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## A literature review on the peer effects of faculty's research productivity

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### Abstract

Peer effects significantly enhance research and innovation capabilities by promoting knowledge sharing, collaborative competition, and learning partnerships among university faculty, emerging as a key mechanism driving academic progress. This paper reviews studies on the peer effects of university faculty's research productivity, elaborates on the concepts of peer effects and research productivity. It analyzes the impacts of peer quality, age, gender, as well as research collaboration and competition at the individual level, and explores the roles of institutional type, size, geographical location, reputation, and cultural atmosphere at the institutional level. Furthermore, it points out the gaps in current research regarding heterogeneity and non-Western contexts. Future research should construct a multi-level analytical framework, explore differentiated impact paths based on the characteristics of Chinese universities, and provide references for improving research innovation levels and optimizing the faculty development ecosystem.

**Keywords:** Research Productivity; Peer Effects; Faculty; Co-authorship

### 1. Introduction

The efficiency and effectiveness of higher education institutions (HEIs) have become central research topics within the field of the economics of education. Sound teaching and robust academic output are often two prevalent metrics for measuring effectiveness. Among these, the contribution of academic research to societal economic growth and development is widely acknowledged[1]. As critical hubs for national scientific innovation, a primary method for HEIs to assess the effectiveness of academic output is by examining faculty research productivity[2]. The quantity and quality of faculty research directly impact departmental and institutional reputation, and are closely linked to individual faculty prestige and advancement within academic reward systems. This is particularly salient against the backdrop of the deepening new wave of technological revolution and industrial transformation, alongside a burgeoning academic labor market. Excellence in research not only enables institutions to gain a competitive edge but also significantly propels economic growth and innovation cycles.

Beyond the individual faculty level, governments and relevant institutions across nations face mounting pressure to enhance research performance amid stringent budgetary constraints. Academic activities spanning multiple disciplines and levels, encompassing both domestic and international spheres, have witnessed not only intensified scientific collaboration and publication output among individuals and organizations, but also significantly heightened competition and uncertainty. Against this backdrop, the need to facilitate and better understand the processes and structures of academic research has become a shared priority for governments and HEI administrators. How to increase output in research and how researchers can access research support from their host institutions are particularly critical concerns.

Peer effects significantly enhance research innovation capacity by facilitating knowledge sharing, collaborative competition, and learning partnerships. This constitutes a critical mechanism driving academic progress[3,4]. The

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clustering of highly productive scholars within a specific university may generate positive spillover effects on the research output of its academic staff [5]. Within the HEI context, peer effects are increasingly vital in mitigating challenges such as teaching-research conflicts and excessive research pressure among faculty. Empirical evidence indicates that peer learning reduces “silo effects” through knowledge complementarity. Such positive interactions not only bolster collective resilience but also provide social support that serves as a crucial moderating factor against research pressure, thereby fostering breakthroughs in research innovation[6]. Nevertheless, potential negative implications of peer effects warrant vigilance. Competition for scarce social capital may intensify academic rivalry[7], particularly under the pressure of “up-or-out” tenure systems where such dynamics risk degenerating into zero-sum competition.

Existing scholarship on faculty research productivity has predominantly focused on individual characteristics, institutional environments, or resource support, extending analysis from the individual to the organizational level. However, investigations into mutual learning and influence among researchers remain insufficiently explored. Further research is warranted to inform policymakers’ decisions in consolidating and promoting research engagement at these levels.

