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Does government support for scientists improve research performance? A comparative synthesis of three Chinese programmes

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Article

Keywords: government support for scientists, research funding, science policy, scientific performance, research evaluation

Posted Date: November 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11401497/v1

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Additional Declarations: No competing interests reported.

Abstract

Does government support for scientists improve research performance? The answer may depend on which outcomes are examined and how support is organised. This study compares three Chinese government-supported programmes: the National Science Fund for Distinguished Young Scholars, the Pearl River Science and Technology Rising Star Program, and the Changjiang Scholars Distinguished Professorship Program. Drawing on three existing evaluations, it examines reported changes in publication output and citation-related indicators, while accounting for differences in research designs, samples, and outcome measures. The findings reveal distinct outcome profiles. For the National Science Fund for Distinguished Young Scholars, estimates are positive for publication output, highly cited papers, and field-weighted citation impact, while citations per paper decline. For the Pearl River programme, several indicators of scientific influence show negative estimates, whereas the estimated change in highly cited papers is not statistically significant. For the Changjiang Scholars programme, median annual publication output increases from 2.11 papers before appointment to 8.81 afterwards, while category-normalised citation impact remains statistically unchanged and other citation indicators decline significantly. These findings indicate that growth in publication output does not necessarily coincide with improvement across all dimensions of scientific influence. The study develops a comparative framework for understanding government support through three policy orientations: investigator-directed research support, early-career talent development, and recognition-linked academic appointments. It also identifies institutional translation, through which universities incorporate awards into evaluation and resource allocation, as a potential explanation requiring further investigation. The analysis highlights the importance of aligning programme evaluation with policy objectives and of using comparable longitudinal data to establish how different forms of support shape scientific performance.

1. Introduction

Public investment in science is often discussed in terms of how much governments spend and which research proposals deserve support. Yet funding decisions also reflect a more fundamental policy choice: what should public investment seek to strengthen—the execution of specific research projects, the development of individual scientists, or the professional standing of researchers whose achievements are expected to benefit the wider scientific community? These objectives frequently overlap in practice, but they place different demands on funding design and evaluation. Since the postwar expansion of public support for basic research, competitive project grants have become a central funding mechanism in many research systems (Bush, 1945). Peer review enables funding agencies to assess proposed research and establish expectations for the use of public resources. At the same time, funding conditions shape how scientists select research questions, organize their work, and respond to institutional incentives (Laudel, 2006; Stephan, 2012).

Research on funding systems shows that these arrangements can produce different outcomes depending on their design and the researchers they support. International comparisons have found no straightforward relationship between the competitiveness of research funding and publication

performance across national systems (Auranen & Nieminen, 2010). Research on funding schemes for unconventional and high-risk research has likewise shown that programs differ in their target populations, selection procedures, funding levels, and duration, with important implications for the kinds of scientific activity they can support (Heinze, 2008). At the level of individual researchers, Wang et al. (2018) found that the relationship between competitive project funding and research novelty varied with researchers' academic status. Azoulay et al. (2011), comparing investigators supported by the Howard Hughes Medical Institute with NIH-funded researchers, found that longer-term support, greater research freedom, and tolerance of early failure were associated with more high-impact publications and changes in research direction consistent with greater scientific exploration. Together, these studies suggest that the effects of public research support depend on the relationship between funding arrangements, researchers' circumstances, and the outcomes used to assess success.

Government support for scientists takes several forms. Competitive grants may be awarded to individual investigators while remaining tied to defined research proposals and accountability requirements. Early-career programmes may combine financial assistance with opportunities for professional development, whereas prestigious academic appointments may confer status, visibility, or access to institutional resources. These arrangements differ in their policy objectives and institutional implications, even when they target similar groups of researchers. Comparing them therefore requires attention to the form of support provided, the purpose it serves, and the outcomes used to evaluate it.

China provides a useful setting for such a comparison because its research system includes government-supported programs with different selection arrangements, career targets, and forms of recognition. This article examines three programs: the National Science Fund for Distinguished Young Scholars, the Pearl River Science and Technology Rising Star Program, and the Changjiang Scholars Distinguished Professorship Program. Each has been evaluated in previous research, although the studies differ in their research designs, samples, and outcome measures (Qiao & Yao, 2020; Qiao et al., 2022, 2025). Their reported findings present a varied picture. The evaluation of the National Science Fund for Distinguished Young Scholars reports improvements in publication output and selected research-quality indicators (Qiao et al., 2022). The study of the regional early-career talent program reports less favorable changes in several citation-related measures (Qiao et al., 2025). The study of Changjiang Scholars appointments identifies a marked increase in publication output alongside broadly stable normalized citation impact (Qiao & Yao, 2020). These differences provide a basis for asking how the objectives and institutional arrangements of government-supported programs relate to the outcomes reported in their respective evaluations.

This article addresses two questions. First, how do the three programs differ in their policy objectives, institutional arrangements, and intended beneficiaries? Second, what patterns emerge from a structured comparison of their reported research outcomes, and what implications do these patterns hold for the evaluation and governance of government support for scientists? To address these questions, the article synthesizes three published evaluations within a common comparative framework. The analysis examines the formal design of each program, the career or institutional context in which it operates, and

the dimensions of scientific performance reported in the original studies. It also uses four analytical concepts—resource access, scientific autonomy, reputation, and research networks—to organize possible explanations for the observed differences. These concepts guide the interpretation of the evidence; the available studies do not directly measure all four mechanisms in a common empirical design, and their estimates are therefore considered in the context of each study rather than treated as directly comparable treatment effects.

The article contributes to research on science policy in three ways. It first brings three Chinese government-supported programs into a common comparative account, distinguishing their institutional arrangements and policy purposes without assuming that their boundaries are mutually exclusive. It then identifies similarities and differences in the outcomes reported by the existing evaluations, making clear which dimensions of performance are supported by the available evidence and where the findings remain difficult to compare. Finally, it draws policy implications concerning the alignment between program objectives and evaluation arrangements. The comparison offers a focused account of how different forms of government support operate within China's research system, while identifying questions that future research can examine through direct measurement of researchers' behavior, longer-term career trajectories, and interactions among funding programs.

2. A Framework for Comparing Government Support for Scientists

2.1 Research Funding as a Set of Distinct but Overlapping Arrangements

Governments support scientific research through multiple funding arrangements, including competitive project grants, institutional block funding, research contracts, fellowships, career-development programs, and awards linked to academic appointments. These arrangements differ in how resources are allocated, what recipients are expected to deliver, and how scientific performance is assessed. Comparative research on university funding has documented substantial variation in the balance between competitive and institutional allocation, as well as differences in the consequences of research evaluation and performance-based funding (Auranen & Nieminen, 2010; Geuna & Martin, 2003). Studies of research funding at the individual level have also shown that the effects of funding depend on the form of support and the characteristics of its recipients (Beaudry & Allaoui, 2012; Wang et al., 2018). This body of research provides a foundation for examining government support for scientists as a set of related policy arrangements rather than as a single funding model.

