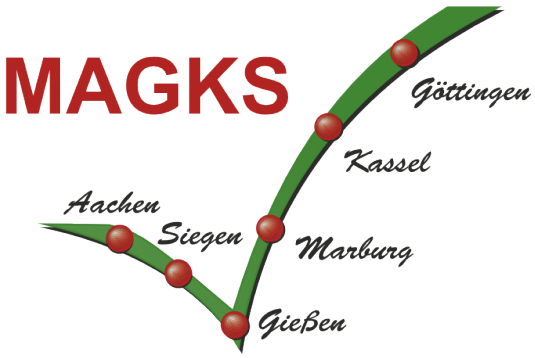

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New Players, different Output?

A longitudinal Analysis of Research Dynamics at German public and private Universities.

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Abstract

This study examines the dynamics of the German university system, focusing on the competition between public and private universities and the impact of institutional boundaries. Utilizing concepts from organizational, institutional, and competition theory, we conceive a framework to explore university input and output measures over two decades. We find that public universities have larger faculties and greater access to public funding, while private universities are more market-oriented and exhibit faster growth in research productivity. Despite their initial disadvantages, private universities have outpaced public universities in publication quantity and quality since 2010. Competition for research funding, talent, and reputation is central to both types of institutions, with public universities securing more highly competitive third-party funding. Our research indicates that both types of universities have led to a form of institutional isomorphism, where both public and private universities are increasingly converging in their strategies regarding publication outcome and personal recruitment but not in funding.

Key words: Private Universities, Public Universities, performance analysis, publication outcome, Germany, University System, Competition

JEL codes: I23, L20, J40

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1. Introduction

The university system in Europe, and particularly in Germany, differs significantly from the structures found in various countries such as the United States or Japan (cf. Casani et al., 2014). While the latter nations have a long history of well-established private universities, which play a central role in their respective university systems, private universities in Germany and much of Europe are relatively new actors (Levy, 2012; Mitterle, 2017). Historically, the German university system has been dominated by public universities, primarily funded by the state and viewed as serving the public interest through education and fundamental research (Teichler, 2007; Hüther & Krücken, 2018).

Private universities in Germany only began to gain prominence in the late 20th century (Buckner, 2017), with a peak in the number of newly founded private universities after the temporary introduction of tuition fees at German public universities in 2007/2008 (Hübner, 2012; Mitterle, 2017). According to the Federal Statistical Office of Germany (2002), there were a total of 283 higher education institutions in the German higher education system in 2001, of which 43 were private universities or private universities of applied sciences (about 15%). In 2020, there were already 423 higher education institutions, of which 106 were private universities or private universities of applied sciences (about 25%).

The rise of these private institutions in Germany, particularly since the 1990s, reflects broader shifts in the governance of universities, influenced by New Public Management principles that emphasize efficiency, competition, and performance measurement (Krücken & Meier, 2006; De Boer et al., 2007). These principles have led to increased autonomy for public universities as well, with a greater focus on input and output measures such as third-party funding and research performance, both in terms of quantity and quality (Schimank, 2005; Stensaker, 2011).

Despite the growing presence of private universities in Germany, relatively little information remains on how these institutions have developed over time, particularly in comparison to their public counterparts (Philipps, 2024). This lack of data is especially pertinent given the dynamic changes in the university sector, driven by demographic shifts, funding constraints, and institutional pressures from both national and international contexts. The question of how private universities have evolved in terms of their research output and their ability to attract third-party funding is a critical one, as these institutions often rely more heavily on tuition fees and private funding sources than public universities (Mitterle, 2017; Buschle & Haider, 2016). Therefore, they often focus on selected subjects where companies or individuals have a correspondingly high willingness to pay for their individual or employees' education or where the state supply of available study places falls short of its demand. In contrast, public universities prioritize broad access and offer a wide range of study subjects and a research mission to serve national interests (Buckner & Zapp, 2021).

This paper aims to explore the performance of public (incumbent) and private (newcomer) universities in Germany, particularly in terms of research input and output measures both in quantity and quality. To be able to compare both forms of universities, we focus on the discipline economics and business studies, since, despite diverse offerings of German private universities, most students at private universities are enrolled in law, social sciences, and business (68%). Accordingly, the majority of academic staff at private universities work in this area. The framing of public universities as incumbents and private universities as newcomers is significant as it reflects the dynamics of market entry and competition within the university system (Levy, 2006; Kyvik, 2009). Research performance is a critical measure of institutional success, contributing to both the academic reputation of the university and its ability to attract competitive funding (Auranen & Nieminen, 2010). In the context of New Public Management,

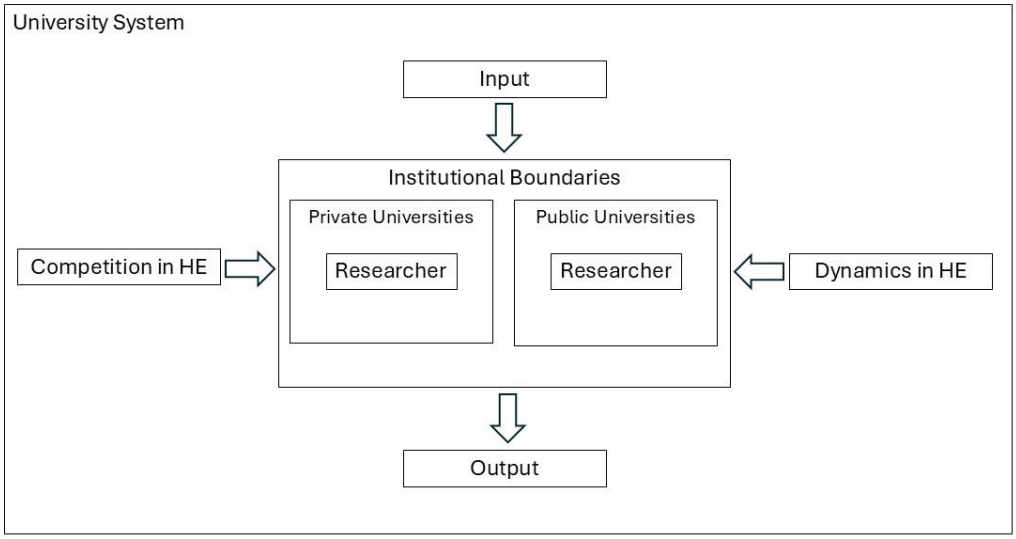
where performance measurement is increasingly important, research output and third-party funding become key indicators of institutional success and sustainability (Geuna & Muscio, 2009). By examining these trends, this paper aims to provide insights into how the incumbent public universities and newcomer private universities in Germany have adapted to institutional pressures, including those arising from New Public Management reforms, and how these pressures have influenced their research performance, funding capabilities, and overall competitive dynamics in the university landscape.

2. The University System and its theoretical Underpinnings

By utilizing theoretical concepts from organizational, institutional, and competition theory, we examine individual phenomena and developments in the German university system. Therefore, we recombine key components of these theories to develop a stylized framework to describe the university system, its competition, and dynamics in the context of different types of universities (see Figure 1). Our framework allows us to compare and contextualize the research performance of both types of institutions - public and private - over two decades in Germany.

Universities operate within institutional boundaries, which influence their behavior and strategic orientation and can be illuminated with the help of institutional theory (see Section 2.1). At the same time, these universities are affected by competition in the research and higher education sector (see Section 2.2) as well as by dynamics that cause changes in the system (Section 2.3). Research-related input measures represent the academic staff of the respective universities, i.e. professors and research teams, as well as financial resources such as third-party funding. Output factors (e.g., publications and citations) are seen as the result of these interactions.

Figure 1 University System



2.1 Institutional Boundaries and their Relevance for Universities

Institutional theory provides valuable explanatory approaches to understanding the behavior of organizations within larger social, political, and economic contexts (DiMaggio & Powell, 1983). According to this theoretical framework, institutions encompass not only governance structures but also social arrangements, norms, rules, and ways of thinking, with symbolic and behavioral systems consisting of representational, constitutional, and normative rules along with regulatory mechanisms, defining a common meaning system and giving rise to distinctive actors and action routines (Scott, 2005; Meyer & Rowan, 1977; Bruckmann & Carvalho, 2018). When applied to universities, this means that both public and private universities are shaped by external institutional pressures such as regulatory requirements, societal expectations, and competitive environments (Krücken, 2014). As Reihlein and Wenzlaff (2016) have identified in their historical perspective on the German university system, the dominating institutional logic from 1998 on is characterized by managerialism and marketization.

Public universities are traditionally seen as institutions serving the public interest with mandates that emphasize social equity, access, and the production of fundamental knowledge (Krücken & Meier, 2006). These universities rely predominantly on state funding, which imposes regulatory guidelines and sets expectations for public service and long-term fundamental research (Krücken, 2014). In contrast, private universities that have emerged in Germany since the 1990s are more market oriented. According to institutional theory, these differences lead to different approaches of public and private universities gathering third-party funding. Public universities, aligned with national and international policy goals, often secure funding from public agencies by prioritizing areas like sustainability or public health (Meyer & Rowan, 1977; Genua & Muscio, 2009). Their ability to access a steady stream of competitive state funding allows them to pursue long-term research goals that align with public needs. In comparison, private universities enjoy more autonomy in their research agendas, aligning their activities closely with market-driven goals, resulting in stronger collaborations with industry partners. However, this reliance on market-oriented research can sometimes limit their sustainability due to the shifting priorities of corporate funding (Clark, 1998; Pinheiro et al., 2015).

