of times the author had collaborated and the number of domestic colleagues that the author had worked with had an impact on the author's scientific output.
- **Hypothesis 2**: There is a positive relationship between the number of published articles, the number of international co-authors, and the number of single-authored papers.

The goal of the study was to obtain some insights about the importance of scientific collaborations as well as the role of authors in improving output.

MATERIALS AND METHODS

Data

The subjects of this survey were social scientists of Vietnamese nationality with scientific publications indexed by Scopus from 2008 to 2017 who met at least one of two criteria: (1) they had at least one publication about Vietnam and/or using data collected in Vietnam; and (2) they were affiliated with a Vietnamese institution.

The dataset was established as follows: First, the research team used sources such as authors' personal pages or institutional websites, Google Scholar, journals, and Scopus. Then authors' information from different sources was compared and confirmed to establish accurate data as well as to map a network among authors and between authors and institutions. We recorded the following traits: (i) age, gender, region; (ii) "career age," i.e., the time since the author's graduation or the start of his/her first research project (if there is information to confirm); (iii) number of publications; (iv) number of co-authors in one publication, and then in the full list of his/her publications; (v) affiliations; (vi) fields of research; (vii) whether or not they were ranked as "professor." Finally, the research team gathered information on 410 authors, accounting for about 80% of Vietnamese scholars whose publications were listed in the Scopus database.

The scientific productivity of the scientist was measured by the number of publications during 2008-2017 and represented by the variable "ttlitems", which was then employed in our models as the dependent variable. Information on article titles, co-authors, journal titles, time of publication was recorded for each and every survey subject, in a pre-designed data form.

The factors that were considered influential to scientific productivity, and used as independent variables in the analysis consist of:

- "au.key": the number of publications in which the subject in question served as the corresponding and/or lead author, unit: item(s);
- "au.solo": the number of publications in which the subject was the single author, unit: item(s) ;
- "au.co": the number of publications in which the subject served as non-lead and non-corresponding co-author, unit: item(s) ;
- "au.uniq": the number of co-authors of the entire body of work of the author in question, unit: people. Note that this variable counts the author in question as well as all his/her co-authoring peers. Each co-author that constituted this number was counted only once, even if he/she co-authored multiple publications with the subject in question;
- "au.vn": the number of all Vietnamese peers appearing in the entire body of work of the subject in question, including both co-authors and the author in question, unit: people. Similarly, each co-authoring peer was counted only once;
- "au.fr": the number of foreign co-authors in the entire body of work of the subject in question, unit: people. Each foreign peer was counted only once;
- "au.ttl": the total number of times the survey subject has collaborated with other authors, unit: times. This is not to be confused with the number of *publications* produced in collaboration; rather, we counted the number of *collaborators* that the subject worked with for each paper in total. The same co-authoring peer could was also counted +1 every time he/she appeared in the list of co-authors with the subject, and on numerous occasions. To better understand this variable, consider the following example: An author named A has published 3 articles. The first publication was a collaboration among five co-authors: A, B, C, D and E. She collaborated with C and D on her second work. Her third article was a single-authored work ("solo"). For this author, her "au.ttl" value would be: 5 + 3 + 1 = 9 (times).

Methodology

We used multivariate linear regression model in this paper, which facilitated the analysis of our continuous dependent variable. The general model is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k + \varepsilon_i$$

The condition for the model is that k independent variables X_i and dependent variable Y must have the same sample size n. Y is a continuous variable, while X_i can be continuous or discrete variables (Craven et al. 2011). The data would then be processed in R (3.3.1). The coefficients β_i

represent the linear effects of the factors X_i on the dependent variable Y. Based on z-values and corresponding p-values, it is possible to determine the statistical significance of the predictor variables in the model. In this study, we have proven that $p < 0.05$, therefore the respective independent variables are considered to be statistically significant.

We also performed tests in order to confirm the validity of the model, most importantly the F test with the pair of hypotheses $H_0 : \beta_1 = \beta_2 = \beta_i = ... = 0$, and H_1, to ensure that at least one coefficient in the model did not equal 0. The test result determined the value of F-statistic and the coefficient: namely, if $p < 0.05$ the hypothesis H_0 would be rejected. It could thus be confirmed that the regression coefficients in the model are not simultaneously equal to 0 (Vuong 2016).

