

Research funding in Türkiye: Linking TUBITAK policy change to scientific productivity

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Abstract

This study examines how policy reforms in Türkiye's national research funding system, particularly those implemented by the Scientific and Technological Research Council of Türkiye (TUBITAK), have shaped scientific productivity between 1980 and 2023. Drawing on bibliometric data, policy documents, and time-series analysis, the research evaluates the impact of TUBITAK funding on publication counts, citation performance, and open access trends. Results indicate that the 2005 reform served as a turning point, triggering measurable increases in research output and visibility. However, this momentum was not sustained after 2015, suggesting a need for more inclusive, internationally oriented, and open science-aligned funding strategies. The study offers new insights into the longitudinal effects of national research policy on scientific outcomes and highlights the importance of policy design in maximizing the impact of public research investment.

Keywords: Research funding policy; Scientific productivity; TUBITAK; Time series analysis

Author contributions: FA: Conceptualisation, methodology, data curation, investigation, visualisation, writing-original draft | ZT: Conceptualisation, methodology, investigation, supervision, writing-review & editing.

Conflict of interest: Authors declare no conflict of interest.

Acknowledgement: This article is part of the doctoral dissertation of Faruk Aydın, titled “*The Effects of Major Research Policy Reforms in the Higher Education System*” conducted under the supervision of Dr. Zehra Taşkın. We would like to express our sincere gratitude to Dr. Serap Emil, Dr. Güleda Doğan and the anonymous peer-reviewer for their invaluable feedback and constructive suggestions, which significantly contributed to the development of this study.

Funding: No funding.

Introduction

Scientific research is central to economic, technological, and social development. To foster scientific productivity and innovation, many countries operate competitive funding programmes that support researchers and their projects. These programmes are designed to increase the quantity of research output and to enhance its quality, visibility, and long-term impact. A growing body of literature links research funding with publication and citation performance. Grant-supported projects tend to yield higher productivity and more influential publications (Heyard & Hottenrott, 2021; Jacob & Lefgren, 2011; Roshani et al., 2021). Funded studies are also more likely to benefit from international collaboration, interdisciplinary approaches, and access to infrastructure and networks. Large-scale programmes such as the National Science Foundation in the United States and Horizon 2020 in Europe have been associated with higher citation rates and more visible outputs (Kaiser et al., 2022; Mitra & Niakaros, 2023).

Effects are not uniform across disciplines or national contexts. Impacts vary with allocation rules, field targeting, and support for early-career researchers and international partnerships (Bol et al., 2018; Thelwall et al., 2023). Health sciences often show stronger effects, while the social sciences and humanities tend to show more limited changes because of different publishing cycles and output types (Agamirova et al., 2023; D. Aksnes & Sivertsen, 2009; Kaplan et al., 2017). In Türkiye, findings are mixed. Some analysis suggest modest effects of government programmes such as those by the Scientific and Technological Research Council of Türkiye (TUBITAK) when measured by publications and citations (Satoglu et al., 2021; Tonta & Akbulut, 2020). Others argue that policy reforms may have altered productivity in ways that have not been examined longitudinally (Ozer-Imer & Imer, 2020; The World Bank, 2019).

This study addresses that gap by analysing how reforms in TUBITAK's funding programmes shaped scientific productivity in Türkiye between 1980 and 2023. Using bibliometric data and time-series analysis, we assess publication counts, citation performance, and open access trends, and we examine whether effects vary across disciplines and policy periods. We ask three questions. What is the overall effect of TUBITAK funding on Türkiye-affiliated research outputs, including publications, citations, and open access rates. How have policy changes in TUBITAK's funding mechanisms influenced these outcomes over time. Are there systematic disciplinary differences in the distribution and effects of TUBITAK-funded publications. Our contribution is a country-level longitudinal analysis that links specific policy reforms to field-sensitive outcomes, uses funder-acknowledgement data, normalises outputs by academic staff, and applies multiple time-series models to compare pre- and post-reform trajectories.

Theoretical Framework

The relationship between research funding and scientific productivity has been theorised as an interplay of material resources, incentives, and institutional norms. Stephan (1996) showed that grants relax resource constraints and build capacity over time. Evidence from the Swiss National Science Foundation indicates that funding catalyses output and dissemination, with effects that persist beyond the award period (Heyard & Hottenrott, 2021). Novel or exploratory grants can yield higher citation impact even after controlling for experience and team size (Zhuang & Acuna, 2019). Concentrating funding among a small elite can produce diminishing marginal returns in both quantity and impact (Mongeon et al., 2016).

Merton's Matthew Effect explains how early success creates reputational momentum that attracts further resources (Merton, 1968). Near-threshold studies show that winners secure substantially more subsequent funding than near-miss applicants, consistent with cumulative

advantage (Bol et al., 2018). Recent work suggests that previously funded researchers apply more often and benefit from self-reinforcing cycles of participation (Beres, 2025). Related analyses identify halo effects in which past performance and reputation amplify the likelihood and duration of future awards, moderated by applicant experience (Liao, 2021).

Taken together, these mechanisms show how funding enables scientific activity at individual and institutional levels, and how the design of funding systems and policies shapes trajectories of productivity, equity, and innovation. Through selective allocation, incentive structures, and institutional mandates, the wider architecture of research funding from national agencies to performance-based frameworks determines how resources translate into outcomes across disciplines and time.

Comparative evidence shows that policy reforms can reconfigure incentives, redistribute advantages, and redefine valued outputs. Longitudinal work on the Baltic states traces how public research funding instruments evolved under the joint influence of institutional legacies and internationalisation pressures, leading to divergent national trajectories in priorities and performance management (Tönismann, 2019). Reform programmes inside large research consortia reach similar conclusions. Analysis of the CGIAR argues for longer time horizons and governance models that align evaluation with capacity development rather than short citation windows or brief grant cycles (Leeuwis et al., 2018).

Institute-level changes in funding rules can shift bibliometric indicators. A study of Korean government research institutes found that a policy change raised the journal impact factors of funded outputs and altered publication profiles, which suggests that rule design can steer journal-based metrics without necessarily increasing publication volume (Kim & Min, 2020). Targeted requirements inside grant programmes also alter research practice. A policy mandating the integration of sex and gender in health research increased attention to these dimensions and identified concrete points where funders can shape methods and reporting standards (Johnson et al., 2014).

National excellence and capacity-building schemes show how design details generate system effects. Taiwan's plan to build first-class universities and top research centres is associated with shifts in institutional performance and efficiency, consistent with incentive responses to selective investment and competitive evaluation (Chang et al., 2009). Challenge-based instruments reshape problem framing and collaboration patterns. Using a wicked-problem lens, one study shows that challenge calls influence team organisation, stakeholder integration, and success criteria, which has implications for portfolio design (Ooi & Husted, 2025). Evaluation regimes that elevate research impact can redirect academic effort and institutional strategy. In the United Kingdom, the rise of the impact agenda has required departments to engage with non-academic beneficiaries and document effects beyond the academy, with consequences for workloads and for field sensitivity in disciplines with different output norms (Smith & Stewart, 2017).

