Academic Mobility as a Driver of Productivity: A Gender-centric Approach

Mariana Macedo[1], Ana Maria Jaramillo[2], and Ronaldo Menezes[2,3]

[1] Center for Collective Learning, ANITI, University of Toulouse, Toulouse, France
[2] Computer Science, University of Exeter, Exeter, UK
[3] Computer Science, Federal University of Ceará, Fortaleza, Brazil
{mmacedo,ajaramillo}@biocomplexlab.org, r.menezes@exeter.ac.uk

Abstract. pSTEM fields (Physical Sciences, Technology, Engineering and Mathematics) are known for showing a gender imbalance favouring men.This imbalance can be seen at several levels, including in university and industry, where men are the majority of the posts. Academic success is partly dependent on the value of the researchers' co-authorship networks. One of the ways to enrich one's network is through academic movement; the change of institutions in search of better opportunities within the same country or internationally. In this paper, we look at the data for one specific pSTEM field, Computer Science, and describe the productivity and co-authorship patterns that emerge as a function of academic mobility. We find that women and men both benefit from national and international mobility, women who never change affiliations over their career are rarely well-cited or highly productive, and women are not well-represented in the overall top-ranking researchers.

Keywords: Academic Mobility · Gender Inequality · Science of Science · Network Science · Data Science

1 Introduction

The environment of academia is very competitive, and people are looking for opportunities to make their ideas more visible to a larger share of the community. Competitiveness arises from the mechanisms leading to promotion and tenure processes, which require academics to reach certain targets. Success in science, and hence one's career, is linked to productivity in terms of the number of publications and citations these works attract [31]. In this environment, and especially in pSTEM fields (Physical Sciences, Technology, Engineering, and Mathematics), gender plays an important, and sometimes discriminatory, role [6,29,33].

When becoming a top-ranked computer scientist, men's and women's career patterns differ significantly, as we have previously discussed [15]. We observed differences in network characteristics, such as the level of repeated co-authors, the composition of the co-authorship network, and network density, among others. However, one important dimension is neither considered in our previous work nor related to the prior literature on gender inequality: academic mobility

(affiliation change) along career paths. Here, we use the same dataset as our previous work [15]. But, this study focuses on the role of academic mobility in the gender patterns of co-authorship networks' evolution, productivity, research impact, as well as the representation of women and men in top-ranked positions.

Academic mobility, understood as a change of affiliation, has frequently been shown as a mechanism to increase and diversify the co-authorship networks [4], with positive effects on career advancement due to fostering productivity [20] and citations [3,13,24]. However, there is evidence that academic mobility can lead to inequalities and biases when there are no research policies to properly integrate underrepresented groups framed by class [22], gender [19,25], race, ethnicity [21] and language [20].

Not all types of mobility are equal. Language barriers make certain movements more likely than others, but also other social constructs can influence decisions, including costs of migration [19], family ties [17], and the research field [3]. For example, people working in medical sciences, accounting, or law are likely to avoid international mobility because regulations vary significantly from country to country, forcing people to have their background revalidated or undergo extra training [12]. For this reason, we look here at two types of mobility: *(1)* international mobility, when a researcher changes their country of affiliation, which generally means a change in the place of work, and *(2)* national mobility, when a researcher change their place of work but not the country. This division will allow us to expand our work to other fields beyond Computer Science. International migration can have different effects on people's collaboration networks; it is expected that international migration will add more diversity to the researcher's co-authorship network and will lead to a broader view and recognition of their research. The patterns in the two groups mentioned above are compared to the ones of non-mobile researchers, those who never changed their affiliation.

According to our data, women and men can reach higher productivity levels in changing institutions (nationally or internationally). Nevertheless, men still consistently benefit more from the movement and women are better represented in top-ranking positions when we consider only non-mobile researchers. Surprisingly, national mobility presents the highest under-representation of women in the top 1% and 5% researchers than international mobility. Despite gender differences in productivity and women's representation, women and men tend to move around the same year of career length. In future, we intend to investigate whether these patterns are consistent with other research fields and datasets.