RESULTS

The collected data showed that a majority of Vietnamese scientists had a small volume of works. Nearly 84% (344 out of 410 people) had five or fewer publications, and only 10 authors had published over 20 academic papers (Fig.1).

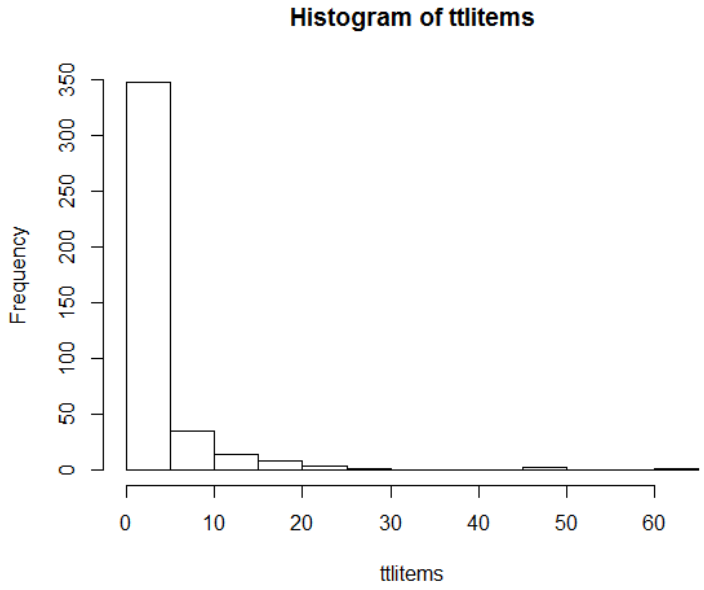

Figure 1: Distribution of scientists by number of publications during 2008-2017 ("ttlitems")

Table 1 shows some descriptive statistics for the continuous variables used in the study. The average value of "au.solo" was 0.729 and its standard deviation 3.337, meaning that very few authors wrote articles alone: 75% of them worked only in projects and never alone for a decade (2008-2017).

Table 1: A few descriptive statistics for continuous variables

Variable	Min	Mean	Max	SD	p-value
"ttlitems"	1	3.60	63	5.89	2.2×10^{-16}
"au.co"	0	2.87	50	4.33	2.2×10^{-16}
"au.solo"	0	0.73	58	3.34	1.24×10^{-5}
"au.ttl"	0.5	13.30	406	29.89	2.2×10^{-16}
"au.uniq"	1	6.52	60	7.75	2.2×10^{-16}
"au.fr"	0	3.03	50	5.92	2.2×10^{-16}

Moreover, only 20% of the publications were "solo". Maximum times of collaboration ("au.ttl") of the entire sample was 406 (refer to the description of variable "au.ttl" above) while its mean value was just 13.3.