The concept of institutional isomorphism, as proposed by DiMaggio and Powell (1983), also plays a role in understanding the development of universities. Both public and private institutions face similar external pressures, such as competition for rankings, the need for visibility, and institutional funding dynamics, leading to convergence in certain aspects of their behavior, despite the foundational differences in their institutional structures. Over time, the influence of New Public Management principles has brought public universities to adopt practices traditionally found in private institutions, such as performance-based evaluations and strategic management approaches (Krücken & Meier, 2006).

2.2 Competition between Universities and its Impact

Clark (1983) distinguishes between three market forms that occur in the higher education sector: consumer market (student choice of institutions and programs), labor market (recruitment and mobility of staff), and institutional market (the relation between universities). In all three of these markets, there are several suppliers and demanders in the context of the higher education sector, resulting in multiple competitive arenas (Krücken, 2021; Bloch et al., 2024). Thus, universities compete for reputation and student attraction on the consumer market, for talented researchers on the labor market and for third-party funding on the institutional market.

2.2.1 Competition for Reputation and Student Attraction

Reputation is a significant factor driving competition between universities. Public universities in Germany have the advantage of long-established reputations and stable government support, which provides them with a solid foundation for maintaining their prestige (Dill, 2009). This long-term stability allows public institutions to attract a diverse student body driven by the quality and breadth of their academic offerings. However, the rise of global rankings has introduced a competitive element, forcing public universities to focus on metrics of research productivity, international collaborations, and student outcomes (Hazelkorn, 2011).

Private universities, by contrast, must build their reputation from scratch, relying on industry partnerships, unique degree offerings, and career-oriented programs to differentiate themselves. Given the lack of financial security compared to public universities, private institutions place a heavy emphasis on employability outcomes and close industry connections as key value propositions for attracting fee-paying students (Aghion et al., 2010). They frequently highlight smaller class sizes, individualized attention, and closer ties to industry to justify tuition fees, particularly in a context where public education is often heavily subsidized or free (Buckner & Zapp, 2021). From a reputational perspective, business schools use research output as a quality signal for student attrition (Besancenot et al., 2009).

2.2.2 Competition for Third-Party Funding

In Germany, as well as various other countries, universities can compete for funding from multiple and interrelated funding streams provided by various sources (cf. Buenstorf & Koenig, 2020; Braun, 1998). Over time an increase in the importance of merit-based funding for universities occurred (cf. Winterhager, 2014). Therefore, securing third-party funding is another crucial aspect of competition among universities. Public universities benefit from a greater degree of access to public research funding through organizations such as the Deutsche Forschungsgemeinschaft (DFG), which places emphasis on long-term, fundamental research initiatives. As a result, public universities often align their research goals with government priorities, ensuring alignment with broader societal needs (Enders, 2004; Casani et al., 2014). Private universities, in contrast, are more dependent on private-sector funding sources such as corporate sponsorships, foundations, and donations (Auranen & Nieminen, 2010). Their focus on applied research, which aligns with industry needs, makes them attractive to corporate partners, but this dependency can come at the cost of academic freedom and might impact the quality and scope of research outputs (Hessels & van Lente, 2010). The competitive environment for third-party funding, thus, drives universities to strategically align their research portfolios by balancing market responsiveness with the pursuit of academic prestige (Hottenrott & Thorwarth, 2011).

2.2.3 Competition for Talent

The ability to attract talented researchers and academic staff is another vital aspect of competition. Public universities are generally seen as more attractive to top researchers due to their secure state funding, established reputations, and the potential for long-term career prospects (Marginson, 2007). Conversely, private universities often grant higher salaries and more flexible working conditions as incentives to recruit high-caliber academics (Close et al., 2011). Attracting renowned scholars may impact a university's ability to secure research funding, boost research productivity, and enhance its overall reputation.

2.3 Dynamics in the University System

In addition to the dynamics within the competitive arenas outlined in Chapter 2.2, higher education is subject to further sectoral dynamics (Kyvik, 2009). We suggest drawing on

research into industry dynamics and viewing the university sector as an industry to better understand these dynamics over time. These dynamics impact both the organizational structure and strategic orientation of institutions, driving them towards convergence while also preserving their unique missions.

2.3.1 Entry and Exit of Universities

Research on industrial dynamics deals with the dynamic change of industries and examines the role of entry and exit of companies, start-ups, and the relationship between established companies (incumbents) and newcomers (cf. Klepper, 1996; Malerba, 1996). A central point within this research is that entries and exits drive market growth and innovation. Start-ups promote competition by challenging established companies to remain innovative and increase their efficiency. While established companies often have resources to continuously invest in research and development, start-ups are often more agile and experimental, making them important sources of radical innovation (see e.g. Baumol, 2004; Carlsson, 2016).

Applied to the higher education sector, industrial dynamics describe a similar dynamic between established universities (incumbents) and new educational institutions or innovative programs (newcomers). This is about how new universities or specialized educational or research-oriented programs enter the market and challenge existing institutions to rethink their teaching methods, research focus, and organizational structures (Kyvik, 2009).

The entry of new players, such as private universities, promotes competition and brings innovative approaches to teaching and research. While traditional universities often have the resources and historical reputation, newer institutions often have the flexibility to respond quickly to technological and societal changes and distinguish themselves with new models for teaching, research, and knowledge exchange.

2.3.2 Resource and efficiency Orientation

Similar to companies in the industry, universities must also operate efficiently as they often have limited resources. Particularly in times of limited public funding and changing student numbers, they must work cost-efficiently, select research projects in a targeted manner, and develop attractive educational programs to attract students and staff. One of the key elements of this dynamic shaping German higher education is the influence of New Public Management. Starting in the 1990s, reforms aligned with New Public Management principles introduced more autonomy for universities, coupled with demands for accountability, transparency, and efficiency (Schimank, 2005). Performance-based funding models were introduced in which institutions are rewarded based on metrics such as research output, student success rates, and international visibility (De Boer et al., 2007). This shift pushed public universities to adopt more strategic and market-oriented management practices, including performance evaluations, strategic planning, and partnerships with industry, blurring the lines between public and private institutions (Krücken, 2014).

Private universities have benefited from this shift by positioning themselves as agile, innovative institutions that can swiftly adapt to market needs and emerging trends (Levy, 2012). The adoption of New Public Management practices by both types of universities has led to a form of institutional isomorphism, where both public and private universities may increasingly converge in their strategies for securing funding and improving research performance (DiMaggio & Powell, 1983).

2.3.3 The Rise of Internationalization in Higher Education

In the same way as companies, universities also face a global market in which they compete and, thus, have set in motion a dynamic of internationalization in the university sector. Over the past two decades, German universities have increasingly engaged in international

collaborations and sought to attract students and scholars from abroad (Teichler, 2007). Both public and private universities recognize the importance of international partnerships to enhance their global visibility and secure funding from international sources like the European Research Council (ERC) (Hazelkorn, 2011). This drive towards internationalization adds an additional layer of competition as universities strive to establish themselves as attractive options for students and researchers globally (Marginson, 2006).

3. Empirical Approach

The following section outlines the empirical approach employed to explore the development of public and private universities over a 20-year period empirically (2001-2020).

3.1 Data

The starting point of our empirical analysis is the publication database Scopus. Using the institutional disambiguation of the German Competence Center Bibliometrics (Donner & Rimmert, 2021) makes it possible to clearly identify the affiliation of publishing researchers in this database. Further, we used journal classifications to identify publications with a focus on economics and business administration. We then linked the publication data aggregated at the university level with further indicators for universities' input and output measures. These are the statistics provided by the Federal Statistical Office of Germany on the annual number of staff in economics and business studies (total number of staff, professors, and researchers with no professorship) and the amount of third-party funding raised from economics and business departments for each university. Additionally, we focus on highly reputable third-party funding in economics and business studies operationalized by grants from the Deutsche Forschungsgemeinschaft (DFG). Finally, we merged our sample with data from the Scimago Journal Ranking (SJR) to assess the quality of publications produced by researchers from German universities.

Our initial data set comprises a total of 200 universities, [1] which includes 14 private universities (Private U), 83 public universities (Public U), 8 private universities of applied sciences (Private UAS), and 95 public universities of applied sciences (Public UAS).[2] We consider only those universities that have economics and business departments and are research-active (i.e. that have produced publications between 2001 and 2020). All indicators relate to input and output measures in the discipline of economics and business studies.[3]

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[1] Since some of the German universities were only founded during the period under investigation, as the comparison of official statistics between 2001 and 2020 above shows, 20 observation years are only available for some publishing universities in our sample. Furthermore, not every higher educational institute transmits its data to the Federal Statistical Office, resulting in missing data in variables relevant for our analysis.

