

PUBLIC-PRIVATE PARTNERSHIP: BIBLIOMETRIC AND VISUALIZED ANALYSIS

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Abstract: *There has been a notable surge in scholarly interest in public-private partnerships (PPP), their forms, models and role in the development of social infrastructure. The growing body of research on PPPs makes bibliometric analysis in this area a pertinent task. This study focuses on the literature on PPPs published between 2000 and 2021 and indexed by Scopus, Google Scholar, and Crossref. The study examines the evolution and structure of publication activity and trends in co-authorship as well as reciprocal citation relationships between articles. The top cited publications, authors and journals are identified. We have also conducted a semantic analysis of publication titles and keyword co-occurrence relationships, building a co-occurrence map in VOSviewer software. These research results can be of interest to scholars and practitioners in the field of public-private partnerships.*

Key words: *public-private partnerships, bibliometric analysis, visualization*

JEL classification: *L32*

1. INTRODUCTION

The development of ownership rights in today's market economy encompasses constant transformations in the state-private sector cooperation forms. These transformations are part of the natural market process of organizing limited resources to satisfy human needs and deliver the

necessary public goods (commodities and services). The idea at the core of public-private partnerships (PPPs) is the increased level of involvement of private-sector stakeholders in building social infrastructure. On a practical level, PPPs can deliver a number of important benefits to governments, including access to financial, managerial, R&D and intellectual resources of the private sector as long as the public participation is well organized, the project is thoroughly planned, and the necessary control over project execution is established.

The public-private partnership (PPP) model has been one of the most extensively discussed topics in the last decade. It came to be seen as an optimal tool for the realization of large-scale national and regional projects as it permits the distribution of risks and responsibilities between the cooperating parties.

'Public-private partnership' is a relatively new concept that appeared in 1992 in the UK, where it was initially known as the Private Finance Initiative and was understood as the government delegating to the private sector some of its functions, e.g. renovation, operation, and management of the publicly owned property. In its current use, this term, however, is open to a broader range of interpretations.

There is no clearly definition or universal understanding of 'public-private partnership'. For example, the World Bank defines PPP as a mechanism for government to procure and implement public infrastructure and/or services using the resources and expertise of the private sector. PPPs are most employed by governments to

solve the problem of ageing infrastructure or lack thereof or to improve the effectiveness of public services. A partnership with the private sector can help foster new solutions and bring finance, in other words, it provides an opportunity to combine the skills and resources of both the public and private sectors and enables both sides to share their risks and responsibilities (World Bank Group, 2022)

This study is aimed at investigating the trends in the development of the public-private partnership concept in the international research literature. The study relies on bibliometric analysis methods and focuses on the data reflecting publication activity between 2000 and 2021.

This study is highly relevant today for several reasons. First off, there has been a notable global increase in PPP utilization over the past two decades, driven by the need to address infrastructure gaps and optimize service delivery in key sectors like transportation, healthcare, and education. The COVID-19 pandemic has underscored the importance of PPPs in crisis response and recovery, with governments using them to accelerate infrastructure development and economic growth amidst fiscal constraints. This study uses the advanced bibliometric and visualization techniques aligns with modern research methods, offering data-driven insights into PPP evolution. By leveraging these tools, the study enhances understanding of PPP dynamics and informs policy and decision-making in both public and private sectors.

Methods: bibliometric analysis, semantic analysis, comparative analysis, tabular analysis.

To collect and analyze the bibliometric information on the topic, we used the free software Publish or Perish (Tarma Software Research Ltd.), which retrieves, analyzes, and exports academic citation records from external data sources. The search was conducted across the three databases:

- Scopus;
- Google Scholar;
- Crossref.

The search term used was 'public-private partnership; PPP'. We also filtered the search results by document type (books, articles, reviews, and conference proceedings) and date range (from 2000 to 2021). As a result of data processing, conversion, and analysis, we built a database containing 876 publications from Scopus, 982 from Google Scholar, and 944 from Crossref.

For data visualization we also used software VOSviewer for clustering and network analysis of bibliometric data.

This study comprises four parts. The first part contains analysis of the publications on PPPs, the dynamics of publication activity in this area, and

citation rates. The second part identifies the top cited publications in the given period. The third part examines the top journals publishing papers on PPPs. The fourth part deals with the keywords used in the titles of publications on PPPs and their frequency.