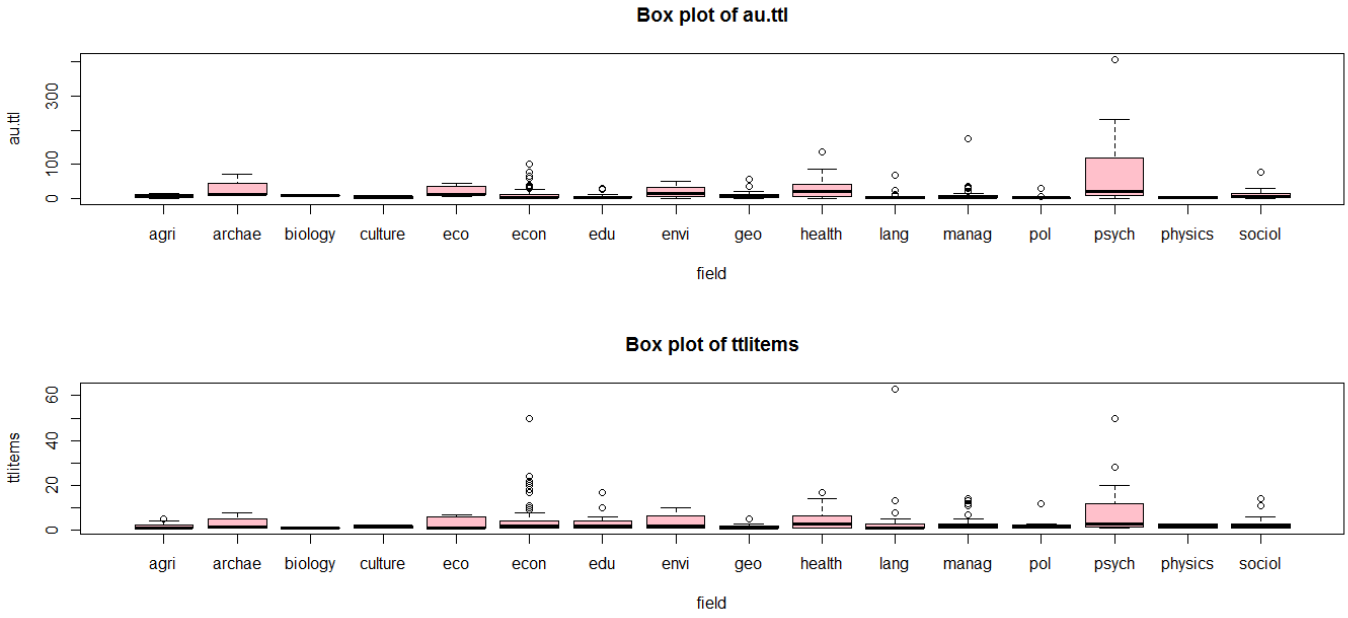

Figure 2. Distribution of the number of times an author collaborated with other authors and scientific output against research fields

Regarding collaborations in various disciplines, some such as economics, healthcare, and psychology, seem to be more attractive than others. The evidence is their dominant proportions shown in Figure 2, especially in economics with 577 collaborative publications, accounting for over 39% of the total. It should also be noted that authors were the most collaborative in the field of healthcare, with

60 collaborators (including both domestic and international authors). However, only 21% of the scientists in these fields have five or more internationally published papers (Figure 2).

The correlations between variables were calculated to preliminarily evaluate the relationships between factors, which were shown in Figure 3. It can be seen that all independent variables mentioned above had a significant impact on the dependent variable ("ttlitems"), with $p < .001$. The correlation coefficient between "au.co" and "ttlitems" was 0.83, implying a strong positive correlation between the number of collaborations and scientific output.