The distinction between project-based funding and support directed toward individual researchers is useful, but the two frequently overlap. Competitive grants may be awarded to individual investigators while requiring detailed proposals, specified research objectives, and formal accountability. Conversely, institutional funding can provide scientists with resources that support their longer-term research activities. In practice, the allocation unit, the formal funding instrument, and the government's policy objective represent separate dimensions of research support. For example, a competitive award may

target an individual scientist while remaining closely tied to a defined research agenda. A career-development program may combine research funding with an academic appointment, while a prestigious appointment may confer recognition and access to institutional resources. Treating these arrangements as mutually exclusive categories would obscure important differences in their institutional design (Heinze, 2008; Laudel, 2006; Stephan, 2012).

This study uses *government support for scientists* as an analytical umbrella for comparing programs intended to strengthen researchers' scientific work, career development, or academic standing. The term covers funding arrangements and recognition-linked appointments, while preserving the distinction between direct financial support and symbolic or positional benefits. The comparison focuses on five dimensions: the intended recipient, the stated policy objective, the form of resources provided, the time horizon and degree of discretion associated with support, and the requirements governing evaluation and accountability. These dimensions make it possible to compare programs that share a broad commitment to supporting researchers but differ in how they are designed and implemented.

2.2 Three Policy Orientations in the Chinese Cases

The three programs examined in this study illustrate different policy orientations within China's system of government support for scientists. They are treated as analytically distinct cases rather than as mutually exclusive categories of funding. Their classification reflects their primary policy emphasis and the institutional arrangements examined in the underlying evaluations. The categories therefore provide a common basis for comparison, while allowing individual programs to combine several forms of support.

2.2.1 Scientist-directed competitive research support

The National Science Fund for Distinguished Young Scholars represents a form of competitive research support directed toward individual scientists. The program selects researchers through a competitive process and provides financial resources intended to strengthen their research capacity. Its institutional design combines investment in the investigator with evaluation of the proposed research, making it a useful case for examining how individual-oriented support operates within a project-based funding system.

Research on competitive funding offers several perspectives for interpreting this arrangement. Jacob and Lefgren (2011), for example, found that receiving a National Institutes of Health research grant increased subsequent publication output, although the estimated effect was modest relative to the scale of the grant. Wang et al. (2018) found that competitive project funding was associated with greater research novelty on average in their Japanese sample, but that this relationship varied by researchers' academic status. These findings indicate that the consequences of competitive funding depend on the recipients and the context in which funding is allocated. For the Chinese case, the key analytical questions concern the program's resource contribution, the scope it provides for investigators to pursue

research agendas, and the dimensions of scientific performance reported in the original evaluation (Qiao et al., 2022).

2.2.2 Early-career talent support

The Pearl River Science and Technology Rising Star Program represents a regional initiative directed toward early-career researchers. Its inclusion extends the comparison from competitive support for distinguished investigators to a program intended to support researchers at an earlier career stage. The relevant policy question concerns how the program's resource arrangements, eligibility requirements, support period, and institutional context relate to researchers' subsequent scientific development.

Career-development support can involve several components, including research funding, access to institutional resources, opportunities to establish an independent research agenda, and connections with collaborators. The relative importance of these components depends on the design of the specific program. Research on the adaptation of scientists to funding conditions shows that funding arrangements can shape research strategies and the content of scientific work (Laudel, 2006). Evidence from Sweden also indicates that successful applicants to a prestigious research grant subsequently outperformed rejected applicants on several measures, including publication activity, international co-authorship, further funding, and spin-off formation (Melin & Danell, 2006). These findings offer relevant context for examining career-development programs, while leaving the specific mechanisms and outcomes of the Pearl River program to be assessed on the basis of its own institutional features and empirical evaluation (Qiao et al., 2025).

2.2.3 Recognition-linked academic appointments

The Changjiang Scholars Distinguished Professorship Program provides a third case, centered on a prestigious academic appointment and the recognition associated with it. The appointment provides a basis for examining how formal academic status relates to subsequent scientific performance. Its institutional features require particular care in interpretation because recognition, employment arrangements, financial support, and access to university resources may be connected without constituting the same policy instrument.

Merton's (1968) account of the Matthew effect offers a useful perspective on the relationship between scientific recognition and cumulative advantage. Academic recognition may increase a researcher's visibility and influence subsequent judgments of scientific merit, while associated institutional resources may expand opportunities for future work. Research on centers of excellence and research-excellence initiatives has similarly documented relationships among long-term resources, prestige, visibility, collaboration, and cumulative advantage (Langfeldt et al., 2015). These studies suggest why recognition-linked appointments warrant examination alongside direct research funding. For the Changjiang Scholars case, however, the appointment and its associated arrangements should be distinguished from prestige as a symbolic attribute. The empirical analysis therefore focuses on the publication patterns reported before and after appointment, while interpreting potential reputational and resource-related pathways in light of the available evidence (Qiao & Yao, 2020).

Table 1 summarises the three programmes according to their primary policy orientation and their relevance to the comparative framework. The categories represent analytical distinctions used in this study; they do not imply that the programmes operate through mutually exclusive institutional arrangements. Specific claims about funding amounts, duration, eligibility requirements, and accountability should be made only where supported by programme regulations or the original evaluations.

Table 1
Comparative framework for the three Chinese government-supported programs

Case	Primary policy orientation	Analytical relevance
National Science Fund for Distinguished Young Scholars	Investigator-oriented competitive research support	Examines the relationship between competitive research support and researchers' subsequent scientific output and influence
Pearl River Science and Technology Rising Star Program	Regional early-career talent support	Provides a case for examining the reported outcomes of a programme focused on young researchers
Changjiang Scholars Distinguished Professorship Program	Recognition-linked academic appointment	Allows comparison of publication and citation-related outcomes before and after academic appointment

2.3 Potential Pathways Linking Support to Scientific Outcomes

The funding literature identifies several pathways through which research support may influence scientific performance. For this study, four analytical concepts—resource access, scientific discretion, reputation, and research networks—provide a structured way to interpret differences across the three cases. They represent plausible pathways identified in previous research and are used here to guide comparative interpretation. The three underlying evaluations do not measure all four pathways within a common empirical design, so the analysis distinguishes evidence about program outcomes from evidence about the mechanisms that may help explain them.