Research Review. Several studies have applied bibliometric and semantic analysis to the field of Public-Private Partnerships (PPPs) to reveal significant trends and insights. G.Castelblanco, J.Guevara, H.Mesa, A.Sanchez (2021) conducted "Semantic Network Analysis of Literature on Public-Private Partnerships," aiming to explore the semantic structure and relationships within PPP research. F.Bao, A. P. Chan, C. Chen, and A. Darko (2018) approached PPP literature from a project lifecycle perspective, examining research across different phases of PPP projects and associated themes. C.Cui, Y. Liu, A. Hope, and J. Wang (2018) focused on PPPs in the infrastructure sector, reviewing studies that elucidate the dynamics and challenges specific to infrastructure-related partnerships. L.Ma, J.Li, R.Jin, Y.Ke (2019) conducted a "Holistic Review of Public-Private Partnership Literature Published Between 2008 and 2018," providing a comprehensive analysis of PPP literature during this period.

The unique feature of this study lies in exploring publication trends among authors and journals on PPP topic, a cluster approach to semantic analysis of the literature and identifying the trends in PPP research from 2000 to 2021.

2. RESULTS

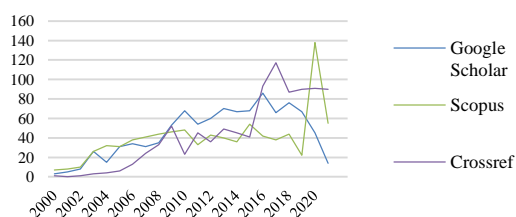
2.1. DYNAMICS OF PUBLICATION ACTIVITY AND CITATIONS OF ARTICLES ON PPPS

Between 2000 and 2021, public-private partnerships (PPPs) have experienced notable trends reflecting evolving approaches to economic collaboration and infrastructure development. One significant trend is the widespread acceptance and adoption of PPPs by governments worldwide. Countries increasingly utilize PPP models across sectors like transportation, healthcare, energy, and education to leverage private sector resources and expertise in delivering public services and infrastructure. A key focus during this period has been on enhancing risk management within PPP projects. Researchers and practitioners have developed frameworks to address financial, operational, and regulatory risks associated with PPPs. Additionally, the research landscape surrounding PPPs has expanded dramatically. There has been a surge in publications and studies

examining different aspects of PPP implementation, performance evaluation, and impact assessment. This growth reflects a deeper interest in understanding the complexities and outcomes of PPP arrangements, aiding evidence-based policymaking, and project management.

By analyzing the data of publication activity on PPPs in the databases for the period of 2000-2021, it should be noted that the graph for each of the databases reached its maximum in the period from 2015 to 2020 (**Figure 1**). For example, in 2020, the number of Scopus registered publications was 138. The two top cited publications were the article by Hong Xian Li 'A review on renewable energy transition in Australia: An updated depiction' (2019), discussing the role of PPPs in the development of infrastructure in the renewable energy sector, and the study published by scholars from Stanford University (Raymond E. Levitt, W. Richard Scott, Carter B. Casady) and the KTH Royal Institute of Technology (K. Eriksson) '(Re)defining public-private partnerships (PPPs) in the new public governance (NPG) paradigm: an institutional maturity perspective' (2019), discussing the changing institutional status of PPPs in the context of the NPG paradigm.

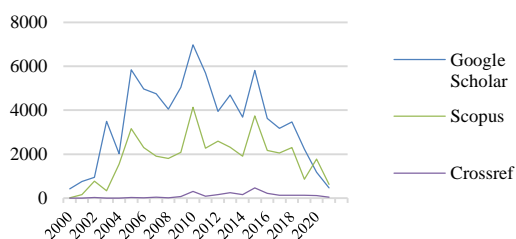
FIGURE 1. Number of publications of publication activity on PPPs in 2000-2021



Source: compiled by the authors

Despite the growing number of publications on this topic, the number of citations registered in each of the databases peaked in 2010 and 2015 and in 2005 for Scopus and Google Scholar (**Figure 2**).

FIGURE 2. Citation rates of publications on PPPs in 2000-2021



Source: compiled by the authors

2.2. THE TOP CITED ARTICLES IN THE GIVEN PERIOD ON PPPS

The analysis of highly cited articles underscores the enduring importance and evolving discourse surrounding PPPs (**Table 1**). These articles contribute significantly to shaping understanding, policy formulation, and practical application of PPPs globally. Key themes explored include performance evaluation, risk management, policy principles, and institutional barriers.