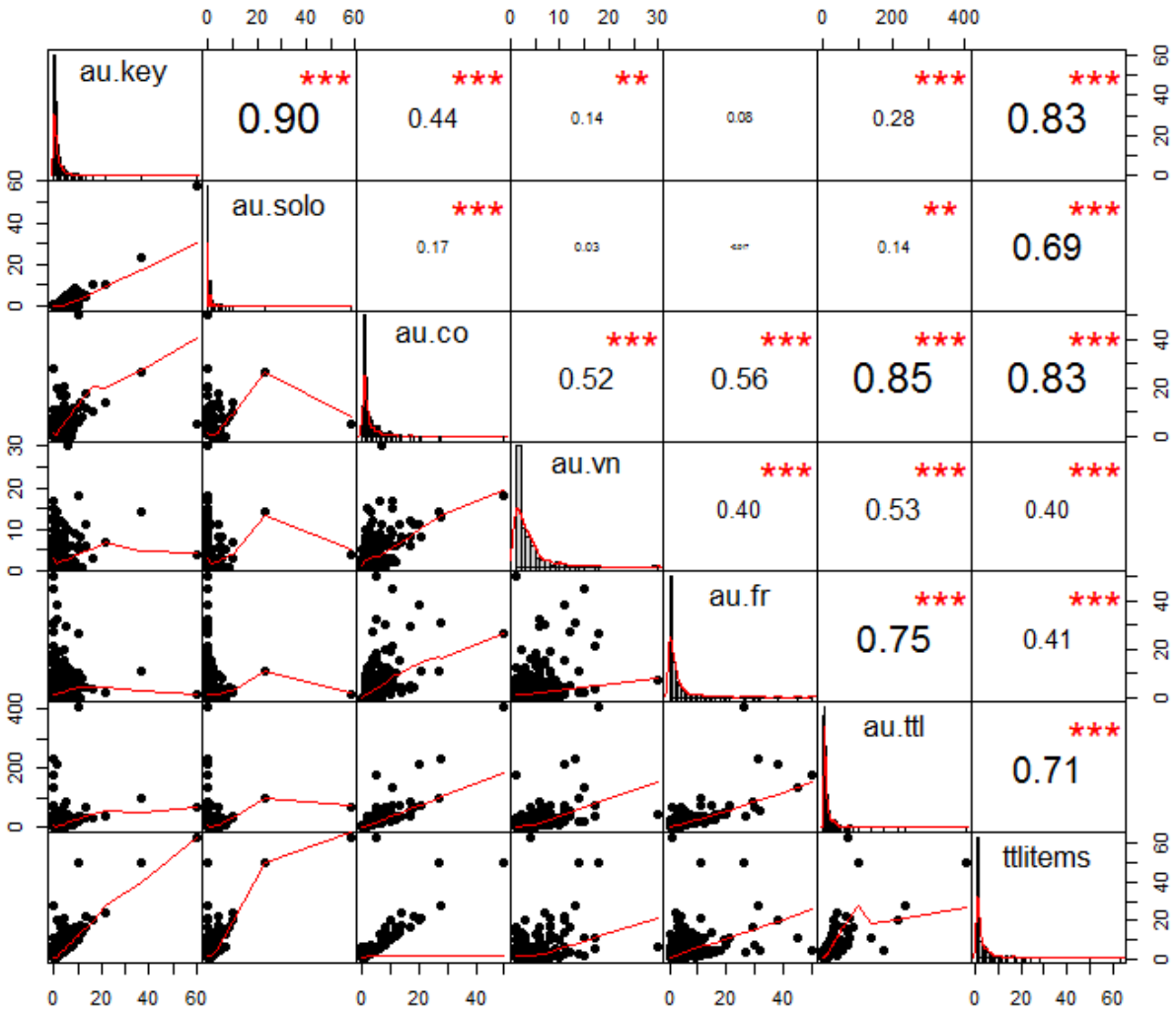

Figure 3. Correlation coefficients in pairs

The relationship between scientific output and collaboration, particularly domestic collaboration

The first model was established with "au.ttl", "au.vn" and "au.solo" as predictors and "ttlitems" as the response variable. As could be observed in the results presented in Table 2, all

estimated coefficients were statistically significant with $p < 0.005$, confirming the hypothesis that a relationship between scientific output and collaborations existed. The model's goodness-of-fit test showed that $F = 818.3$ ($df_1 = 3$, $df_2 = 406$), and $p = 2.2 \times 10^{-16}$, thus rejecting H_0 and showing that the relationship has been meaningful.

Table 2. Estimation results of "ttlitems" as influenced by "au.ttl", "au.vn" and "au.solo".

	Intercept	"au.ttl"	"au.vn"	"au.solo"
	β_0	β_1	β_2	β_3
"ttlitems"	0.824^{***} [4.975] (9.67×10^{-7})	0.115^{***} [26.288] (2×10^{-16})	0.134^{**} [3.290] (0.0011)	1.067^{***} [32.002] (2×10^{-16})

Signif. codes: '***' 0.001 '**' 0.01; z-value in square brackets; p-value in round brackets. Residual standard error: 2.226 on 406 degrees of freedom. Multiple R-squared: 0.8581, Adj. R-squared: 0.857. F-stat.: 818.3 on 3 and 406 df, p-value: $< 2.2\times10^{-16}$

In Table 2, the coefficient of "au.ttl" was positive ($\beta_1 = 0.115$, $p = 2 \times 10^{-16}$), meaning that the greater the total number of times of collaboration occurred, the more articles the scientist had published during the period examined. Moreover, $\beta_2 = 0.134$ ($p = 0.0011$) indicated that domestic collaborations also had a positive correlation with scientific performance. Last but certainly not least, among all coefficients, the largest was $\beta_3 = 1.067$ of "au.solo", which implied that more independent authors produced a larger quantity of works than those who wrote fewer articles alone.