[2] Since this paper focuses on research performance and, consequently, academic reputation within a competitive context, we have decided to exclude institutions that do not actively engage in this competition from our data set. The rationale is that including institutions not participating in the research "race" could skew the analysis and obscure the dynamics we aim to study. After removing these institutions, only two private universities of applied sciences remain in the data set, which is insufficient for meaningful statistical analysis. Therefore, we will not further analyze this category in our study. By refining our data set to include only those institutions actively involved in research and publication activities, we aim to provide a clearer and more accurate comparison of research performance between public and private universities in Germany

[3] Initial examinations of the data set reveal that not all institutions actively participate in the "race" for reputation and academic competition. Specifically, 39 out of the 200 institutions show publications in economics and business studies over the 20-year period, but these publications occur rather sporadically – meaning that there are fewer than 9 years within the 20-year window in which the institution produced at least one publication. This group includes one private university (out of 14), five public universities (out of 83), six private universities of applied sciences (out of 8), and 27 public universities of applied sciences (out of 95). The notably high proportion of private universities of applied sciences with sporadic publications in economics stands out, although it is not surprising. These institutions are predominantly oriented towards teaching and student education, focusing on practical training and professional preparation as part of their core business model. Their primary mission is to provide applied learning experience rather than to contribute to academic research output and scholarly publications. With regard to our theoretical framework (in particular section 2.2), this result indicates that individual private universities deliberately avoid competition in

3.2 Input and Output Measures

By linking and processing this data, we can create multiple indicators that serve to map and analyze the level and development of various input and output measures among different types of universities in the German university system over a period of two decades.

Our first input measure is the *research staff composition* consisting of the number of professors on the one hand and the number of other research staff on the other to understand the structural differences and their dynamic changes between public and private universities. This also helps to contextualize subsequent analyses, as the following indicators are considered in relation to research staff (research staff as the denominator), which differs significantly between the various university types. Secondly, the annual *research degree,* as the number of authors in relation to the total number of academic staff at each university, is intended to provide information on the extent to which the university is involved in the dissemination of research results. In addition, the share of top researchers of all research staff covers the endowment of high-performing researchers at the university. The academic staff consists of professors and other academic researchers. An author is defined as a researcher who has published at least one article in the respective year under review. The top researcher is defined as the number of top 10% researchers employed at a department, based on the number of publications throughout the 2001-2020 period. Furthermore, to track success in acquiring funding, the annual *third-party funding* in economics and business studies per professor is calculated at the university level. Alternatively, the variable *DFG funding* per professor is intended to provide a more granular picture of how universities perform in prestigious and highly competitive funding contests.

Our first output measure aims to shed light on the quantity of research. The *research productivity* of universities per year is calculated by dividing the annual number of publications in economics and business studies by the number of researchers in this discipline. The average annual number of co-authors per publication provides a picture of the university's *intensity of cooperation* and their researchers' integration into the networks. In addition, the annual *degree of internationalization*, as the proportion of publications with at least one foreign affiliated co-author in the total publications of the institution, records the embedding in the global research community of economics and business studies. Finally, to determine the *quality of the research output*, two alternative indicators are used. Firstly, the number of citations in the 3-year period following publication should provide an initial impression of the relevance of the research contributions of the respective universities. Secondly, the mean SJR score of publications at the university level, which evaluates journals according to their scientific influence based on citation analysis and the prestige of a journal, is intended to show how qualitatively high the research results produced by the universities are.

Most of these indicators are directly linked to the criteria used in large international rankings where universities strive to improve their standing. Thus, the chosen indicators are highly relevant for understanding competitive dynamics in higher education (Hazelkorn, 2011) and provide a comprehensive picture of the development of research-related input and output of universities of different types. For an overview of the input and output measures of our analysis and the related indicators we use, see Table 1.

Table 1 Overview of Input and Output Measures and their related Indicators

Input

research and position themselves exclusively in the field of teaching, while the majority of these institutions are actively involved in research.

Measure	Indicator
Research staff composition	Number of professors
	Number of other researchers
Annual research degree	Share of authors of all research staff
	Share of top researchers of all research staff
Annual third-party funding	Average third-party funding per year and professor
	Average number of DFG-projects per year and professor
Output	
Measure	**Variable**
Research productivity	Average number of publications per year and researcher
	Average number of publications per year and research group
Intensity of cooperation	Number of co-authors per publication
Degree of internationalization	Share of international co-authored publications
Quality of research output	Average 3-year citations per publication
	Average SJR-score per publication

3.3 Method

For each measure, we estimate two regression models with robust standard errors to correct for heteroskedasticity. The first estimation is a static analysis, in which we use a pooled regression model of the form:

$$Y_{ut} = \alpha * UniType_u + \beta * yearFE_t + \gamma * fieldFE_u + \epsilon$$

where Y represents the dependent variable of interest of university u at time t. The variable $UniType$ captures the type of university u, distinguished between public universities, private universities, or public universities of applied sciences. The term $yearFE$ represents year-fixed effects, accounting for time-specific influences, such as global research trends, that might affect the dependent variable. The variable $fieldFE$ represents field fixed effects, which control for variations in research focus across institutions, such as the proportion of publications in economics, business administration, or other fields. Lastly, ϵ denotes the error term, capturing unobserved factors.

The second estimation represents temporal analysis, in which we divide the data into five-year intervals and estimate the following model to depict the dynamics in the university system:

$$Y_{ut} = \alpha * UniType_u + \beta * yearCluster_t + \gamma\ UniType_u * yearCluster_t + \delta * fieldFE_u + \epsilon$$

The equation additionally incorporates an interaction term $UniType_u * yearCluster$ between university type and time period, where $yearCluster_t$ is an aggregated 5-year time period. This approach allows us to assess both the static differences and the dynamic changes over time among different types of institutions.

Further, we control the size effects among the institutions: we normalize the number of economics publications by dividing them by the number of researchers—both professors and academic staff—at each institution. This approach ensures that our comparisons account for differences in institutional size. A similar normalization is applied to third-party funding: we calculate the total third-party funds allocated in euros on a per-professor basis at each institution. Similarly, we include the number of highly reputable and competitive grants from

the Deutsche Forschungsgemeinschaft (DFG) per professor. This method allows us to assess the efficiency and effectiveness of institutions in securing research funding relative to their academic staff size. Economics as a discipline is divided into business studies and economics. However, publication strategies and publication patterns in more economic- or more business-affiliated institutes can differ significantly between these subfields. To account for this, we calculate mean shares of business and economic publications for each institution (by publishing journal). For summary statistics, see Table A1 in the Appendix.

4. Differences in Input and Output Measures of different University Types

4.1 Research Staff Composition

We first examine an input measure of the university system – the research staff composition, by capturing changes in professorship positions and other academic staff separately. The regression coefficients can be found in Tables A2 and A3.