2.3.1 Resource access

Financial support enables researchers to employ research staff, obtain equipment and data, maintain research activities, and pursue projects that require substantial investment. Research on public and private funding in Canadian nanotechnology has documented relationships between research financing and scientific publication, while also showing that funding effects vary according to the form of support and the stage of a researcher's career (Beaudry & Allaoui, 2012). Jacob and Lefgren (2011) likewise found a positive but modest effect of receiving an NIH research grant on subsequent publication output. These findings provide a basis for examining whether the amount, duration, and form of support differ across the Chinese programs and how their reported outcomes correspond to these differences.

2.3.2 Scientific discretion

Funding arrangements also shape researchers' discretion over research questions, methods, and the timing of their work. Laudel (2006) showed that scientists adapt their research strategies to the conditions attached to funding. Azoulay et al. (2011), in a study comparing Howard Hughes Medical Institute investigators with NIH-funded researchers, found that longer-term support and greater freedom to experiment were associated with more high-impact publications and changes in research direction consistent with scientific exploration. The Howard Hughes program is privately funded, so this evidence provides a comparative insight into funding design rather than a direct example of government policy. For the Chinese cases, the relevant issue is the extent to which each program's formal arrangements allow researchers to allocate resources and pursue research agendas over time.

2.3.3 Reputation and visibility

Scientific recognition may shape subsequent opportunities by signaling achievement and increasing visibility within the research community. Merton (1968) described how recognition can contribute to cumulative advantage, as prior success influences the allocation of subsequent attention and opportunities. Langfeldt et al. (2015), examining research-excellence initiatives in four Nordic countries, found that long-term resources, prestige, and visibility were associated with enhanced collaboration, risk-taking, and international recruitment, while also identifying limits to cumulative resource concentration. This literature provides a basis for considering the role of reputation in recognition-linked appointments. It also highlights the importance of distinguishing symbolic recognition from the resources and institutional positions that may accompany it.

2.3.4 Research networks

Scientific work often depends on collaboration and access to complementary expertise. Researchers' positions within co-publication networks can be associated with their ability to access collaborators and generate subsequent scientific output. Tahmooresnejad et al. (2015), comparing nanotechnology research in Canada and the United States, found that research funding and scientists' positions in prior co-publication networks were related to scientific production. Melin and Danell (2006) also reported differences in international co-authorship and other subsequent outcomes between approved and rejected applicants for a prestigious research grant in Sweden. These studies suggest that networks are a relevant dimension for examining career-development and recognition-linked programs. For the present comparison, network expansion is treated as a potential pathway whose operation depends on program arrangements and direct evidence about collaboration.

The four concepts are related but analytically distinguishable. Additional resources may enable new collaborations; recognition may increase researchers' visibility to potential partners; and greater discretion may allow scientists to pursue collaborative or exploratory research. The relative importance of these pathways is likely to vary across programs and contexts. The comparative framework therefore uses these concepts to organize possible explanations of heterogeneous outcomes, rather than

assuming in advance that a particular program activates a specific mechanism or that one mechanism accounts for its observed results.

2.4 Comparative Framework and Analytical Expectations

The comparative framework is guided by three analytical expectations. First, differences in programme objectives and institutional arrangements should be considered when interpreting variation in reported scientific outcomes. Second, programme performance may differ across outcome dimensions, making a multidimensional assessment more informative than a single overall measure. Third, the alignment between policy objectives and evaluation criteria provides a basis for assessing whether performance measures reflect the purposes of public support.

Figure 1 summarises the analytical framework used to compare the three programmes. These expectations organise the comparison without presuming that the three programmes share a common causal structure or form a coordinated policy portfolio. Establishing whether they complement one another would require evidence on overlapping beneficiaries, sequential participation, or combined effects. Section 3 explains how the existing evaluations are compared and how differences in their empirical designs shape the interpretation of the results.

Note

The framework compares three Chinese government-supported programmes by their policy orientations and institutional arrangements. Solid arrows indicate links explicitly reflected in programme design. Dashed arrows indicate potential pathways discussed in prior research that are not consistently measured across the three evaluations. The outcome dimensions organise the comparison, while individual evaluations cover different subsets of these outcomes. Arrows represent analytical connections rather than established causal mechanisms.

3. Research Design

3.1 Research Strategy

This study presents a structured comparative synthesis of three existing evaluations of government-supported programmes in China. The original studies provide the empirical evidence, while the present analysis examines how their reported outcomes relate to programme objectives and institutional arrangements. Its contribution lies in organising these findings within a common analytical framework, rather than estimating new treatment effects from a pooled dataset.

The three evaluations differ in their empirical designs. The study of the National Science Fund for Distinguished Young Scholars uses propensity score matching combined with difference-in-differences analysis, and the Pearl River Science and Technology Rising Star Program is examined through a difference-in-differences design. The Changjiang Scholars evaluation reports within-person comparisons of scientific performance before and after appointment. These approaches provide different levels of

leverage for causal interpretation, so their estimates are interpreted in the context of each original design.

The programme is the unit of comparison in this synthesis, while individual scientists remain the units of observation in the underlying studies. The analysis compares policy orientation, institutional arrangements, reported outcome patterns, and the potential pathways discussed in the original research. It does not pool effect estimates or rank the three programmes on a common scale. Instead, it examines what the reported results reveal about the range of outcomes associated with different forms of government support and identifies where further evidence is required.

3.2 Case Selection

The three programmes were selected purposively because they represent different orientations of government support and have been examined in previous empirical studies. The National Science Fund for Distinguished Young Scholars represents investigator-oriented competitive research support; the Pearl River Science and Technology Rising Star Program represents regional early-career talent support; and the Changjiang Scholars Distinguished Professorship Program represents recognition-linked academic appointment.

The cases provide analytical contrasts rather than a statistically representative sample of Chinese science policy programmes. Their value lies in the variation in policy objectives, support arrangements, and reported outcomes. These orientations are used as a basis for comparison rather than treated as mutually exclusive categories of public support.

3.3 Data Sources and Original Evaluations

The empirical basis of the study consists of three previously conducted evaluations by the research team. These studies examine the National Science Fund for Distinguished Young Scholars (Qiao et al., 2022), the Pearl River Science and Technology Rising Star Program(Qiao et al., 2025), and the Changjiang Scholars Distinguished Professorship Program(Qiao & Yao, 2020), respectively. They draw on administrative or bibliometric information to assess changes in researchers' scientific performance following programme participation or appointment.

The three evaluations differ in their identification strategies and outcome measures. The evaluation of the National Science Fund for Distinguished Young Scholars uses propensity score matching combined with difference-in-differences analysis (PSM-DID) to compare award recipients with a matched comparison group. The evaluation of the Pearl River Science and Technology Rising Star Program uses a difference-in-differences (DID) design to estimate changes associated with programme participation. The evaluation of the Changjiang Scholars Distinguished Professorship Program uses a comparison-based design to examine changes in publication and citation-related indicators around appointment. These designs provide different forms of empirical leverage, and their assumptions and limitations should be considered when interpreting the results across cases.