Policy stability is also important. Evidence from Mexico's wind and solar sector shows that political instability and policy reversals undermine innovation systems by increasing uncertainty and reducing the adaptability of key actors, which is a caution for research funders that rely on long planning horizons and cumulative capability building (Aguiar-Hernandez & Breetz, 2024)

Effective research systems depend on policy portfolios that are both stable and diverse. Stability reduces uncertainty and supports long-term capability building, while diversity in instruments accommodates different disciplinary cycles and institutional contexts. Guided by this perspective, the present study investigates how major policy changes by Türkiye's main public funding agency, TUBITAK, reshaped incentives and outcomes between 1980 and 2023. The next section summarises these changes and sets up the periodisation used in the empirical analysis.

Research Funding Schemes in Türkiye

Türkiye-based researchers can benefit from a wide range of national and international research funding opportunities. Among these, the main public funding agency is TUBITAK,¹ which plays a central role in supporting the country's scientific and technological development. In addition to TUBITAK, other national actors include the Turkish Academy of Sciences (TÜBA),² the Council of Higher Education (YÖK),³ and research-oriented ministries such as the Ministry of Industry and Technology⁴ and the Ministry of National Education.⁵

Türkiye's science, technology, and innovation policy has evolved through a sequence of national strategies, Supreme Council for Science and Technology (BTYK) decisions, and legal instruments (Hazer, 2025). Since the early 1990s, strategy documents and council decisions have linked public research funding to national development priorities and clarified the roles of ministries, universities, and public research organisations. In the 2000s, the Vision 2023 strategy and its implementation plans broadened the policy toolkit from project grants toward performance management, targeted programmes, and coordination mechanisms. This institutional background frames the funding instruments discussed below.

TUBITAK offers an extensive portfolio of funding schemes, including grants for basic and applied research, innovation projects, research infrastructure, fellowships, and event organization. TUBITAK's recent funding programs reflect a clear shift toward metric-driven evaluation models, where eligibility and success are closely tied to publication performance, citation impact, and institutional prestige. This approach increasingly aligns research funding with quantitative indicators and global rankings, favouring applicants who meet high-performance benchmarks. For example:

- The 2218 Postdoctoral Fellowship Program⁶ requires applicants to surpass specific thresholds in publication points, often calculated through journal indexing and impact factors, and to be affiliated with mentors who meet similarly high-performance standards.
- The 2223⁷ and 2224⁸ programs link eligibility to the inclusion of events in internationally recognized indexes such as Web of Science's Conference Proceedings Citation Index or Scopus, reinforcing the use of bibliometric databases.
- The 2232-A International Leading Researchers⁹ and 2232-B Young Researchers programs¹⁰ prioritize individuals listed among the world's most highly cited scientists, as identified by Clarivate's "Highly Cited Researchers" list.

¹ <https://tubitak.gov.tr/en>

² <https://www.tuba.gov.tr/en>

³ <https://www.yok.gov.tr/en>

⁴ <https://www.sanayi.gov.tr/anasayfa>

⁵ <https://www.meb.gov.tr/en/>

⁶ <https://tubitak.gov.tr/en/scholarships/postdoctoral/research-scholarship-programs/2218-national-postdoctoral-research-fellowship-program>

⁷ <https://tubitak.gov.tr/en/funds/scientific-events/event-organizing-funds/2223-b-grant-program-organizing-scientific-meeting-within-country>

⁸ <https://tubitak.gov.tr/en/funds/scientific-events/event-participation-funds/2224-grant-program-participation-scientific-meetings-abroad>

⁹ <https://tubitak.gov.tr/en/scholarships/international/research-scholarship-programs/2232-international-fellowship-outstanding-researchers>

¹⁰ <https://tubitak.gov.tr/en/scholarships/postdoctoral/research-scholarship-programs/2232-b-international-fellowship-early-stage-researchers>

- The 2247-A National Leading Researchers¹¹ and 2247-D National Young Leaders programs¹² require applicants to have multiple publications in Q1-ranked journals and to demonstrate above-average normalized citation impact, often calculated via Scopus or Web of Science metrics.

Moreover, institutional reputation based on international university rankings has become a formalized criterion in several scholarship schemes:

- The 2205 Undergraduate Scholarship¹³ and 2213/2214 Graduate Scholarships¹⁴ require students to be admitted to universities ranked within the global top 100-1000 according to QS, THE, ARWU, or SCImago.
- The 2232 programs¹⁵ further assess candidates based on recent academic affiliations with institutions ranked in the global top 100-250, making institutional ranking a proxy for researcher quality.

These policies illustrate TUBITAK's broader orientation toward evaluation models centred on measurable academic prestige, particularly in terms of publication visibility and institutional standing. While intended to incentivize excellence and international competitiveness, such criteria may also raise concerns about accessibility, equity across disciplines, and the long-term implications of metric-centric funding allocation.

Comparatively, Türkiye's trajectory aligns with wider EU and OECD shifts from market-failure frameworks toward system and mission-oriented approaches that couple directionality with iterative learning. Recent syntheses emphasize flexibility, mid-course correction, and co-development with stakeholders as design features of mission policies, which helps contextualize Türkiye's turn to impact metrics and priority areas during the 2000s (Hazer, 2025).

Policy Changes in TUBITAK Funding Programs Over Time

TUBITAK's funding programs have evolved in line with legally binding reforms enacted through the Official Gazette. We focus on three statute-level changes that redefined the scope, evaluation rules, and instrument mix of the national funding system: 1991, 2005, and 2009. These dates are not analytical cut-offs chosen ex post. They are the promulgation years of formal regulations that restructured program architecture and eligibility, which is why they anchor our periodisation and the counterfactual forecasts reported in the analysis.

1991 Reform (Regulation on the Principles of Encouragement and Support of the Scientific and Technological Research Council of Türkiye Research and Development Projects, 1991): This policy introduced formal criteria for research project types (basic, applied, developmental) and emphasized alignment with national development goals. Projects in “positive sciences” were prioritized, and multi-stakeholder collaboration was encouraged. Importantly, intellectual property rights were clarified, assigning patent ownership to public institutions but subjecting their international licensing to TUBITAK approval.

¹¹ <https://tubitak.gov.tr/en/scholarships/postdoctoral/research-scholarship-programs/2247-national-outstanding-researchers-program>

¹² <https://tubitak.gov.tr/en/scholarships/postdoctoral/research-scholarship-programs/2247-d-national-early-stage-researchers-program-0>

¹³ <https://tubitak.gov.tr/en/scholarships/lisans-onlisans/burs-programlari/2205-undergraduate-scholarship-program>

¹⁴ <https://tubitak.gov.tr/en/scholarships/postgraduate/research-scholarship-programs/2213-overseas-graduate-scholarship-program-only-phd>

¹⁵ <https://tubitak.gov.tr/en/scholarships/international/research-scholarship-programs/2232-international-fellowship-outstanding-researchers>

2005 Reform (Regulation on Project Incentive and Support Principles of the Scientific and Technological Research Council of Türkiye, 2005): Marking a broadening of disciplinary coverage, this reform introduced support for the social sciences and humanities alongside natural and applied sciences. The Career Program was launched to support early-career researchers. The Rapid Support Program targeted small-scale, time-sensitive university projects. The concept of guided (targeted) projects was introduced, focusing funding on strategically important research areas. However, while these programs diversified access, gaps remained in practical implementation—particularly for SSH disciplines.

2009 Reform (Regulation on Programs Conducted by the Research Support Programs Presidency of the Scientific and Technological Research Council of Türkiye, 2009): This phase further institutionalized strategic project selection, international collaboration, and commercialization goals. A more systematic approach was introduced for proposal review, monitoring, and evaluation. Ethical rules were clarified, and financial procedures became more detailed, including budget components for bursaries, travel, equipment, and services. The Career Program was expanded, and public-sector researchers were incentivized through bonuses. This reform also introduced formal mechanisms for enforcing research integrity and managing project outcomes.