Figure 2 Number of professors and other researchers per university type

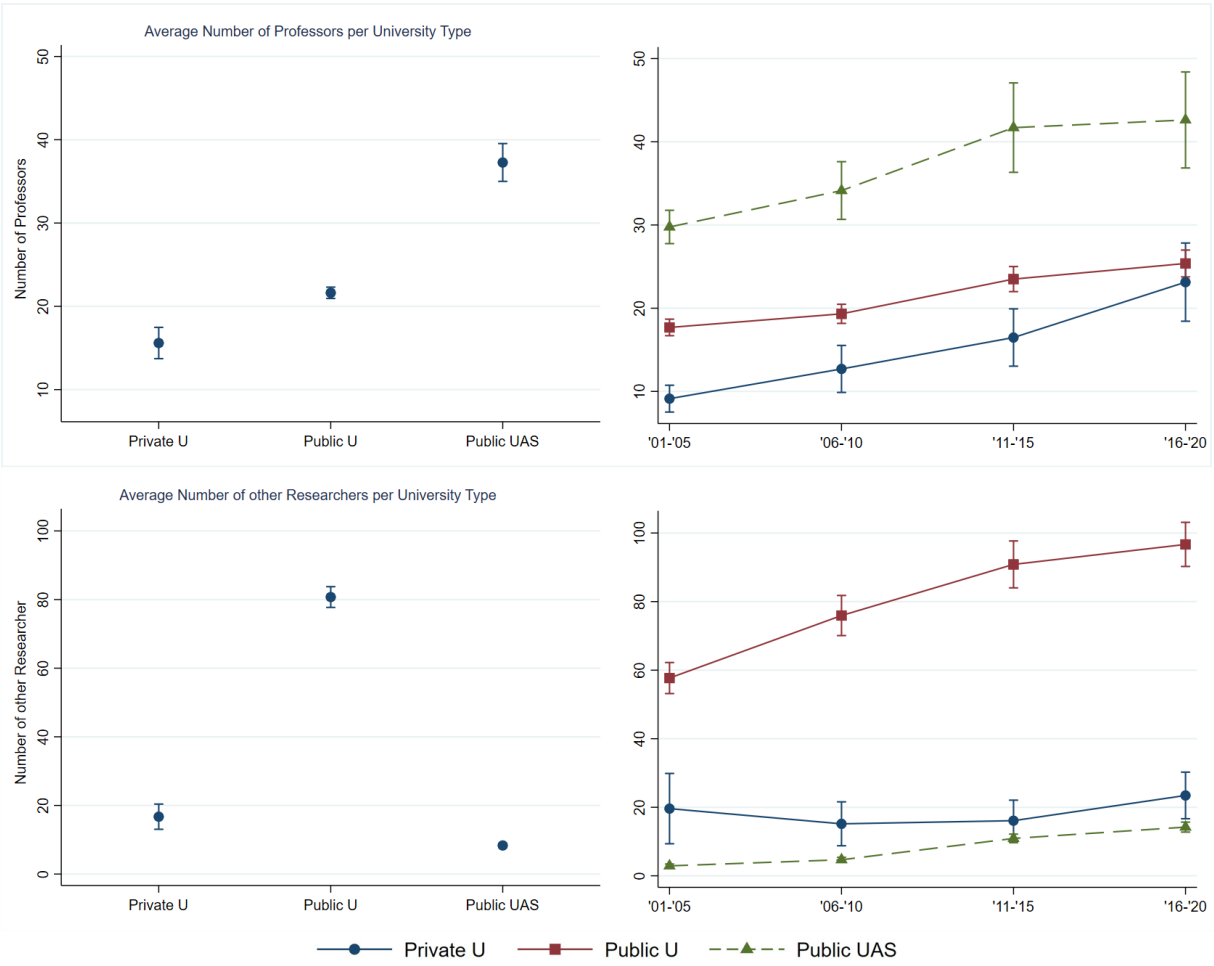


Figure 2 presents both pooled and dynamic (in five-year intervals) comparisons of the number of professors and other academic staff. The figure reveals that public universities of applied sciences (Public UAS) employ, on average, around 37 professors in an economics and business faculty, compared to approximately 21 at public universities (Public U) and around 15 at private universities (Private U). This suggests that faculties at public universities are, on average, larger than those at private universities.[4] Over time, an increase in the number of professors is observed across all types of universities. During the period from 2001 to 2005,

[4] Public universities of applied sciences stand out largely because their teaching is primarily conducted by professors, who make up the majority of the faculty, and because academic staff are typically not assigned for researcher training. The particularly high staff number of universities of applied science is caused partly due to a selection effect in our database, as we only consider universities of applied science whose employees are also active in research in addition to teaching and who actively play the game for publications.

economics and business faculties at private universities employed only about half the number of professors found at public universities, but by 2020, the number of professors at both institution types had converged. This suggests a disproportionate growth in economics faculties at private universities, which at the same time represents the increasing importance of these institutions within the German university system.

Regarding other academic staff (employees without a position as a professor), economics and business faculties at public universities employed, on average, 80 staff members, which is considerably more than at private universities (approximately 20) and public universities of applied science (approximately 10). The significant difference in the number of other academic staff in relation to professorship positions is due to different institutional logics between private and state universities. Professors at public universities are the holders of a chair and the heads of specialist research areas. They supervise a larger research group, often consisting of doctoral and post-doctoral students, that are responsible for academic and administrative aspects. The chair structure at private universities is much less pronounced, and their structure is often closer to an Anglo-Saxon departmental structure with greater individual autonomy for individual researchers.

Over time, we find a divergence between public and private universities for the number of (other) researchers. While we observe a doubling of the number of professors at private universities, the number of academic staff remains constant at private universities. The number of professors at state universities has risen at a much slower rate, while the number of academic staff at public universities increased significantly (from approximately 60 to around 100 between 2001 and 2020). This indicates that no institutional isomorphism can be observed between public and private universities on the organizational level, regarding employment structure.

4.2 Annual Research Degree

Initial descriptive examinations of our linked publication university database reveal that not all institutions actively participate in the "race" for reputation and academic competition. Specifically, 39 out of the 200 institutions show publications in economics and business studies over the 20-year period, but these publications occur rather sporadically – meaning that there are fewer than 9 years within the 20-year window in which the institution produced at least one publication. This group includes one private university (out of 14), five public universities (out of 83), six private universities of applied sciences (out of 8), and 27 public universities of applied sciences (out of 95). The notably high proportion of private universities of applied sciences with sporadic publications in economics stands out, although it is not surprising. These institutions are predominantly oriented towards teaching and student education, focusing on practical training and professional preparation as part of their core business model. Their primary mission is to provide an applied learning experience rather than to contribute to academic research output and scholarly publications. Regarding our theoretical framework (in particular section 2.2), this result indicates that individual private universities deliberately avoid competition in research and position themselves exclusively in the field of teaching, while the majority of these institutions are actively involved in research.

Figure 3 Share of research active staff and top researcher over all research staff

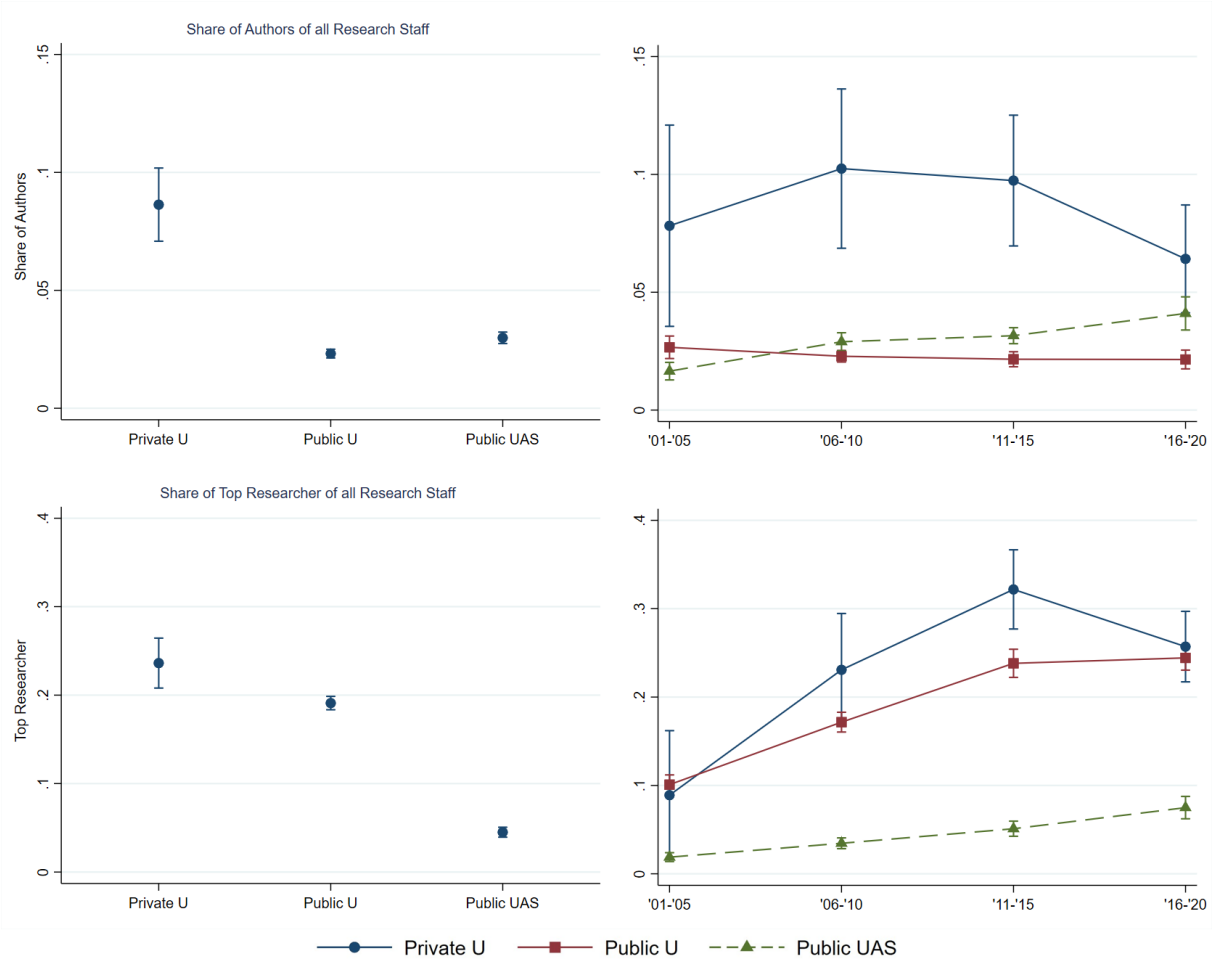
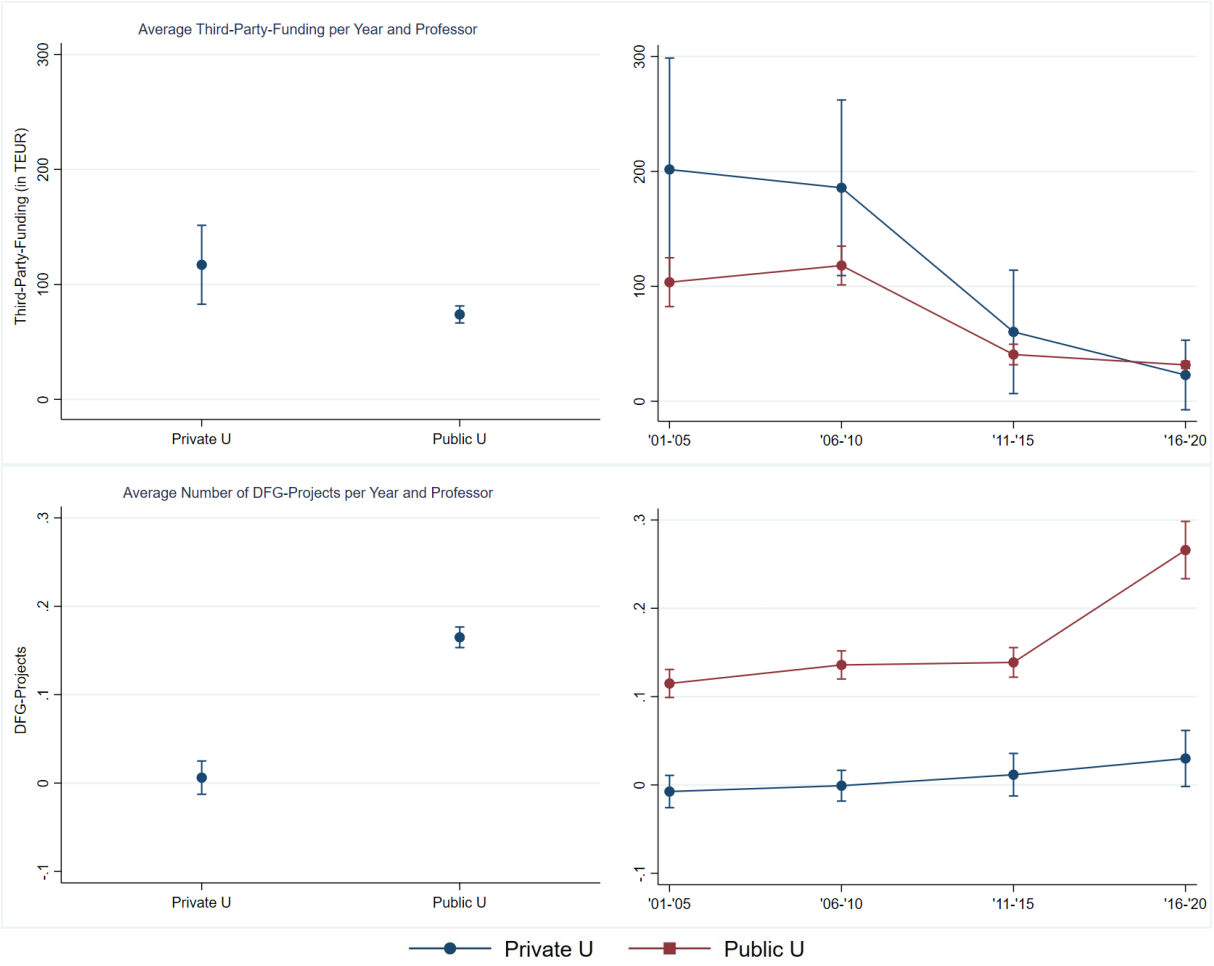