2 Data

Computer Science is a field in which women have been a minority over many years [6,29,33]. Countries have adopted new policies to encourage women to enter and not drop out of the field [7,10,28], but we still do not have women well-represented in top-ranked positions [32]. In this paper, we study the gender role of academic mobility from the data of the Computer Science field of the ACM

Table 1: Number of authors and papers per gender and category. There is an overlap in the number of papers published by `women` and `men` for the papers with co-authors from both genders.

Quantity	Category	`women`	`men`	Total
authors	`all`	14,433 (16%)	77,344 (84%)	91,777
	`international`	4,859 (14%)	29,254 (86%)	34,113
	`national`	3,235 (15%)	17,897 (85%)	21,132
	`non-movers`	6,339 (17%)	30,193 (83%)	36,532
papers	`all`	176,325	746,211	809,397
	`international`	96,571	491,884	544,698
	`national`	56,730	288,231	324,971
	`non-movers`	37,507	170,581	198,330

(Association for Computing and Machinery) Digital Library. The data were collected by Divakarmurthy and Menezes [9], and the gender of the authors was inferred by Jaramillo et al. [15] using Genderize [1] and Namepedia [2]. The data comprises bibliometric information for research papers published between 1980 and 2012 (e.g. authors, authors' affiliation, title, keywords, and year). We use the authors' affiliations from the publications to trace the researchers' mobility. An institution's name can be written differently, for example, *University of Toulouse* and *Université de Toulouse* refer to the same institution. Faustino et al. [11] preprocessed the data to match these affiliations, and we reuse their approach here.

Based on the affiliations provided by each researcher in each publication, we classify researchers according to their movement as *(i)* non-movers (`non-movers`), researchers with the same affiliation in all the publications; *(ii)* national (`national`), researchers with all the affiliations from the same country, but at least 2 different affiliations; and *(iii)* international (`international`), researchers with at least 2 affiliations from different countries. In total, we have 14,433 women and 77,344 men in our data, with a women's proportion of around 16%, which is slightly consistent across the categories of career movements (see Table 1). For the case of publications, at least one woman participates in around 22% of the papers in our dataset. For each researcher, we consider the first year of publication available in our dataset as year 0 of their career length. In the shorter career length, there are more authors and papers as researchers have different career lengths and the longer the length, the fewer people belong to that group (see Fig. 1). We analyse the first 25 years of their career, as we can have at least 300 researchers for any category.

3 Methods and Results

3.1 Mobility and Co-authorship Networks

Co-authorship networks have been related to increments in researchers' productivity [5,14,15,23,31]. It is, however, still necessary to study how academic

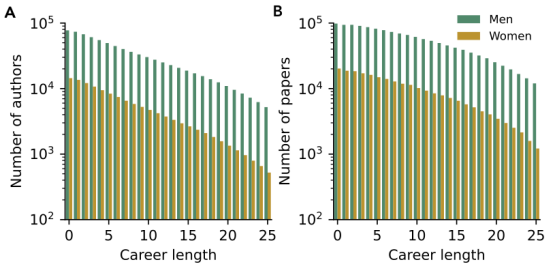

Fig. 1: **(A)** Number of authors per career length. **(B)** Number of papers in the dataset per career length.

mobility can shape the co-authorship networks of women and men in an egocentric way. Here, we analyse the gender differences in the temporal patterns of the co-authorship networks between the researchers across career movement categories. For each researcher, we constructed ego co-authorship networks over the career length ℓ. The authors i and j connect with a link weighted by the number of co-authored papers published in our dataset, $W_\ell(i, j)$. In Fig. 2, we show the temporal evolution of 12 metrics of the ego co-authorship networks for each career length that we explained in our previous work [15].