Notably, China’s national strategy has explicitly integrated research collaboration as a core component of higher education reform. In 2020, the Ministry of Education’s Guidelines on Strengthening the Reform of Faculty Development in Higher Education Institutions for the New Era articulated the objective to “develop high-level innovative teams to provide faculty support for enhancing research innovation capacity.” This policy orientation deeply aligns with the ongoing transformation toward an organized research paradigm. New quality productive forces, catalyzed by technological revolution and industrial upgrading, demand that faculty transcend traditional “lone scholar” models and transition toward team-based, socially embedded collaboration[8]. Research indicates that high-level team integration can elevate research productivity by over 30%, manifested through significant increases in high-impact publications, patent output, and talent development efficiency[9]. Furthermore, the institutional affiliation network—where peer influence patterns are assessed through faculty’s host institutions—remains critically understudied. Faculty professional ties constitute vital channels for research practice, with academic staff becoming professionally interconnected through shared membership in academic departments, dissertation committees, research teams, and similar entities[10]. Among these, host institutions exhibit shorter physical proximity and stronger affiliation bonds than other organizations. Notably, China’s Double First-Class universities implement vertically decentralized governance models, positioning schools/departments as core sites for research productivity. However, existing literature seldom engages with China’s distinctive institutional governance structures, inadequately addressing how enhanced school-level autonomy affects team knowledge spillover efficiency or how university-school structures shape faculty collaboration. These constitute crucial research directions for advancing faculty research productivity.

This study systematically synthesizes existing research on faculty’s peer effects. It reviews scholarship on peer effects in faculty research production at both individual and institutional levels, delineating the core issues, principal findings, and evolutionary trends within this domain to establish a comprehensive cognitive framework. Building upon this foundation, the research further identifies gaps in the literature and outlines future research directions. The ultimate aim is to deeply investigate the driving mechanisms and pathways of peer effects in research production through the lenses of resource allocation, academic atmosphere, organizational support, and peer relationships. Thereby, it seeks to establish a research foundation for enhancing faculty research innovation capacity and refining faculty development ecosystems.

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## 2. Conceptual Definition

### 2.1. Peer effects

Within HEI research environments, peer effects manifest as direct or indirect influences on faculty research productivity driven by colleagues’ research behaviors, competency structures, or organizational culture[11]. Positive peer support factors, such as collaborative group climates and communication networks, exert favorable impacts on research productivity[5]. Through collaboration, faculty integrate diverse knowledge and skills, broaden research perspectives, and enhance the quality and efficiency of research. This is particularly critical for interdisciplinary projects requiring participation from faculty across distinct disciplinary backgrounds, where collaboration facilitates knowledge integration and innovation[12].

Over the past two decades, measurement models for peer effects have evolved from homogeneity-based to heterogeneity-based approaches. Regardless of the model adopted, limitations in identifying peer effects must be addressed. The selection problem and the reflection problem constitute core challenges. Several studies have effectively

mitigated these issues through random group assignment and using pre-treatment characteristics to measure peer ability. Methods such as randomized assignment and quasi-natural experiments can alleviate these concerns, while comparative analyses of similar contexts under standardized frameworks retain significant reference value.

**2.2. Research productivity**

Research productivity refers to the scholarly output generated by academics. Overall, its measurement centers on two primary questions: First, how should research productivity be measured? The two most significant indicators are publication output and citation rates. Publication output quantifies the volume of scientific production. As a proxy for impact, bibliometricians employ citations per publication to gauge knowledge dissemination and spillover effects. Additionally, to measure research productivity more accurately, considerations must include author position/contribution weighting[13]and disciplinary differences in publication norms.

Second, what factors correlate with faculty research productivity? Faculty research productivity exhibits significant variation and correlates with numerous factors, collectively influenced by individual characteristics, workload allocations, research style differences, and institutional attributes[14,15]. At the individual level, multiple studies identify key predictors of research output, including: personal traits[16], gender, educational background, early publication records, academic rank[17], publication productivity during early career stages, self-efficacy[18], dedicated research time[19], connections with colleagues conducting similar research internally and externally[3]. At the institutional level, institution type, size, collaborative group climates, and frequent peer communication significantly impact individual faculty research productivity[20,21,22,23].

In synthesis, research productivity is shaped by multifaceted factors, broadly categorizable into two dimensions: external and internal. This study has identified 32 factors highly correlated with research productivity (16 internal and 16 external factors).