Figure 3 presents our second input measure, the annual research degree, captured by the proportion of authors (i.e., the share of publication-active researchers among all researchers in a given year) and the share of top researchers of all researchers at a department. The high proportion of professors relative to academic staff (predominantly pre-doctoral researchers) is also reflected in the proportion of authors. At private universities, about 8.5% of all academic staff (professors and other academic researchers) are publication-active in any given year, compared to only 2.5% to 4% at public universities and public universities of applied science. Additionally, only minimal temporal dynamics are observed. Overall, private universities (approximately. 24%) have a slightly but significantly higher share of top researchers than public universities (19%), while at public universities of applied science only 5% of all publication active researchers are top researchers. Over time, public and private universities developed rather similarly, raising their top-researcher share to about 25% in recent years, while public universities of applied science cannot catch up and are even further behind.

4.3 Annual Third-Party Funding

We investigate the level and changes over time of third-party funding as our third input measure. Regarding third-party funding per professor, we differentiate between volume (in thousand euros) and the number of high-reputation third-party projects (DFG projects) per professor per year (see Figure 4).

Figure 4 Third-Party Funding per Professor and DFG-Projects per Professor



Universities of applied sciences are excluded from this comparison because they generally do not have significant success in securing third-party funding and have almost no high-reputation third-party projects allocated. Therefore, focusing the comparison on private and public universities provides a clearer picture of the differences in funding capabilities. On average (pooled), professors at private universities secure significantly more third-party funding (€120,000 per year) compared to professors at public universities (€75,000 per year).

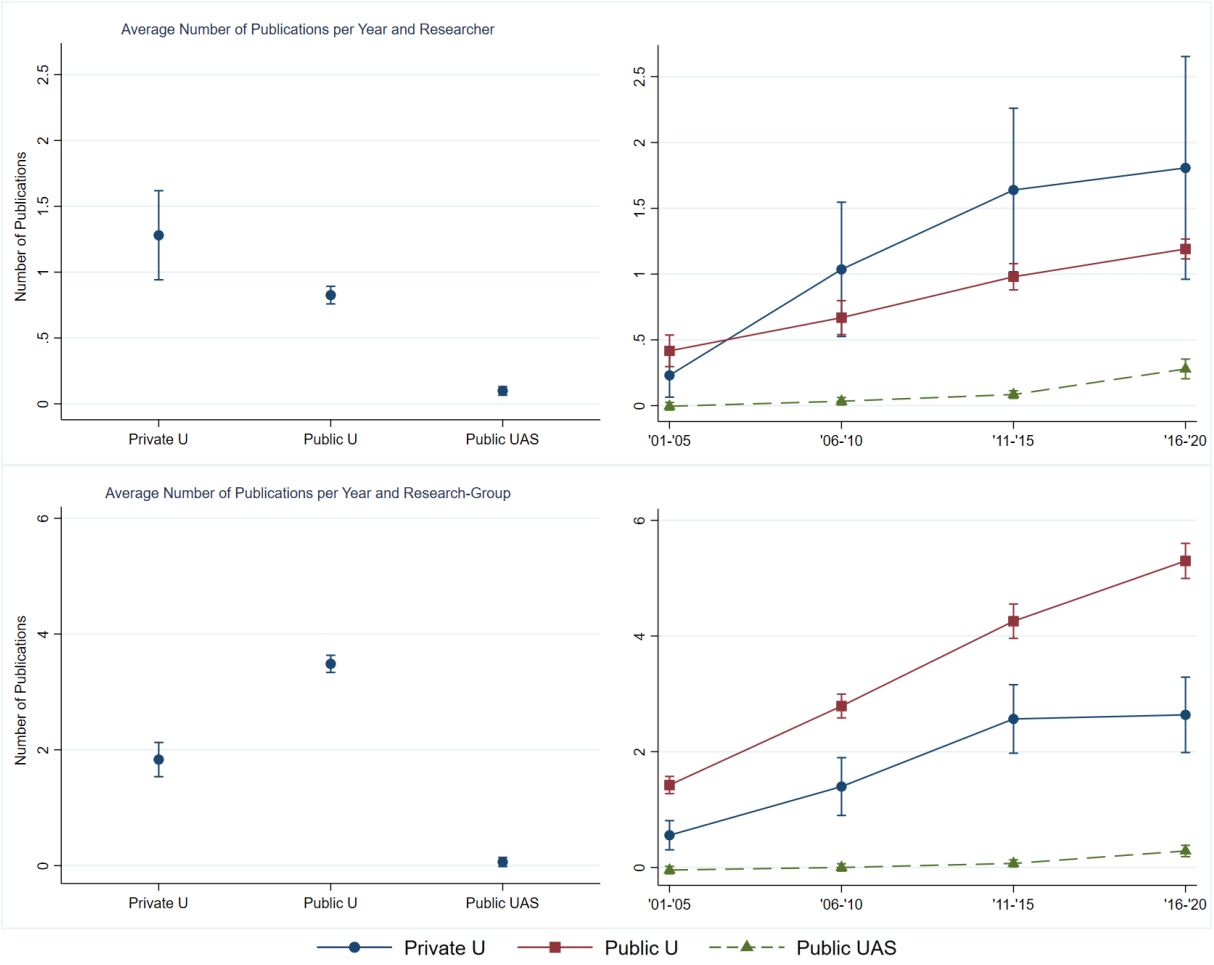
However, the dynamic analysis reveals a more nuanced picture: while third-party funding at private universities was significantly higher until 2010, it converged with that at public universities by 2020. Interestingly private universities cannot extend the competitive advantage in the acquisition of third-party funds over time. Third-party funding per professor decreased for both university types but much more for private universities. Two factors may contribute to this: firstly, the increase in the number of professors at private universities. Since private universities heavily rely on industry and foundation funding that does not need to be directly acquired, the share per professor automatically decreases as staff numbers increase. Secondly, increased competition for third-party funding is evident, as more professors are being hired over time and are collectively applying for limited resources.

Regarding high-reputation DFG funding, the picture is clear: private universities secure almost no DFG funding, while public universities obtain around 0.15 DFG projects per professor per year. Although private universities show a slight upward trend, particularly since 2015, the number of DFG projects at public universities has roughly doubled, with private universities unable to keep up.

