RESEARCH ARTICLE

# Faculty mobility and research dynamics at Historically Black Colleges and Universities

Xiang Zheng[1], Erjia Yan[2], and Chaoqun Ni[1]

[1]Information School, University of Wisconsin–Madison, Madison, WI, USA
[2]College of Computing & Informatics, University of Drexel, Philadelphia, PA, USA

**Keywords:** academic mobility, bibliometrics, career development, matching, quantitative analysis, research performance

## ABSTRACT

Historically Black Colleges and Universities (HBCUs) play a foundational role in promoting equality in U.S. higher education and society. Studying faculty transitions and research dynamics at HBCUs is crucial to understanding and addressing these institutions' challenges, such as the brain drain and its relationships with faculty research practices. By tracking the affiliation changes of 139 professors and their research outcomes (consisting of 4,269 publications) and comparing them with a matched control group with similar backgrounds, we revealed a moving penalty for professors moving from Predominantly White Institutions (PWIs) to HBCUs, who experienced declines in research productivity and citation impact. In contrast, professors transitioning from HBCUs to PWIs benefited from the moving premium of increasing high-impact publications. Professors at HBCUs tend to increase their collaborations with PWIs before transitioning, while those moving to PWIs reduce their collaborations with HBCUs. Our findings highlight the ongoing challenges HBCUs face and underscore the need for comprehensive strategies to strengthen these institutions' research functionality and ultimately their overall academic standing.

## 1. INTRODUCTION

Historically Black Colleges and Universities (HBCUs) have played a foundational role in promoting equality in U.S. higher education and society (Allen, Devost, & Mack, 2020). Since the establishment of HBCUs after 1865, HBCUs were the primary institutions educating Black Americans prior to the Civil Rights Act of 1964 and have provided educational opportunities to millions of students who were excluded from traditional higher education institutions (Allen, Jewell et al., 2007; Baylor, 2010; Roebuck & Murty, 1993). While the civil rights movement and racial integration facilitated broader access to higher education for Black students, the notion of HBCUs is not obsolete, as Black Americans and other minority students still need prioritized community and academic support (Baylor, 2010). Despite making up only 3% of U.S. higher education institutions, HBCUs boast impressive educational achievements: They are responsible for educating a significant proportion of Black professionals, including 80% of Black federal judges, 85% of Black doctors, and 50% of Black engineers (Allen et al., 2020; Seymore, 2005).

However, these institutions face the challenge of losing faculty to Predominantly White Institutions (PWIs), in what is known as a "brain drain" (Allen, 1991; Morris, 1972). Although, before the late 1960s, separate sets of standards were developed for Black and White colleges,

an open access journal

Check for updates

Citation: Zheng, X., Yan, E., & Ni, C. (2024). Faculty mobility and research dynamics at Historically Black Colleges and Universities. *Quantitative Science Studies*, *5*(4), 844–860. https://doi.org/10.1162/qss_a_00334

DOI: https://doi.org/10.1162/qss_a_00334

Peer Review: https://www.webofscience.com/api/gateway/wos/peer-review/10.1162/qss_a_00334

Received: 26 June 2024
Accepted: 18 September 2024

Corresponding Author:
Chaoqun Ni
chaoqun.ni@wisc.edu

Handling Editor:
Vincent Larivière



The MIT Press

against the background of racial integration, HBCUs are evaluated on the same criteria as other colleges and universities (Roebuck & Murty, 1993). Since the landmark *Brown v. Board of Education* decision, the competition for outstanding faculty between HBCUs and PWIs has intensified, often leaving HBCUs at a disadvantage (Seymore, 2005). This trend is concerning because it involves many Black professors and students moving from HBCUs to PWIs, with few moving in the opposite direction (Allen, 1991). However, faculty flow is not always unidirectional. While elite universities increasingly recruit highly qualified Black faculty to increase faculty diversity (Barrett & Smith, 2008), some high-profile Black scholars and coaches are making the deliberate choice to join HBCUs (Broady, Perry, & Romer, 2021). A U.S. Commission on Civil Rights (2010) report affirms that the brain drain is reasonable from HBCUs, as resistance to Black attendance at PWIs has faded and the need for segregated schooling has declined. This indicates a complex landscape that merits deeper investigation.

Unraveling the reasons and consequences behind the brain drain and academic mobility is important for HBCUs because faculty, along with their expertise and competencies, are valuable institutional assets (Rosenblatt & Sheaffer, 2001). One crucial perspective to understanding academic mobility is its impact on faculty's research practices. Mobility significantly affects a researcher's research practices, as it affects the researcher's knowledge, colleagues, coauthors, and available resources (Bäker, 2015). The resulting research performance, which is often measured by productivity and citation impact, is the most common measure and criterion for promotion and tenure evaluation (Zheng, Yuan, & Ni, 2022). Understanding how mobility specifically impacts these scientific metrics within HBCUs can provide insights into academic careers and success factors in these institutions. Despite the recognized impact of mobility, the role of mobility in shaping academic careers at HBCUs remains under-explored, particularly in terms of long-term scientific output.

To address these gaps, we aim to analyze how faculty's research dynamics change before and after moving to or from HBCUs. Specifically, we focus on the following research questions:

1. What are the patterns of faculty migration between HBCUs and PWIs?
2. How does faculty mobility affect the scientific performance of professors at HBCUs?
3. Does faculty mobility impact the collaboration practices of HBCU professors?

By investigating these questions, this study provides an in-depth understanding of the effect of mobility between HBCUs and PWIs. It also highlights the need to enhance the research functionality of HBCUs to fulfill their mission in the face of evolving academic landscapes. Moreover, despite being a case study situated in the context of U.S. higher education, with its history of segregation, this study also sheds light on similar institutions worldwide, especially those primarily serving systematically marginalized groups, such as women and Indigenous peoples. It is hoped to inspire future research, examining this study's findings regarding faculty research performance within more types of institutions under various unique cultural contexts in which they operate.

## 2. LITERATURE REVIEW

### 2.1. Research at HBCUs

People often perceive HBCUs to be primarily teaching institutions, whereas the research component at HBCUs is also indispensable. The strong research and scientific contributions of

HBCUs have been described by Sampson (2023). Using social work as an example, Marshall Jr. et al. (2016) demonstrated that faculty at HBCUs actively engaged in various research agendas identifying unique challenges faced by marginalized groups, particularly those of African descent. Their research outcomes also received national and international recognition, with findings published in high-impact journals (Marshall, Davis Smith et al., 2016). Moreover, HBCUs play a crucial role in producing Black STEM Ph.D. graduates in the United States, with many earning both their undergraduate and graduate degrees from these institutions (American Institutes for Research, 2014; Sampson, 2023). This underscores the importance of HBCUs in training Black researchers and diversifying the research workforce and leadership in the United States, which highly relies on the research proficiency of the HBCU faculty (Agesa, Granger, & Price, 1998).

Despite these contributions, studies suggest that the scientific performance of HBCUs may not compare favorably to PWIs using conventional metrics. Agesa et al. (1998) reported that a significant portion of economics departments at HBCUs are not actively engaged in publishing research. Slater (1994) found that White scholars in STEM fields were three times more likely to be cited than their counterparts at HBCUs from 1989 to 1993. Additionally, Marshall et al. (2016) observed generally low *h*-index scores among 65 faculty members at five doctoral-granting schools of social work. Overall, HBCUs have often been labeled academically inferior to PWIs and tend to underperform on measures traditionally used to evaluate colleges and universities (Hardy, Kaganda, & Aruguete, 2019).

