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Quantifying Academic Careers: Large-Scale Data and Changing Individual Research Productivity from a Life Cycle Perspective

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Research Domains

Academic practice, work, careers and cultures (AP)

Abstract

This longitudinal study explores persistence in individual research productivity over time. We examine academic careers of 2,326 current Polish full professors in 14 STEMM disciplines, studying their lifetime biographical and lifetime publication histories. Every full professor is compared with their peers at earlier career stages. We used prestige-normalized productivity in which more weight is given to articles in high-impact than in low-impact journals, recognizing the highly stratified nature of academic science. Our results show that membership in top productivity classes is to a large extent determined by being in these classes earlier. The combination of biographical and demographic data of all Polish scientists (N=100,000) with raw Scopus publication data on Poland (N=1 million) made it possible to assign all full professors retrospectively to different productivity, promotion age, and promotion speed classes. Hiring both low-productivity and high-productivity scientists may have long-standing consequences for institutions and the national science system.

Full paper

Introduction

This study explores persistence in research productivity at the individual level over time. We examine the trajectories of the academic careers of 2,326 current full professors, including their lifetime biographical histories and their lifetime publication histories. We studied the dates of their academic promotions and their publication output between promotions over a 40-year period across 14 science, technology, engineering, mathematics, and medicine (STEMM) disciplines. Our focus is not on productivity per se but on transitions between productivity classes throughout the professors' academic careers, from the assistant professor stage to the full professor stage.

Data ane methods

We used a combination of administrative, biographical, and bibliometric data. It was not possible to perform lifetime retrospective analyses of individual scientists without having full access to raw bibliometric metadata for all publications by all individual scientists in the past 40 years. It was not possible to construct retrospective productivity classes for all scientists by discipline, career stage, and selected period without having access to each scientist's global publication metadata.

Hypotheses

Our six hypotheses pertain to: persistence of high productivity (H1) and low productivity (H2) over time; and persistence of high productivity at the beginning and towards the end of academic careers (H4); as well as disciplinary differentiation (H3) and gender differentiation (H5) in mobility between productivity classes, and individual vs. organizational features (H6) in logistic regression analysis estimating odds ratio of belonging to top and bottom productivity classes. An overaching research question is about changes in productivity from a life-cycle perspective: have current top performing full professors always been top performing while current low performing full professors – always low performing?

Results

In this study, we applied the notion of climbing the academic ladder, which defines an academic career that spans several decades.

Current full professors have previously been first assistant professors and then associate professors. They remained for a specific number of years at each stage of their academic careers. In each stage, they demonstrated specific productivity—that is, a certain number of publications in a four-year reference period. We assigned seven academic career classes to each full professor (Figure 1).