4.4 Research Productivity

Figure illustrates our first output measure, captured by the average annual publications per researcher (overall) and per professor (interpreted as research group) for each type of university. In the pooled sample, private universities show significantly more publications (approximately 1.3) than public universities (about 0.9) or public universities of applied science (about 0.1). An interesting pattern emerges over time: the lead in publication quantity at private universities only began to emerge after 2010. Before that point, the different types of institutions had similar levels of publication activity. Thus, a divergence is observed between public and private universities, with private universities moving ahead slightly. Public universities of applied science also show an increase over time but still lag behind considerably.

Figure 5 Average annual Publications per Researcher and Research Group



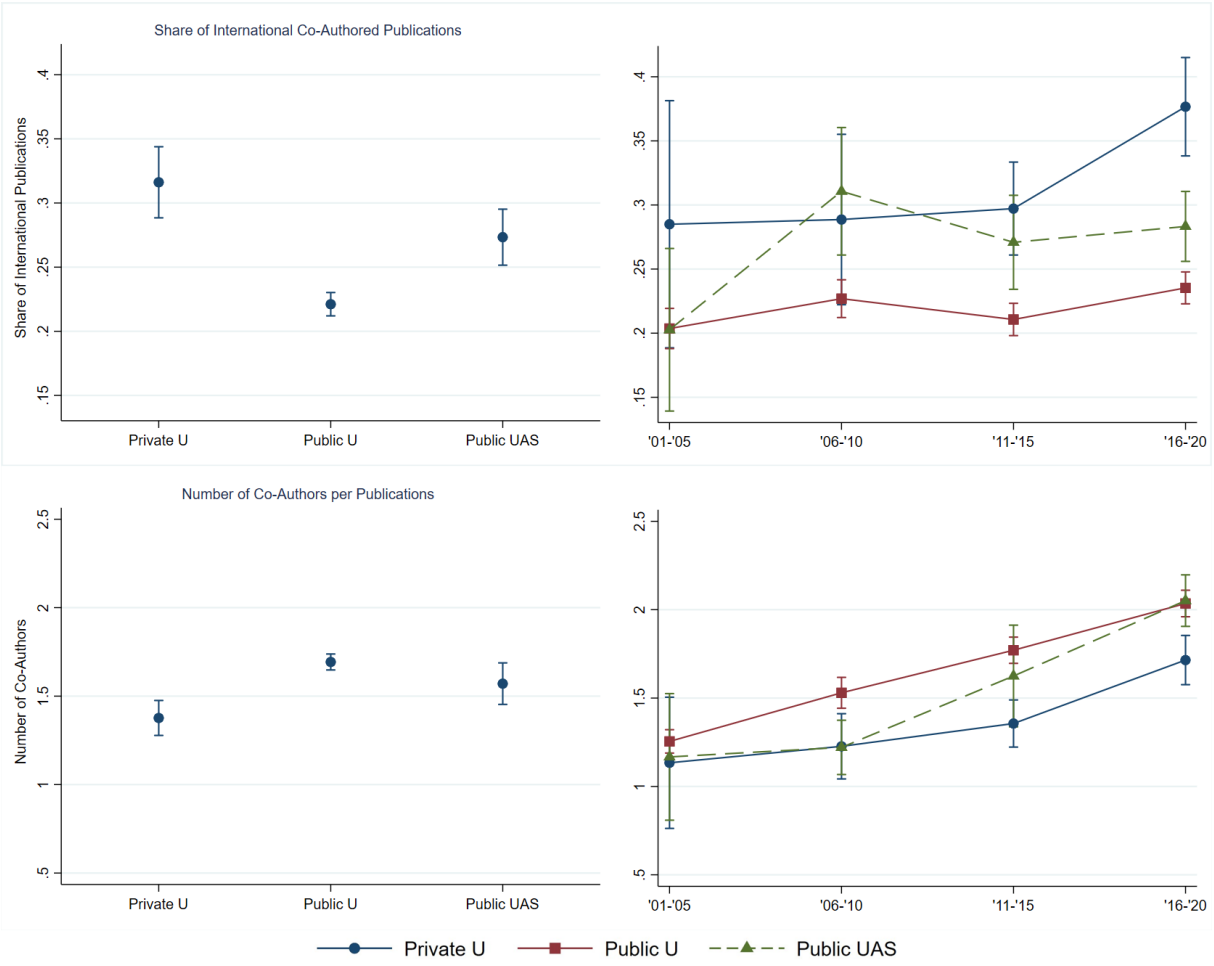
Considering the number of publications per research group, the figures are reversed: public universities (with approximately 3.5 publications per research group) have significantly higher numbers compared to private universities. Over time, the initial differences (in the 2001-2005 period) become more pronounced, and the types of universities diverge further. These figures are closely tied to the size of each research group. Figure 2 shows that academic staff numbers are increasing at public universities while stagnating at private universities. Against this background, the increase in publications per research group at private universities until 2015 can be interpreted as productivity growth (relative to public universities).

4.5 Intensity of Cooperation and Degree of Internationalization

In terms of the average number of (international) co-authors per publication, used as a proxy for (international) social networks, minor differences are evident between university types (Figure). The share of internationally co-authored publications is around 32% for private universities, which is significantly higher than the 22% observed for public universities. Public universities of applied science fall between private and public universities in this regard. Over time, the trend is generally static, except for private universities, which have significantly increased their international collaboration in the last period considered, from 2016 to 2020.

Regarding the total number of co-authors per publication, public universities exhibit the highest value (around 1.7), followed by public universities of applied science (1.6). Publications from private universities have significantly fewer co-authors, which may follow different organizational logics. It is important to consider that private universities employ fewer academic staff per professor, which naturally impacts the number of co-authors. Professors at public universities often co-author first publications with their doctoral students, who are often employed by the university, as part of the academic training process through on-the-job learning. Over time, there is a general increase in the number of co-authors across all university types, which mostly occurs in parallel.

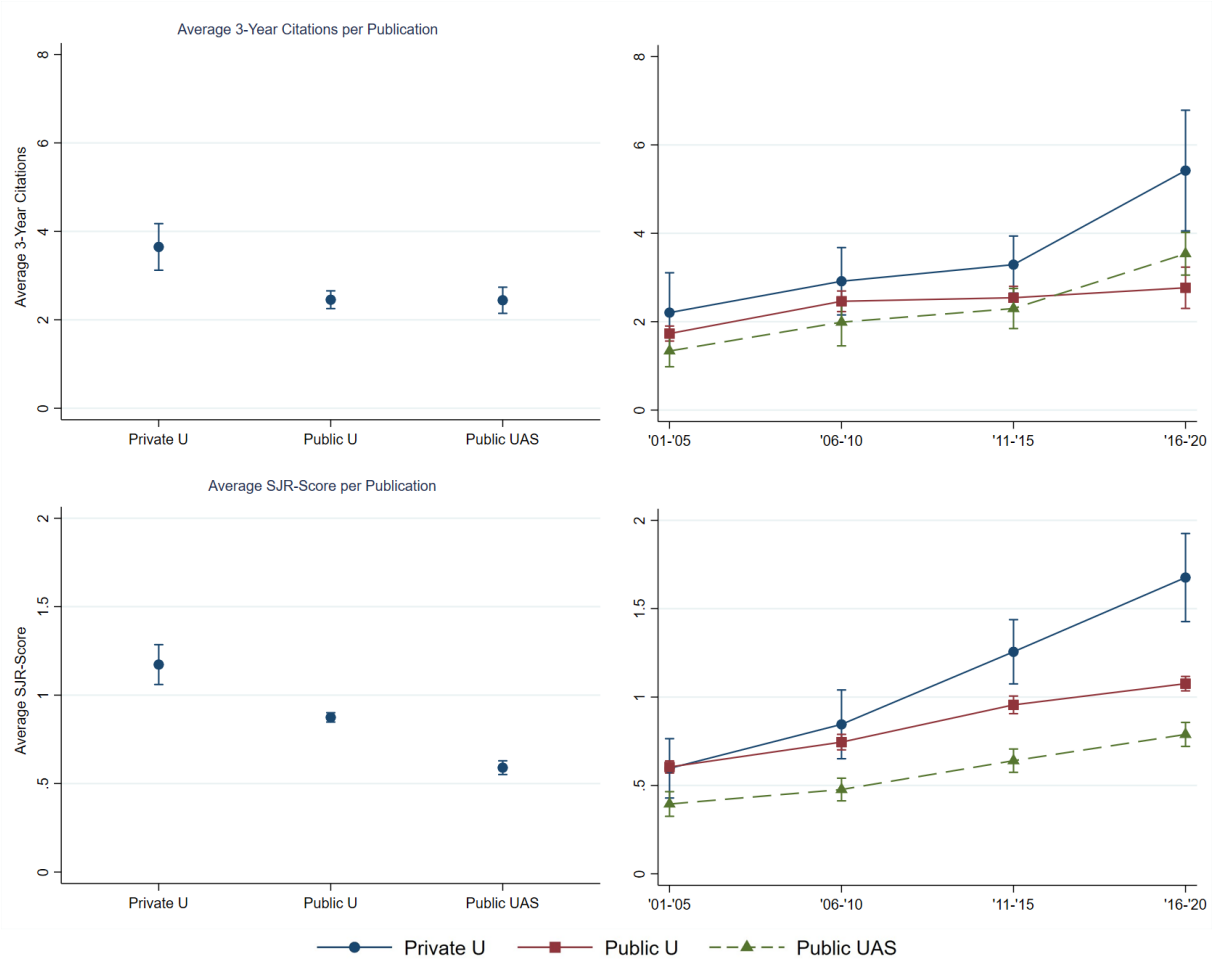
Figure 6 Share of International co-authored Publications and Number of co-Authors per Publication



4.6 Quality of the Research Output

Figure 7 examines the quality of publications and faculty staff. Publications from private universities show a distinct advantage in terms of quality indicators: they receive approximately one additional citation in a three-year period compared to public universities and universities of applied science. The SJR-score also favors private universities, with an average SJR-score of about 1.2 per publication, while public universities and public universities of applied science have average scores of approximately 0.9 and 0.6, respectively. The temporal comparison reveals an interesting pattern: initially, all university types start at a similar level (around 2 citations in a three-year window) and develop in parallel until 2015. Since 2016, private universities have shown a disproportionate increase in the number of three-year citations. The SJR-score exhibits a similar trend: although the starting point is roughly the same for all types, private universities quickly pull ahead. Albeit public universities and public universities of applied science see improvements, but to a lesser extent. Overall, regarding quality indicators, all types of institutions start at approximately the same level, but private universities exhibit significantly better development over time.