Table 2 also reported $R^2 = .8581$. This statistic means that the independent variables in the model "au.ttl", "au.vn" and "au.solo" explain 85.81% of the change of "ttlitems". The relationships between these variables are depicted in the following equation:

$$ttlitems = 0.824 + 0.115 \times au.ttl + 0.134 \times au.vn + 1.067 \times au.solo \quad \text{(Eq.1)}$$

It can be inferred from (Eq.1) that, if other factors remained controlled, an increase of one unit of the number of times of collaborations would result in the number of scientists' publications rising by 0.115 units on average. Similarly, one extra unit of domestic collaborator would mean a growth of 0.134 units in average scientific output.

Using (Eq.1), we could determine an estimate of a scientist's body of work by looking at the number of times they collaborated, the number of domestic authors they had worked with producing

scientific content, and the number of articles they had published as a solo author. Namely, if a scientist had 30 single-authored works and had collaborated 40 times and with 15 domestic authors, the estimated total number of his/her papers would be calculated as follows:

$$0.824 + 0.115 \times 40 + 0.134 \times 15 + 1.067 \times 30 = 39.44$$

The result meant that the scientist had produced a total of over 39 articles during their entire career, as estimated using influential factors involved in our analysis.

Importance of international collaborations

In this model, while never ceasing to emphasize the importance of collaborations in scientific production in general, we specifically sought to figure out the role of international collaborations. Therefore, we chose to model our regression using "au.co", "au.fr" and "au.key" as independent variables. As presented in Table 3, $p < .0001$, which means all coefficients are statistically significant. In addition, the results showed that $F = 3381 (df_1 = 3,\ df_2 = 406)$, and $p = 2.2 \times 10^{-16}$, once again rejecting the null hypothesis H_0. The relationships between the above factors and scientific output were thus technically affirmed, with the predictors explaining 96% of the variation of the response variable.

Table 3. Estimation results of "ttlitems" against "au.co", "au.fr" and "au.key".

	Intercept	"au.co"	"au.fr"	"au.key"
	β_0	β_1	β_2	β_3
"ttlitems"	-0.126[c] [-1.79] (0.074)	0.736[***] [40.36] (2×10^{-16})	0.052[***] [4.34] (1.78×10^{-5})	0.821[***] [53.21] (2×10^{-16})

Significance: '[***]' 0.001 '[c]' 0.1; z-value in square brackets; p-value in round brackets. Residual standard error: 1.159 on 406 degrees of freedom. Multiple R-squared: 0.9615, Adj. R2: 0.9612. F-stat.: 3381 on 3 and 406 df, $p < 2.2\times10^{-16}$

The equation describing the relationships between factors in Table 3 was established as follows:

$$ttlitems = -0.126 + 0.736 \times au.co + 0.052 \times au.fr + 0.821 \times au.key \qquad \text{(Eq.2)}$$

As in the previous part of our analysis, we were able to use (Eq.2) to estimate a scientist's decennial production (2008-2017) by looking at the number of collaborative articles, the number of

publications in which they were a key author, and the number of foreign colleagues they had collaborated with.

The value +0.736 ($p = 2 \times 10^{-16}$) of β_1 showed that when the number of co-authored publications increased by one paper and other factors were controlled, scientific output would increase by 0.736 on average. Similarly, the coefficient $\beta_3 = +0.821$, $p = 2 \times 10^{-16}$ led us to conclude that the author's ability to play a key role in publications was a significant boost in the quantity of their scientific contribution.

Conversely, the factor of overseas collaborations displayed a relatively small influence on scientific productivity with a coefficient of 0.052, which meant that for authors, an increment in international collaborators only led to a small growth of scientific output. The Pearson correlation coefficient between these two factors $\rho_{(ttlitems,au.fr)} = 0.405$ ($p = 2.2 \times 10^{-16}$) also predicted the weak association between them.