TABLE 1. Top cited publications on PPPs, Google Scholar

Author / Title	Year	Cites
GA Hodge, C Greve. Public-private partnerships: an international performance review	2007	1789
ER Yescombe. Public-private partnerships: principles of policy and finance	2011	1476
X Zhang. Critical success factors for public-private partnerships in infrastructure development	2005	1036
D Grimsey, MK Lewis. Are Public Private Partnerships value for money?: Evaluating alternative approaches and comparing academic and practitioner views	2005	866
A Akintoye, M Beck, C Hardcastle. Public-private partnerships: managing risks and opportunities	2008	853
R Osei-Kyei, APC Chan. Review of studies on the Critical Success Factors for Public-Private Partnership (PPP) projects from 1990 to 2013	2015	834
YH Kwak, YY Chih, CW Ibbs. Towards a comprehensive understanding of public private partnerships for infrastructure development	2009	833
EH Klijn, GR Teisman. Institutional and strategic barriers to public-private partnership: An analysis of Dutch cases	2003	791
TA Börzel, T Risse. Public-private partnerships: Effective and legitimate tools of international governance	2005	730
GA Hodge, C Greve. The challenge of public-private partnerships: Learning from international experience	2005	637

Source: compiled by the authors

These articles collectively cover a range of topics including performance evaluation, financial principles, risk management, and critical success factors in PPPs. The volume of citations

underscores the importance and relevance of these themes in shaping understanding and practice within the realm of public-private partnerships.

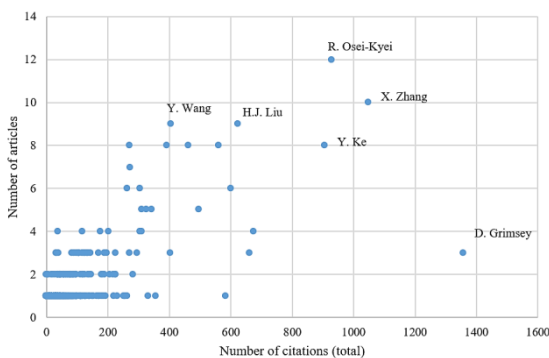
Figure 3 shows a point diagram summarizing the Scopus data on the number of publications and the aggregate number of citations for specific authors. The summary table contains 633 top cited authors in the given period, including the following:

- R. Osei-Kyei (12 articles, 929 citations). R.Osei-Kyei investigates factors of success of PPP projects, strategies of effective PPP management and potential risks of such partnerships for their key stakeholders. His most highly cited works include 'Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013'; 'Critical success criteria for public-private partnership projects: international experts' opinion'; and 'Implementing public-private partnership (PPP) policy for public construction projects in Ghana: critical success factors and policy implications'.

- X. Zhang (10 articles, 1048 citations). X.Zhang discusses the choice of private partners for PPP projects and the corresponding procurement protocols. His most highly cited works include 'Critical success factors for public-private partnerships in infrastructure development'; 'Paving the way for public-private partnerships in infrastructure development', which makes a particular focus on the barriers to the realization of infrastructure PPP contracts; and 'Criteria for selecting the private-sector partner in public-private partnerships'.

- Henry J. Liu (9 articles, 622 citations). Henry J.Liu explores methods of PPP performance measurement and ways of preventing the opportunistic behavior of the key stakeholders. His top cited works include 'Life cycle critical success factors for public-private partnership infrastructure projects' and 'Conceptual framework for the performance measurement of public-private partnerships'.

FIGURE 3. Number of publications and citations for specific authors in 2000-2021

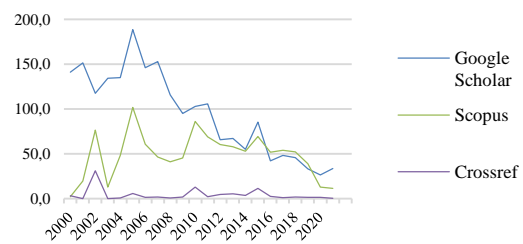


Source: compiled by the authors

The most highly cited author in the Scopus database is D.Grimsey, who publishes extensively on the risks and economic viability of PPP projects. His paper 'Evaluating the risks of public private partnerships for infrastructure projects' considers the risks of the private and public sector and his paper 'Are Public Private Partnerships value for money?: Evaluating alternative approaches and comparing academic and practitioner views' discusses the trade-off between quality and price in PPP projects. In 2004, Grimsey published a book entitled 'Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance', where he traced the evolution of the public private partnership concept.

Analysis of the average citation rate per publication (total number of citations divided by the total number of papers each year) shows a trend that is inverse to the intensity of publication activity (**Figure 4**).