Figure 7 Average 3-Year Citations and SJR-Score per Publication



5. Discussion and Conclusion

This paper investigates the performance of public and private universities in Germany, recognizing that a comprehensive understanding of changes in the university system requires a holistic perspective on diverse input and output factors (cf. Koenig, 2024). By analyzing empirical trends in research output and success in securing third-party funding, this study offers insights into how established public and emerging private universities in Germany have responded to institutional pressures, particularly those stemming from New Public Management reforms. We examine how various types of universities have shaped their research performance, funding capacity, and competitive positioning within the higher education sector. Key indicators of university input and output activities in our analysis include both the quality and quantity of publications, as well as third-party funding and research staff.

Our findings highlight key differences between public and private universities in terms of research staff composition, publication output, and quality, as well as third-party funding. Regarding input factors, public universities have significantly more academic staff, but private universities saw a disproportionate increase in the number of professors from 2001 to 2020. Public universities of applied science emphasize teaching, reflected in their higher professor-to-staff ratio. In third-party funding, private universities initially secured more funding per professor, though this converged by 2020. However, public universities dominate in securing prestigious DFG funding, while private universities have very few DFG-funded projects. Lastly, while public universities of applied science showcase small positive developments in almost every metric, they are still considerably below private and public universities. We believe that these differences are due to universities of applied science focusing more on teaching rather than knowledge creation. Moreover, their much slower development in almost every metric indicates that they do not focus as much on competition in research activities as private and public universities, whose increase in almost all dimensions is much more pronounced.

In terms of publication output, private universities have a higher number of publications per researcher, particularly since 2010, while public universities excel in publications per research group due to larger group sizes. Private universities also have more international co-authorship. Regarding publication quality, private universities outperform public ones, showing higher average SJR scores and more citations within three years. Since 2016, the quality gap has widened, with private institutions improving more rapidly.

The difference in research staff size and composition reflects the differing missions of public and private universities. Public universities are geared towards larger research groups and fundamental research, aligning with institutional pressures to serve public interests (Krücken & Meier, 2006). Public universities have professors as academic and administrative leaders of specific subjects, leading to further employees like doctorate candidates, post-doctoral researchers, and lecturers. Private universities, operating within a more market-oriented logic, tend to have smaller research groups and a higher reliance on professors for research output. This highlights their adaptability and focus on efficiency, which aligns with New Public Management principles emphasizing responsiveness and competition (Krücken & Meier, 2006; De Boer et al., 2007).

The higher number of publications per researcher at private universities since 2010 can be linked to their competitive need to build a reputation from scratch. This aligns with their market-driven goals and focus on metrics that contribute directly to reputation-building, such as productivity and international collaborations (Buckner & Zapp, 2021). Public universities' larger research output per research group emphasizes their capacity to leverage economies of scale in research, with larger teams contributing to overall productivity.

The greater degree of international collaboration at private universities supports their strategy of leveraging international partnerships to gain visibility and attract funding. This supports the argument that internationalization is an essential component for private institutions seeking to differentiate themselves and align with global standards (Teichler, 2007). Moreover, this behavior can be interpreted through the lens of institutional isomorphism (DiMaggio & Powell, 1983), as private universities attempt to mimic practices that boost their academic prestige.

The quality advantage shown by private universities in recent years may reflect the influence of New Public Management principles, with private institutions focusing on metrics like citations and high-impact journal publications to showcase their efficiency and output quality (Geuna & Muscio, 2009). However, the divergence in quality indicators after 2016 also suggests that private universities may be selectively investing resources into specific high-quality research areas, whereas public universities maintain a broader focus on fundamental research, aligning with national policy objectives (Meyer & Rowan, 1977). These results also indicate a potential trade-off for public universities: while they excel in producing a higher number of publications per research group, private universities focus more on quality indicators. This finding aligns with institutional theory, suggesting that public institutions, under pressure to serve public needs, may prioritize quantity to meet broad research goals, while private institutions may concentrate on fewer, higher-quality outputs to enhance their competitive standing.

In addition, the convergence in third-party funding per professor between private and public universities by 2020 suggests increasing competition and a leveling playing field. Private universities, heavily reliant on industry and foundation funding, may struggle to sustain the high levels of funding per professor as staff numbers increase. The near absence of DFG funding at private universities reinforces the notion that their research agendas are more market-driven and less aligned with national policy priorities, which are favored in DFG evaluations (Enders, 2004). It also suggests that while private universities are successful in attracting industry-linked funding, they struggle with prestigious, competitive grants. This points to a potential vulnerability in the sustainability of private university funding models, as they remain dependent on industry trends and are less aligned with the national science agenda.

Our study has several limitations that merit careful consideration. A key limitation regarding the generalizability of our findings is the focus on Germany. National university systems vary significantly across countries (cf. e.g. Musselin, 2005), which restricts the extent to which our conclusions can be drawn to other contexts. However, the German case offers a unique opportunity to analyze the emergence of a new type of university—private universities and universities of applied sciences—and to interpret their development of various research-related input and output factors through the lens of existing theories. Moreover, given the various factors influencing the German university system between the early 2000s and 2020, many of which cannot be disentangled in our empirical analysis, the observed patterns should be understood as descriptive rather than causal. Despite these limitations, this study provides the first comprehensive overview of the evolution of a new form of university within a national context, incorporating a broad range of input and output factors.

Further research could build on our findings in several ways. Comparative studies of university systems in other countries would be particularly valuable, as they could shed light on the extent to which the dynamics observed in Germany are unique or part of broader global trends. Additionally, future analyses should aim for a more comprehensive investigation of the diverse outputs associated with universities' missions—research, teaching, and knowledge transfer—and the interactions between these dimensions. Such an approach would help to better capture the complex and multidimensional nature of universities and their evolving roles within society.

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Appendix

Table A1 Summary Statistics

VARIABLES	(1) N	(2) mean	(3) sd
Type of University	3,110		
Private University	246		
Public University	1,553		
Public UAS	1,311		
Share of economic Publications	3,110	0.362	0.129
Share of business Publications	3,110	0.575	0.122
Share of other Publications	3,110	0.063	0.0604
Average Number of Professors per Institute and Year	2,938	27.79	29.83
Average Number of Researchers per Institute and Year	2,938	45.54	56.71
Average Number of Authors per Institute and Year	3,110	29.34	46.85
Average Number of Publications per Institute and Year	3,110	42.65	70.71
Average Number of Publications per Researcher and Year	2,904	0.584	1.625
Average Number of Publications per Research Group and Year	2,892	2.048	3.374
Share of international Publications of all Publications	2,689	0.247	0.213
Average Number of Co-Authors per Institute and Year	2,689	1.625	1.266
Share of Top Researchers affiliated with Institute	2,878	0.132	0.148
Average Number of 3-years citations per Publication	2,689	2.543	3.274
Average SJR-Score per Institute and Year	2,689	0.797	0.565
Amount of annual third-party funding per Professor	1,560	78.44	155.0
Average number of DFG-Grants per Professor	1,665	0.146	0.208