We show topological characteristics in the first row of Fig. 2. Both women and men who are `national` and `international` movers have more co-authors than `non-movers` (Fig. 2A). Previous literature has shown that living abroad can increase the social capital gained by proximity; if there is no discrimination, social ties could expand and diversify [30]. Consequently, the high number of co-authors translates into a higher weighted degree (Fig. 2B) (more co-authored papers with the same researchers), a lower density (Fig. 2C) (as an effect of the increased network) and lower average clustering (Fig. 2D) (multiple co-authors working in separate groups). On the second row of Fig. 2, we show the composition of corrected proportions of both total and new co-authors from each gender as alters. As in our previous paper [15], each gender is more likely to collaborate with the same gender, correcting by the gender distribution in the dataset (Fig. 2E and Fig. 2F). Homophily does not change with academic mobility, and women `national` movers are the group with the highest homophily. On the last row of the Fig. 2, we show the triadic closure and its maintenance when each gender is an alter connecting the ego node with a new node. Women are more likely to introduce/maintain co-authors to/with women, and the same happens to men (Fig. 2I–L). However, values smaller than 0.5 in Fig. 2I and Fig. 2J show that researchers are more likely to have completely new co-authors.

In summary, the change of affiliations and countries has a small effect on the characteristics of egos' co-authorship networks. We found that academic mobility has a positive effect on expanding the number of co-authors, which resembles the ones expected from top-ranking researchers [15]. Nevertheless, career movements

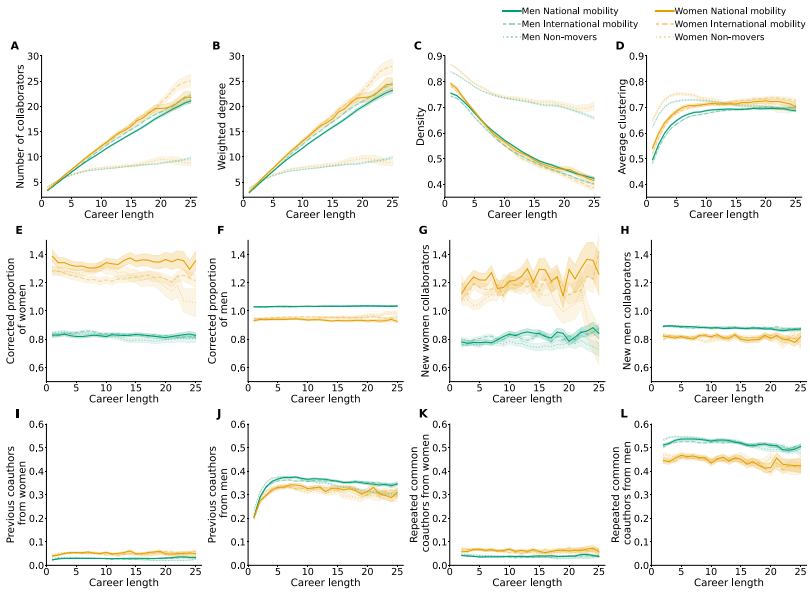

Fig. 2: Co-authorship network analysis per gender and category. **(A)** Number of co-authors **(B)** Weighted Degree **(C)** Density **(D)** Average clustering **(E)** Corrected proportion of `women` **(F)** Corrected proportion of men **(G)** New `women` co-authors **(H)** New `men` co-authors **(I)** Previous coauthors from `women` **(J)** Previous coauthors from `men` **(K)** Repeated common coauthors from `women` **(L)** Repeated common coauthors from `men`.

are beneficial to both women and men when it comes to the number of co-authors, potentially having a positive impact on productivity and citations.

3.2 Mobility and Productivity

Academic mobility positively impacts the productivity of researchers [3,20,24,13]. In this paper, we look at "productivity" as the number of published papers and the number of citations to measure the impact of researchers in Computer Science. Fig. 3 shows that each gender increases their productivity over their career length regardless of the categories of movements. `International` movers benefit the most, followed by similar trends for `national` movers, with an average of 3 times higher productivity than `non-movers`.

