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Research paper

Privatization of Railways: A Bibliometric and Systematic Analysis of Global Research Trends

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Abstract

This study offers a comprehensive bibliometric and systematic review of global research on railway privatization spanning from 1991 to 2025. Utilizing a dual-method approach, the analysis draws on 632 peer-reviewed articles retrieved from the Scopus database. The bibliometric component maps publication trends, influential authors, leading institutions, and thematic clusters using tools such as VOSviewer and Biblioshiny. The systematic review complements this with critical insights into research themes, policy frameworks, and methodological developments. The study identifies key geographic contributors—including the United Kingdom, China, India, Japan, and Sweden—and reveals four dominant thematic clusters: economic efficiency and deregulation, governance in public-private partnerships (PPPs), sustainability and urban transport, and high-speed rail reforms. Despite a robust focus on operational efficiency, risk management, and investment models, the review highlights major thematic gaps. Issues like labor rights, equity, environmental sustainability, and representation of the Global South remain underexplored. Co-citation and keyword analyses reveal a technocratic bias, often sidelining the socio-political and environmental dimensions of privatization. The study concludes that while railway privatization research has matured in volume and sophistication, its relevance and inclusiveness can be enhanced by integrating interdisciplinary methods, expanding regional diversity, and embed-ding social justice into governance discourse. Future research must address these imbalances to support equitable, sustainable, and resilient railway systems globally.

Keywords: *Deregulation; High-Speed Rail; Privatization; Public-Private Partnerships; Railway Privatization; Railway; Sustainability.*

1. Introduction

Railway privatization denotes the transfer of authority over railway infrastructure and services from government entities to private enterprises (Ke et al., 2017). Various methods of railway privatization exist, including the complete sale of assets, the establishment of public-private partnerships (PPPs), the awarding of operational franchises, or allowing private enterprises to compete with government-operated organizations (Bougette et al., 2021; Xiong et al., 2020). The methodology for railway sector privatization differs throughout nations owing to their distinct institutional frameworks and economic and political systems (Antonelli et al., 2020). Railway privatization began with the free market reforms of the late twentieth century, mostly in the 1980s and 1990s. Initially, rail transportation was governed by state monopolies due to the substantial capital investment needed and the strategic significance necessitating government regulation. By the mid-20th century, several national systems, notably those in the United Kingdom, India, and Japan, encountered budgetary deficits, operational challenges, asset deterioration, and diminishing ridership due to increasing competition from road and air transport (Eichengreen, 1995; Lawal, 2024).

The global trend of economic liberalization in the 1980s, driven by neoliberalism, provided the rhetorical foundation and policy justification for railway privatization. Having seen successful privatization in many other sectors, governments view the private sector as a kind of cure-all, capable of delivering better services, increasing efficiency, reducing budgetary pressures through competition, and fostering innovation (Eisenkopf et al., 2006). The United Kingdom remains a leader with the Railways Act 1993, which privatized British Rail's infrastructure, operations, and train rolling stock into separate companies (Jupe & Funnell, 2015). Japan followed by creating regional passenger and freight companies after restructuring JNR in 1987 (Tomikawa & Goto, 2025); Sweden began liberalization in 1988 through the vertical separation of infrastructure (Banverket) and operations (SJ) (Knieps, 2013). There are many reasons cited for privatization. Economically, divestment draws private sector funds for infrastructure development and reduces the state's balance sheet liabilities (Pereira et al., 2018). Private operators are expected to introduce performance-based accountability and customer focus in a sector historically marked by bureaucratic sluggishness (Bougette et al., 2021). From a political perspective, privatization reflects a commitment to market-oriented reform, often driven by IMF and World Bank structural adjustment programs, and ensures better connectivity in underserved areas (Quiroz Flores & Pfaff, 2021).