CONCLUSIONS

Previous research on scientific collaborations such as Manh (2015); Nguyen et al. (2017) focused on understanding the scientific community in Vietnam as a whole, as well as the structure of collaborations in general. In contrast, this paper used a dataset with specific details regarding authors and articles. In analyzing such personalized data, we provided concrete, quantitative results showing how collaborations (both domestic and international) impacted scientific output, first on an individual scale, then on an aggregated level. It should however be noted that this dataset focused primarily on authors in the social sciences. Our choice was based on the fact that this field was relatively new and still in its developmental stage in Vietnam, which meant that the extant literature on its specificities remains scarce, despite the fact that the social sciences were especially crucial to transitioning societies like that of Vietnam. We aimed to contribute refined knowledge on the current state of social sciences in Vietnam through our in-depth analysis and specific conclusions below.

Two heads are better than one: Collaboration and the improvement of scientific output

As scientific research developed in Vietnam, collaboration has become more and more popular: as shown in our data, over 90% of scientists (379 out of 410) worked with other authors to publish. In this study, the role of collaborations in boosting scientific output was reflected not only by the number of collaboratively authored papers, but also by the number of collaborations as well as the number of domestic/international co-authors.

The number of articles published in international journals by Vietnamese scientists remains modest. On the other hand, according to our results, collaborations between scientists improved their performances. In fact, authors in Vietnam must have intuitively known this, considering how they were generally inclined towards collaborative work, so much so that co-authored papers accounted for a vast majority (83.7%) of publications by Vietnamese social scientists. This result supported earlier findings regarding the role of collaborations in boosting productivity (Bordons et al. 1996; Hampton et al. 2011; Landry et al. 1996; Lee and Bozeman 2005; Pao 1992), such as the positive correlation of the number of collaborators and scientific output with an estimate coefficient $\beta = 0.26$ ($p = 0.001$) established by Lee and Bozeman (2005).

Investigations also showed that the number of times an author collaborates was positively related to the number of publications, with a coefficient of correlation being 0.71 ($p < .001$). This not only meant that the scientist produced more when working with colleagues more often, but also demonstrated the reverse: Vietnamese authors who had an ampler body of works relied more on collaborators. Again, this finding was logical and supported by previous results. According to Lee and Bozeman (2005), authors spent up to 51.1% of their studying time working in research groups and just only 15.9% working alone. Collaborative projects provided scientists with opportunities to share not only academic resources but also practical knowledge regarding research work. The flow of exchange between collaborators also helps to diversify research questions and broaden the vision of each scientist, which was particularly significant when it came to social matters. As the old proverb said, "Two heads are better than one": It was fairly understandable why collaborated works made up such a large portion of publications among Vietnamese social scientists.

Not only did the number of times an author collaborates count, the origins of collaborators mattered as well: domestic and international collaborations had, in fact, different degrees of impact on an author's production of scientific contents. While it should be noted that foreign collaborators only influenced scientific output to a relatively small extent ($\beta_{au.fr} = 0.052$, $p < 0.001$), Vietnamese scholars were still increasingly interested in collaborating with international colleagues: more than 65% of them had worked on an article with foreign colleagues at least once in their career. This was not paradoxical, as the factor of international collaboration still plays an important role in scientific careers. In fact, working with overseas authors not only boosted the quality of research and the volume of output, but also enhanced a scientist's reputation (Glänzel 2001). Given that academia in Vietnam was as much in a developing state as the country itself, and that Vietnamese social sciences were even younger than other fields, it was not difficult to understand the motives for Vietnamese social scientists seeking collaboration with foreign authors: it would improve their chances of getting published,

expand their network in the scientific world and help them establish a much-needed academic reputation.

It was thus clear that the positive effects of collaborations are supported by empirical findings. The advantages had led to a worldwide tendency towards multiple authorship since the 1950's (Greene 2007), which are manifested even more strongly in Vietnam's young scientific community. While it was true that "no one is wise enough on his own" (*Nemo solus satis sapit*), the inclination to collaborate all the time was not without its downsides, especially in the specific context of the Vietnamese society, where not all scientists had proven their individual scientific capacity outside of collaborative projects. We shall examine this in the following section.