In the analysis of the gender differences in Fig. 3B–D, we observe statistically significant differences in most career years. In the early career stages, women are slightly more productive than men, but after 10 years, men tend to keep up and increase their productivity faster. The highest differences between genders are for `national` movers. We argue that this difference might be due to the fact that

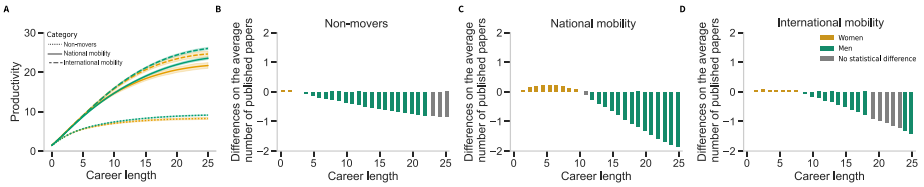

Fig. 3: Productivity over career year. **(A)** Cumulative number of published papers. Gender differences between the average productivity of **(B)** `non-movers`, **(C)** `national` movers and **(D)** `international` movers.

most movements occur within high-income countries, where more institutions have high international rankings.

Then, we study the gender differences when combining the number of national and international movements. In Fig. 4, our results indicate a higher fraction of women in the `non-movers` category (Position 1,1 on the heatmap) but a higher proportion of `men` on the rest of the heatmap. When we look at the productivity trends combining movement categories, Fig. 4B, we found that `men` tend to have higher productivity for `non-movers` and lower values of `national` and `international` movements. In contrast, women who moved three times have higher productivity than men in the same situation.

We analyse the relationship between productivity and citations in Fig. 6; the distribution of `women`/`men` and their fraction in the four quadrants of the plots. The smallest fractions for both genders are for `non-movers` (high-right quadrant: 0.16% `women` and 0.23% `men`), and the largest fraction of both genders are also for `non-movers` (low-left quadrant: 98.52% `women` and 97.85% `men`). The highest difference between the movement categories is for researchers in the quadrant of high productivity-low citations, with national and international movers having, on average, 10 and 8 times more than `non-movers`. Regarding citations, `women` in both quadrants of high and low productivity get no differences when moving nationally (3.35%) or internationally (3.34%). In contrast, the fraction of `men` slightly increases when moving internationally (5.02%) compared to nationally(4.3%).

Then, we use Gini coefficient [8], as an inequality metric, to measure the evenness from the distribution of productivity and citations (Table 2). We observe that `women` have a more evenly distributed number of papers and citations than `men`. The Gini coefficients are higher when considering the number of citations than the productivity, indicating that citations have higher variability. The gender differences from the Gini coefficients are higher for `national` movers. In contrast, `non-movers` researchers were the ones with the smallest Gini in productivity, and the highest in the number of citations, suggesting that their productivity does not translate literally to citations. The last aligns with Fig. 6 in the legend of the top panels, where national and international movers have higher correlation values ($S_M, S_W \approx 0.7$) than `non-movers` ($S_M, S_W \approx 0.5$).

International movers have Gini Coefficients more similar between productivity and citations, showing the smallest gender differences.

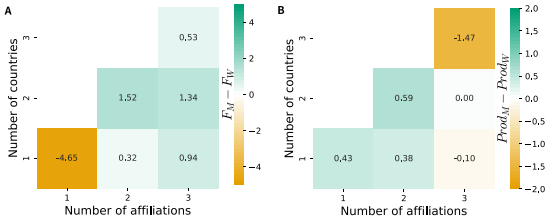

Fig. 4: **(A)** Differences on the fraction of `men` (F_M) and `women` (F_W) considering the number of countries and affiliations. **(B)** Differences on the productivity of `men` (Prod_M) and `women` (Prod_W). We do not consider a higher number of countries and affiliations, as the percentages of researchers are smaller than 1%.