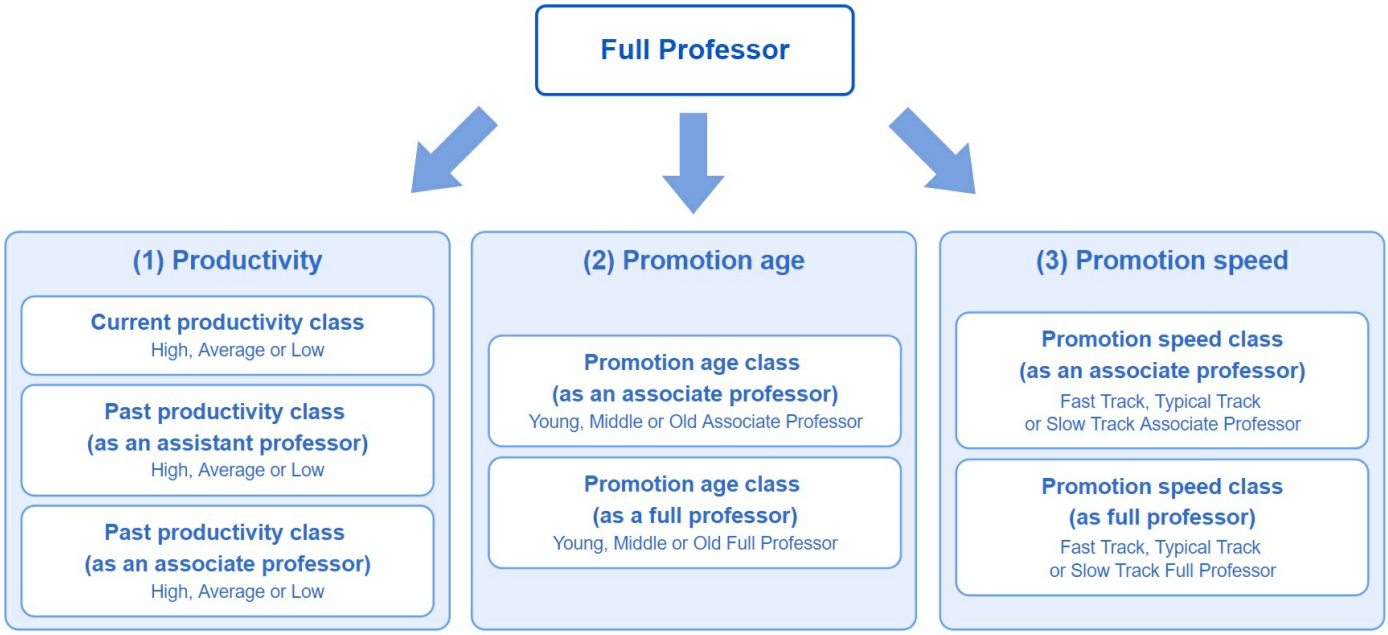

Figure 1. Classification scheme used for full professors: productivity, promotion age, and promotion speed classes.

The majority of highly productive scientists (Top) remained highly productive compared with their peers in the same discipline and within the same academic position, which is shown in thick left-to-right horizontal flows (Figure 2). More than half of the highly productive scientists moved from the top class to the top class in the first (52.6%) and second stages of their academic careers (50.8%). Patterns are similar across STEMM fields (Figure 3).