**Table 1** Factors highly correlated with research productivity

Category	Dimension	Specific Variables	Category	Dimension	Specific Variables
Internal Variables	Demographic Variables	1. Gender	External Variables	Organizational-level Characteristics	1. Institution type
		2. Age			2. Department size
		3. Position			3. Positive group atmosphere
		4. Professional title			4. Colleagues and working environment
		5. Marital status			5. Institutional expectations regarding research
		6. Number of children			6. Frequent communication
	Personal Traits	1. Personal ability			7. Leadership traits
		2. Personal confidence			8. Departmental culture that supports research
		3. Creative thinking		System-level Resources	1. University research funding
		4. Motivation			2. Availability of equipment and technical facilities
		5. Pursuit			3. Number of books and periodicals in the university library
		6. Research interest and time investment			4. Provision of sufficient research freedom
		7. Work habits			5. Accessibility of colleague communication platforms
		8. Previous publishing activities			6. Provision of adequate and fair salaries

		9. Academic quality during doctoral studies			7. Provision of fair promotion and other reward opportunities
		10. Time required to complete the degree			8. Appropriate workload strategies

### 3. Literature Review on Peer Effects at the Individual Level

#### 3.1. Peer Quality and Matching

While some studies demonstrate positive impacts of peer interactions on academic output efficiency and research quality enhancement, others report non-significant associations. Earlier evidence indicated substantial correlations between peer quality and productivity[24], suggesting that higher-quality peers generate greater knowledge spillovers through creative exchange, feedback, and formal/informal collaboration[25].

However, other investigations yield ambiguous findings regarding university-level peer effects. Kim's sampling of economists revealed diminishing causal effects of location-specific factors over recent decades[26]. In a comprehensive bibliometric analysis of mathematicians, Dubois et al. concluded that local interaction effects are insignificant [27]. Such divergence likely relates to peer quality heterogeneity. Waldinger leveraged the expulsion of Jewish scholars under the Nazi regime as exogenous variation in faculty productivity, confirming knowledge externalities in doctoral supervision[28]. Yet in a follow-up study using the same exogenous shock, Waldinger detected no peer effects among senior faculty, reflecting their reliance on established professional networks[29].

These disparities are largely attributable to variations in peer characteristics such as gender, age, and academic rank. For instance, Bosquet et al. (2022) investigated peer effects in academic research, specifically examining sender-recipient dynamics of knowledge spillovers, where senders generate spillovers and recipients benefit from them. Leveraging France's national academic competition as a natural experiment, the authors found that peer effects depend critically on research field alignment[30].

Matching theory suggests that if knowledge spillovers are geographically bounded, improved researcher-institution alignment enhances spillover potential[31]. Complementarily, Borjas et al. (2015) analyzed post-Soviet mathematician emigration, revealing that departmental peer outflows had no consistent productivity impact, whereas the emigration of top-5% quality collaborators caused an 8% annual publication decline per 10% outflow[32]. Further reinforcing domain proximity as critical, Azoulay et al. (2010) found superstar mortality most severely affected coauthor productivity when collaborators worked in closely related fields. [33].

Collectively, these findings indicate that peer effects and researcher-peer matching quality constitute critical moderators of knowledge spillover efficacy, a crucial yet underexplored nexus deserving deeper scholarly attention.

#### 3.2. Faculty Age and Peer Effects

Age remains a focal variable in sociological studies of scientific output. According to the age-achievement curve, scientists' major contributions most frequently occur between their late 30s and early 40s, declining thereafter. This peak manifests earlier in theoretical disciplines and later in empirically driven fields[34]. In their seminal study on age and research productivity, Levin and Stephan (1991) identified persistent lifecycle effects within a comprehensive research output model. Analysis of 903 natural scientists demonstrated that productivity significantly declines with advancing age. Critically, this inverse relationship was attributable to the aging process itself rather than differential access to resources between senior and junior scientists within the cohort[35]. Recent decades' aging of Western research populations has reignited interest in age-productivity relationships. While the cumulative advantage hypothesis posits that age signifies sustained/enhanced career success, cognitive capacities may lag behind rapidly evolving knowledge. Abramo et al. (2016) statistically analyzed 2006-2010 research outputs of 11,989 Italian full professors across 11 disciplines (e.g., medicine, biology, civil engineering), finding an overall monotonic negative correlation between age and research productivity. This relationship proved stronger in disciplines like theoretical physics but attenuated in fields reliant on team collaboration[36].