Institutional constraints contribute to the gap in faculty productivity between HBCUs and PWIs (Betsey, 2007). Historically, oppressed by the racial power structure, HBCUs suffered from poor financial resources, physical plants, and teaching facilities (Roebuck & Murty, 1993). Even today, research funding poses a significant obstacle for many HBCUs (Phoenix & Henderson, 2016), as demonstrated by a decrease in federal R&D support. In 2021, 56 HBCUs reported federally supported R&D spending totaling $402 million, which amounted to $339 million in constant 2012 dollars, a 35% decrease from the $516 million reported in 2012 and accounted for less than 1% of total federally financed U.S. academic R&D (National Science Board, National Science Foundation, 2023). Consequently, faculty at HBCUs face financial disadvantages, with an average salary of $69,180 in 2018–2019, significantly lower than the $87,384-dollar average for faculty at PWIs (Clery, 2021). Additionally, HBCUs still face challenges in advancing research, including aging infrastructure, limited access to digital technologies, and outdated equipment (Matthews, 2012).

Despite previous research, few studies have focused on the relationship between research performance, faculty mobility, and brain drain concerning HBCUs. It remains unclear whether the unfavorable scientific performance of HBCUs is primarily due to institution-level factors, such as funding and research environment, or the personal competence of the hired faculty. Tracing the performance of the same group of faculty as they move between HBCUs and PWIs will provide valuable evidence to clarify this issue.

### 2.2. Effect of Mobility Between Institutions

Academic mobility affects various aspects of faculty, including their research performance (Gureyev, Mazov et al., 2020; Scellato, Franzoni, & Stephan, 2015; Sugimoto, Robinson-Garcia et al., 2017), salaries (Barbezat & Hughes, 2001), and career development (Li & Tang, 2019; Zubieta, 2009). For research performance, mobility is often seen as a means to enhance research efficiency and impact, as it facilitates scientific collaboration (Gureyev et al., 2020; Scellato et al., 2015; Sugimoto et al., 2017). Previous studies showed that researchers who

change affiliations during their careers tend to have higher publication and citation rates. For example, Ejermo, Fassio, and Källström (2020) found that mobility leads to a long-lasting 32% increase in a researcher's publications and a 63% increase in citations. A case study at Washington State University demonstrated that mobile researchers produce publications with greater impact, and domestically mobile researchers produced publications with higher research impact, albeit in smaller numbers compared to internationally mobile researchers (Payumo, Lan, & Arasu, 2018). Halevi, Moed, and Bar-Ilan (2016) observed that top-performing researchers across seven disciplines who had mobility between at least two affiliations exhibited increased output and impact. In China, both domestically moved and cross-border returned Chinese scientists are found to outperform their stationary counterparts in terms of publication numbers and collaborator counts (Huang, Cheng et al., 2024; Liu & Hu, 2022).

However, other evidence suggests that institutional mobility may have minimal or no effect on research performance. Aksnes, Rørstad et al. (2013) analyzed Norwegian university researchers and found that although mobile researchers tend to have slightly higher publication and citation rates, controlling for demographic characteristics could nullify most of this increase. Similarly, two studies focusing on German-language economists and U.K. academic researchers found no significant impact of mobility on average productivity (Bolli & Schläpfer, 2015; Fernández-Zubieta, Geuna, & Lawson, 2015). Negative aspects of mobility may also emerge, particularly in the short term, as it may disrupt scientific collaboration due to severed connections with former colleagues and the time required to establish new scientific ties (Bäker, 2015).

Given these findings, it is clear that the effects of mobility are not universal and can differ depending on the institution and country contexts (Abramo, D'Angelo, & Di Costa, 2022). Most previous research has focused on research-intensive universities, which may not include or accurately represent minority-serving institutions such as HBCUs (e.g., Payumo et al., 2018). Consequently, the advantages of mobility observed in broader contexts may not uniformly apply to HBCUs, highlighting a gap in our knowledge regarding the impact of mobility on research performance at these institutions.

## 3. DATA AND METHODS

### 3.1. Data Sources

Our faculty data is collected from the Academic Analytics Research Center (AARC) U.S. higher education institution faculty rosters data set. These faculty rosters include U.S Ph.D.-granting institutions' employment records for tenured and tenure-track professors from 2011 to 2020. The data set tracks the career trajectories of 314,141 tenured or tenure-track professors from 393 institutions. The available variables for each professor include professor names, gender, affiliation, department, career ranks, and publication records, on an annual basis from 2011 to 2020. Mobile professors can be identified when a professor's affiliations changed between two adjacent year captures by AARC.

Eleven HBCUs were designated as R2 institutions according to the 2018 version of the Carnegie Classification of Institutions of Higher Education (CCIHE), among which 10 were included in the current study (Delaware State University did not have sufficient data covered by AARC and therefore was not included): Howard University, Florida Agricultural and Mechanical University, Jackson State University, North Carolina Agricultural and Technical State University, Morgan State University, Hampton University, University of Maryland Eastern

Shore, Texas Southern University, Clark Atlanta University, and Tennessee State University. We define all other non-HBCUs as PWIs.

In AARC, between 2011 and 2020, 3,187 tenure-track or tenured professors were affiliated with the 10 HBCUs. To identify professors who moved between HBCUs and PWIs, we initially identified 171 professors affiliated with at least one HBCU and one PWI from 2011 to 2020. To determine the exact year of their academic move between HBCUs and PWIs, we searched their career experience on various online platforms such as school websites, LinkedIn, and personal websites. In this process, we manually corrected any data errors and excluded professors who did not have a clear move year. For example, we excluded professors who were affiliated with both HBCUs and PWIs for an extended period. As a result, we were left with a sample of 139 professors, referred to as the mobile group.

For a more comprehensive research profile of professors, we matched the digital object identifiers (DOI) and person names recorded in AARC with Scopus to gather additional bibliographic data. When matching names, we replaced special characters such as á and é with their standard forms. We only considered publications within the year range from 2011 to 2020, which is when the authors' affiliations in AARC were available. Our analysis focused on research articles, conference proceedings, and reviews published in journals or conferences. We excluded professors who did not have any publications during the years when their affiliations were known. In total, we included 4,269 publications authored by 104 professors in our analysis of these professors, and collected information on journals, citations, and collaborators based on Scopus.

### 3.2. Comparison Group Construction

Mobile professors who moved between HBCUs and PWIs (mobile group) are the focus of this study. We classified the mobile group into two subgroups: HBCU-PWI group (professors transitioning from HBCUs to PWIs) and the PWI-HBCU group (professors moving from PWIs to HBCUs). The HBCU-PWI mobile group consisted of 60 professors, who were once affiliated with 60 institutions, while the PWI-HBCU mobile group had 79 professors, who were once affiliated with 76 institutions[1].

To isolate the effect of affiliation changes on research practice, we constructed a comparison group as the baseline to compare with the sample professors. The comparison group consists of professors with similar characteristics to the mobile professors who moved between HBCU and PWI (mobile group) but remained at their original institution with no affiliation change. Specifically, we initially identified all professors who were only affiliated with one institution for a minimum of 5 years. Then, for each professor in the mobile group, we extracted professors who were in the same department and obtained their highest degree within 2 years of the target professor's year of highest degree.