Across these reforms, a consistent trend is evident: an increasing emphasis on impact-oriented funding, measured through publication counts, citation performance, and institutional prestige. These changes aligned Türkiye's research funding strategies more closely with international models but also introduced new challenges related to evaluation fairness, disciplinary diversity, and equitable access.

Together, these reforms reflect TUBITAK's broader institutional transition from a project-oriented funder to a strategic actor in Türkiye's science and innovation system. This shift provides the foundation for assessing the longitudinal effects of national funding policies on scientific productivity in the country.

In parallel with these funding reforms, policy attention in Türkiye has increasingly turned to open science. Dissemination routes, embargo limits, licensing, and repository deposit requirements shape the visibility and timing of research uptake, so open access policy functions as a complementary lever to funding rules. To situate the subsequent analyses, we next outline TUBITAK's 2019 Open Science Policy and explain how it interacts with funding-led incentives and with observed trends in publication, citation, and open access.

Although this is not a regulation published in the Official Gazette, TUBITAK's Open Science Policy (TUBITAK Open Science Policy, 2019) adopted on 14 March 2019 represents a substantive system-level shift and should be considered alongside formal reforms. The policy requires Green Open Access deposit of the accepted manuscript for any publication produced wholly or partly with TUBITAK support in the TUBITAK Open Archive (Aperta) at the time of acceptance, sets maximum embargoes of 6 months for STEM fields and 12 months for the social sciences and humanities, recommends Gold Open Access where appropriate, encourages authors to retain copyright and use permissive licences, promotes data management planning and open data where legally and ethically feasible, and states that compliance will be considered in performance assessment and future applications.

Data and Method

Data Collection

To evaluate the impact of major policy reforms in Türkiye's national research funding system, specifically those enacted by TUBITAK, this study builds on a comprehensive, multi-source dataset covering the years 1980 to 2023. The dataset integrates bibliometric records of Türkiye-affiliated scientific publications with information on the funding bodies that supported them, as well as policy documentation and university-level statistics. Data collection was carried out in three stages:

- **Policy and program documentation:** Structural features and eligibility criteria of TUBITAK funding programs were examined using official calls, program guides, and policy documents available on TUBITAK's website. Policy changes and legal frameworks were verified through the Official Gazette archives, enabling periodization around the key reform years (1991, 2005, and 2009).
- **Bibliometric data extraction:** Bibliometric indicators were retrieved in April 2024 from Web of Science and InCites databases. The dataset includes all Türkiye-affiliated publications from 1980 to 2023, along with their citation counts, open access status, and the funders acknowledged in each publication. OECD major subject categories were used for classification of disciplines.
- **Normalization and institutional data:** Publication and citation series were normalised by university faculty counts from the Turkish Higher Education Council's official statistics¹⁶ to account for changes in research capacity. "Academic staff" denotes faculty members: Professors, Associate Professors, and Doctoral Faculty Members. Research assistants, instructors, and administrative staff are excluded. Annual faculty counts were compiled at the university level, aligned to the publication year, and indicators are reported as output per faculty member. We did not apply discipline-specific denominators in the main normalisation because a complete and consistent time series of faculty by discipline is not available for the entire 1980-2023 period. To address disciplinary heterogeneity, the analysis presents disaggregated trends and shares by broad fields in Figure 3 and related panels. This design separates levels from composition and allows readers to see whether fields with different publication norms move differently over time.
- **Funding data:** Funding attribution was taken from InCites database using the normalized Funding Agency, Grant Number, and Acknowledgments fields. A record is coded as TUBITAK-supported if "TÜBİTAK" or "TUBITAK" appears in the normalized funder list or if a TUBITAK grant number is present. Mixed-funded publications are counted as TUBITAK-supported because the project received TUBITAK support and the acknowledgments field is non-fractional; our aim is to capture outcomes associated with any TUBITAK involvement rather than exclusive sponsorship. Records without a TUBITAK funder string or grant number are coded as non-supported.

To allow comparative analysis, the dataset was structured into two major categories: 1) Publications supported by TUBITAK, 2) Publications with no TUBITAK support. Each group was examined across multiple indicators (publication volume, citation count, open access share), with additional controls for reliability and consistency.

¹⁶ <https://istatistik.yok.gov.tr/>

Analysis

We combined descriptive statistics with time-series modelling to assess the effects of TUBITAK policy changes on publication trajectories. Annual series cover 1980 to 2023 for Turkiye-affiliated publications, TUBITAK-acknowledged publications, citations, and open-access shares. Where indicated, outputs were normalised by academic staff. Descriptive analyses summarised funding programme criteria that emphasise publication and ranking indicators and plotted annual counts, citation totals, and open-access percentages, including discipline-specific comparisons.

Policy periodisation followed the major reforms in 1991, 2005, and 2009. To reflect delayed policy response, we implemented a four-year impact window after each reform. This informed three forecasting designs that serve as counterfactuals: models trained on 1980-1995 and projected to 1996-2023, models trained on 1980-2009 and projected to 2010-2023, and models trained on 1980-2013 and projected to 2014-2023. Because the 2005 and 2009 reforms are close in time, potential overlap or spillover effects were addressed directly in this design. Models trained to 1995 provide a baseline that is uninformed by either the 2005 or 2009 changes. Models trained to 2009 primarily reflect the 2005 regime. Models trained to 2013 reflect the consolidated post-2009 regime. We interpret deviations cautiously where timing implies that both reforms could contribute.

Time-series models were estimated in IBM SPSS Statistics 25. We used the SPSS Expert Modeler to screen candidate specifications, followed by manual verification. In SPSS Modeler, the Expert Modeler automatically searches across ARIMA and exponential-smoothing forms, can include seasonal variants when specified, and returns the best model for the target series, along with a model nugget and exportable parameter report (Lin et al., 2015). In practice this is configured by selecting “Expert Modeler” in the Time Series node, restricting to ARIMA models where appropriate, and enabling consideration of seasonal models; parameters can then be extracted from the generated model and exported for reporting and replication.

We considered nonseasonal ARIMA(p , d , q) and exponential-smoothing models, including Simple, Holt, and Brown. Annual data showed no seasonal pattern in autocorrelation plots, so seasonal terms were not used in the final specifications. When variance increased with the mean, we compared models on the original and log scales and retained the specification with the lower information criterion. For ARIMA models, differencing orders were determined during identification in the Expert Modeler and then confirmed by inspecting autocorrelation and partial autocorrelation plots.

Model selection prioritised the normalised Bayesian Information Criterion. When two models had similar BIC values, we chose the one with the lower out-of-sample error on a fixed holdout. For each training window, we held out the last five years for validation, generated forecasts, and computed mean absolute percentage error and root mean squared error. In the Results and figure captions, we name the selected model for each panel and provide key parameters, for example ARIMA(0, 2, 0), or Holt with level smoothing Alpha and trend smoothing Gamma.

Residual diagnostics were applied to all retained models. We examined residual autocorrelation and partial autocorrelation, conducted Ljung-Box Q tests at conventional lags to assess whiteness, and inspected residual plots for signs of heteroscedasticity or structural breaks. Models that failed the white-noise test or showed systematic residual autocorrelation were replaced by the next best specification.