Beyond age, research productivity differentials are explicable through academic rank or tenure status. Collaborative experiences differ substantially between senior faculty and junior faculty, postdoctoral researchers, or graduate students. Partnerships productive for experienced junior researchers may prove inefficient for mentors. However, significant learning effects may enhance collaboration efficiency for senior scholars. They possess not only accumulated

knowledge and scientific-technological human capital (STHC) but also greater experience in collaborative processes, yielding higher marginal returns on collaboration.

### 3.3. Faculty Gender and Peer Effects

Gender-mediated peer effects in research productivity warrant critical examination. Among the most consistent findings in research productivity literature is that women tend to exhibit slightly lower publication rates than men [37,38]. This gender disparity in research productivity may stem from three interconnected factors: first, women generally engage in fewer collaborative partnerships and maintain less extensive collaborative networks; second, gender discrimination systematically constrains resource access, thereby limiting publication capacity; third, compared to male counterparts, women demonstrate lower likelihood of having full-time domestic partners while bearing greater primary childcare responsibilities. Furthermore, marital status significantly interacts with gender in productivity outcomes, with married males demonstrating peak productivity and unmarried females the lowest observed output levels.

Contrary to prevailing perceptions of lower female output, Powell et al. (2009) found female-authored publications receive higher citation rates. Their analysis of 464 articles in 20 leading architecture journals (2003) revealed that 71% of female-authored works were cited versus 63% of male-authored works. Borrego et al. (2010) corroborated this pattern through bibliometric analysis of 731 doctoral dissertations [4]. Conversely, other studies report negligible gender disparities in publication impact. Stack's (2002) multivariate regression of 2,125 articles in four premier criminal justice journals (1964-1996) found comparable citation rates across genders [39]. Slyder et al. (2011) further supported this finding through gender comparison of citation rates for 213 highly cited publications by tenured forestry and geography faculty at 10 US universities, demonstrating gender parity in citation performance [40].

To elucidate gender disparities in research productivity, numerous studies have focused on family-related variables, including marital status, number of dependent children, and spousal academic affiliation. However, empirical evidence regarding the impact of familial factors remains divergent. Beyond childcare responsibilities, an increasingly critical yet understudied dimension involves eldercare obligations toward aging parents or relatives [41]. Collectively, this equivocal evidence underscores the imperative for more nuanced investigations into how gender and family-related variables modulate peer effects within research productivity dynamics.

### 3.4. Research Collaboration and Competition

Knowledge spillovers manifest significantly through collaboration, enhancing both the quantity and quality of research outputs. Collaboration constitutes a pivotal mechanism for elevating individual scientists' efficiency and represents the standard practice for mentoring graduate students and postdoctoral researchers [42]. Crucially, tacit knowledge and technical expertise are disseminated most effectively through collaborative engagement [43]. By leveraging complementary strengths and accessing others' specialized skills, research teams generate synergistic effects that exceed the sum of individual contributions.

Since the 20th century, scientific collaboration has expanded dramatically: single-author publications no longer predominate, with team science becoming the normative paradigm. In JSTOR-indexed articles, coauthored works rose from ~6% in 1900 to >60% by 2011; among Web of Science-indexed publications, this proportion reached 75% [44]. Concurrently, team sizes increased from an average of 1.9 authors per paper (1955) to 3.5 authors (2000) [45]. Enhanced societal mobility and information technologies now facilitate extensive transcendent collaboration—spanning institutional, regional, and international boundaries [46]. Globally, publications involving three or more institutions surged from one-third to one-half between 1981 and 1995, underscoring this transformative shift [47].