The virtuous circle of education and academia

Our study put emphasis on the importance of the corresponding author who plays the vital role in a collaborative project. Corresponding authors were often the one who came up with initial ideas and problematics, suggested the appropriate approach to the research questions, and approved protocols to be followed in the conduct of the study. As key authors, they were also responsible for the manuscript correction, proofreading, and correspondence with journal editors during the submission of the paper. These experiences provided corresponding authors with a capacity to produce better research. Their role, generating ideas and supervising the overall process, while not necessarily doing all tasks concerning the research, also gave key authors the unique advantage of being able to take part in a number of projects at the same time.

In addition, corresponding authors were usually senior authors, meaning that they had broad visions, profound knowledge, as well as refined skills acquired during their career, hence a higher quality output. Additionally, as senior authors, they were also more familiar with paper submission and publication, and were likely less hindered by administrative difficulties. All of this boosted their rate of acceptance compared to less experienced authors.

The presence (or lack) of these advantages, pertaining both to the role of corresponding author and to the experiences of a senior author, had a powerful influence on a scientist's number of publications, with $\beta_3 = 0.821$. However, according to our data, only a little over half of Vietnamese social scientists (56.6%) had assumed the role of corresponding author during their entire career. As a matter of fact, not only was it fairly rare for a scholar in Vietnam to be a key author in a scientific project, but it was also shown in our data that a great majority of Vietnamese social scientists had only ever written works in collaboration with their colleagues: only about 25% of surveyed scientists (103 out of 410 people) had published single-authored papers in ten years (2008-2017). This meant that very few Vietnamese authors in the field of social sciences had acquired the above-mentioned skill sets,

which could only be obtained through independent publishing and/or coordinating a project as a corresponding author, some of which were fundamental to a scientist in the academic world today. This troubling tendency to rely on the resources of collaborations, foreign or domestic, perhaps explained in part the modesty of Vietnam's current scientific production, especially in the field of social sciences. It should also be noted that our dataset was limited to Vietnamese social scientists qualified by international standards (being indexed in Scopus). This group of authors is only the tip of the iceberg, considering the immense number of so-called scientists in Vietnam who have never published in an international journal, and whose varying levels of quality of scientific output were even more sporadic.

Our findings raised questions about the real quality of Vietnamese academics as well as their output, and consequently about the efficiency of Vietnamese higher education system. Vietnam had only recently introduced the requirement of *a minimum* of two scientific publications indexed in Scopus or ISI for a doctoral student to validate their thesis (MOET 2017). Education had always figured among pressing matters in Vietnam, but public discussions have primarily focused on compulsory education rather than higher education, much less on training in scientific research. Vietnamese society has held onto the mentality that the system should be fixed bottom-up (i.e. by reforming the primary and secondary educational programs), yet failed to realize that without an adequate basis in scientifically proven findings, these reforms would only be inefficient at best and destructive at worst. Without qualified scientists, especially in the social sciences, Vietnam would only be going in vicious circles with her unsuccessful educational reforms and ineffective policies regarding scientific improvement.

In line with our results, we have several suggestions in hopes of improving Vietnamese scientific capacity, especially concerning the field of social sciences. On one hand, admitting the undeniable benefits of collaborations on scientific output, younger researchers and novices should highly consider attaching themselves to research groups with evident research records to enrich both their experiences and their records. To support this, future centers of excellence at universities that aim to promote quality research can first explore the collaborative research operations in social studies, where senior and prolific researchers should play a coordinating and leading role. On the other hand, in order to avoid negative dependence by some scientists on more acclaimed authors in order to improve the collective quality of the Vietnamese scientific community, single-authored papers should be praised as a way to encourage researchers to nourish genuine capacities that will augur success for future scientific leaders. It is advised that the government keeps a watch and closely measures scientific efficiency—using internationally acclaimed indicators such as the impact factor—as a criterion for governmental scientific funding, particularly regarding the output of official institutions.

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