The outcome measures capture related but non-identical aspects of scientific performance. The original evaluation of the National Science Fund for Distinguished Young Scholars considers publication productivity and citation-based indicators of research impact. The Pearl River programme evaluation examines research output and indicators of scientific influence and collaboration. The Changjiang Scholars evaluation focuses on publication productivity and citation-related measures of academic performance. These measures provide a basis for identifying broad patterns across cases, while differences in operationalisation limit direct numerical comparisons.

Table 2 summarises the main features of the three original evaluations. It records each programme's policy orientation, target career stage, identification strategy, and principal outcome dimensions. The table is intended to make the empirical basis of the comparison transparent; it does not imply that the original studies use identical samples, measures, or estimation procedures.

Table 2
Main characteristics of the three original evaluations

Case	Programme	Policy orientation	Target career stage	Empirical strategy reported in the original study	Principal outcome dimensions
Case 1	National Science Fund for Distinguished Young Scholars	Investigator-oriented research funding	As defined by the original study's eligibility criteria and sample	Propensity score matching combined with difference-in-differences (PSM-DID)	Publication productivity; citation-based research impact
Case 2	Pearl River Science and Technology Rising Star Program	Early-career talent development	Early career	Difference-in-differences (DID)	Research productivity; research influence; collaboration-related outcomes, where measured
Case 3	Changjiang Scholars Distinguished Professorship Program	Recognition-linked academic support	As defined by the original study's appointment sample	Comparison-based analysis of outcomes before and after appointment	Publication productivity; citation-based indicators

3.4 Comparative Analytical Framework

The comparative analysis proceeds in three stages. First, each programme is characterised in terms of its policy orientation and institutional arrangements. This stage distinguishes the form of support provided from the broader policy purpose it is intended to serve. Competitive research funding, early-career talent development, and recognition-linked academic support may all benefit individual scientists, but they create different institutional contexts and expectations.

Second, the analysis summarises the principal findings reported in each original evaluation. It considers the direction and scope of the estimated effects across the outcome dimensions examined by the original studies, giving priority to the measures and comparisons that each study actually reports. Where the studies use different indicators or observation periods, the analysis describes the results in their original terms rather than treating them as directly equivalent estimates.

Third, the reported patterns are interpreted through the analytical framework developed in Section 2. Four potential pathways guide this interpretation: resource enhancement, scientific discretion, reputational accumulation, and network expansion. These pathways provide a common vocabulary for examining how programme design might be connected to scientific outcomes. Their explanatory relevance is assessed against the institutional features of each programme and the evidence reported in the original evaluations. Because the three studies do not necessarily measure these pathways directly or in a consistent manner, the analysis treats them as interpretive mechanisms rather than as empirically established mediators.

The final comparison asks whether the differences in reported outcomes are consistent with the programmes' distinct policy orientations. It also considers the implications of those patterns for programme governance, including the alignment between policy objectives, forms of support, and evaluation criteria. This approach moves from individual programme findings to a broader interpretation of government support for scientists, while keeping the distinction between causal estimates from the original studies and theoretical inferences made in the present analysis explicit.

4. Results

4.1 Three Empirical Profiles of Government Support for Scientists

The three evaluations reveal distinct patterns in researchers' scientific performance following government support. The results vary across publication output, citation-based indicators, and other measures of scientific influence. These differences provide the empirical starting point for comparing the programmes, while the findings should be interpreted in light of the outcome measures and identification strategies used in each original study.

The evaluation of the National Science Fund for Distinguished Young Scholars reports positive estimates for publication output and two indicators of research influence, alongside a decline in average citations per paper. In the model reported in Appendix Table A1, the estimated coefficient for publications is 1.02 ($p < .01$). The coefficient for Top 10% highly cited papers is 0.33 ($p < .01$), while the Field-Weighted Citation Impact (FWCI) coefficient is 0.15 ($p < .01$). By contrast, the coefficient for citations per paper is − 5.39 ($p < .01$). Taken together, these estimates indicate that publication output and the representation of highly cited work increased, while the average citation performance of individual papers followed a different trajectory. The pattern therefore depends on which dimension of scientific performance is

examined: growth in output and selected indicators of research influence does not necessarily coincide with an increase in citations per paper.

The Pearl River Science and Technology Rising Star Program presents a different pattern across the indicators reported in Appendix Table A2. The estimated effect on Top 10% highly cited papers is − 0.148 and is not statistically significant. The estimate for FWCI is − 0.202 ($p < .10$), while patent citations decline by 0.608 ($p < .05$) and the number of countries citing recipients' publications declines by 3.351 ($p < .01$). These results point to less favourable estimates for several measures of citation-related, technological, and international influence, although the change in Top 10% highly cited papers is statistically indistinguishable from zero in the reported model. The available table provides a partial picture of the programme's effects. The estimates also leave open the question of why the observed changes occurred. Funding duration and continuity may be relevant considerations, but their explanatory roles require direct evidence beyond the outcome estimates presented here.

The evaluation of the Changjiang Scholars Distinguished Professorship Program reveals a third pattern. Among the 176 researchers examined, the median number of annual SCI publications increased from 2.11 before appointment to 8.81 afterwards, representing a difference of 6.70 papers per year. This increase is statistically significant (Wilcoxon $Z = -11.221$, $p < .001$). Citation-related indicators present a more varied picture. Median citations per paper-year declined from 19.70 to 5.63 (Wilcoxon $Z = -10.706$, $p < .001$). The Category Normalized Citation Impact (CNCI) changed only slightly, from 1.26 to 1.25, with no statistically significant difference (Wilcoxon $Z = -1.275$). The Journal Normalized Citation Impact (JNCI) declined from 1.11 to 0.99, a statistically significant change (Wilcoxon $Z = -3.351$, $p < .001$). Taken together, these results show a substantial increase in publication output alongside declines in citation frequency and journal-normalized impact, while field-normalized citation impact remains statistically unchanged.

The three evaluations show variation both in the direction of reported effects and in the dimensions of scientific performance examined. Section 4.2 compares these patterns while accounting for differences in outcome definitions and empirical design.

4.2 Comparing Outcomes Across Programmes

Table 3 summarises the principal results reported in the three evaluations. Rather than assigning each programme a single rating, the comparison distinguishes publication output from citation-normalized indicators and other measures of scientific influence. This approach preserves differences in the empirical results and makes clear where the current evidence supports comparison and where further information is required.