We computed the distance between each pair of professors in the mobile group and the pool of candidates. The distance is calculated using the following method:

$$D_{ij} = \left(U_i - U_j\right)^2 + \left(V_i - V_j\right)^2 + G_{ij}$$

where $U_i$ is the ranking percentile of professor $i$'s institution, $V_i$ is the ranking percentile of professor $i$'s highest degree institution, and $G_{ij}$ is a binary variable indicating whether professors $i$ and $j$ are of the same binary gender.

[1] Some professors were counted separately in both groups because of their multiple-moving trajectories. In this case, they will have different move years and publication coverage.

Gender is included in this analysis due to previous research highlighting gender disparities in research performance (Larivière, Ni et al., 2013; Zheng et al., 2022). We used binary gender data from AARC for each professor, determined through the NamSor algorithm based on their names (Namsor, n.d.). If the gender of either professor is unknown, we set $G_{ij} = 0$.

An institution's ranking is determined based on AARC data using the SpringRank algorithm, which ranks institutions based on their capabilities to place their graduates in other highly ranked institutions (De Bacco, Larremore, & Moore, 2018; Wapman, Zhang et al., 2022). This is a physically inspired model and an efficient algorithm to infer hierarchical rankings of nodes in directed networks. Rankings based on the SpringRank algorithm follow the principle that interactions are more likely to occur between individuals with similar ranks. This study followed the approach by Wapman et al. (2022) and constructed a directed faculty hiring network based on our AARC data. Each node of this network is a U.S. institution, and each edge is weighted by the number of faculty graduating from the source node and hired by the target node. The SpringRank algorithm generates a real-valued rank for each institution based on the network. The final percentile rankings are converted from these real values.

For each professor in the mobile group, we selected four professors with the least distances as their match in the comparison group with replacement. The one-to-many matching is used because the control group in our study includes many more subjects than the mobility group, which can increase the statistical power (Baek, Park et al., 2015). A 1:4 matching ratio is commonly used and often elicits a low bias (Linden & Samuels, 2013). We finally matched 385 unique professors with 12,194 publications in the comparison group, corresponding to 95 professors (45 HBCU-PWI and 50 PWI-HBCU mobile professors) in the mobile group sample.

### 3.3. Sample Description

Table 1 and Table 2 compare the attributes of professors in the mobile and comparison groups. We observe that the two groups demonstrate high similarity in the mean and standard deviation regarding institution rankings and highest degree year. They also have close gender and department field distributions. However, men and certain fields, such as Engineering and Medicine and Health, are overrepresented in the sample. This imbalance may be due to the larger number of male professors and the higher prevalence of these fields in academia.

### 3.4. Dimensions of Faculty Research Practices

This study focuses on the following research performance measures: productivity, citation impact, and journal impact. Productivity is represented by the annual publication number. Citation impact is measured by the citation counts within a citation window of 3 years. Considering that the impact of papers is time and field dependent, we calculated its percentile (ranging from 0 to 100) among all papers indexed by Scopus in the same year and subfield. Subfields are defined by the Scopus-based classification system developed by Science-Metrix, which uses journal information to classify each paper in Scopus into 174 subfields. For multidisciplinary journals, this system uses character-based convolutional deep neural networks to classify at the individual paper level. Self-citations, defined as citations from a publication with at least one shared author in the first or last authorship, were excluded for all involved publications to avoid the potential influence of citation manipulation (González-Sala, Osca-Lluch, & Haba-Osca, 2019).

**Table 1.** Comparison of institution ranking percentile and highest degree year between the mobile and comparison groups

| | Mobile | | | | Comparison | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Min** | **Max** | **Mean** | **SD** | **Min** | **Max** |
| *HBCU-PWI* | | | | | | | | |
| Institution ranking percentile | 28.48 | 24.03 | 4.34 | 82.14 | 28.86 | 23.92 | 3.32 | 83.67 |
| Highest degree year | 2003.89 | 9.48 | 1979.00 | 2018.00 | 2004.06 | 9.25 | 1977.00 | 2017.00 |
| *PWI-HBCU* | | | | | | | | |
| Institution ranking percentile | 49.67 | 27.25 | 0.51 | 94.90 | 49.69 | 26.97 | 0.51 | 95.41 |
| Highest degree year | 2002.88 | 8.86 | 1978.00 | 2015.00 | 2002.83 | 8.81 | 1976.00 | 2016.00 |

Impact factor (IF) is still a widely used and straightforward metric to evaluate journals today. To determine the impact of our data set's journals, we calculated the IF based on Scopus data using the same methodology as Clarivate's *Journal Citation Report* (Zheng & Ni, 2024).

$$IF_{ij} = \frac{\sum_{k=j-2}^{j-1} m_{ijk}}{\sum_{k=j-2}^{j-1} n_{ik}}$$

where $IF_{ij}$ is the IF for journal $i$ in year $j$, $m_{ijk}$ is the number of citations made in year $j$ to journal $i$'s past publications published in year $k$, and $n_{ik}$ is the number of journal $i$'s publications in

**Table 2.** Comparison of gender and affiliated department field between the mobile and comparison groups

| | HBCU-PWI | | | | PWI-HBCU | | | |
|---|---|---|---|---|---|---|---|---|
| | Mobile | | Comparison | | Mobile | | Comparison | |
| | **Count** | **%** | **Count** | **%** | **Count** | **%** | **Count** | **%** |
| *Gender* | | | | | | | | |
| Woman | 14 | 31.11 | 54 | 29.67 | 15 | 30.00 | 63 | 30.58 |
| Man | 18 | 40.00 | 73 | 40.11 | 26 | 52.00 | 106 | 51.46 |
| Unknown | 13 | 28.89 | 55 | 30.22 | 9 | 18.00 | 37 | 17.96 |
| *Affiliated department field* | | | | | | | | |
| Applied Sciences | 3 | 4.92 | 10 | 4.85 | 8 | 12.12 | 29 | 11.51 |
| Education | 2 | 3.28 | 3 | 1.46 | 3 | 4.55 | 9 | 3.57 |
| Engineering | 15 | 24.59 | 49 | 23.79 | 15 | 22.73 | 55 | 21.83 |
| Humanities | 4 | 6.56 | 17 | 8.25 | 4 | 6.06 | 16 | 6.35 |
| Mathematics & Computing | 6 | 9.84 | 23 | 11.17 | 6 | 9.09 | 18 | 7.14 |
| Medicine and Health | 13 | 21.31 | 43 | 20.87 | 9 | 13.64 | 41 | 16.27 |
| Natural Sciences | 9 | 14.75 | 32 | 15.53 | 13 | 19.70 | 48 | 19.05 |
| Social Sciences | 9 | 14.75 | 29 | 14.08 | 8 | 12.12 | 36 | 14.29 |

year *k*. Similarly, we normalized a journal's IF by calculating its percentile among all journals in the same year and subfield indexed by Scopus. The papers ranked top 10% of citations (top-citation) and papers published in journals ranked in the top 10% by impact factor (top-IF) within a specific year and subfield are considered as papers with significant impact. We also used Source Normalized Impact per Paper (SNIP), a field-normalized journal impact measure originally calculated based on Scopus, to examine the results (Roldan-Valadez, Salazar-Ruiz et al., 2019).