Validation used a fixed five-year holdout for each training window and standard residual checks. Forecasts from each window serve as counterfactuals that exclude later reforms. We

compare these projections with the realised series and interpret any gaps in relation to specific TUBITAK policy changes and the discipline-specific publishing context.

The forecasting design provides counterfactual projections that exclude later policy regimes, which supports statements about association rather than causation. We therefore interpret deviations between forecasts and realised series as evidence consistent with policy-related change, not as proof of causal impact. Several system-level factors can co-move with publication outcomes, including changes in national R&D expenditure, expansion of higher education and faculty headcount, shifts in international collaboration rates, economic growth cycles, and open access policies at funder and university level. Because the time-series models are univariate by construction, these potential confounders are not included as regressors and should be borne in mind when interpreting results.

Findings

This section examines the performance indicators of Türkiye-affiliated scientific publications supported by TUBITAK between 1980 and 2023. The analysis focuses on total publication output, cumulative growth trends, time-series patterns, citation performance, and open access rates. It aims to reveal the effects of TUBITAK funding on scientific publishing in Türkiye and how policy changes over different periods have influenced these indicators. Figure 1 presents the distribution of total Türkiye-affiliated publications and TUBITAK-supported publications, normalized by the number of academic staff.

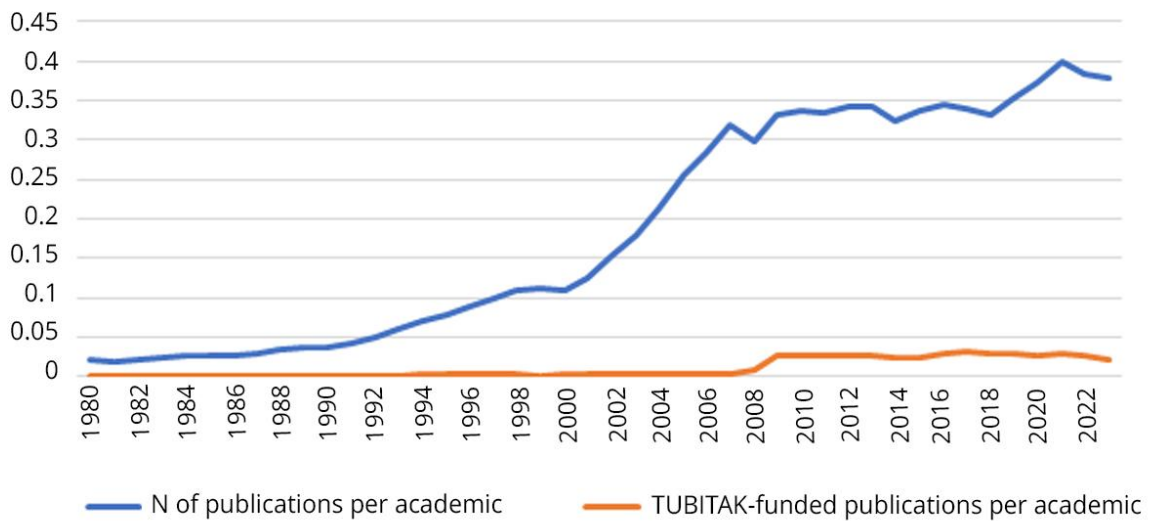


Figure 1. Number of publications per academic

The number of total publications per academic remained relatively low during the 1980s and 1990s. However, it began to increase significantly in the early 2000s and entered a more stable growth phase during the 2010s. In contrast, the number of TUBITAK-supported publications per academic followed a similar pattern to total publications during the 1980s but did not keep pace with the overall growth in subsequent years. Although there was a noticeable increase in TUBITAK-supported publications around 2009, the volume has remained much lower than total academic output and represents only a limited share. The cumulative growth rates of all Türkiye-affiliated publications and TUBITAK-supported publications are shown in Figure 2.

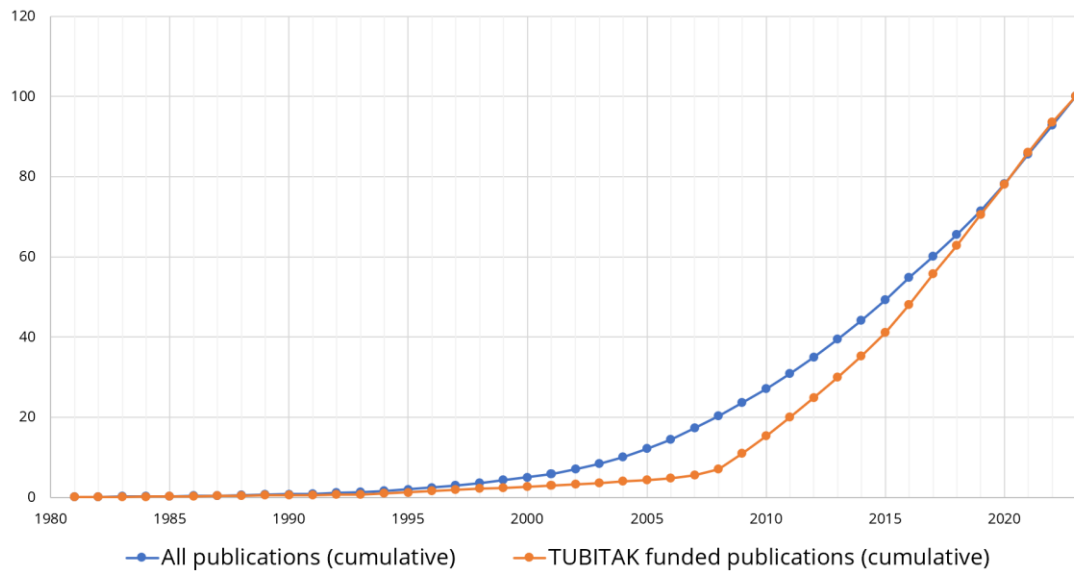


Figure 2. Cumulative growth of all Türkiye-affiliated publications and TUBITAK-funded publications (1980-2023)

Between 1980 and 2000, both curves remained at relatively low levels. However, after this period, a clear upward trend began. Between 2000 and 2010, both curves accelerated significantly, showing a marked increase. From 2008 onward, the rise in TUBITAK-funded Türkiye-affiliated publications gained momentum and began to follow a growth trajectory parallel to that of total Türkiye-affiliated publications. This surge can likely be attributed to the impact of the major policy reform introduced in 2005. By 2020, the cumulative growth of TUBITAK-funded publications had reached a level close to that of total publications from Türkiye. Up to 2023, both curves continued to follow a parallel trajectory, with the gap between them narrowing to a minimal level.

Disciplinary Differences

While these overall trends indicate a growing alignment between TUBITAK-funded outputs and the national research landscape, they may obscure significant variations across disciplines. Different fields have distinct publication cultures, funding needs, and access to institutional support, all of which influence how national funding translates into research output. Therefore, to fully understand the effects of TUBITAK's funding policies, it is essential to examine how support is distributed across academic disciplines and how this distribution shapes scientific productivity within each domain. Figure 3 presents the share of TUBITAK-funded publications as a proportion of all Türkiye-affiliated publications between 1980 and 2023, along with its distribution across disciplines.