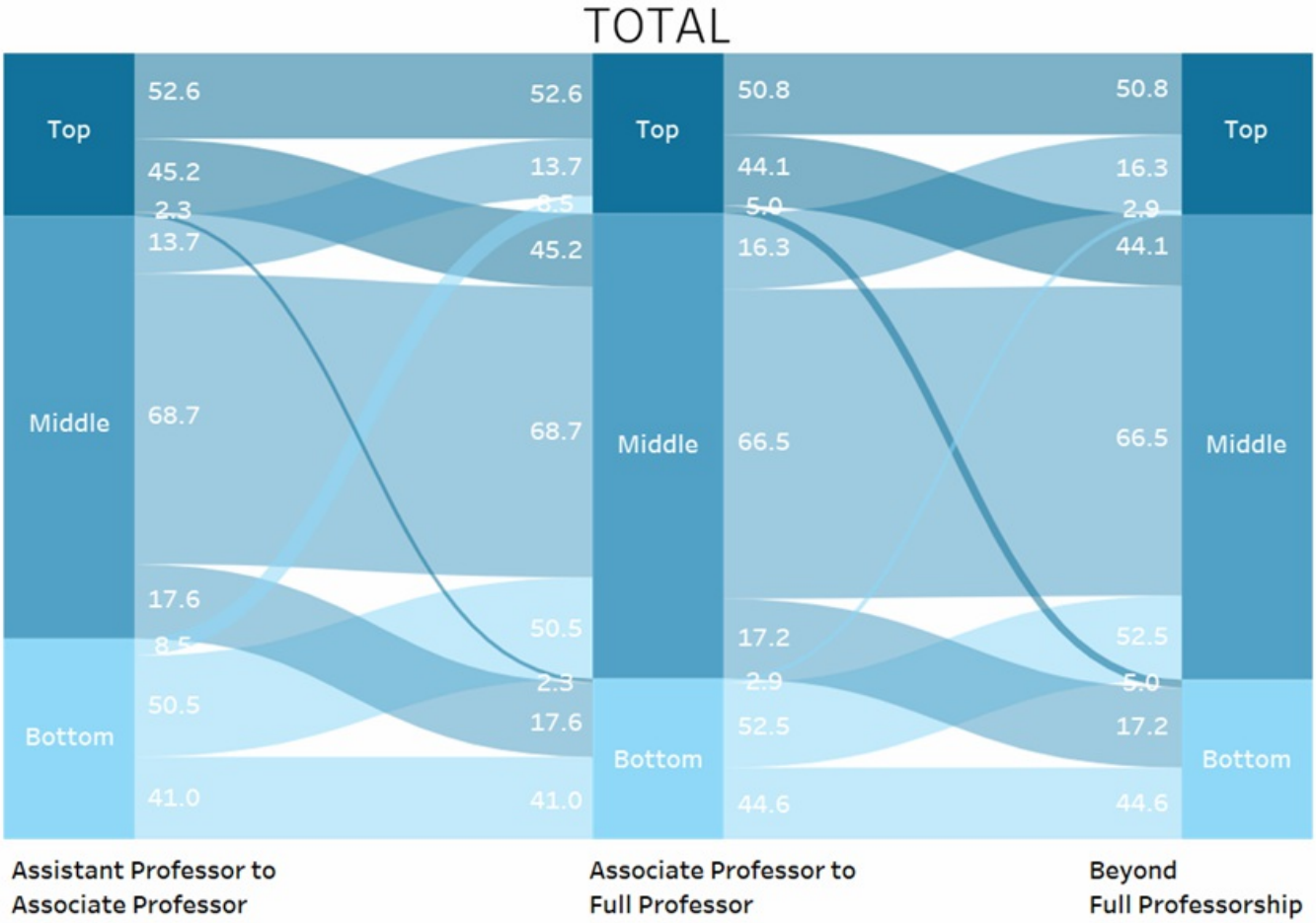

Figure 2. Sankey diagram of retrospectively constructed mobility between productivity classes in the three stages of an academic career. All STEMM disciplines (TOTAL) are combined, and only current full professors are shown. Top (upper 20%), middle (middle 60%), and bottom (lower 20%) productivity classes are shown in percentages of 100% (or rounded) in each of the three classes. The bottom class in the left column is larger than 20%, and the middle class is smaller than 60%; the cutting-off points did not permit a different division into classes. N = 2,326