In addition, academic migration is often a source of cross-institution and international collaboration. To observe this factor, we calculated a cross-HBCU-PWI collaboration rate:

$$Rate_{ij} = \frac{n_{ij}}{N_{ij}}$$

where $n_{ij}$ is the number of HBCU and PWI collaboration publications, and $N_{ij}$ is the total number of collaboration publications by the mobile professors. This rate reflects how much the migration between HBCUs and PWI may contribute to institutional collaboration.

### 3.5. Analytical Methods

Our comparison between the mobile and comparison groups is based on descriptive statistics and regression analysis. We converted all years into years relative to the move, which sets the last year of the first affiliation as 0. In theory, most professors need to transfer to their new affiliation to be reflected in next year's AARC survey data. Due to the limitations of our data period, we set our observation period from −4 (4 years before the move) to 4 years (4 years after the move). We estimated the following regression model to examine their productivity differences:

$$y_{it} = \beta_0 + \sum_{\tau=-3}^{4} \beta_\tau \left( Treat_i \times PostYear_{it}^{\tau} \right) + Rank_{it} + \alpha_i + \varepsilon_{it}$$

where $y_{it}$ is the productivity of individual $i$ in year $t$, and $Treat_i$ is a binary variable indicating whether individual $i$ is in the mobile group (1) or comparison group (0). $PostYear_{it}^{\tau}$ is a binary variable indicating the years relative to the move year for individual $i$ in year $t$, with Year −4 serving as the reference. It is 1 if $t = \tau$; otherwise, it is 0. $Rank_{it}$ is the institution's ranking for individual $i$ in year $t$. $\alpha_i$ is the fixed effect for individual $i$ to control for unobserved, time-invariant characteristics. $\varepsilon_{it}$ is the error term. Standard errors are clustered at the individual level.

## 4. RESULTS

### 4.1. Faculty Mobility Patterns at HBCUs

Our results suggest that faculty migration between HBCUs and PWIs is asymmetrical (Figure 1). Among the 139 mobile professors, 60 professors experienced moving from HBCUs to PWIs, and 79 professors experienced moving from PWIs to HBCUs during the period of investigation. Howard University was the primary institution involved in academic mobility, as both the source and the destination. For Howard University, 21 professors from 20 different institutions transitioned from PWIs to these HBCUs. Conversely, 19 professors moved from HBCUs to PWIs, coming from 19 different institutions. Furthermore, the faculty exchange pattern between HBCUs and PWIs suggests the migration direction is related to the institution rankings. Approximately 83% of professors at HBCUs opted for positions at higher-ranked PWIs, whereas a mere 15.2% of those at PWIs chose higher-ranked HBCUs. This

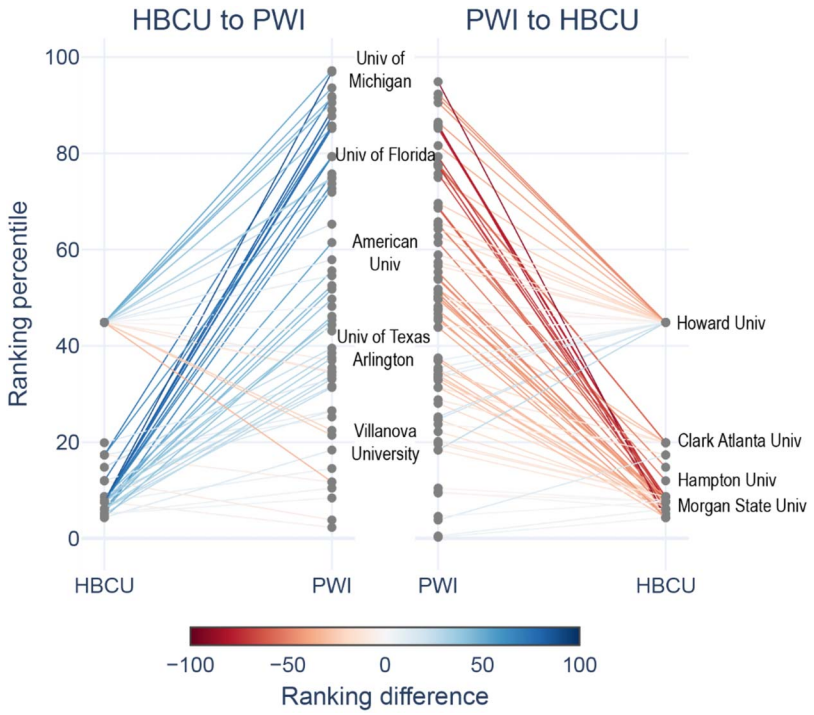


**Figure 1.** Mobile trajectories and institution ranking differences. Lines are colored proportional to the differences between the destination and source institution ranking percentile. Ranking percentiles are calculated based on Wapman et al.'s (2022) SpringRank algorithm. Five example PWIs near the 20, 40, 60, 80, and 100th percentiles and part of HBCUs' names are labeled.

difference suggests that there may be distinct motivations driving the two types of academic mobility.

#### 4.2. Mobile Professors' Shift in Research Productivity

The analysis indicates that professors transitioning between institution types exhibit varying productivity trends, with those moving from HBCUs to PWIs generally increasing their output, while those moving to HBCUs from PWIs often seeing a decline. Specifically, professors in the HBCU-PWI mobile group consistently outperform their peers who remained at HBCUs in terms of annual productivity, showing a notable increase in publication rates 3 years postmove, although the difference is not statistically significant due to overlapping confidence intervals (Figure 2a). Conversely, in the PWI-HBCU mobile group, there is a noticeable decline in average annual productivity from 2.87 (Year –4) to 2.13 (Year 4) following their transition, aligning with the trends observed in the comparison group, suggesting that these professors may struggle to maintain their prior productivity levels when moving to HBCUs (Figure 2b).

Furthermore, the event-study analysis confirms and highlights a significant drop in productivity for professors moving from PWIs to HBCUs around the year of transition (Figure 2c). Specifically, we observed that the PWI-HBCU group published significantly fewer articles compared to the comparison group, especially noticeable in Year 4, with an average of 0.546 fewer publications (CI [−0.929, −0.162], $p < 0.001$). Conversely, the differences in publication rates between the HBCU-PWI group and the comparison group were not statistically

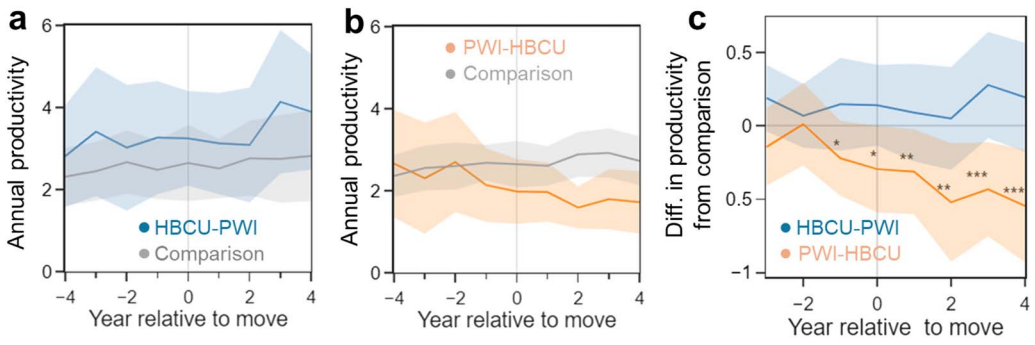


**Figure 2.** Annual publications by year. Year 0 on the *x*-axis denotes the year of the move event. Error bands represent 95% confidence intervals. Numbers of annual publications by year between (a) the HBCU-PWI and (b) the PWI-HBCU group and their matched comparison group. (c) Estimated annual publication differences between the mobile and comparison group professors. Each line is connected by the point estimates of the annual publication differences in different years before and after the academic move. Values above zero indicate a higher number of publications compared to the comparison group. Estimates are obtained by fixed-effect regression models relative to Year −4. Year 0 on the *x*-axis denotes the year of the move event. Asterisks denote the statistical significance of the difference for a specific year. $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

significant. This evidence further supports the conclusion that professors transitioning to HBCUs experience a notable decrease in productivity postmove.