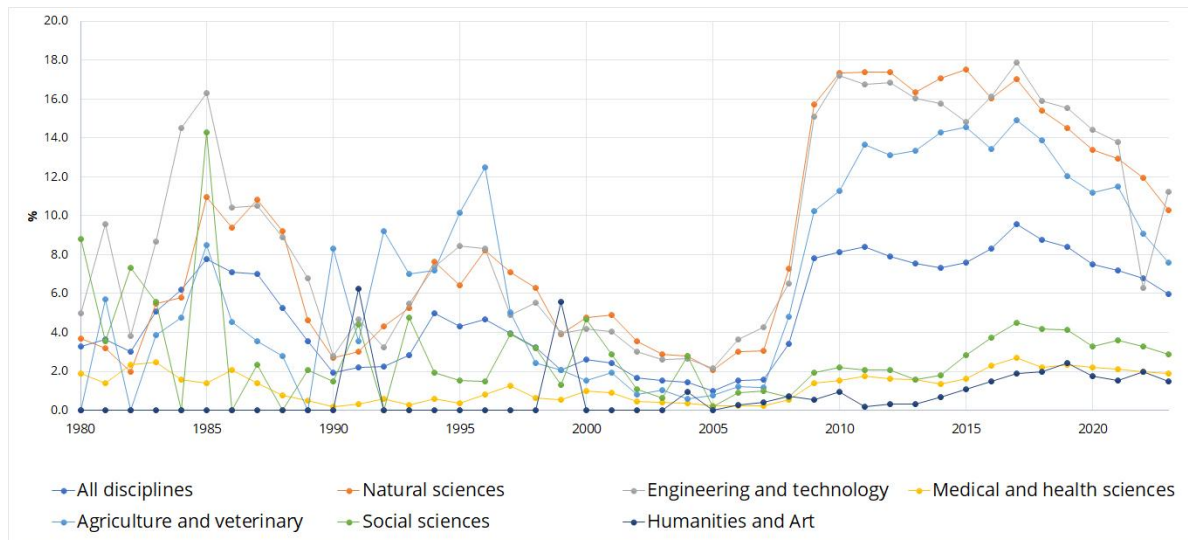


Figure 3. Proportion of TUBITAK-funded publications within all Türkiye-affiliated publications by discipline (1980-2023)

An analysis of the proportion of TUBITAK-funded publications among all Türkiye-affiliated publications between 1980 and 2023 reveals notable fluctuations over time, with a significant increase observed particularly between 2005 and 2015. When examined by discipline, natural sciences and engineering emerge as the fields with the highest proportion of TUBITAK-supported publications. Engineering and technology reached a peak around 2010, while natural sciences experienced a marked increase in the 2005-2015 period. Although the proportion of funded publications in medical and health sciences was lower compared to these fields, there was a noticeable upward trend after 2005. In the fields of agriculture and veterinary sciences, the share of TUBITAK-supported outputs remained generally low, but showed a gradual increase after 2010. In contrast, the proportions for social sciences and humanities remained consistently low and showed no significant increase or fluctuation throughout the period. After 2015, there was a general decline in the share of TUBITAK-funded publications across most disciplines.

To correctly interpret these fluctuations—particularly those observed after 2005—it is important to consider changes in Türkiye's higher education system. Over time, the number of universities and academic staff in the country has steadily increased, influencing both the scale and distribution of research output.

The literature has consistently shown that access to research funding varies across disciplines. Xu et al. (2015) noted that social sciences and humanities are at a disadvantage compared to the natural sciences in accessing both national and international funding, which leads to significant disparities in research productivity and the proportion of funded publications. Similarly, Kaplan et al. (2017) emphasized that limited research funding in the social sciences contributes to lower levels of funding-supported outputs in these fields. Aksnes & Sivertsen (2009) also found that natural sciences, engineering, and medical sciences enjoy higher productivity and better access to funding than the social sciences and humanities. Walters (2014) reported that social science journals receive fewer citations and less funding compared to journals in the natural sciences. More recently, Agamirova et al. (2023) highlighted that structural challenges further limit access to funding in the social sciences and humanities. These findings suggest that disparities in funding access are not unique to Türkiye but reflect a broader global trend.

Open Access

TUBITAK has adopted a comprehensive open science policy that emphasizes transparency, accessibility, and public value in research (TUBITAK Open Science Policy, 2019). As part of its national strategy, it actively supports a wide range of open science practices, including open access publishing, open data, and open educational resources. TUBITAK provides technical infrastructure for Turkish Diamond Open Access journals through its DergiPark¹⁷ platform, facilitating free and non-commercial publishing in many disciplines. While it does not currently offer Article Processing Charge (APC) support within research projects, it strongly encourages Green and Diamond Open Access models. These initiatives underscore TUBITAK's commitment to embedding open science principles into publicly funded research.

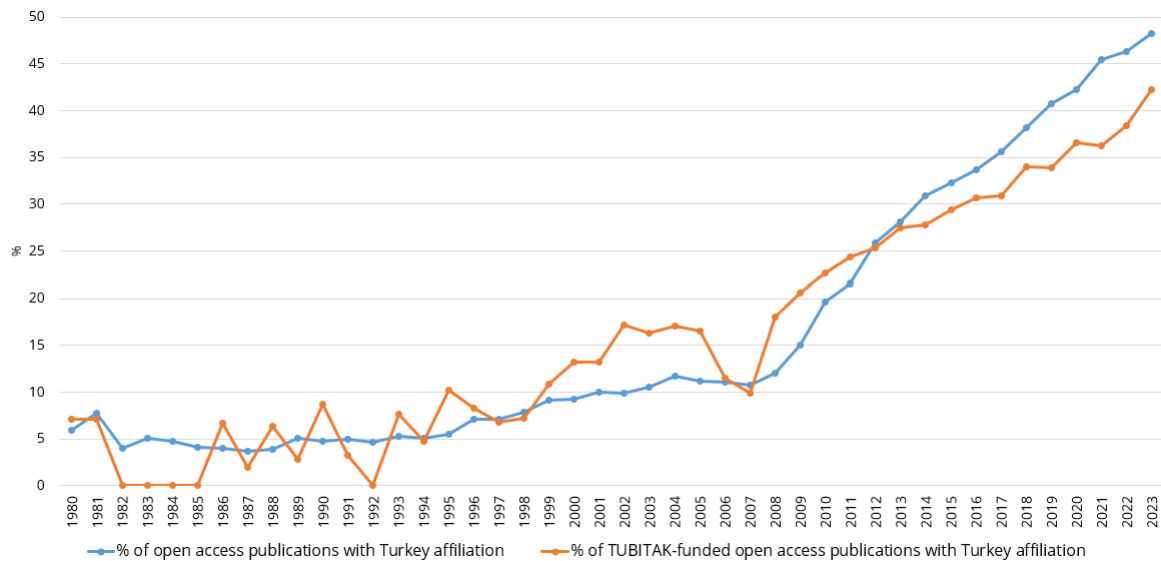


Figure 4. Percentage of open access publications with Türkiye affiliation and TUBITAK-funded open access publications (1980-2023).

Figure 4 illustrates the percentage of open access publications affiliated with Türkiye, along with the share of those that are TUBITAK-funded, between 1980 and 2023. During the 1980s and 1990s, the share of open access publications remained low, showing only limited growth. However, from the early 2000s onward, there has been a consistent upward trend, accelerating notably after 2009. TUBITAK-funded open access publications, in contrast, displayed a more fluctuating pattern between 1980 and 2000, with sharp increases and declines in some years. After 2008, this trend shifted into a steady increase.