Empirical studies confirm that collaboration enhances research output. Interviews with 41 Nobel laureates in science revealed they produce more publications and exhibit stronger collaborative inclinations than control-group scientists [48]. A seminal 2014 analysis of economist coauthorship (1970-2011) demonstrated collaboration boosts individual productivity, though effects diverge substantially between high- and low-productivity researchers [49]. Productivity is modulated by partner quality: collaborating with high-productivity scientists typically elevates individual output, whereas partnerships with low-productivity peers often diminish it [50]. While collaboration's impact varies across disciplines, collectively authored publications generally demonstrate superior quality, yielding higher publication and citation rates [51,52]. International collaborations particularly enhance impact, with coauthored papers appearing in higher-impact journals and accruing more citations [53].

However, collaboration may conversely reduce research productivity due to transaction costs inherent in cooperative endeavors. Significant resources are consumed through communication maintenance, social accommodation, delayed

feedback, and coordination of contributions[54]. Additional challenges include free-riding behaviors and author contribution misattribution, wherein conventional authorship sequences inadequately reflect actual input disparities. While collaboration elevates some researchers' productivity, it may drain established scholars' efficiency [55]. Critically, collaboration exacerbates inequality: elite-university scientists disproportionately partner with peers at prestigious institutions, concentrating knowledge production and dissemination within exclusive networks while amplifying institutional advantage through multi-university publications[35].

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## 4. Literature Review on Peer Effects at the Institutional Level

### 4.1. Institutional Typology, Peer Effects, and Research Productivity

Research institutions can be categorized into public and private entities based on governance structures and funding sources. Jordan et al. (1988, 1989) examined organizational influence and institutional type on departmental research productivity, finding robust evidence that private institutions correlate with higher academic productivity, particularly as department size decreases[21,22]. However, Golden and Carstensen's (1992) reanalysis of the same dataset revealed that departmental research output increases with size when controlling for research support and departmental reputation ratings. Consistent with Jordan et al.'s findings regarding institutional type, public universities demonstrate lower research output due to balanced commitments to teaching and public service alongside research[25].

Institutions further bifurcate into research-intensive (encompassing public and private research universities, mission-focused on graduate education and scholarly output) and teaching-focused institutions (prioritizing undergraduate instruction or applied education). Ju's analysis of Changing Academic Profession (CAP) survey data identified significant differentials in faculty research productivity determinants. While collaboration with domestic and international colleagues consistently enhances productivity across institutional types, critical differentials emerge: in research-intensive institutions, faculty research orientation significantly boosts productivity within mature research ecosystems, with administrative and environmental factors exerting minimal influence; conversely, teaching-focused institutions exhibit stronger productivity returns from international collaboration and domestic coauthorship, though administrative support attitudes paradoxically correlate negatively with output—likely indicating compensatory measures in research-weak environments where peer support proves more efficacious than institutional backing[56].

### 4.2. Institutional Scale, Peer Effects, and Research Productivity

Stephan (1996) systematically analyzed the operational mechanisms, resource allocation, and economic impacts of scientific research from an economic perspective. Notably, studies correlating firm size with survival probability suggest larger organizations possess higher viability—an analogy providing referential insights for scientific contexts. Just as scale influences corporate survival, the magnitude of researchers' resources and collaborative teams may potentially impact research trajectories and career development[57].

However, no definitive correlation between scale and research productivity emerges at team, departmental, or institutional levels [58]. At the team scale, literature robustly indicates individual researchers' output is primarily driven by core collaborative units (typically <8 members) rather than departmental or institutional dimensions[59]. Across scientific disciplines, productivity generally increases with team size up to optimal thresholds of ~6-8 members, beyond which marginal productivity gains diminish. Thresholds vary disciplinarily: applied fields like clinical medicine sustain larger configurations (~10 members), while theoretical disciplines like mathematics exhibit lower optima[60]. The proliferation of interdisciplinary research fundamentally reshapes this dynamic. Zhu et al. (2021) demonstrate that higher disciplinary diversity steepens the positive scale-productivity curve, whereas homogeneous teams follow inverted U-curve patterns, indicating multidisciplinary integration necessitates larger teams for effective resource synthesis[61].