### 4.3. Mobile Professors' Shift in Research Impact

For the research impact, we first examined the average citation percentiles and IF percentiles per year for faculty who published at least one paper (Figure 3a). The mobile and control groups have large overlapping confidence intervals and do not show significant trend differences. However, regarding the high-impact papers, we found that the HBCU-PWI group began to produce a higher percentage of top-citation publications compared to the comparison group, reaching a peak in the second year (20% vs. 14%) (Figure 3b). In terms of high-IF publications, the HBCU-PWI group initially published fewer in the year of the transition (15% vs. 21%), but they started to publish several high-IF publications comparable to the comparison

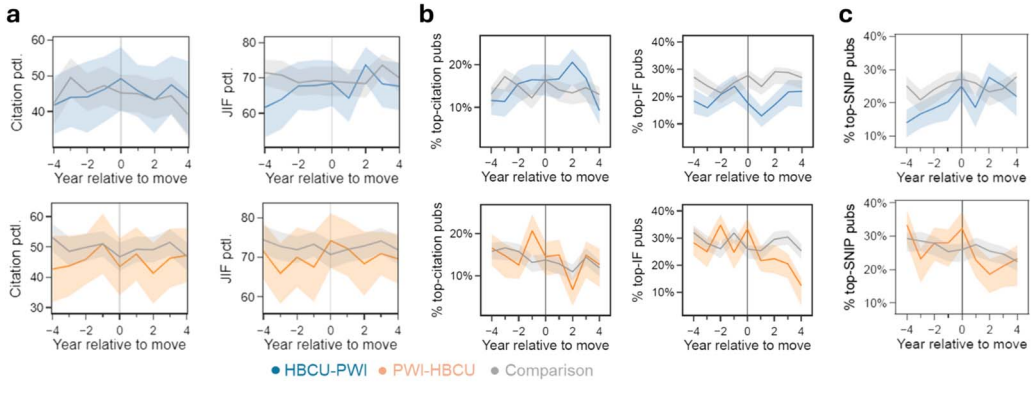


**Figure 3.** Share of top impact publications by years. Year 0 on the *x*-axis denotes the year of the move event. (a) Average citation percentiles and IF percentiles per year for faculty who published at least one paper. Error bands represent 95% confidence intervals. (b) Share of top-citation and top-IF publications of the mobile and comparison groups. Bootstrap confidence intervals were estimated by 1,000 resampling faculty members with replacement for each year. (c) Share of top-SNIP publications of the mobile and comparison groups.

group after the second year. Conversely, the PWI-HBCU group maintained similar levels of high-citation and high-IF publications to the comparison group before the transition year, but their output fell below that of the comparison group, particularly after Year 2. This trend suggests that professors may face challenges in publishing high-impact papers after transitioning to HBCUs. We also used SNIP as an alternative measure of journal impact and found similar results (Figure 3c).

After accounting for individual differences, we examined the differences in gained citations and IF between the mobility and control groups (Figures 4(a) and (b)). The results suggest that the PWI-HBCU group tends to be cited less than the control group in certain periods. Moreover, controlling for other variables, the HBCU-PWI group was significantly more likely to publish a higher proportion of high-impact papers, including both top-citation and top-IF papers, compared to the comparison group after the second year (Figures 4(c) and (d)). Meanwhile, the PWI-HBCU group exhibited increasingly negative disparities in their high-impact publications relative to the comparison group posttransition, with statistical significance observed in certain years. This divergence shows the potential influence of institutional environments on academic publishing patterns. It suggests that professors who move to PWIs may encounter enhanced opportunities or resources for high-impact publishing, while those transitioning to HBCUs may encounter obstacles that could hinder their ability to publish at the highest levels.

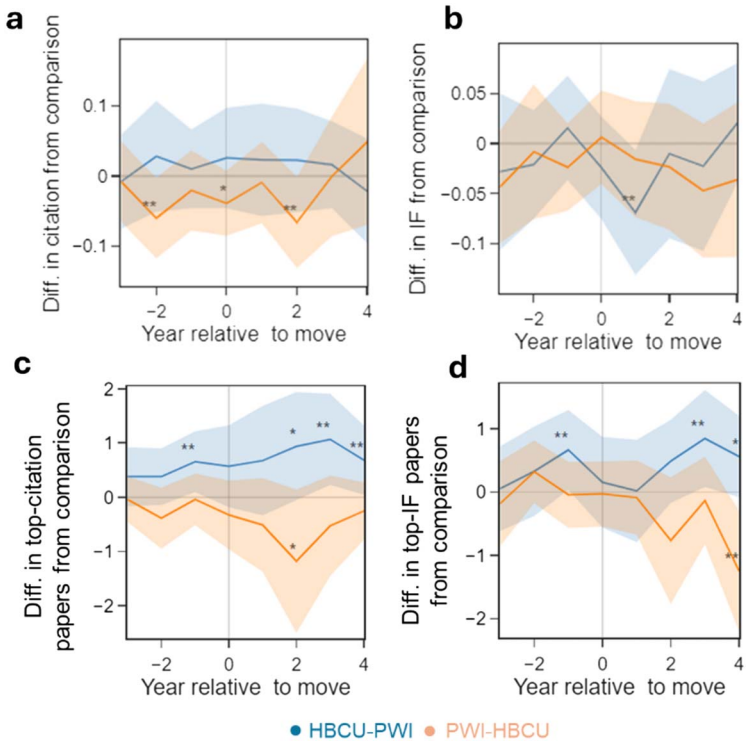


**Figure 4.** (a) Estimated citation, (b) IF, top-citation, (c) publication, and (d) top-IF publication differences between the mobile and comparison group professors. Each line is connected by the point estimates of the annual differences in different years before and after the academic move. Values above zero indicate a higher number of publications compared to the comparison group. Estimates are obtained by fixed-effect regression models relative to Year −4. Year 0 on the *x*-axis denotes the year of the move event. Error bands represent 95% confidence intervals. Asterisks denote the statistical significance of the difference for a specific year. *$p < 0.01$, **$p < 0.05$, ***$p < 0.1$.

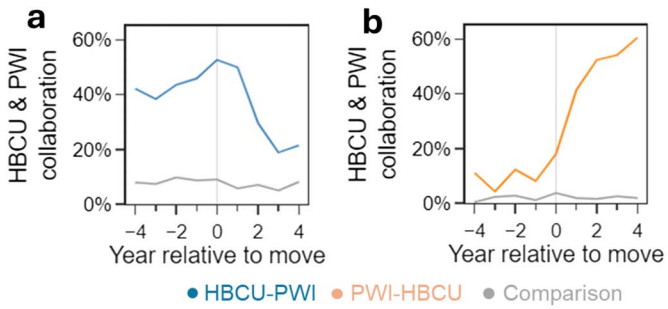


**Figure 5.** Share of HBCU and PWI collaboration publications among all collaborative publications by year. Year 0 on the *x*-axis denotes the year of the move event. (a) Between the HBCU-PWI group and their matched comparison group; (b) between the PWI-HBCU group and their matched comparison group.