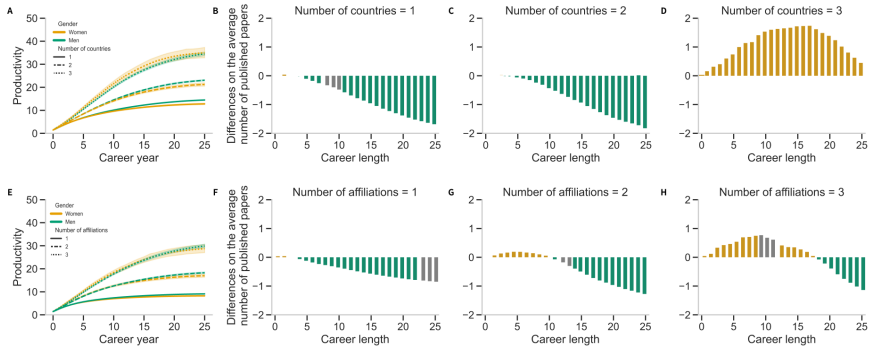

Fig. 5: **(A)** Productivity per gender and number of countries over the career length. Gender differences between the average productivity of researchers who worked in **(B)** 1 country, **(C)** 2 countries and **(D)** 3 countries. **(E)** Productivity per gender and number of affiliations over the career length. Gender differences between the average productivity of researchers who worked in **(F)** 1 affiliation, **(G)** 2 affiliations and **(H)** 3 affiliations.

In summary, `non-movers` have lower productivity and research impact from citations, not reaching the same levels of researchers who move nationally and internationally. The fraction of women and men decreases as we consider the number of countries and affiliations where researchers worked. Productivity correlates more with citations for movers, and researchers with international mobility are more productive and cited. When looking at national movers with high

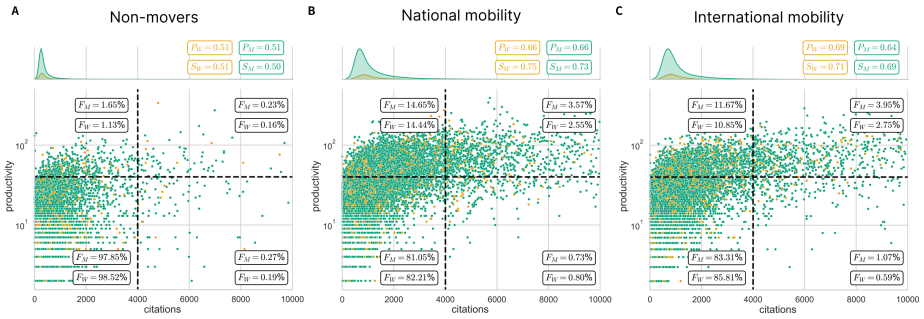

Fig. 6: Productivity versus citations across career movements: **(A)** Non-movers **(B)** National mobility **(C)** International mobility. Mobility has a role in how distributed `women` (yellow) and `men` (green) are in the plot, making the kurtosis smaller and increasing the number of productive and highly-cited researchers. The plot indicates the fraction of `women` (F_W) and `men` (F_M) for each quadrant, and it shows the Pearson ($P_{M|W}$) and Spearman correlations ($S_{M|W}$) between the productivity and citations for each gender.

productivity and high citations, there is a slightly higher fraction of women than men ($0.80 - 0.73 = 0.07\%$).

3.3 Mobility and Gender Differences

For Computer Science, women are generally underrepresented in the top-ranking positions [14,15,18]. Here, we test the hypothesis that `women` are even more underrepresented when considering career movements. Women's representation in the top-ranking decreases as we increase the percentage of people in the ranking related to productivity (Fig. 7A) and citations (Fig. 7B). Considering productivity, for the top 1% researchers, we see that `women` are much more underrepresented for the group of researchers who moved affiliations within the same country. In comparison, considering citations, the top 1% have much lower values of women representation for all the categories, and the top 1-10% for `national` and `international` movers are much similar. In general, we see that `women` are more underrepresented in the top 1-15% across all categories and the percentages higher than 30% in the top-ranking slightly stabilize the women rate. We

Table 2: Gini coefficients from the productivity and citations' distributions.