These team-scale findings extend to departmental (meso-level) contexts, where optimal departmental size approximates multiples of ~8.5 full-time equivalents (FTEs), with peak productivity near these thresholds[62]. However, UK studies found no evidence of scale economies beyond the social sciences at departmental levels[63].

Similarly, institutional-scale analyses reveal no consistent relationship between university size and research output. Some studies indicate scale-neutral productivity with diminishing returns to labor/capital inputs, suggesting dynamic diseconomies of scale nationally[64]. Neither departments nor universities demonstrate conclusive efficiency advantages at larger scales; some evidence indicates inverse relationships[65]. Bonaccorsi and Daraio (2002) observed null or negative scale-performance correlations in chemistry, environmental science, and engineering[66]. Conversely, other research identifies superlinear scaling: university output doubling generates >2× citation impact[67]. Frenken et

al. (2017) quantified 1% size increases corresponding to 1.18% more highly cited publications, 1.09% more international collaborations, and 1.14% more industry partnerships[68]. Alternatively, scale may reconfigure rather than augment output—larger units correlate with higher international journal visibility and intensified scholarly exchange[69].

Collectively, no definitive scale-productivity relationship emerges across team, departmental, or institutional levels. The interplay between institutional scale and faculty research productivity in Chinese universities warrants targeted investigation.

#### **4.3. Institutional Geography, Peer Effects, and Research Productivity**

Geographical location significantly influences academic resource distribution and collaborative network formation. Geographical proximity facilitates knowledge dissemination and collaborative partnerships by enabling face-to-face interaction and informal cooperation, thereby enhancing knowledge sharing and innovation [70]. Provincial-level analyses confirm more pronounced peer effects in technological innovation outcomes among geographically adjacent regions with institutional homogeneity and shared regional clusters[71].

However, advancements in information/communication technologies and transportation infrastructure have progressively delocalized knowledge spillovers. Contemporary research increasingly recognizes the importance of aspatial proximities—social networks, institutional affiliations, and cognitive similarity—in shaping collaborative ecosystems. Social networks serve as critical conduits, facilitating both local and non-local partnerships while enabling multiscale knowledge collaboration. Illustratively, Borjas et al. (2015) found no consistent significant effects of geospatial factors on research production[32].

Consequently, the localization of knowledge spillovers remains contested[72]. While face-to-face interaction may build trust more efficiently and reduce communication costs among institutional colleagues, it potentially constrains spillovers within localized boundaries[73]. Empirical trends suggest diminishing geographical constraints[74,75]. Crucially, given China's pronounced regional educational disparities, particularly between central/western regions, further investigation is warranted to determine whether this global delocalization pattern holds within China's unique developmental context.

#### **4.4. Institutional Reputation, Peer Effects, and Research Productivity**

A robust positive correlation exists between institutional reputation and the volume/quality of high-impact journal publications[76]. Prestigious institutions disproportionately attract elite scholars and secure critical resources, thereby amplifying research productivity. Porter and Toutkoushian (2006) quantified this relationship: each one-point increase in reputation score corresponded to an 80% rise in publications per faculty member. Notably, reputation exerts a weaker influence on productivity in teaching-focused institutions. High-reputation universities not only possess superior capacity to recruit top faculty but also command greater research funding and infrastructure, generating self-reinforcing productivity cycles through these exogenous resource advantages[77].

Crucially, reputation-research output relationships entail endogeneity concerns—these variables form a reciprocal causal loop wherein reputation attracts productive scholars who subsequently enhance institutional standing. Methodologically rigorous studies address this through simultaneous equations modeling. Exogenous institutional characteristics (founding year, public/private status, resource endowments) serve as instrumental controls. This approach confirms differential reputation-productivity elasticities between research-intensive universities and liberal arts colleges after accounting for mutual dependencies.