### 4.4. Mobile Professors' Shift in Research Collaboration

Furthermore, we examined the cross-HBCU-PWI collaboration of the professors. Prior to the move, the cross-HBCU-PWI collaboration rates (see Section 3) for the HBCU-PWI group were significantly higher than those of the comparison group (52.8% vs. 9.0% in Year 0) (Figure 5a). There was a notable drop immediately after the move in the following 2 years, indicating a reduction in such collaborations when the professors were in PWIs. In contrast to the HBCU-PWI group, the trend for the PWI-HBCU group was upward (Figure 5b). Collaborations were relatively low or stable before the move. However, starting in Year 0, there was a consistent and significant increase in collaborative publications from 18% to 60.6%, indicating a growth in collaboration with PWI after they moved to HBCUs. The comparison group shows a relatively flat trend, ranging between 1% and 4% compared with the mobile group. This suggests that the observed fluctuations in collaborations were largely due to the move. These findings indicate that professors with transition experience or intent almost always have higher cross-HBCU-PWI collaboration rates than their peers. However, they tend to increase collaboration with PWIs when in HBCUs but reduce collaboration with HBCUs when in PWIs. Analyzing the number and percentage of collaborators before the move and after the move, and those continuing to collaborate across both periods, we found that the retention rates were relatively low (7.92% for the HBCU-PWI group and 7.22% for the PWI-HBCU group), suggesting that collaborations are more reshaped by the transition rather than sustained from pre-existing relationships (Table 3).

**Table 3.** Distribution of collaborators before and after institutional transition by group

| Group | Collaboration period | Number of collaborators | Percentage of collaborators |
|---|---|---|---|
| HBCU-PWI | Postmove only | 971 | 45.78 |
| | Premove only | 982 | 46.3 |
| | Continuous | 168 | 7.92 |
| PWI-HBCU | Postmove only | 574 | 50.53 |
| | Premove only | 480 | 42.25 |
| | Continuous | 82 | 7.22 |

## 5. DISCUSSION

By tracking the mobility of 139 professors, our analysis suggests that the in-flow of HBCU faculty (79 professors) is larger than the out-flow (60 professors), which suggests that HBCUs are experiencing a net positive gain in faculty mobility and are potentially mitigating the brain drain effect. We also found that a majority of professors at HBCUs moved to higher-ranked PWIs, whereas more professors at PWIs moved to lower ranked HBCUs. This trend differs from the faculty hiring of Ph.D. graduates, where most Ph.D. graduates are placed as faculty in institutions whose prestige is lower than their Ph.D. institutions (Clauset, Arbesman, & Larremore, 2015). This may be due to the different motivations for professors in academic mobility. For professors moving from HBCUs to higher-ranked PWIs, motivations may include the pursuit of enhanced research opportunities, access to more substantial resources, and a broader academic network (Abramo et al., 2022). On the other hand, those transitioning from PWIs to HBCUs, despite often moving to institutions of lower rank, may be motivated by a commitment to mentorship and education within a culturally significant context, opportunities for leadership positions, and a desire to contribute to the empowerment of historically underserved communities (Agesa et al., 1998; Hong, Yan et al., 2024).

Our study further revealed that professors transitioning from PWIs to HBCUs experience a "moving penalty" on research productivity and citation impact. These professors exhibit a decline in productivity compared to their counterparts who remained at PWIs, with this gap in productivity widening over time. Additionally, they face challenges in publishing high-impact papers at levels comparable to their peers at PWIs; their share of high-impact publications is lower than that of the comparison group posttransition. This observation underscores the challenges HBCUs face in providing adequate research support, attributed to heavier teaching loads and the additional responsibilities of student mentorship at HBCUs (Gasman, 2013; Jackson, 2002). Consequently, faculty at HBCUs have limited time, funding, labor, and resources for research activities, compared to their PWI peers (Escobar, Bell et al., 2021). This situation may also reflect the self-selection that professors preferring to focus on administrative or teaching roles may actively opt for HBCUs (Agesa et al., 1998; Hong et al., 2024). These factors may explain that the shift from PWIs to HBCUs appears to penalize faculty research performance after they have completed the move.

In contrast, professors transitioning from HBCUs to PWIs may benefit from a "moving premium," which enhances certain aspects of a professor's research career, notably high-impact publications. While our research indicates an increase in the average annual productivity of professors after transitioning from HBCUs to PWIs, this difference did not reach statistical significance. This finding suggests that while there is a perceived improvement in productivity, it may not be as pronounced or consistent across all cases. However, a notable and significant observation was the increase in the percentage of high-impact publications by these professors around 2 years after transitioning, compared to their counterparts who remained at HBCUs. These results indicate that being in PWIs may increase the likelihood of publishing high-impact publications compared to being in HBCUs. This gap in research impact may be related to various disparities between HBCUs and PWIs, such as institutional rank, academic quality, financial resources, and collaboration opportunities (Broady et al., 2021; Morris, 1972).

Our analysis also revealed significant differences in the tendency to conduct collaboration across HBCUs and PWIs before and after professors transitioned. Professors from HBCUs tend to increase their collaboration with PWIs before moving, and, conversely, those who transition

to PWIs show a reduction in collaborations with HBCUs. Previous studies claim that researchers generally tend to collaborate more with spatially proximate researchers (Kabo, Cotton-Nessler et al., 2014; Ma & Huang, 2024). However, this trend in our study suggests that faculty at HBCUs rely more on external collaborations with PWIs in publishing. Professors who have moved or are about to move demonstrate significantly higher collaboration rates across HBCUs and PWIs, especially when they are based at HBCUs. This implies that faculty at HBCUs who maintain a broader network with PWIs are more inclined to transition to these institutions. Professors moving from PWIs to HBCUs also continue to leverage their established connections with PWI researchers after such a move. Thus, the dynamics of research collaboration emerge as a pivotal factor in academic mobility, underscoring the role of inter-institutional partnerships in shaping academic careers and research landscapes.

## 6. CONCLUSIONS AND LIMITATIONS

By revealing the "moving penalty" for professors transitioning from PWIs to HBCUs, the "moving premium" for professors transitioning from HBCUs to PWIs, and the fact that HBCU professors rely more on collaboration with PWIs, our results reflect the institutional factor of HBCUs in disadvantaging HBCU faculty's research. Access to resources from PWIs through affiliation change and collaboration can improve the faculty's performance. This reflects the ongoing challenges regarding research faced by HBCUs and emphasizes the need for comprehensive strategies to support HBCUs. Enhancing funding, research infrastructure, and institutional support at HBCUs could mitigate the brain drain phenomenon, promoting a more balanced and equitable academic ecosystem that fosters high-quality research across all institutions. Addressing these disparities is crucial for promoting diversity, equity, and inclusion in academia, ensuring that all institutions can support their faculty in achieving high-impact research outcomes.

