AI Widens the Gap: How Career Stage Shapes the Benefits of AI Adoption in Science

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Abstract. Does AI democratize science or amplify existing hierarchies? Using OpenAlex data covering approximately 40 million natural-science papers (1980–2025), we find that AI adoption generates strongly heterogeneous productivity gains across career stages. Among non-AI authors, Junior PIs gradually converged toward Senior PI productivity levels after 2000, reaching near-parity around 2017. AI adoption disrupts this convergence: the productivity premium over non-AI baselines reaches +1.4 papers per year for Senior PIs but only +0.8 for Junior PIs and nearly zero for Pre-PIs. These findings suggest that AI reinforces the Matthew effect in scientific output, calling for targeted support for junior researchers.

Keywords: AI adoption · scientific productivity · career stages · Matthew effect · science of science

1 Introduction

Scientific careers are increasingly polarized, with senior scientists dominating resources while junior researchers remain temporary contributors [1, 2]. Meanwhile, [3] show that AI expands individual impact while narrowing science's collective focus—yet whether these gains are equally distributed across career stages remains unknown. This paper addresses that gap: does AI adoption widen or narrow the productivity gap between senior and junior researchers?

2 Methodology

We use OpenAlex, covering ∼40 million natural-science papers (1980–2025), filtered to journal articles with valid ISSNs and non-empty English abstracts. **AI classification** follows the two-stage BERT classifier of [3] (AIProb ≥ 0.5). **Career stages** are defined by last-authorship history: Pre-PIs (<3 last-author papers), Junior PIs (<6 years of sustained last-authorship), and Senior PIs (≥6

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years). An author is an *AI adopter* in year t if they published $\geq$1 AI paper that year. The outcome of interest is *productivity*, measured as mean last-authored papers per author per year, computed at the author-year level to ensure a consistent denominator across groups.

3 Results

Fig. 1 reveals two dynamics. Among non-AI authors, Junior PI productivity gradually converged toward Senior PI levels after 2000, reaching near-parity around 2017; Pre-PI productivity remained low throughout. Among AI adopters, the premium over each group's non-AI baseline is strongly heterogeneous: Senior PIs gain $\sim$1.4 extra papers per year by 2025, Junior PIs gain $\sim$0.8, and Pre-PIs virtually nothing ($\sim$0.1). While non-AI Junior PIs naturally caught up to Senior PIs, AI adoption introduces a new stratification: Senior PI adopters pull further ahead through the AI channel.

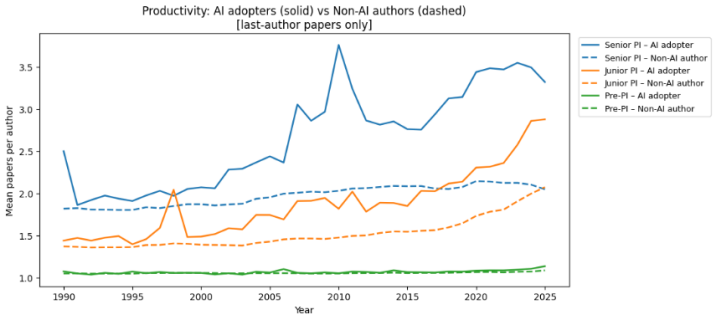

Fig. 1. Productivity by career stage, 1990–2025.

4 Conclusion

AI adoption reinforces the Matthew effect in science [4], amplifying rather than equalizing the productivity gap across career stages. Senior PIs capture disproportionate gains while Pre-PIs see virtually none, likely due to disparities in team resources and domain expertise. Equitable AI integration will require targeted interventions for junior researchers. Future work will extend this to country-level stratification and regression-based causal identification.

Disclosure of Interests. The authors have no competing interests to declare.

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