#### **4.5. Cultural Environment, Peer Effects, and Research Productivity**

The cultural environment encompasses faculty workplace dynamics and intellectual stimulation derived from departmental colleagues, visiting scholars, and graduate students. Faculty productivity is significantly influenced by peer productivity as an external contextual factor. Studies confirm that vibrant, stimulating environments foster robust scholarly exchange, with positive research climates characterized by active team atmospheres and frequent colleague communication[78]. Departments hosting high-performance research groups typically exhibit foundational interaction qualities—shared research objectives and collective goal commitment—yielding positive productivity impacts[79]. Organizational environments affect performance through motivational pathways:

Heightened organizational commitment correlates with increased publication output[80].

Empirical evidence identifies organizational support as a significant predictor of knowledge creativity. Scholars have developed comprehensive faculty research productivity models. These models establish that individual traits' influence on research output is moderated by the organizational environment's capacity to facilitate scholarly activities, while leaders' traits and managerial approaches further condition organizational efficacy[80].

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## 5. Conclusion

Peer effects manifest as critical yet complex nonlinear mechanisms influencing research productivity at both individual and institutional levels, with significant empirical inconsistencies persisting across studies.

Peer quality impacts research productivity contingent on matching characteristics and contextual factors. While high-caliber peers enhance output through knowledge spillovers, this effect is moderated by gender, age, and academic rank: female and senior researchers derive weaker benefits from peer spillovers, whereas males exhibit stronger productivity gains from same-gender collaboration [30,32]. Crucially, peer effect efficacy depends on optimal matching—tacit knowledge transfer necessitates dense collaborative networks, and superstar mortality most severely impacts cognitively proximate collaborators [33], indicating that geographical and cognitive proximity jointly shape spillover intensity. Waldinger's finding that senior scholars remain unaffected by local peer quality further underscores career-stage and network-maturity moderations [28,29].

Peer effect realization is institutionally constrained across multiple dimensions: institutional type mediates outcomes, with private and research-intensive universities demonstrating superior efficiency through resource concentration [56], while public institutions' teaching/service obligations dilute research investment [23]; scale thresholds exhibit differential impacts, as team productivity peaks at 6-8 members [60] whereas departmental/institutional scale effects remain contested—showing either diseconomies of scale [58,66] or superlinear growth [68]; spatial dynamics reveal geographical proximity facilitates tacit knowledge transfer, though digitalization progressively weakens such constraints [32]. Notably, consensus emerges regarding reputational capital and supportive cultural environments as robust positive predictors of faculty productivity [77,78,80].

Substantial research lacunae persist, notably the absence of unified theoretical frameworks explaining heterogeneity drivers such as gender, age, and disciplinary variations in peer effects; concurrently, non-Western contexts—particularly China's Double First-Class universities- remain critically underexplored despite their distinctive resource allocation patterns, cultural incentives, and hierarchical structures that may differentially modulate peer effect dynamics.

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## 6. Future Directions

Future scholarship should establish multilevel, mechanism-informed analytical frameworks to systematically investigate differential pathways through which peer effects modulate higher education institution (HEI) faculty research productivity. At the individual level, research must dissect how gender, age, and academic background characteristics bifurcate peer effects through competitive or collaborative modalities. Institutionally, studies should examine how geographic positioning, institutional scale, and faculty composition regulate peer interaction intensity and cultural climates. Mechanistically, grounded theory approaches should uncover mediating pathways involving work-time allocation, work-family conflict, and perceived organizational support efficacy[81].

Critically, research must engage China's distinctive "danwei system" organizational logic to develop applications aligned with local research ecosystems. For individual incentives, recognizing collaborative innovations can shift research paradigms from "lone-scholar models" toward organized collaboration. Regarding organizational governance, optimizing team formation and resource allocation—leveraging age/disciplinary complementarities—can amplify collective synergy. At the strategic level, responding to national mandates for organized research, peer effects should address the "high-quantity, low-quality" predicament, thereby advancing scientific-technological self-reliance and regional coordination strategies. Ultimately, such integration will accelerate early-career faculty capability appreciation and elevate institutional research competitiveness, furnishing theoretical foundations and practical paradigms for Double First-Class advancement.

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