This study is subject to several limitations, and caution needs to be exercised while interpreting the results. While we aims to provide a representative picture of HBCU faculty mobility and research practices, our scope is limited to only 10 HBCUs. Moreover, the relatively stable nature of faculty positions can contribute to a lower frequency of job changes, which restricts our sample size. Our data only capture the faculty job changes from 2011 to 2020, which may not apply to other periods and the future. Not all knowledge produced is represented by publications, as tacit knowledge is not captured. Scopus does not encompass all publications and may suffer from a low representation of publications in certain fields, including arts and humanities. Citations may not accurately reflect the true impact and academic quality. Like other matching methods, our approach only accounts for observable variables when comparing the groups. This indicates that the estimation may be biased by unmeasured, unobservable factors. Due to the aggregated affiliation data per paper in our data set, we could not directly specify and control for the specific institutions of individual collaborators before and after the move. Future research can aim to capture a more comprehensive view of academic mobility by including more data sources with high granularity.

## ACKNOWLEDGMENTS

We thank Mat Kelly, Deanna Zarrillo, Jiangen He, Robert Palmer, and Xi Hong for constructive comments and suggestions. We thank Baolu Yu for her support in verifying the professors' profiles. We thank the ICSR Lab of Elsevier for sharing the Scopus data and computation resources. We thank the Academic Analytics Research Center for data sharing.

## AUTHOR CONTRIBUTIONS

Xiang Zheng: Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing—original draft, Writing—review & editing. Erjia Yan: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Writing—review & editing. Chaoqun Ni: Conceptualization, Data curation, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing—review & editing.

## COMPETING INTERESTS

The authors have no competing interests.

## FUNDING INFORMATION

This work was supported by U.S. National Science Foundation award Nos. 2122525, 2121861, and 2122691.

## DATA AVAILABILITY

Codes for this project are available on GitHub (https://github.com/MetascienceLab/hbcu-mobility). For research purposes, readers can contact Elsevier and the Academic Analytics Research Center for access to data.

## REFERENCES

Abramo, G., D'Angelo, C. A., & Di Costa, F. (2022). The effect of academic mobility on research performance: The case of Italy. *Quantitative Science Studies*, *3*(2), 345–362. https://doi.org/10.1162/qss_a_00192

Agesa, J., Granger, M., & Price, G. N. (1998). Economics research at Historically Black Colleges and Universities: Rankings and effects on the supply of Black economists. *The Review of Black Political Economy*, *25*(4), 41–53. https://doi.org/10.1007/s12114-998-1010-z

Aksnes, D. W., Rørstad, K., Piro, F. N., & Sivertsen, G. (2013). Are mobile researchers more productive and cited than non-mobile researchers? A large-scale study of Norwegian scientists. *Research Evaluation*, *22*(4), 215–223. https://doi.org/10.1093/reseval/rvt012

Allen, H. L. (1991). The mobility of Black collegiate faculty revisited: Whatever happened to the "brain drain"? *Journal of Negro Education*, *60*(1), 97–109. https://doi.org/10.2307/2295536

Allen, W. R., Devost, A., & Mack, C. (2020). Hidden in plain sight: Historically Black Colleges and Universities in America. *Quaderni di Sociologia*, *LXIV*(83), 25–46. https://doi.org/10.4000/qds.4044

Allen, W. R., Jewell, J. O., Griffin, K. A., & Wolf, D. S. (2007). Historically Black Colleges and Universities: Honoring the past, engaging the present, touching the future. *Journal of Negro Education*, *76*(3), 263–280.

American Institutes for Research. (2014). *HBCUs key to producing black STEM Ph.D.'s, but these grads have less aid, more debt*. American Institutes for Research. https://www.air.org/news/press-release/hbcus-key-producing-black-stem-phds-these-grads-have-less-aid-more-debt

Baek, S., Park, S. H., Won, E., Park, Y. R., & Kim, H. J. (2015). Propensity score matching: A conceptual review for radiology researchers. *Korean Journal of Radiology*, *16*(2), 286–296. https://doi.org/10.3348/kjr.2015.16.2.286, PubMed: 25741190

Bäker, A. (2015). Non-tenured post-doctoral researchers' job mobility and research output: An analysis of the role of research discipline, department size, and coauthors. *Research Policy*, *44*(3), 634–650. https://doi.org/10.1016/j.respol.2014.12.012

Barbezat, D. A., & Hughes, J. W. (2001). The effect of job mobility on academic salaries. *Contemporary Economic Policy*, *19*(4), 409–423. https://doi.org/10.1093/cep/19.4.409

Barrett, T. G., & Smith, T. (2008). Southern coup: Recruiting African American faculty members at an elite private southern research university. *American Educational Research Journal*, *45*(4), 946–973. https://doi.org/10.3102/0002831208321445

Baylor, R. E. (2010). Loss of accreditation at historically Black colleges and universities. *New Directions for Higher Education*, *2010*(151), 29–38. https://doi.org/10.1002/he.398

Betsey, C. L. (2007). Faculty research productivity: Institutional and personal determinants of faculty publications. *Review of Black Political Economy*, *34*(1–2), 53–85. https://doi.org/10.1007/s12114-007-9004-9

Bolli, T., & Schläpfer, J. (2015). Job mobility, peer effects, and research productivity in economics. *Scientometrics*, *104*(3), 629–650. https://doi.org/10.1007/s11192-015-1625-3

Broady, K., Perry, A. M., & Romer, C. (2021). *Underfunding HBCUs leads to an underrepresentation of Black faculty*. https://policycommons.net/artifacts/4142801/underfunding-hbcus-leads-to-an-underrepresentation-of-black-faculty/4951483/

Clauset, A., Arbesman, S., & Larremore, D. B. (2015). Systematic inequality and hierarchy in faculty hiring networks. *Science Advances*, *1*(1), e1400005. https://doi.org/10.1126/sciadv.1400005, PubMed: 26601125

Clery, S. (2021). *The calm before COVID: The last look at faculty salaries before the tumultuous pandemic*. NEA Higher Education. https://www.nea.org/sites/default/files/2021-04/2021%20Higher%20Ed%20Special%20Salary%20Issue_0.pdf

De Bacco, C., Larremore, D. B., & Moore, C. (2018). A physical model for efficient ranking in networks. *Science Advances*, *4*(7), eaar8260. https://doi.org/10.1126/sciadv.aar8260, PubMed: 30035220

Ejermo, O., Fassio, C., & Källström, J. (2020). Does mobility across universities raise scientific productivity? *Oxford Bulletin of Economics and Statistics*, *82*(3), 603–624. https://doi.org/10.1111/obes.12346

Escobar, M., Bell, Z. K., Qazi, M., Kotoye, C. O., & Arcediano, F. (2021). Faculty time allocation at Historically Black Universities and its relationship to institutional expectations. *Frontiers in Psychology*, *12*, 734426. https://doi.org/10.3389/fpsyg.2021.734426, PubMed: 34721203

Fernández-Zubieta, A., Geuna, A., & Lawson, C. (2015). Mobility and productivity of research scientists. In A. Geuna (Ed.), *Global mobility of research scientists* (pp. 105–131). Academic Press. https://doi.org/10.1016/B978-0-12-801396-0.00004-1

Gasman, M. (2013). *The changing face of Historically Black Colleges and Universities*. University of Pennsylvania. https://repository.upenn.edu/handle/20.500.14332/35096

González-Sala, F., Osca-Lluch, J., & Haba-Osca, J. (2019). Are journal and author self-citations a visibility strategy? *Scientometrics*, *119*(3), 1345–1364. https://doi.org/10.1007/s11192-019-03101-3