Table 3
Summary of outcomes reported in the three original evaluations

Programme	Publication output	Citation-normalized indicators	Other reported indicators
National Science Fund for Distinguished Young Scholars	Publications: β = 1.02 (p < .01); Top 10% papers: β = 0.33 (p < .01)	FWCI: β = 0.15 (p < .01); citations per paper: β = −5.39 (p < .01)	The current Appendix Table A1 does not show additional outcome estimates beyond those listed
Pearl River Science and Technology Rising Star Program	Top 10% highly cited papers: β = −0.148 (not statistically significant)	FWCI: β = −0.202 (p < .10)	Patent citations: β = −0.608 (p < .05); countries citing publications: β = −3.351 (p < .01)
Changjiang Scholars Distinguished Professorship Program	Median annual SCI publications: 2.11 before appointment and 8.81 afterwards (difference = + 6.70; Wilcoxon Z = − 11.221, p < .001)	CNCI (median): 1.26 before appointment and 1.25 afterwards (p = .202); JNCI (median): 1.11 before appointment and 0.99 afterwards (p = .001).	Median citations per paper-year: 19.70 before appointment and 5.63 afterwards (difference = − 14.07; Wilcoxon Z = − 10.706, p < .001).

Note. The table reproduces the estimates currently reported in the manuscript and its appendix.

Across the available indicators, no single programme presents a uniformly positive or negative outcome profile. The National Science Fund for Distinguished Young Scholars shows positive estimates for publication output and selected citation-based indicators alongside a negative estimate for citations per paper. The Pearl River programme reports negative estimates for several measures of scientific influence, while the Changjiang Scholars evaluation combines higher publication output with mixed changes in citation-related indicators.

These profiles suggest that assessments of government support depend partly on the outcomes examined. They provide a basis for comparing programme orientations, while differences in samples, outcome measures, and identification strategies preclude a common numerical ranking of overall effectiveness.

4.3 Interpreting the Results Through Potential Explanatory Pathways

Section 2 identifies four potential pathways linking government support to scientific outcomes: resource enhancement, scientific discretion, reputational accumulation, and network expansion. These pathways offer a common vocabulary for interpreting the three cases. The original evaluations, however, do not measure all four mechanisms in a consistent manner. The comparison therefore assesses whether the observed patterns are compatible with the proposed explanations, rather than treating the mechanisms as directly estimated causal channels.

For the National Science Fund for Distinguished Young Scholars, resource enhancement provides an immediate point of connection between programme design and reported outcomes: the programme supplies competitive research support, and the evaluation records positive estimates for publication output, Top 10% papers, and FWCI. Scientific discretion is another plausible pathway, given the programme's investigator-oriented design, but its independent contribution cannot be established from the outcome estimates alone. The decline in citations per paper also indicates that the programme's reported effects vary across indicators, making a single, uniformly positive interpretation inappropriate.

The Pearl River Science and Technology Rising Star Program places early-career talent development at the centre of its policy orientation. Its reported estimates show less favourable changes in several indicators of research influence. These results make programme duration, continuity of support, and the transition towards research independence relevant questions for further investigation. The available estimates do not, by themselves, determine whether those factors account for the observed pattern. Similarly, the number of countries citing recipients' publications captures the geographical breadth of citation, rather than directly measuring collaboration or the formation of research networks.

The Changjiang Scholars evaluation offers a different setting in which formal academic recognition and institutional status are central programme features. The increase in publication output is compatible with several potential explanations, including changes in professional visibility, access to resources, and institutional opportunities. Yet the reported pre- and post-appointment comparisons do not isolate these pathways. The combination of increased publication output, stable CNCI, and declines in other citation indicators also cautions against treating academic recognition as having a uniform effect on every dimension of research performance.

Table 4 summarises these interpretive connections and distinguishes programme features from mechanisms that remain to be tested. It replaces a numerical ranking of mechanisms with a more transparent account of the available evidence.

Table 4
Interpretive links between programme design and reported outcomes

Programme orientation	Design feature relevant to interpretation	Empirical pattern in the current evaluation	Potential explanatory pathway	Evidence status
Investigator-oriented competitive funding	Competitive research support directed towards selected investigators	Positive estimates for publications, Top 10% papers, and FWCI; negative estimate for citations per paper	Resource enhancement; potentially scientific discretion	Programme support is part of the design; the independent effect of discretion is not directly identified
Early-career talent development	Support directed towards researchers at an earlier career stage	Negative estimates for several influence-related indicators; no statistically significant estimate for Top 10% papers	Career development, continuity of support, and network development as questions for further study	The outcome pattern is reported, but the proposed explanatory pathways are not directly tested in the current evidence
Recognition-linked academic support	Academic recognition associated with a formal appointment	Higher publication output, stable CNCI, and declines in other citation indicators	Reputational accumulation; potentially broader access to resources and professional networks	Recognition is part of the programme design; the causal contribution of reputation and networks remains unmeasured

Note. The table presents theoretically informed interpretations of programme design and reported outcomes. It does not treat the four pathways as measured mediators, and it does not imply that a pathway has been causally established in every case.

Taken together, the comparison highlights the value of evaluating government support across multiple dimensions of scientific performance. Publication output, citation-normalized impact, technological influence, and the geographical reach of citations capture related but distinct outcomes. The three cases illustrate how an assessment centred on one indicator may yield a different conclusion from an assessment using a broader set of measures. The findings therefore motivate a differentiated approach to programme evaluation, in which performance indicators are aligned with programme objectives and interpreted in relation to the institutional arrangements and empirical designs through which the evidence was produced. Whether the programmes function as complementary elements of a wider policy portfolio remains an important question for future research, requiring evidence on programme interactions, overlapping participation, or their combined effects.

5. Discussion

5.1 Heterogeneous Funding Effects in the Context of Existing Research

The three evaluations are consistent with research showing that the relationship between public funding and scientific performance varies across funding arrangements and researcher populations. Auranen and Nieminen (2010) found no straightforward relationship between the competitiveness of national university funding systems and publication performance. Jacob and Lefgren (2011) estimated a modest increase in publication output following receipt of an NIH grant, while Heyard and Hottenrott (2021) documented positive output effects of Swiss National Science Foundation grants alongside variation across outcome measures. Wang et al. (2018) further showed that the relationship between competitive funding and research novelty varied with researchers' academic status. Together, these studies suggest that funding effects depend on the form of support, the researchers receiving it, and the outcome being assessed.

The comparison of the Chinese programmes adds a related but distinct perspective. Fan and Qin (2025) found that project-based and talent-related funding were associated with different patterns of academic achievement in a Chinese university. The present analysis extends this discussion by comparing three programmes that differ in their primary policy orientation and by highlighting variation within, as well as across, outcome dimensions. The results suggest that programme differences are worth examining through a multidimensional framework, rather than reducing each programme to a single measure of success.