FIGURE 4. Average citation rate per publication in 2000-2021



Source: compiled by the authors

For instance, in 2005, there were published 31 papers with an average rate of 102 cites; in 2015, 54 publications with an average citation rate, 69; and in 2021, there were 55 publications that were on average cited 11 times.

2.3. THE TOP JOURNALS PUBLISHING ON PPPS

Tables 2-3 show journals with the largest number of publications on public-private partnerships in 2000-2021. The analysis covered Google Scholar and Scopus databases.

The leading journals in this field are The International Journal of Project Management, Journal of Construction Engineering and Management, Journal of Management in Engineering, and Sustainability and Construction Management and Economics.

TABLE 2. TOP JOURNALS PUBLISHING ON PPPS IN SCOPUS DATABASE

Journal	Country	Number of publications	Number of citations	Average citation rate per paper
International Journal of Project Management	UK	55	6878	125.1
Journal of Construction Engineering and Management	USA	49	3674	75.0
Journal of Management in Engineering	USA	34	1613	47.4
Construction Management and Economics	UK	31	2390	77.1
Sustainability (Switzerland)	USA	27	604	22.4
Engineering, Construction and Architectural Management	UK	25	755	30.2
International Journal of Construction Management	China	19	409	21.5
Journal of Infrastructure Systems	USA	18	738	41.0
Journal of Cleaner Production	UK	15	671	44.7
Public Management Review	UK	13	755	58.1

Source: compiled by the authors

TABLE 3. TOP JOURNALS PUBLISHING ON PPPS IN GOOGLE SCHOLAR DATABASE

Journal	Country	Number of publications	Number of citations	Average citation rate per paper
International Journal of Project Management	UK	29	7175	247.4
Journal of Management in Engineering	USA	24	2017	84.0
Sustainability	USA	21	752	35.8
Construction Management and Economics	UK	15	2029	135.3
Public money and Management	UK	14	1788	127.7
International Journal of Construction Management	China	11	635	57.7
Engineering, Construction and	UK	11	596	54.2

Architectural Management				
International Journal of Public Sector Management	UK	11	1678	152.5
Public Management Review	UK	11	1117	101.5
Australian Journal of Public Administration	USA	8	802	100.3

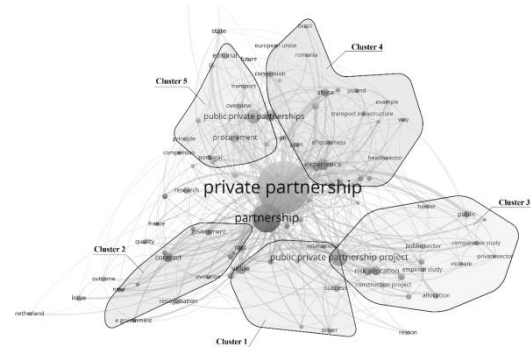
Source: compiled by the authors

The studies on PPPs often rely on reports, guidelines, standards and overviews of the PPP market prepared by international organizations. The top cited sources are The PPP Reference Guide: Version 3.0 (2017), published by the World Bank; UN's The Guiding Principles on People-first Public-Private Partnerships in support of the United Nations Sustainable Development Goals (2019); UNECE Public-Private Partnerships Evaluation Methodology for the Sustainable Development Goals (2021); International PPP Standards (2019); Public-Private Partnership Handbook (2008), published by the Asian Development Bank (ADB); The Guide to Guidance – How to Prepare, Procure and Deliver PPP Projects (2018), prepared by the European PPP Expertise Centre of the European Investment Bank; and the IMF's Public-Private Partnerships, Government Guarantees, and Fiscal Risk (2006).

2.4. KEYWORD ANALYSIS

To visualize the results of the semantic analysis of the keywords, we used VOSviewer to build a map of co-occurring keywords, where the size of the nodes designates co-occurrence frequency of the keywords in the input files. The resulting clusters of keywords are shown in Figure 5.