Gureyev, V. N., Mazov, N. A., Kosyakov, D. V., & Guskov, A. E. (2020). Review and analysis of publications on scientific mobility: Assessment of influence, motivation, and trends. *Scientometrics*, *124*(2), 1599–1630. https://doi.org/10.1007/s11192-020-03515-4

Halevi, G., Moed, H. F., & Bar-Ilan, J. (2016). Researchers' mobility, productivity and impact: Case of top producing authors in seven disciplines. *Publishing Research Quarterly*, *32*(1), 22–37. https://doi.org/10.1007/s12109-015-9437-0

Hardy, P. M., Kaganda, E. J., & Aruguete, M. S. (2019). Below the surface: HBCU performance, social mobility, and college ranking. *Journal of Black Studies*, *50*(5), 468–483. https://doi.org/10.1177/0021934719847910

Hong, X., Yan, E., Palmer, R. T., & Ni, C. (2024). *Untangling faculty turnover: Exploring retention and attrition at HBCUs* (SSRN Scholarly Paper No. 4900723). https://doi.org/10.2139/ssrn.4900723

Huang, Y., Cheng, X., Tian, C., Jiang, X., Ma, L., & Ma, Y. (2024). Talent hat, cross-border mobility, and career development in China. *Quantitative Science Studies*, *5*(3), 516–532. https://doi.org/10.1162/qss_a_00312

Jackson Jr., D. H. (2002). Attracting and retaining African American faculty at HBCUs. *Education*, *123*(1), 181–185.

Kabo, F. W., Cotton-Nessler, N., Hwang, Y., Levenstein, M. C., & Owen-Smith, J. (2014). Proximity effects on the dynamics and outcomes of scientific collaborations. *Research Policy*, *43*(9), 1469–1485. https://doi.org/10.1016/j.respol.2014.04.007

Larivière, V., Ni, C., Gingras, Y., Cronin, B., & Sugimoto, C. R. (2013). Bibliometrics: Global gender disparities in science. *Nature*, *504*(7479), 211–213. https://doi.org/10.1038/504211a, PubMed: 24350369

Li, F., & Tang, L. (2019). When international mobility meets local connections: Evidence from China. *Science and Public Policy*, *46*(4), 518–529. https://doi.org/10.1093/scipol/scz004

Linden, A., & Samuels, S. J. (2013). Using balance statistics to determine the optimal number of controls in matching studies. *Journal of Evaluation in Clinical Practice*, *19*(5), 968–975. https://doi.org/10.1111/jep.12072, PubMed: 23910956

Liu, M., & Hu, X. (2022). Movers' advantages: The effect of mobility on scientists' productivity and collaboration. *Journal of Informetrics*, *16*(3), 101311. https://doi.org/10.1016/j.joi.2022.101311

Ma, X., & Huang, T. (2024). Proximity still matters in research collaboration! Evidence from the introduction of new airline routes and high-speed railways in China. *Scientometrics*, *129*(4), 2227–2253. https://doi.org/10.1007/s11192-023-04910-3

Marshall, Jr., I., Davis Smith, B., Green, M. T., Anderson, B., Harry, S. V., ... Hill, S. (2016). Scholarly productivity of social work faculty at Historically Black Colleges and Universities: Are *h*-index scores a suitable measure? *Journal of Social Work Education*, *52*(1), 95–107. https://doi.org/10.1080/10437797.2016.1112645

Matthews, C. M. (2012). *Federal support for academic research*. Congressional Research Service.

Morris, E. W. (1972). The contemporary negro college and the brain drain. *Journal of Negro Education*, *41*(4), 309–319. https://doi.org/10.2307/2966977

Namsor. (n.d.). *Namsor*. Retrieved February 28, 2023, from https://namsor.app/.

National Science Board, National Science Foundation. (2023). *Academic research and development* (No. NSB-2023-26; Science and Engineering Indicators 2024). https://ncses.nsf.gov/pubs/nsb202326

Payumo, J. G., Lan, G., & Arasu, P. (2018). Researcher mobility at a U.S. research-intensive university: Implications for research and internationalization strategies. *Research Evaluation*, *27*(1), 28–35. https://doi.org/10.1093/reseval/rvx038

Phoenix, S., & Henderson, M. (2016). Expanding library support for faculty research in Historically Black Colleges and Universities. *Journal of Library Administration*, *56*(5), 572–594. https://doi.org/10.1080/01930826.2016.1180939

Roebuck, J. B., & Murty, K. S. (1993). *Historically Black Colleges and Universities: Their place in American higher education*. Westport, CT: Praeger.

Roldan-Valadez, E., Salazar-Ruiz, S. Y., Ibarra-Contreras, R., & Rios, C. (2019). Current concepts on bibliometrics: A brief review about impact factor, Eigenfactor score, CiteScore, SCImago Journal Rank, Source-Normalised Impact per Paper, *H*-index, and alternative metrics. *Irish Journal of Medical Science*, *188*(3), 939–951. https://doi.org/10.1007/s11845-018-1936-5, PubMed: 30511320

Rosenblatt, Z., & Sheaffer, Z. (2001). Brain drain in declining organizations: Toward a research agenda. *Journal of Organizational Behavior*, *22*(4), 409–424. https://doi.org/10.1002/job.89

Sampson, J. J. (2023). The contributions HBCUs continue to make in maintaining the nation's prominence in science and technology. *Accounts of Chemical Research*, *56*(11), 1253–1255. https://doi.org/10.1021/acs.accounts.3c00216, PubMed: 37105685

Scellato, G., Franzoni, C., & Stephan, P. (2015). Migrant scientists and international networks. *Research Policy*, *44*(1), 108–120. https://doi.org/10.1016/j.respol.2014.07.014

Seymore, S. B. (2005). I'm confused: How can the Federal Government promote diversity in higher education yet continue to strengthen Historically Black Colleges? *Washington and Lee Journal of Civil Rights and Social Justice*, *12*(2), 287–320.

Slater, R. B. (1994). Rating the science departments at Black colleges and universities. *Journal of Blacks in Higher Education*, *4*, 90–96. https://doi.org/10.2307/2963381

Sugimoto, C. R., Robinson-Garcia, N., Murray, D. S., Yegros-Yegros, A., Costas, R., & Larivière, V. (2017). Scientists have most impact when they're free to move. *Nature*, *550*(7674), 29–31. https://doi.org/10.1038/550029a, PubMed: 28980663

U.S. Commission on Civil Rights. (2010). *The educational effectiveness of Historically Black Colleges and Universities*. U.S. Commission on Civil Rights.

Wapman, K. H., Zhang, S., Clauset, A., & Larremore, D. B. (2022). Quantifying hierarchy and dynamics in U.S. faculty hiring and retention. *Nature*, *610*(7930), 120–127. https://doi.org/10.1038/s41586-022-05222-x, PubMed: 36131023

Zheng, X., & Ni, C. (2024). The significant yet short-term influence of research covidization on journal citation metrics. *Journal of the Association for Information Science and Technology*, *75*(9), 1002–1017. https://doi.org/10.1002/asi.24939

Zheng, X., Yuan, H., & Ni, C. (2022). Meta-research: How parenthood contributes to gender gaps in academia. *eLife*, *11*, e78909. https://doi.org/10.7554/eLife.78909, PubMed: 35822694

Zubieta, A. F. (2009). Recognition and weak ties: Is there a positive effect of postdoctoral position on academic performance and career development? *Research Evaluation*, *18*(2), 105–115. https://doi.org/10.3152/095820209X443446