Gini coefficient	Category	`women`	`men`	(`women-men`)
Productivity	`international`	0.5352	0.5352	0.0000
	`national`	0.5270	0.5403	-0.0133
	`non-movers`	0.4860	0.4945	-0.0085
Citations	`international`	0.6921	0.7044	-0.0123
	`national`	0.6966	0.7160	-0.0194
	`non-movers`	0.7191	0.7251	-0.0060

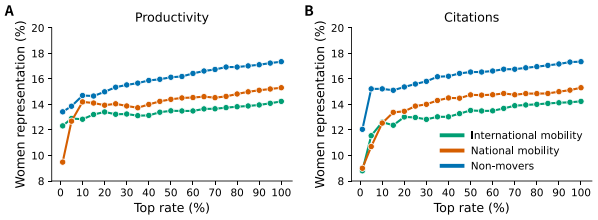

Fig. 7: Women representation (%) in the top-ranking considering **(A)** productivity and **(B)** citations as we increase the percentages of researchers. For instance, the top 100% researchers are the entire data equal to gender distribution in Table 1. For national mobility, the top 1% researchers reach the lowest women representation, equal to 9.48%.

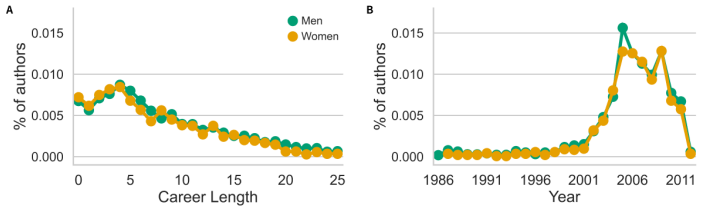

Fig. 8: Percentage (%) of women and men per **(A)** career length and **(B)** year.

then test whether the career movements are happening at different rates for both genders over the career. In Fig. 8, we observe that the gender differences are small and that the patterns are similar across genders. Therefore, we argue that, regardless of gender differences identified in the number of co-authors and productivity, there are no indicators that when the movement occurs, it has a major role in the career. This is why researchers are more likely to move at the beginning of their careers.

In conclusion, women are not well-represented in the top-ranking, and researchers with national mobility showed the smallest representation of women for the top 1%. At the beginning of their careers, women and men are more likely to change affiliations, and there are no statistical gender differences in which year or career length they decide to move.

4 Discussion

Similar to market trends, scientific knowledge spreads through networks hopefully leading to impact [16,27]. Academic mobility, in which researchers change institutions across different cities and countries, has been studied by geographers and bibliometricians to understand the impact of the movements in researchers' careers and the spreading of knowledge [20,24,26]. When appropriate integration policies are in place, the researcher's productivity, co-authorship networks, and

citations are strengthened. However, when the integration policies do not consider the external social constructs groups of researchers, the same strategies to pursue "successful" careers can be detrimental to certain groups because groups are not homogeneous [4]. For example, caregivers of children or relatives move less because they have insufficient financial or social support [25]. The sad reality is that women experience less mentoring support and more conflict when it comes to balancing family and academic responsibilities than men. In fact, a higher percentage of senior women researchers do not have children compared to senior men researchers [17]. Therefore, women and men in senior positions may have to make different decisions in their personal lives in order to maintain similar productivity levels.

In this paper, we examined the patterns in the career of women and men researchers in the dataset of publications from the ACM Digital Library (between 1980 and 2012). Using network analyses, we found similar characteristics across genders and career movements on the co-authorship networks. Nonetheless, we found differences in the number of co-authors that men and women gain over their careers, suggesting that changing affiliations nationally and internationally benefits productivity. Social ties can positively impact productivity, as writing papers collaboratively can speed up the process and lead to better quality work. However, we find that the small differences between the number of co-authors for women do not impact their productivity, making them more productive than men. Furthermore, as men are the majority in our data, gender homophily benefits high productivity levels more for men than for women.

We also found that the gender differences in productivity between `non-movers` researchers are smaller than when compared to the movers. Perhaps it is a case of the rich-getting-richer or selection bias, which could make men more likely to be hired in high-ranked institutions than women. The gender gap in women's representation within high-ranked institutions within and across countries needs to urgently be investigated. For instance, how is the relationship between moving from a developing nation to a developed nation different from moving across developed nations from a gender-centric perspective?