Up until 2013, the share of TUBITAK-funded open access publications closely mirrored the overall open access rate of Türkiye-affiliated publications, with the two curves occasionally surpassing each other. However, from 2013 to 2023, a divergence became evident: the overall share of open access publications in Türkiye consistently exceeded the share among TUBITAK-funded outputs. This pattern may be attributed to two key factors. First, many Turkish universities have entered into transformative agreements that support Gold Open Access publishing, which could have elevated the national open access rate independently of project-based funding. Second, the dataset used in this study is based on Web of Science, which tends to have stronger coverage of professional, high-impact factor journals—many of which follow Gold Open Access models (Taşkın et al., 2024). Since TUBITAK primarily supports Green and Diamond Open Access and does not provide funding for APCs, the open access outputs it supports may be underrepresented in such indexes. Therefore, the observed gap is not necessarily indicative of a

¹⁷ <https://dergipark.org.tr/en/>

lack of alignment with open science principles, but rather reflects both structural differences in access models and limitations in data coverage. Nonetheless, the findings highlight an opportunity for TUBITAK to further enhance the visibility of its funded research through stronger open access mandates and potential support for APCs in appropriate cases.

Modelling the Temporal Impact of Funding Policies

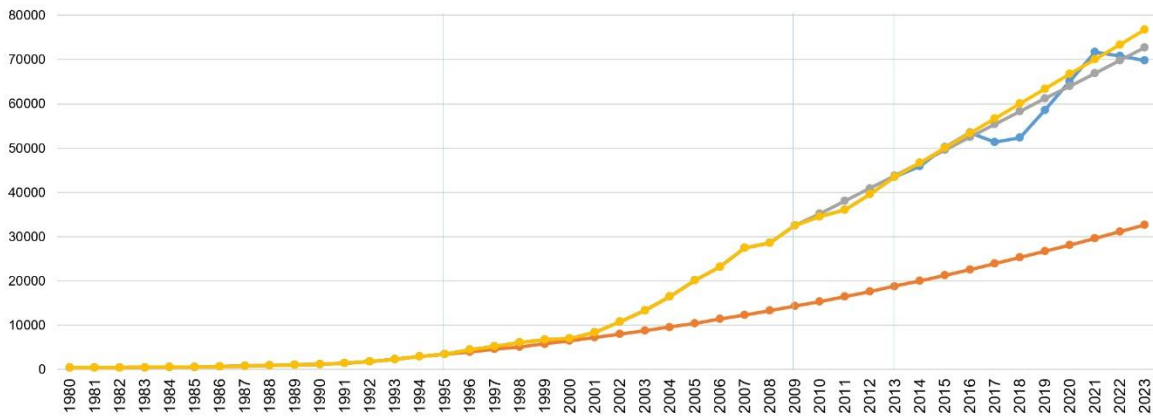
Number of publications

To analyse the longitudinal trends of TUBITAK-funded publications in greater detail, a time series analysis was conducted for the period 1980-2023 using both the total number of Türkiye-affiliated publications and the number of TUBITAK-funded publications. The results are presented in Figure 5.

Panel (a) shows the growth of Türkiye-affiliated publications alongside the results of three forecasting models based on different historical windows. The model based on 1980-1995 data applied an ARIMA(0,2,0) structure, but its estimates were not statistically significant (ES = 38.000, SE = 21.584, $p = 0.102$), and the model underestimated the observed publication growth during 1996-2023. By contrast, the model using 1980-2009 data employed Holt's method and produced more aligned forecasts. While the level smoothing parameter was statistically significant (Alpha: ES = 0.699, SE = 0.239, $t = 2.921$, $p = 0.007$), the trend smoothing parameter was only marginally significant (Gamma: ES = 1.000, SE = 0.587, $t = 1.704$, $p = 0.099$). The model based on 1980-2013 data used Brown's double exponential smoothing, yielding a strong fit with significant results (ES = 0.697, SE = 0.088, $t = 7.935$, $p < 0.001$), and closely matched the actual publication trend over the forecasted period.

Panel (b) displays the growth of TUBITAK-funded Türkiye-affiliated publications and corresponding forecasts. The model using 1980-1995 data followed an ARIMA(0,1,0) structure but failed to achieve statistical significance (ES = 8.867, SE = 5.731, $p = 0.144$), underestimating the rise in funded publications in the 1996-2023 period. The 1980-2009 and 1980-2013 models both used Brown's exponential smoothing and yielded statistically significant results. The 1980-2009 model showed high predictive power (ES = 1.000, SE = 0.198, $t = 5.054$, $p < 0.001$), although it overestimated publication counts for 2010-2023. The 1980-2013 model also demonstrated a strong and significant fit (ES = 0.750, SE = 0.085, $t = 8.834$, $p < 0.001$), better aligning with actual observed data, though it too projected higher values than observed in the post-2020 period.

a) Growth in the number of Turkey-affiliated publications and results of the time series analysis



b) Growth in the number of TUBITAK-funded Turkey-affiliated publications and results of the time series analysis

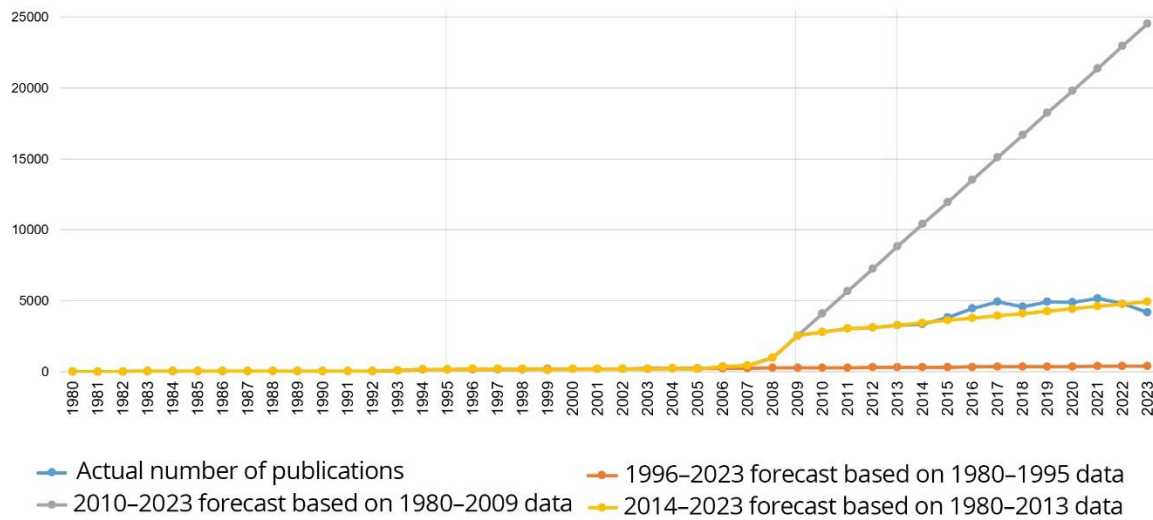


Figure 5. Growth in the number of Türkiye-affiliated publications and results of the time series analysis (a) and TUBITAK-funded Türkiye-affiliated publications and the results of the time series analysis (b)

The results of the time series analysis offer suggestive evidence that the policy reform introduced in 2005 may have had a substantial effect on the growth of scientific publications in Türkiye. The model using data up to 1995—prior to the 2005 policy shift—significantly underestimated the actual increase in publication output observed from 1996 onward, indicating that past trends alone could not account for the acceleration in scientific production that followed. In contrast, the model based on data up to 2013, which includes the post-reform period, closely mirrors the actual growth in publication numbers, particularly through 2020.