FIGURE 5. Visualization of co-occurrences of terms in publication titles



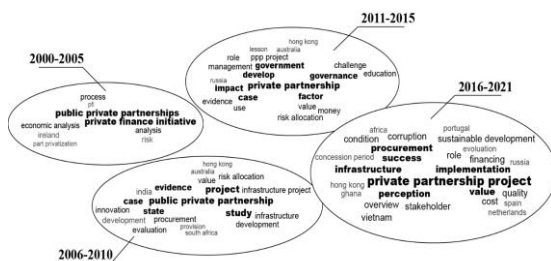
Source: compiled by the authors

Our analysis was aimed at identifying the most significant research themes in publications on PPPs. Figure 5 shows the main keywords and relationships between them. The larger is the size of the node, the higher is the word frequency. Thicker links indicate the frequency of co-occurrence between the words; the smaller is the distance between the nodes, the stronger is the relationship. In VOSviewer, clusters of keywords are highlighted in color. In total, we identified five clusters of keywords. The most frequently occurring keyword is 'private partner', which is in the same cluster (cluster 1) as 'value', 'success', 'relationship', 'driver', 'quality' and 'result'. The second cluster around the word 'partnership' includes such words as 'contract', 'government', 'tools', 'revision', 'evaluation', 'time', and 'efficiency'. The third cluster around the keyword 'public-private partnership project' comprises the following words: 'public sector', 'risk allocation', 'private sector', and 'empirical study'. The fourth cluster is centred around the word 'experience' and includes the following words: 'effectiveness', 'health care', 'transport infrastructure', 'example', and 'barriers'. And, finally, the fifth cluster is built around the word 'procurement' and includes the words 'principles', 'future', 'concession', and 'overview'.

Analysis of the frequency of selected semantic units in titles has shown that most of them are related to contract management, methods of risk management, project management, and efficiency management, development of PPP models in various sectors of economy of specific countries.

To analyze the research trends, we built a map of keywords used in publication titles. The data were grouped according to the four time periods: from 2000 to 2005, from 2006 to 2010, from 2011 to 2015, and from 2016 to 2022 (Figure 6).

FIGURE 6. Map of semantic structures used in publication titles



Source: compiled by the authors

Figure 6 shows a significant increase in the semantic diversity of publication titles in the given period. In the early 2000s, when this research area was still in its budding stage, there was many

publications dealing with the forms of PPP contracts, including PFI contracts. In the period when the most highly cited papers were published (from 2006 to 2010), much scholarly attention was given to the assessment of PPP efficiency, infrastructure projects, and risks for each side. In the same period, there were published overviews of PPP practices and guidelines for building PPPs in specific territories. In the following 5 years, there was a visible growth in scholarly interest in the problem of risk distribution in PPPs, management of contract implementation, and analysis of the existing practices. This period also saw an increase in the number of publications on socially important PPP projects (e.g. in education). In recent years, much attention has been given to the problems of sustainable development, opportunism and corruption, qualitative evaluation of completed projects, and project management.

CONCLUSION

This study presents the results of a bibliometric analysis of the main trends in the research on public-private partnerships. Our key findings are as follows.

Despite its 15-year history, the field remains vibrant, even though we have detected a certain decline in the publication activity. Until 2017, the average rate of growth in publication activity was 26%; between 2018 and 2021, the annual growth rate was -2%.

Our analysis has shown that studies of PPPs present a large and diverse field. Presently much research interest is concentrated on the effectiveness of different PPP contract models and mechanisms of building such complex contracts, risk reduction and distribution, and ensuring efficiency and quality at all stages of project implementation. There is a large number of highly cited publications discussing PPPs in health care, tourism and transport in specific national contexts. In recent years, there has been a growing number of publications on corruption, opportunism and other negative factors impacting PPP project performance and ways to tackle these problems.

We have also identified the following groups of journals publishing research on this topic, with journals on corporate management and project management accounting for the largest number of such publications. Another significant group consists of the journals specializing in public administration.

We used semantic analysis methods to identify the most pertinent topics of discussion and built a retrospective map of semantic structures. Our analysis of the keyword co-occurrence trends shows that there is considerable research focus on

contractual relationships in PPPs, risk distribution and reduction, and the new areas where PPP projects can be applied and new forms that such partnerships may take.

This research is essential for understanding the evolving dynamics of PPPs globally and the implications for infrastructure development and service provision. Policymakers benefit from this analysis by gaining a nuanced understanding of trends in PPPs, allowing them to design effective policies that encourage private sector involvement while safeguarding public interests. Additionally, insights on risk allocation and management in PPPs aid in crafting frameworks that mitigate financial and operational risks associated with large-scale projects.

For the academic community, this study contributes to the body of knowledge by highlighting popular research themes and identifying influential works and authors in the field of PPPs. Understanding citation patterns and publication trends helps researchers prioritize areas of investigation and identify gaps in existing literature. Moreover, the analysis serves as a reference point for discussions on PPP efficiency, innovation, and governance, informing future research agendas and academic discourse.

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