This contribution should be understood as a comparative framework for interpreting existing evidence. The available evaluations do not establish that every policy orientation produces a fixed set of outcomes, nor do they demonstrate that the three programmes function as complementary components of a coordinated portfolio. Those claims require direct evidence on the mechanisms of programme effects and on interactions among programmes.

5.2 When Publication Growth and Scientific Influence Diverge

A notable pattern across the cases is that publication output and citation-based indicators do not always move in the same direction. The National Science Fund for Distinguished Young Scholars is associated with positive estimates for publication output and selected indicators of research influence, while citations per paper decline. The Changjiang Scholars evaluation similarly combines a substantial increase in publication output with broadly stable CNCI and declines in other citation-related indicators. These patterns are not inherently contradictory: publication counts capture the volume of output, whereas citation-based measures reflect different aspects of how publications are received and used.

One possibility is that changes in publication volume alter the composition of a researcher's output portfolio. Additional publications may differ in disciplinary context, publication age, topic, and

subsequent citation trajectory. Field-normalised indicators, citations per paper, and the number of highly cited papers also capture different parts of the citation distribution. These differences provide plausible explanations for the observed patterns, but the current evaluations do not isolate their relative contributions. Further analysis of publication-level data, citation windows, and field-specific outcomes would help identify the processes behind these divergent indicators.

The Pearl River programme presents a different outcome profile, with negative estimates for several measures of scientific influence. This raises a distinct question about the relationship between support for early-career researchers and their longer-term development. Project duration and continuity of support are relevant considerations, as discussed in the original evaluation (Qiao et al., 2025), but the comparative evidence does not establish that these factors fully account for the observed changes. Testing this explanation would require following recipients over a longer period and examining how support continuity, research independence, and subsequent opportunities relate to their scientific trajectories.

The broader implication is that programme evaluation should distinguish between increasing the volume of scientific output and improving its influence. A multidimensional assessment can identify which outcomes change and where the evidence remains ambiguous. It can also guide the choice of observation window: some outcomes may emerge during a funding period, while others may require longer follow-up. This approach provides a more precise basis for comparing programmes than an overall label of effectiveness or ineffectiveness.

5.3 From Policy Design to Institutional Translation

The results also raise a broader question about the relationship between a programme's formal design and the role it acquires within universities. A government programme may be designed to provide research resources, encourage early-career development, or recognise scientific achievement. Once the programme enters university personnel systems, its award or appointment may also become a signal used in recruitment, promotion, resource allocation, and assessments of institutional standing. In this way, support directed towards individual scientists may acquire organisational consequences that extend beyond the original programme objectives.

This possibility is particularly relevant to recognition-linked support, but it can also arise in programmes that combine research funding with formal talent status. The Matthew effect provides a useful theoretical starting point: scientific recognition can generate cumulative advantages by influencing the visibility and rewards attached to researchers and their work (Merton, 1968). Research on excellence initiatives further suggests that the relationship between prestige, resources, and scientific performance is complex. Long-term funding and visibility can support interdisciplinary work, risk-taking, and international recruitment, while cumulative advantages may remain subject to institutional limits (Langfeldt et al., 2015). Recognition can therefore provide access to new opportunities, although the distribution of these opportunities depends on how universities and funding organisations allocate resources and evaluate researchers.

A related insight emerges from research on the governance of public science. Changes in evaluation systems influence the authority of funding bodies, universities, research managers, and individual scientists over research priorities and assessments of performance (Whitley, 2011). From this perspective, a talent award is more than a label attached to an individual: it may also become a resource used by organisations to make decisions about scientific capacity and academic status. The same award can consequently operate through two connected channels. At the individual level, it may provide financial resources, reputation, and professional opportunities. At the organisational level, it may influence how a university identifies talent, allocates support, and signals its own scientific standing.

Institutional change theory provides a way to develop this argument further. Mahoney and Thelen (2010) explain how existing rules and arrangements can acquire new functions through changes in their interpretation and implementation, including processes of institutional conversion. Applied to science policy, this perspective suggests that the organisational effects of a programme may evolve as universities incorporate its awards into their own personnel and evaluation arrangements. A programme designed to support independent research could gradually become an important signal of institutional prestige, while a recognition scheme could influence access to research resources and career opportunities.

This is a promising explanation for the broader significance of government support for scientists, but it remains a proposition for future empirical investigation. The three evaluations considered here focus on scientific outcomes and do not directly track how university recruitment criteria, performance assessment rules, or internal resource allocation change after an award. The present findings therefore motivate the hypothesis that institutional translation can shape programme effects; they do not establish that this process occurred in every case. Testing the hypothesis would require examining university personnel policies, award-related resource allocation, and the experiences of recipients and non-recipients. Such evidence would help distinguish the effects of programme design from those arising through the organisational use of awards.

5.4 Differentiating Governance by Policy Objective

The governance implications of the comparison concern the alignment between programme objectives and evaluation arrangements. Research evaluation systems can shape researchers' incentives and the distribution of authority in public science (Geuna & Martin, 2003; Whitley, 2011). Governance should therefore be considered part of the programme's institutional design: it influences which activities are rewarded, how performance is interpreted, and whether the evaluation horizon reflects the programme's objectives. Table 5 summarises the corresponding governance priorities for investigator-oriented research support, early-career talent development, and recognition-linked academic appointments.

Table 5
Aligning governance arrangements with the objectives of government support for scientists

Policy orientation	Primary governance emphasis	Suggested evaluation focus	Risk to monitor
Investigator-oriented research funding	Scientific accountability with appropriate discretion over research implementation	Research quality, originality, integrity, progress towards the research agenda, and longer-term outcomes	Incentives to prioritise predictable short-term outputs over exploratory research
Early-career talent development	Developmental review and continuity of support	Research independence, sustained research trajectory, collaboration, mentoring, and progression towards future research opportunities	Premature evaluation against short-term publication targets or discontinuity between funding stages
Recognition-linked academic support	Proportionate accountability combined with assessment of academic leadership	Research quality, mentoring, team development, disciplinary contributions, and the use of associated institutional resources	Cumulative advantage, resource concentration, and the use of recognition as a substitute for broader performance assessment

The three arrangements share a requirement for proportionate accountability, but their evaluation priorities differ. Research support calls for assessment of the research agenda and responsible resource use; early-career support requires attention to continuity and the development of research independence; recognition-linked appointments call for assessment of scientific contribution and academic leadership, alongside appropriate accountability for associated resources. These recommendations follow from the programmes' stated orientations and the wider literature. Whether such differentiated arrangements improve programme outcomes remains a question for empirical evaluation.