This alignment suggests that the rise in research output during the late 2000s and early 2010s was not merely a continuation of pre-existing trends but may have been influenced by the structural changes in research funding and institutional priorities implemented during and after 2005. The 2005 policy reform, which expanded funding programs, restructured evaluation criteria, and promoted broader participation in research, appears to have coincided with, and possibly contributed to, a notable shift in the trajectory of national publication performance.

Moreover, the analysis also reveals that the growth observed after 2009 did not sustain its pace in the post-2020 period, with actual publication numbers falling below projections. This

divergence suggests that while the 2005 reform may have catalysed a medium-term boost in productivity, its long-term sustainability may have been affected by subsequent changes in policy direction, such as the shift toward more selective and priority-focused funding strategies after 2015.

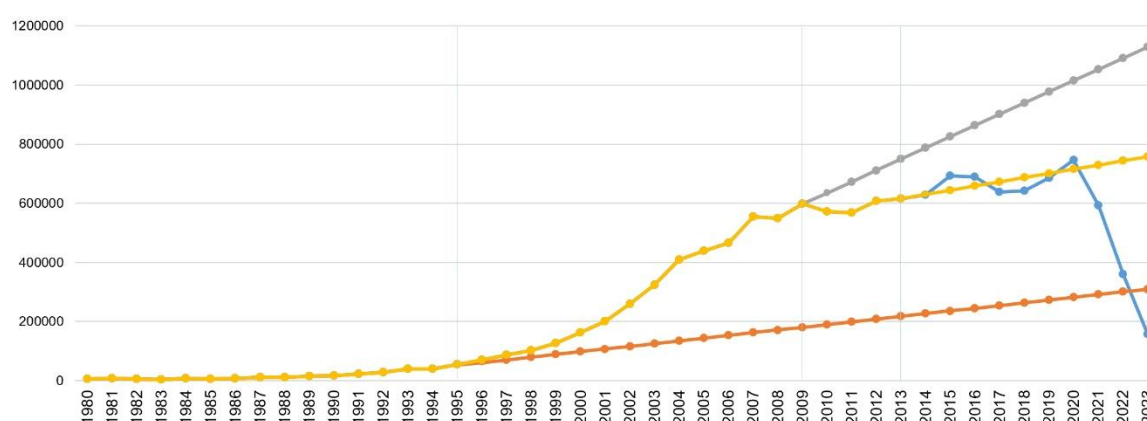
Number of citations

To assess the evolution of citation performance over time, a time series analysis was conducted for citations received by both Türkiye-affiliated publications and TUBITAK-funded Türkiye-affiliated publications between 1980 and 2023. The results are visualized in Figure 6 and reflect distinct trends in citation accumulation and model forecasting accuracy.

Panel (a) presents the total number of citations received by all Türkiye-affiliated publications. A gradual increase is observed from 1980 to 2000, followed by a marked acceleration in citation counts during the post-2000 period. The model based on 1980-1995 data applied Holt's exponential smoothing method but yielded non-significant results for both the level and trend parameters (Alpha: $ES = 0.499$, $SE = 0.288$, $t = 1.735$, $p = 0.105$; Gamma: $ES = 1.000$, $SE = 0.853$, $t = 1.172$, $p = 0.261$), and failed to capture the scale of citation growth in later years. In contrast, the models using 1980-2009 and 1980-2013 data employed Brown's exponential smoothing technique and produced statistically significant results (1980-2009: $ES = 0.598$, $SE = 0.086$, $t = 6.594$, $p < 0.001$; 1980-2013: $ES = 0.623$, $SE = 0.088$, $t = 7.935$, $p < 0.001$), closely aligning with the actual increase in citations until 2020. Notably, a decline in observed citations occurs after 2020, which may be attributed to the natural citation lag for recently published works.

Panel (b) displays the citation trends for TUBITAK-funded Türkiye-affiliated publications. Citation counts remained minimal until 2008, after which a substantial increase was observed. However, this trend plateaued and began to decline after 2020. The model based on 1980-1995 data used Holt's method but was statistically insignificant for both smoothing parameters (Alpha: $ES = 0.099$, $SE = 0.142$, $t = 0.697$, $p = 0.497$; Gamma: $ES \approx 0$, $SE = 0.148$, $t \approx 0.000005$, $p = 1.000$), and failed to predict the eventual rise in citations. The 1980-2009 model, based on Brown's smoothing, was statistically significant ($ES = 1.000$, $SE = 0.209$, $t = 4.785$, $p < 0.001$), but it considerably overestimated citation counts for the 2010-2023 period. The 1980-2013 model applied simple exponential smoothing and showed a strong and significant fit ($ES = 1.000$, $SE = 0.174$, $t = 5.741$, $p < 0.001$), producing forecasts more consistent with actual citation values—though it, too, projected values slightly higher than observed after 2020.

a) Citations received by Turkey-affiliated publications and results of the time series analysis



b) Citations received by TUBITAK-funded Turkey-affiliated publications and results of the time series analysis

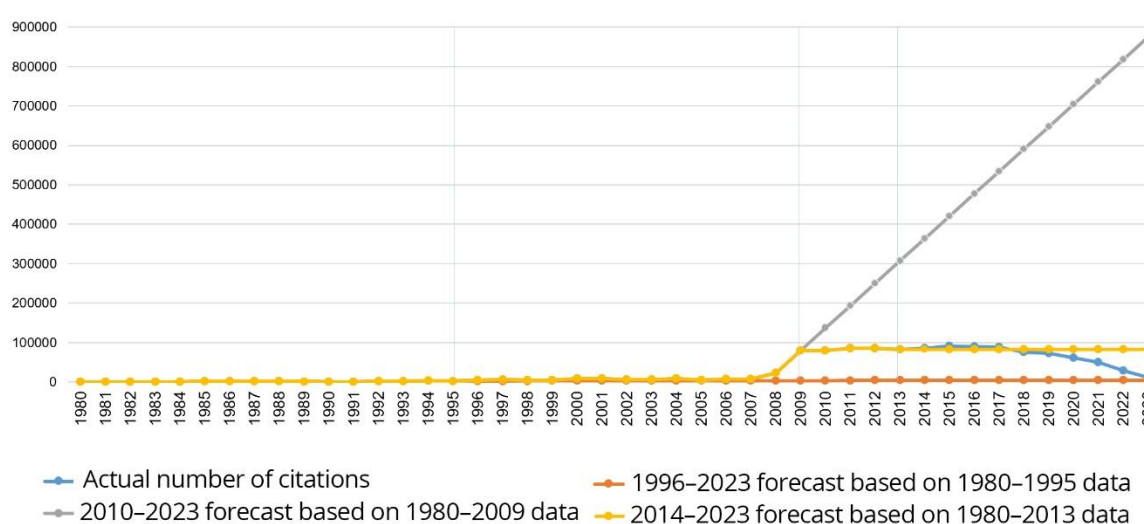


Figure 6. Citations received by Türkiye-affiliated publications (a) and TUBITAK-funded Türkiye-affiliated publications (b), along with time series forecasts for 1996-2023, 2010-2023, and 2014-2023

When viewed together, the two panels suggest that the overall acceleration in citation performance for Türkiye-affiliated publications began around 2000, while for TUBITAK-funded publications, a significant increase only became apparent after 2008. In both cases, the citation trajectory flattens after 2020. These post-2020 declines are likely not reflective of reduced research impact but rather the delay in citation accumulation that typically affects newer publications. Importantly, the results also demonstrate that forecast accuracy improves when later data (e.g., up to 2013) are included, reinforcing the notion that policy shifts, particularly the reforms implemented in 2005, may have influenced not only publication output but also citation performance in the years that followed.