It is important to note that our analyses are based on assumptions and definitions limited by the available data. In our analyses, we first assume that gender is binary, and therefore no physical or biological differences between people play a role. Secondly, we did not analyse the authors with unisex names, and the libraries used to detect names still need to be more effective for Asian names. We attempted to overcome this limitation by using databases of gendered names, but we did not ensure that gendered detection was unbiased. We also highlight that women are still underrepresented in senior career stages, which can be caused by a lack of data. Nevertheless, we cannot guarantee that this unbiased disproportion is not affected by a lack of data. Another limitation of tracing academic mobility from publications is that we should not only consider researchers who kept publishing in ACM venues. Since our data is limited to one dataset, it is possible that researchers changed their preferred form of publication. Given

that computer scientists consider the ACM to be well respected and therefore important to their careers, we believe this is the exception and not the rule.

5 Conclusion

This paper demonstrates how gender and mobility may affect one's productivity and impact in computer science, as measured by papers and citations. Although there is no indication of differences when women and men change affiliations, gender differences in productivity increase over the career length. Indeed, changing affiliations benefit both genders, but there is still an open question of how women can make up for the advantages men have in their careers. Moreover, the policies have not yet translated into a decrease in the gender differences in productivity and citations for our data until 2011. Still, the percentage of women and men who can change affiliations has stayed the same over the years. One follow-up question is whether these changes are evenly distributed when compared to top-ranking institutions and others.

References

1. Genderize. https://genderize.io/, accessed: 2020-11-11
2. Namepedia. http://www.namepedia.org/, accessed: 2020-11-11
3. Aman, V.: A new bibliometric approach to measure knowledge transfer of internationally mobile scientists. Scientometrics (2018). https://doi.org/10.1007/s11192-018-2864-x
4. Barjak, F., Robinson, S.: International collaboration, mobility and team diversity in the life sciences: Impact on research performance. Social Geography (2008). https://doi.org/10.5194/sg-3-23-2008
5. Bravo-Hermsdorff, G., Felso, V., Ray, E., Gunderson, L.M., Helander, M.E., Maria, J., Niv, Y.: Gender and collaboration patterns in a temporal scientific authorship network. Applied Network Science **4**(1), 112 (2019). https://doi.org/10.1007/s41109-019-0214-4, `https://doi.org/10.1007/s41109-019-0214-4`
6. Casad, B.J., Franks, J.E., Garasky, C.E., Kittleman, M.M., Roesler, A.C., Hall, D.Y., Petzel, Z.W.: Gender inequality in academia: Problems and solutions for women faculty in stem. Journal of neuroscience research **99**(1), 13–23 (2021)
7. Cech, E.A., Blair-Loy, M.: The changing career trajectories of new parents in stem. Proceedings of the National Academy of Sciences **116**(10), 4182–4187 (2019)
8. Ceriani, L., Verme, P.: The origins of the Gini index: Extracts from Variabilità e Mutabilità (1912) by Corrado Gini. Journal of Economic Inequality (2012). https://doi.org/10.1007/s10888-011-9188-x
9. Divakarmurthy, P., Menezes, R.: Area diversity in computer science collaborations. pp. 2041–2042. Trento Italy (2012). https://doi.org/10.1145/2245276.2232115
10. Dryburgh, H.: Underrepresentation of girls and women in computer science: Classification of 1990s research. Journal of educational computing research **23**(2), 181–202 (2000)
11. Faustino, J., Iyer, N., Mendonza, J., Menezes, R.: Characterizing the dynamics of academic affiliations: A network science approach. In: Complex Networks XI, pp. 393–404. Springer (2020)