Table A2 Regression Results for pooled Analysis

VARIABLES	(1) Number Prof	(2) Number Researcher	(3) Share Authors	(4) Share top Researcher	(5) Third Party Funding	(6) Number DFG Proj
Private Uni	-6.029***	-64.02***	0.0632***	0.0452***	43.22**	-0.159***
(Reference: Public Uni)	(1.022)	(2.453)	(0.00797)	(0.0151)	(18.12)	(0.0136)
Uni of applied sciences	15.65***	-72.40***	0.00671***	-0.146***		
(Reference: Public Uni)	(1.200)	(1.574)	(0.00155)	(0.00553)		
2006-2010	2.877***	10.32***	0.00487**	0.0507***	13.56	0.0211**
(Reference: 2001-2005)	(0.951)	(2.031)	(0.00244)	(0.00526)	(13.89)	(0.0102)
2011-2015	8.431***	20.43***	0.00499**	0.0976***	-69.74***	0.0255**
(Reference: 2001-2005)	(1.330)	(2.220)	(0.00239)	(0.00590)	(11.71)	(0.0104)
2016-2020	10.31***	25.27***	0.00648**	0.106***	-81.34***	0.139***
(Reference: 2001-2005)	(1.435)	(2.138)	(0.00275)	(0.00590)	(10.81)	(0.0161)
Share Econ Publ.				0.152***	76.79***	0.390***
				(0.0334)	(27.72)	(0.0617)
Share Business Publ.				0.00437	155.1***	0.302***
				(0.0408)	(46.08)	(0.110)
Constant	16.06***	66.34***	0.0190***	0.0685**	-2.799	-0.198***
	(0.683)	(1.688)	(0.00199)	(0.0326)	(31.25)	(0.0762)
Observations	2,938	2,938	2,896	2,878	1,560	1,665
R-squared	0.095	0.418	0.098	0.416	0.089	0.127
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Field FE	No	No	No	Yes	Yes	Yes

Table A2 (Continuing)

VARIABLES	(7) Number Publications	(8) Number Publications RG	(9) Share int. Pub.	(10) Number Co-Authors	(11) 3-y-Citations	(12) SJR Score
Private Uni	0.455***	-1.653***	0.0951***	-0.316***	1.194***	0.299***
(Reference: Public Uni)	(0.174)	(0.169)	(0.0155)	(0.0586)	(0.294)	(0.0598)
Uni of applied sciences	-0.727***	-3.421***	0.0523***	-0.123*	-0.0122	-0.284***
(Reference: Public Uni)	(0.0466)	(0.102)	(0.0135)	(0.0681)	(0.217)	(0.0274)
2006-2010	0.181***	0.783***	0.0440***	0.195***	0.650***	0.131***
(Reference: 2001-2005)	(0.0475)	(0.0757)	(0.0134)	(0.0624)	(0.129)	(0.0233)
2011-2015	0.405***	1.637***	0.0223*	0.479***	0.812***	0.340***
(Reference: 2001-2005)	(0.0452)	(0.0923)	(0.0123)	(0.0764)	(0.125)	(0.0245)
2016-2020	0.603***	2.243***	0.0466***	0.819***	1.615***	0.496***
(Reference: 2001-2005)	(0.0486)	(0.0994)	(0.0118)	(0.0631)	(0.171)	(0.0248)
Share Econ Publ.	0.236	-0.490	-0.0608	-2.241***	-1.212	0.351**
	(0.182)	(0.531)	(0.0706)	(0.436)	(1.080)	(0.136)
Share Business Publ.	0.584**	0.597	-0.181**	-1.075**	-2.108	-0.582***
	(0.272)	(0.609)	(0.0886)	(0.468)	(1.498)	(0.180)
Constant	0.0987	2.124***	0.316***	2.708***	3.240***	0.803***
	(0.198)	(0.492)	(0.0716)	(0.403)	(1.155)	(0.139)
Observations	2,901	2,878	2,689	2,689	2,689	2,689
R-squared	0.178	0.480	0.025	0.082	0.039	0.254
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3 Regression Results for trend Analysis

VARIABLES	(1) Number Prof	(2) Number Researcher	(3) Share Authors	(4) Share top Researcher	(5) Third Party Funding	(6) Number DFG Proj
Reference: Public Uni						

Private Uni	-8.559***	-38.08***	0.0516**	-0.0119	98.06*	-0.122***
	(0.964)	(5.718)	(0.0219)	(0.0376)	(50.92)	(0.0133)
Uni of applied sciences	12.07***	-54.79***	-0.0101***	-0.0820***		
	(0.964)	(5.718)	(0.0219)	(0.0376)	(50.92)	(0.0133)
Reference: Years 2001-2005						
Years 2006-2010	1.637**	18.24***	-0.00381	0.0707***	14.48	0.0210*
	(0.774)	(3.774)	(0.00274)	(0.00787)	(13.71)	(0.0113)
Years 2011-2015	5.812***	33.15***	-0.00507*	0.137***	-62.93***	0.0239**
	(0.919)	(4.187)	(0.00292)	(0.00943)	(11.54)	(0.0115)
Years 2016-2020	7.686***	38.98***	-0.00518	0.143***	-71.97***	0.151***
	(0.966)	(4.019)	(0.00317)	(0.00868)	(10.74)	(0.0179)
Private Uni # 2006-2010	1.936	-22.67***	0.0280	0.0711	-30.39	-0.0144
	(1.828)	(7.230)	(0.0279)	(0.0498)	(64.74)	(0.0137)
Private Uni # 2011-2015	1.536	-36.67***	0.0242	0.0955**	-78.40	-0.00482
	(2.145)	(7.362)	(0.0261)	(0.0445)	(57.70)	(0.0163)
Private Uni # 2016-2020	6.318**	-35.15***	-0.00888	0.0246	-106.9**	-0.114***
	(2.710)	(7.450)	(0.0249)	(0.0431)	(52.65)	(0.0238)
UAS # 2006-2010	2.740	-16.46***	0.0163***	-0.0551***		
	(2.184)	(3.802)	(0.00386)	(0.00835)		
UAS # 2011-2015	6.125**	-25.14***	0.0201***	-0.105***		
	(3.066)	(4.244)	(0.00389)	(0.0102)		
UAS # 2016-2020	5.175	-27.68***	0.0297***	-0.0874***		
	(3.261)	(4.096)	(0.00515)	(0.0109)		
Share Econ Publ.				0.150***	78.05***	0.389***
				(0.0334)	(27.44)	(0.0622)
Share Business Publ.				-0.00285	159.2***	0.299***
				(0.0404)	(46.05)	(0.110)
Constant	17.69***	57.70***	0.0266***	0.0486	-9.635	-0.198***
	(0.506)	(2.314)	(0.00243)	(0.0332)	(30.74)	(0.0766)
Observations	2,938	2,938	2,896	2,878	1,560	1,665
R-squared	0.097	0.428	0.116	0.439	0.095	0.132
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Field FE	No	No	No	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3 (Continuing)

VARIABLES	(7) Number Publications	(8) Number Publications RG	(9) Share int. Pub.	(10) Number Co-Authors	(11) 3-y-Citations	(12) SJR Score
Reference: Public Uni						
Private Uni	-0.186*	-0.867***	0.0813	-0.121	0.474	-0.00779
	(0.105)	(0.150)	(0.0499)	(0.193)	(0.474)	(0.0881)
Uni of applied sciences	-0.421***	-1.469***	-0.000965	-0.0878	-0.395*	-0.209***
	(0.0682)	(0.0941)	(0.0338)	(0.186)	(0.221)	(0.0407)
Reference: Years 2001-2005						
Years 2006-2010	0.252***	1.366***	0.0233**	0.275***	0.730***	0.141***
	(0.0819)	(0.121)	(0.00976)	(0.0519)	(0.132)	(0.0257)
Years 2011-2015	0.563***	2.832***	0.00707	0.516***	0.811***	0.351***
	(0.0730)	(0.159)	(0.00899)	(0.0475)	(0.135)	(0.0281)
Years 2016-2020	0.774***	3.874***	0.0317***	0.780***	1.036***	0.471***
	(0.0674)	(0.164)	(0.00899)	(0.0470)	(0.222)	(0.0254)
Private Uni # 2006-2010	0.553*	-0.525*	-0.0196	-0.182	-0.0202	0.108
	(0.284)	(0.307)	(0.0604)	(0.215)	(0.611)	(0.133)
Private Uni # 2011-2015	0.846**	-0.822**	0.00516	-0.294	0.275	0.308**
	(0.334)	(0.362)	(0.0531)	(0.204)	(0.575)	(0.129)
Private Uni # 2016-2020	0.803*	-1.794***	0.0600	-0.199	2.178**	0.608***
	(0.443)	(0.390)	(0.0535)	(0.205)	(0.864)	(0.155)
UAS # 2006-2010	-0.214***	-1.320***	0.0847**	-0.221	-0.0768	-0.0588
	(0.0819)	(0.122)	(0.0418)	(0.205)	(0.327)	(0.0533)
UAS # 2011-2015	-0.474***	-2.716***	0.0611	-0.0581	0.150	-0.106*
	(0.0734)	(0.159)	(0.0379)	(0.240)	(0.297)	(0.0552)
UAS # 2016-2020	-0.490***	-3.544***	0.0489	0.104	1.164***	-0.0779
	(0.0770)	(0.169)	(0.0357)	(0.201)	(0.363)	(0.0541)
Share Econ Publ.	0.231	-0.583	-0.0617	-2.229***	-1.151	0.352***
	(0.180)	(0.503)	(0.0705)	(0.438)	(1.085)	(0.136)
Share Business Publ.	0.552**	0.387	-0.182**	-1.062**	-2.027	-0.581***
	(0.270)	(0.569)	(0.0884)	(0.469)	(1.503)	(0.179)
Constant	0.0157	1.412***	0.329***	2.677***	3.302***	0.803***
	(0.206)	(0.465)	(0.0715)	(0.410)	(1.166)	(0.140)
Observations	2,901	2,878	2,689	2,689	2,689	2,689
R-squared	0.194	0.544	0.030	0.085	0.048	0.267
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1