5.5 Limitations and Future Research

Several limitations define the scope of the present analysis and suggest directions for further research. First, the comparison draws on three previously conducted evaluations by the research team. This approach enables a structured comparison of programme designs and reported findings, but it also limits the breadth of the evidence base. The cases were selected for their theoretical relevance and the availability of prior evaluations, rather than through a systematic review of all scientist-oriented funding schemes. The findings should therefore be interpreted as a theory-building comparison of three Chinese programmes. Future research could extend the evidence base through a systematic review of funding evaluations and a more comprehensive classification of programmes across national research systems.

Second, the three original evaluations differ in their empirical designs, samples, observation periods, and outcome measures. The first uses matched recipients and non-recipients in a difference-in-differences framework, the second applies a difference-in-differences design, and the third reports within-person comparisons before and after appointment. These strategies offer different forms of evidence, and the

third design, as documented in the current manuscript, provides a less direct basis for causal attribution because it lacks a clearly reported comparison group. The numerical estimates should therefore be interpreted within the design of each original study. A harmonised dataset covering multiple programmes, shared outcome definitions, and consistent observation windows would allow future research to examine differences in effects more directly.

Third, the four proposed pathways—resource enhancement, scientific discretion, reputational accumulation, and network expansion—are currently used as interpretive concepts. The original evaluations do not measure them consistently, and the present synthesis does not estimate mediation effects. Future studies could develop direct indicators of each pathway. Resource enhancement could be measured through funding amount, duration, and access to research infrastructure; scientific discretion through changes in researchers' control over research agendas and implementation; reputational accumulation through subsequent awards, appointments, and institutional recognition; and network expansion through collaboration ties, mobility, and the formation of new research partnerships. Linking these measures to longitudinal research outcomes would help establish which pathways contribute to particular forms of scientific performance.

Fourth, the analysis relies heavily on publication and citation-related indicators. These measures are valuable for examining scientific output and scholarly influence, but they capture only part of the contribution made by researchers and public research programmes. Future research could combine bibliometric measures with evidence on technological development, knowledge transfer, interdisciplinary research, mentoring, research integrity, and longer-term career progression. Qualitative evidence from recipients, unsuccessful applicants, university managers, and funding agencies would also provide insight into how researchers respond to programme requirements and how universities incorporate awards into personnel and resource-allocation decisions.

Finally, the three cases are situated within China's science policy system. Their institutional features provide a useful setting for examining government investment in scientists, while the extent to which the proposed framework applies elsewhere remains an open empirical question. Cross-national comparisons could examine whether similar policy orientations produce comparable outcomes under different funding rules, university governance systems, and academic labour markets. A further priority is to examine the policy portfolio directly by tracking recipients' participation in multiple programmes, the timing of successive awards, and the interaction between research grants and talent-related support. Such designs would help determine when different funding instruments reinforce one another and when their overlapping requirements create competition for researchers' time and attention.

These extensions would move the discussion from an analytical classification of funding arrangements towards a more comprehensive explanation of how programme design, institutional implementation, and researchers' career trajectories interact. They would also provide a stronger empirical basis for deciding when differentiated funding instruments operate as complementary components of a research system and what governance arrangements enable them to fulfil their intended purposes.

6. Conclusion

This study compares three Chinese programmes supporting scientists through competitive research funding, early-career talent development, and recognition-linked academic appointments. Their reported outcomes vary across publication output and citation-related measures, highlighting the importance of distinguishing research volume from different dimensions of scientific influence. The comparison offers a framework for examining how programme orientations relate to scientific performance while accounting for differences in the underlying evaluations.

The findings suggest that programme evaluation should reflect the objectives and time horizons of the support provided. Research funding, career development, and academic recognition involve different expectations and may require different evaluation priorities. Further progress will depend on comparable longitudinal data, direct measurement of the mechanisms linking programme design to outcomes, and evidence on whether successive or overlapping programmes reinforce one another. Such research would establish the conditions under which differentiated forms of government support contribute to scientific development.

Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not encompass studies involving human participants conducted by any of the authors.

Informed consent

This article does not include any studies involving human participants conducted by the authors.

Funding

This work was supported by the 2022 Priority Project of the Beijing Municipal Education Science Planning under the 14th Five-Year Plan, entitled “Research on Deepening the Reform of Research Performance Evaluation for Faculty at Universities in the Capital in the New Era” [grant number CFEA22015].

Author Contribution

J.S. and J.Q. conceptualized and designed the research, and J.S. collected the data. T.C. processed the data, developed the methodology, and constructed the models. X.Q. conducted the literature review and wrote the original draft. J.Q. supervised the research and reviewed and edited the manuscript. All authors reviewed the manuscript.

Data Availability

The data used in this comparative synthesis are drawn from the three published studies cited in the manuscript. No new primary data were collected.

References

1. Auranen O, Nieminen M (2010) University research funding and publication performance—An international comparison. Res Policy 39(6):822–834. https://doi.org/10.1016/j.respol.2010.03.003
2. Azoulay P, Graff Zivin JS, Manso G (2011) Incentives and creativity: Evidence from the academic life sciences. RAND J Econ 42(3):527–554. https://doi.org/10.1111/j.1756-2171.2011.00140.x
3. Beaudry C, Allaoui S (2012) Impact of public and private research funding on scientific production: The case of nanotechnology. Res Policy 41(9):1589–1606. https://doi.org/10.1016/j.respol.2012.03.022
4. Bush V (1945) Science: The endless frontier: A report to the President on a program for postwar scientific research. U.S. Government Printing Office
5. Fan X, Qin H (2025) Differential effects of research funding types on academic career achievements. Eur J Educ 60(3):e70194. https://doi.org/10.1111/ejed.70194
6. Geuna A, Martin BR (2003) University research evaluation and funding: An international comparison. Minerva 41(4):277–304. https://doi.org/10.1023/B:MINE.0000005155.70870.BD
7. Heinze T (2008) How to sponsor ground-breaking research: A comparison of funding schemes. Sci Public Policy 35(5):302–318. https://doi.org/10.3152/030234208X317151
8. Heyard R, Hottenrott H (2021) The value of research funding for knowledge creation and dissemination: A study of SNSF Research Grants. Humanit Soc Sci Commun 8:217. https://doi.org/10.1057/s41599-021-00891-x
9. Jacob BA, Lefgren L (2011) The impact of research grant funding on scientific productivity. J Public Econ 95(9–10):1168–1177. https://doi.org/10.1016/j.jpubeco.2011.05.005
10. Langfeldt L, Benner M, Sivertsen G, Kristiansen EH, Aksnes DW, Brorstad Borlaug S, Foss Hansen H, Kallerud E, Pelkonen A (2015) Excellence and growth dynamics: A comparative study of the Matthew effect. Sci Public Policy 42(5):661–675. https://doi.org/10.1093/scipol/scu083
11. Laudel G (2006) The art of getting funded: How scientists adapt to their funding conditions. Sci Public Policy 33(7):489–504. https://doi.org/10.3152/147154306781778777