12. Glinos, I., Wismar, M., Buchan, J.: Governing health professional mobility in a changing Europe. European Journal of Public Health (2014). https://doi.org/10.1093/eurpub/cku164.121
13. Horta, H.: Deepening our understanding of academic inbreeding effects on research information exchange and scientific output: New insights for academic based research. Higher Education (2013). https://doi.org/10.1007/s10734-012-9559-7
14. Jadidi, M., Karimi, F., Lietz, H., Wagner, C.: Gender disparities in science? dropout, productivity, collaborations and success of male and female computer scientists. Advances in Complex Systems (2018). https://doi.org/10.1142/S0219525917500114
15. Jaramillo, A.M., Macedo, M., Menezes, R.: Reaching to the top: The gender effect in highly-ranked academics in computer science. Advances in Complex Systems **24** (2021). https://doi.org/10.1142/S0219525921500089
16. Jepsen, D.M., Sun, J.J.M., Budhwar, P.S., Klehe, U.C., Krausert, A., Raghuram, S., Valcour, M.: International academic careers: Personal reflections. International Journal of Human Resource Management (2014). https://doi.org/10.1080/09585192.2013.870307
17. Leemann, R.J.: Gender inequalities in transnational academic mobility and the ideal type of academic entrepreneur. Discourse (2010). https://doi.org/10.1080/01596306.2010.516942
18. Lerman, K., Yu, Y., Morstatter, F., Pujara, J.: Gendered citation patterns among the scientific elite. Proceedings of the National Academy of Sciences **119**(40), e2206070119 (2022)
19. Leung, M.W.: Unsettling the Yin-Yang harmony: An analysis of gender inequalities in academic mobility among Chinese scholars. Asian and Pacific Migration Journal (2014). https://doi.org/10.1177/011719681402300202
20. Marginson, S.: What drives global science? The four competing narratives. Studies in Higher Education (2022). https://doi.org/10.1080/03075079.2021.1942822
21. Marmolejo-Leyva, R., Perez-Angon, M.A., Russell, J.M.: Mobility and international collaboration: Case of the Mexican scientific diaspora. PLoS ONE (2015). https://doi.org/10.1371/journal.pone.0126720
22. McMahon, M.E.: Higher education in a world market. Higher Education (1992). https://doi.org/10.1007/bf00137243
23. Newman, M.E.: The structure of scientific collaboration networks. Proceedings of the national academy of sciences **98**(2), 404–409 (2001)
24. Petersen, A.M.: Multiscale impact of researcher mobility. Journal of the Royal Society Interface (2018). https://doi.org/10.1098/rsif.2018.0580
25. Sautier, M.: Move or perish? Sticky mobilities in the Swiss academic context. Higher Education (2021). https://doi.org/10.1007/s10734-021-00722-7
26. Scellato, G., Franzoni, C., Stephan, P.: Migrant scientists and international networks. Research Policy **44**(1), 108–120 (2015)
27. Shen, W., Xu, X., Wang, X.: Reconceptualising international academic mobility in the global knowledge system: towards a new research agenda. Higher Education **84**(6), 1317–1342 (2022). https://doi.org/10.1007/s10734-022-00931-8, `https://doi.org/10.1007/s10734-022-00931-8`
28. Stephenson, C., Miller, A.D., Alvarado, C., Barker, L., Barr, V., Camp, T., Frieze, C., Lewis, C., Mindell, E.C., Limbird, L., et al.: Retention in computer science undergraduate programs in the us: Data challenges and promising interventions. ACM (2018)

29. Stout, J.G., Grunberg, V.A., Ito, T.A.: Gender roles and stereotypes about science careers help explain women and men's science pursuits. Sex Roles **75**(9), 490–499 (2016)
30. Urry, J.: Mobility and proximity (2002). https://doi.org/10.1177/0038038502036002002
31. Wang, D., Barabási, A.L.: The science of science. Cambridge University Press (2021)
32. Wang, L.L., Stanovsky, G., Weihs, L., Etzioni, O.: Gender trends in computer science authorship. Communications of the ACM **64**(3), 78–84 (2021)
33. Xu, Y.J.: Gender disparity in stem disciplines: A study of faculty attrition and turnover intentions. Research in higher education **49**(7), 607–624 (2008)