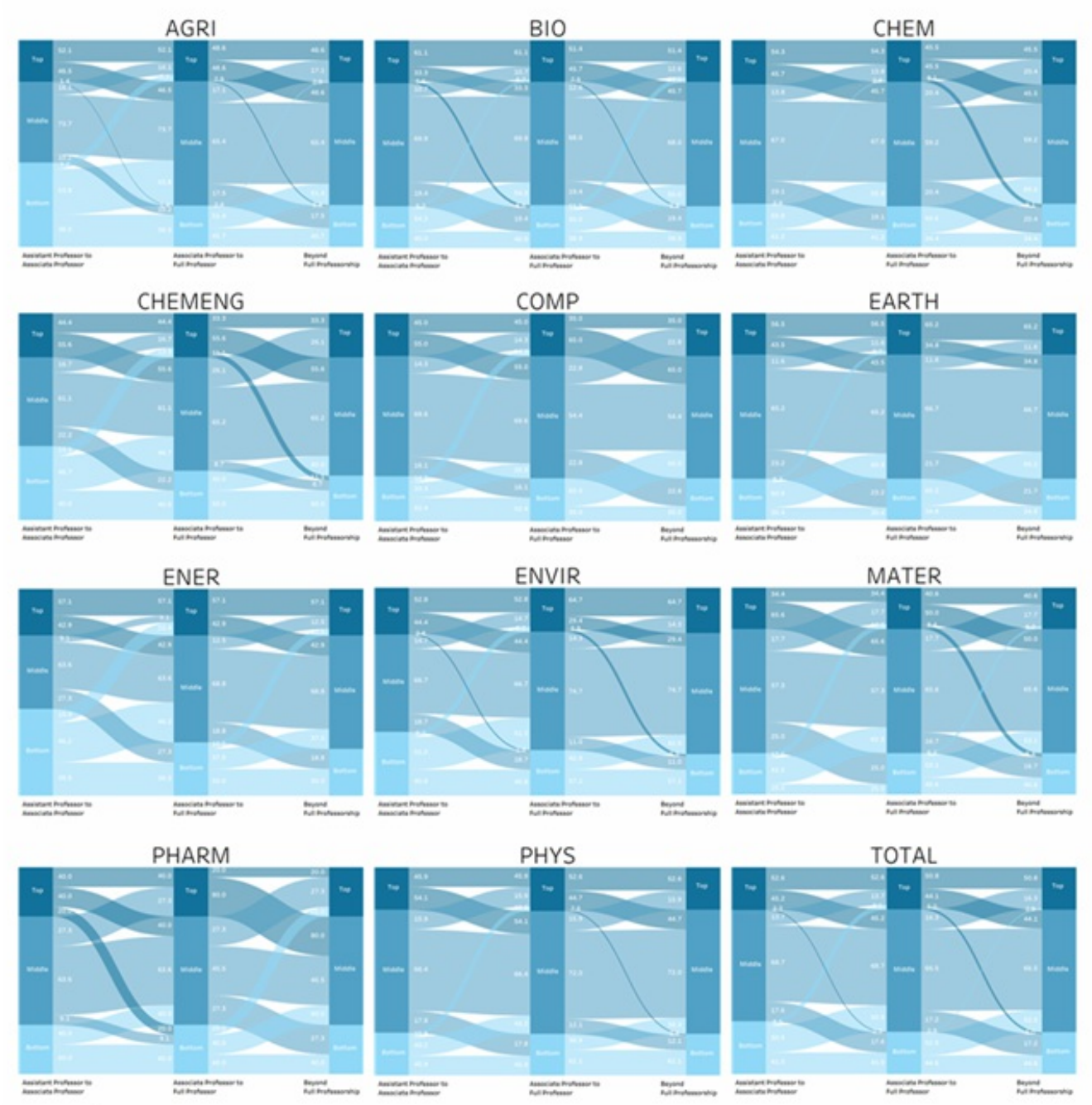

Figure 3 Overview: Sankey diagrams of retrospectively constructed mobility between productivity classes in the three stages of academic careers. Eleven STEMM disciplines and all disciplines combined (TOTAL), current full professors only.

Logistic regression analysis

We also examined odds ratio estimates of belonging to top and bottom productivity classes for current full professors and, retrospectively, for them at earlier stages of their academic careers to belong to these two classes. The results of our logistic regression models supported previous findings that professors appointed early tended to be more productive than professors appointed later in

their careers (Abramo et al. 2016). Membership in the class of young full professors increased the odds of belonging to the class of highly productive scientists by an average of 94.2%. Interestingly, in the Polish context, neither gender nor age (biological or academic) emerged as a predictor of membership in the class of highly productive full professors.

Conclusions

The results of this study supported all six hypotheses. They also supported the “sacred spark” theory of productivity (Cole & Cole 1973; Stephan & Levin 1992). Some scientists are superb at doing science from the moment they enter the academic workforce to their late career stages. About half of the highly productive full professors had always been highly productive, regardless of the trajectories of their personal lives or their external circumstances (e.g., the post-communist transition period in the Polish economy, which severely affected the academic sector). Highly productive full professors in their 60s were also highly productive when they were assistant and associate professors in their 30s, 40s, and 50s.

The patterns of mobility between productivity classes over the course of an entire academic career may have far-reaching implications for hiring and promotion. Hiring and tenure to both low-productivity and high-productivity scientists may have long-standing consequences for institutions and the national system. After entering the system and achieving job stability, scientists in Poland (where attrition is very low) and elsewhere usually remain in the system for years, if not decades.

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