Discussion

This study aimed to evaluate the impact of research funding provided by TUBITAK on academic publication output, citation performance, and open access dissemination in Türkiye.

Funded research is widely recognized to stimulate scientific productivity and scholarly visibility (Pao, 1991). The findings indicate that while TUBITAK funding has indeed supported the growth of scientific publications, its impact has not been linear over time. One critical turning point appears to be the 2005 policy reform, which significantly broadened disciplinary eligibility and introduced new programmatic instruments such as the Career Program and Rapid Support initiatives.

The time-series analysis is consistent with a marked shift in research output around the 2005 reform. Forecasts based on pre-2005 data (training to 1995) systematically underpredict later publication and citation trends, whereas models estimated with data that include the post-2005 regime (through 2013) align more closely with observed growth, especially between 2008 and 2020. These patterns suggest that underlying trends alone do not account for the increase and that the shift coincides with institutional and policy changes, in particular the expansion and restructuring of TUBITAK funding schemes.

However, this momentum was not sustained in the long term. After 2015, a deceleration in both publication and citation growth is observed. This may be attributed to a strategic shift in TUBITAK's funding priorities, as documented in its 2018-2023 and 2024-2028 Strategic Plans (*TUBITAK 2018-2023 Strategic Plan*, 2018; *TUBITAK 2019-2023 Strategic Plan*, 2019; *TUBITAK 2024-2028 Strategic Plan*, 2024). The focus transitioned from output-based evaluation to support for high-impact technologies, national priorities, and thematic areas. While valuable for aligning science with societal goals, this change may have unintentionally limited the volume of supported publications and citations, especially in disciplines not aligned with priority areas. External factors such as the COVID-19 pandemic and economic constraints may have also contributed to this slowdown (TUBITAK, 2024).

The citation analysis reveals a similar trend. While citation counts for TUBITAK-supported publications rose steadily post-2009, they remained below national averages and plateaued after 2020. These results suggest that despite efforts to improve international visibility—one of TUBITAK's stated policy objectives—citation performance has not fully kept pace. Enhancing international engagement, supporting broader dissemination, and incentivizing global collaborations may be necessary to align with these ambitions.

The open access findings add further nuance. TUBITAK has taken meaningful steps to promote open science through its 2019 Open Science Policy (TUBITAK Open Science Policy, 2019) and the DergiPark Diamond OA platform.¹⁸ However, the absence of mandatory open access requirements or APC funding within research grants has limited the visibility of funded outputs in global indexes. While open access rates for TUBITAK-supported publications were comparable to national averages until 2013, a gap emerged thereafter. This divergence underscores the growing influence of university-level transformative agreements and the structural constraints of TUBITAK's OA model, which emphasizes Green and Diamond OA over Gold OA formats that dominate in Web of Science.

Disciplinary differences remain another challenge. Despite increased support following the 2005 reform, funding in the social sciences and humanities continues to lag behind STEM disciplines. These imbalances mirror global trends but suggest a need for more targeted mechanisms to ensure equitable access to funding across fields.

In summary, the findings reveal that the 2005 policy reform represents a pivotal moment in Türkiye's research funding history, one that led to measurable increases in scientific output and visibility. Yet the long-term sustainability of these gains remains uncertain. Future reforms should build on the successes of the 2005 policy shift while also addressing persistent

¹⁸ <https://dergipark.org.tr/en/>

challenges that limit the broader impact of research funding. This includes developing a more inclusive funding architecture that better supports underrepresented disciplines, particularly in the social sciences and humanities. It also calls for tempering the current tilt toward metric-driven evaluation (Hicks et al., 2015; Wilsdon et al., 2015). Journal-based indicators do not uniformly capture contribution and can disadvantage fields with longer publication cycles or non-journal outputs, so safeguards such as field-normalised indicators, transparency, and the use of expert judgment alongside metrics are needed to align incentives with substance and novelty (Aksnes et al., 2019; Hicks, 2012; Sandström & Besselaar, 2016). Strengthening mechanisms for international collaboration and improving strategies to enhance citation performance are essential to increase the global visibility of Turkish research. In parallel, TUBITAK's open science policies should be reinforced through more robust mandates and supportive funding structures to align with global trends in open access publishing. Finally, funding strategies must strike a balance between addressing national priorities and maintaining compatibility with international research standards to ensure both relevance and competitiveness.

Limitations

This study uses univariate time-series models and policy-anchored forecast comparisons, which support statements of association rather than causation. Results may be influenced by concurrent system changes such as national R&D expenditure, expansion of higher education and faculty headcount, international collaboration, macroeconomic cycles, and open science policies. We mitigate timing concerns through training windows aligned to the 1991, 2005, and 2009 reforms and by applying a four-year response window, yet the proximity of the 2005 and 2009 reforms can still produce spillovers that are difficult to isolate. Normalisation relies on university-level counts of Professors, Associate Professors, and Doctoral Faculty Members and excludes research assistants and instructors. Because a complete time series of faculty by discipline is unavailable for 1980-2023, we did not compute discipline-normalised indicators for the full period; instead, disciplinary variation is shown through field-disaggregated figures, which means within-field heterogeneity is only partially captured. Open access detection and funder acknowledgements may contain measurement error. These constraints do not change the main patterns but call for cautious interpretation.

Conclusion

This study examined how TUBITAK's funding policies relate to scientific publication trends in Türkiye. The time-series evidence is consistent with higher output and visibility after key reforms, although effects differ by discipline and change over time. These patterns point to the importance of instrument design, policy stability, and field sensitivity when interpreting national research trajectories.

Variation has two dimensions in our results. First, disciplinary: STEM shows the largest increases in funded output and visibility after 2005, while the social sciences and humanities display more modest changes, as illustrated in Figure 3. Second, temporal: output accelerates after the 2005 reform, with the most rapid growth between about 2008 and 2020, followed by a deceleration after 2015 and a plateau gains after 2020. Stating these patterns explicitly clarifies where funding instruments have been most effective and where adjustment is needed.

To enhance effectiveness, funding strategies should balance volume growth with stronger scholarly contribution, rigor, and openness. Broadening the disciplinary reach of awards, with particular attention to the social sciences and humanities, would address structural imbalances

and support a more inclusive research ecosystem. Strengthening open science practices is also critical. Clear deposit mandates, short embargoes, and robust support for Green and Diamond routes through national infrastructure would increase accessibility and reuse. Integrating open access compliance into grant monitoring and assessment can reinforce these goals. Finally, deeper integration of TUBITAK-funded projects into international collaborations and networks can raise global visibility and citation performance.

The policy record indicates increased support for the social sciences and humanities after 2005, yet the field-level patterns in Figure 3 suggest weaker uptake and output responses in SSH than in STEM and Health. Future work should model disciplines separately with consistent faculty denominators by field, link awards to outputs using grant-level microdata, and complement quantitative analysis with qualitative evidence on programme implementation and publishing norms in SSH.

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