12. Mahoney J, Thelen K (2010) A theory of gradual institutional change. In: Mahoney J, Thelen K (eds) Explaining institutional change: Ambiguity, agency, and power. Cambridge University Press, pp 1–37. https://doi.org/10.1017/CBO9780511806414.003
13. Melin G, Danell R (2006) The top eight percent: Development of approved and rejected applicants for a prestigious grant in Sweden. Sci Public Policy 33(10):702–712. https://doi.org/10.3152/147154306781778579
14. Merton RK (1968) The Matthew effect in science. Science 159(3810):56–63. https://doi.org/10.1126/science.159.3810.56
15. Qiao J, Pan T, Ma J (2025) Quyu keji rencai xiangmu dui qingnian rencai de peiyu xiaoguo yanjiu [Research on the cultivation effects of regional science and technology talent programmes for young researchers]. World Sci-Tech R&D 47(2):260–271 (in Chinese). https://doi.org/10.16507/j.issn.1006-6055.2024.09.002
16. Qiao J, Sun N, Shen J, Wang K (2022) Kexue jijin dui xueshu chanchu de changqi yingxiang yanjiu [Long-term effects of science funding on academic output]. □□□□□□ (12):88–98 (in Chinese). https://doi.org/10.13580/j.cnki.fstc.2022.12.016
17. Qiao J, Yao C (2020) A comparative study on Changjiang Scholar Distinguished Professors' SCI papers published before and after their election: The analysis based on related data of science, engineering, agriculture and medicine disciplines. J High Educ Manag 14(5):83–92 (in Chinese). https://doi.org/10.13316/j.cnki.jhem.20200829.010
18. Stephan P (2012) How economics shapes science. Harvard University Press
19. Tahmooresnejad L, Beaudry C, Schiffauerova A (2015) The role of public funding in nanotechnology scientific production: Where Canada stands in comparison to the United States. Scientometrics 102(1):753–787. https://doi.org/10.1007/s11192-014-1432-2
20. Wang J, Lee Y-N, Walsh JP (2018) Funding model and creativity in science: Competitive versus block funding and status contingency effects. Res Policy 47(6):1070–1083. https://doi.org/10.1016/j.respol.2018.03.014
21. Whitley R (2011) Changing governance and authority relations in the public sciences. Minerva 49(4):359–385. https://doi.org/10.1007/s11024-011-9182-2

Figures

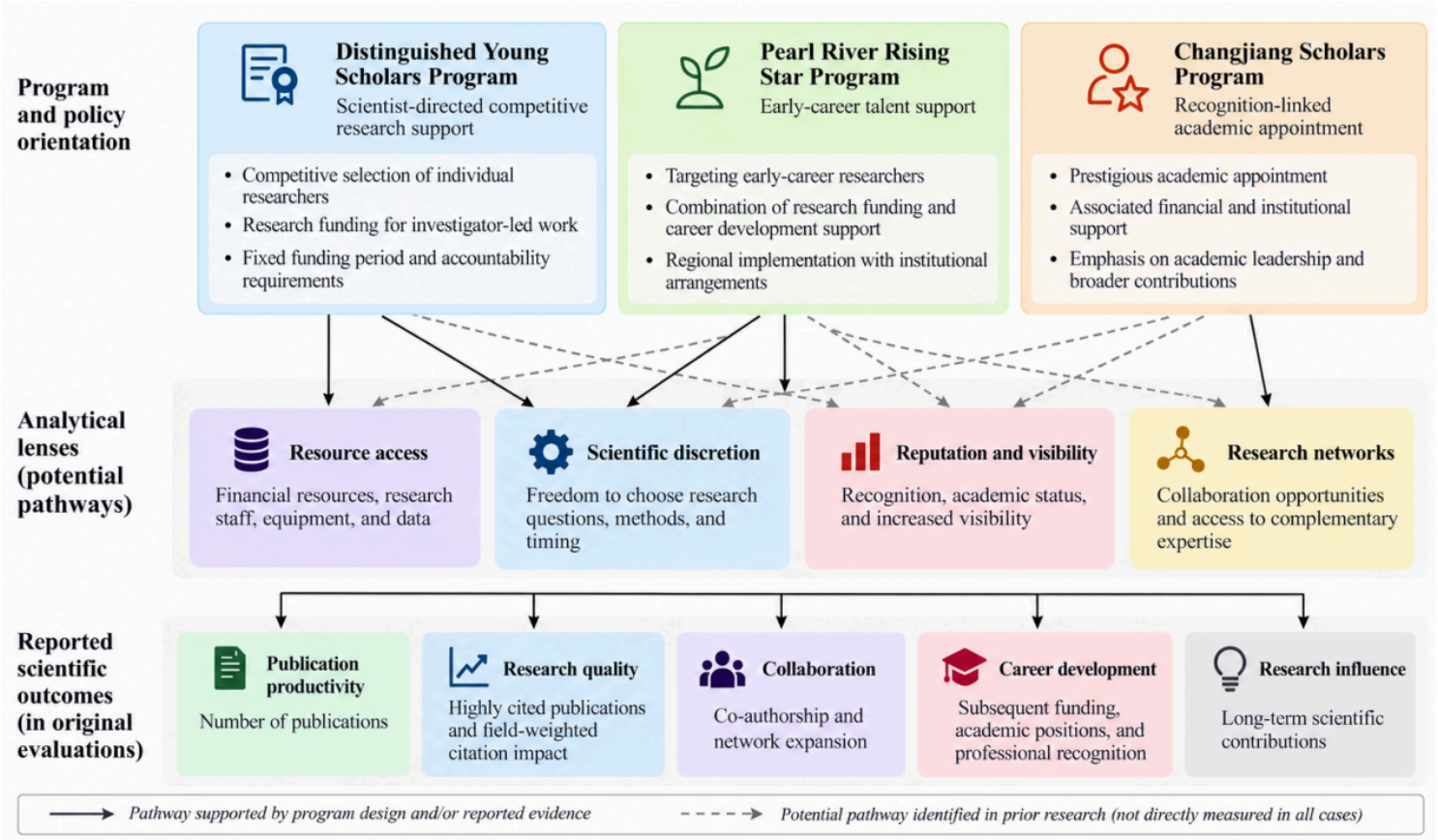

Figure 1

Analytical framework for comparing government support for scientists in China.

Note. The framework compares three Chinese government-supported programmes by their policy orientations and institutional arrangements. Solid arrows indicate links explicitly reflected in programme design. Dashed arrows indicate potential pathways discussed in prior research that are not consistently measured across the three evaluations. The outcome dimensions organise the comparison, while individual evaluations cover different subsets of these outcomes. Arrows represent analytical connections rather than established causal mechanisms.

Supplementary Files

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- AppendixTables.docx