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1.1. Rise of Privatization in Public Infrastructure

Table 1: Historical Roots of Railway Privatization

Country/Region	Period	Historical Context	Key Event	Legacy/Impact
United Kingdom	1990s	Post-war nationalized British Rail faced inefficiencies and losses	Railways Act 1993: Privatization of British Rail; separation of infrastructure and operations	Benchmark for global privatization; mixed outcomes on cost and efficiency
Japan	1987	Japanese National Railways (JNR) was burdened with debt and inefficiency	Privatization of JNR: Split into six regional JR passenger companies and one freight company	Improved financial performance and service quality (Tomikawa & Goto, 2025)
Argentina	The early 1990s	Economic liberalization under President Carlos Menem	Concessions of railway operations under long-term leases	Rapid privatization, but a decline in rural coverage and service
Sweden	1988 onwards	Drive for competition and modernization	Vertical separation of infrastructure (Banverket) and operations (SJ)	One of the first competitive open-access markets (Knieps, 2013)
Germany	Mid-1990s	Post-reunification push for efficiency and competition	Creation of Deutsche Bahn AG as a joint-stock company; gradual service liberalization	Strong state ownership is retained alongside emerging competition
India	2000s–present	Long-standing public ownership, rising modernization pressures	Introduction of PPPs and trial private-sector train operations on select corridors	Gradual privatization of services without full asset divestment (Pereira et al., 2018)
New Zealand	1993	Economic reforms and public-sector downsizing pressures	Sale of New Zealand Rail Ltd to private investors	Subsequent re-nationalization due to financial and service failures (Eichen green, 1995)

Despite some improvements, the results have been mixed, and people still debate them. Some models have helped make services better and expanded their reach, but others have caused safety concerns, raised fares higher, led to conflicts with workers, and reduced government oversight. Understanding the history and reasons behind these policies is important for creating rules that balance a thriving market with the public's interests (McCartney & Stittle, 2017).

- United Kingdom: Back in the early 1990s, British Rail, which had been state-owned since 1948, was struggling with not enough investment, inefficiencies in how it operated, and rising financial problems. In response, the government introduced the Railways Act of 1993. This law broke up the railway system into separate parts: the tracks and stations (infrastructure), the trains themselves, and the operating companies. Private companies were given the chance to run certain routes through franchises, and a new organization called Railtrack was created to manage the infrastructure. The goal was to boost competition, attract private funding, and improve service quality through market regulation. While many routes did see better service and newer trains, this breakup also caused coordination issues, safety problems (like the Hatfield train crash and Railtrack's own failures), and mixed results on efficiency and costs. All of this showed the challenges—and dangers—of trying to open railway services to private players on a large scale, setting an important example worldwide (Jupe & Funnell, 2015; McCartney & Stittle, 2017).
- Japan: By the mid-1980s, Japanese National Railways (JNR) was struggling. They were buried in debt, had way too many staff on the payroll, and their operating costs were through the roof. Then, in 1987, they decided to shake things up by privatizing the company. They split JNR into six regional passenger companies—like JR East, JR Central, and so on—plus a separate freight operator. Each of these new JR companies was given a specific region to cover and was tasked with making a profit and offering better service. Passenger numbers went up, trains ran on time more often, and they started doing better financially—all proof that a carefully planned privatization, with a clear regional focus and proper government oversight, can breathe new life into a company that's been struggling as a government monopoly (Tomikawa & Goto, 2025).
- Argentina: Back in the early 1990s, during President Carlos Menem's push to open the economy, Argentina handed out long-term concessions to private companies for nearly all intercity and commuter train services. The idea was to quickly attract foreign investment and stop the trains from getting worse. In Buenos Aires's main metro area, privatization led to some short-term improvements in how the trains ran. But in the more rural and less profitable regions, the private operators pulled back on service, cutting routes, letting old trains fall into disrepair, and leaving some communities pretty much cut off from train travel. All of this shows how privatizing without proper support systems or strong rules can make regional gaps even wider (Eichengreen, 1995).
- Sweden: Starting in 1988, Sweden introduced a model where the rail system was split vertically: Banverket took charge of the rail infrastructure as a publicly owned entity, while SJ remained the national operator, operating under commercial guidelines. By the late 1990s, opening up access regulations allowed private and regional companies to compete for service contracts alongside SJ. This move towards competition spurred innovations like flexible scheduling and services that responded to passenger demand. Sweden's experience shows that a gradual approach—combining structural separation with regulated entry—can create one of the most genuinely competitive rail markets in Europe (Knieps, 2013).
- Germany: After reunification, Germany set out to modernize its huge railway system. In 1994, they created Deutsche Bahn AG as a joint-stock company, but it was still fully owned by the government. This move helped introduce a more businesslike approach to managing the network and prepared it for future competition. Over the following ten years, the government started putting regional passenger services out to tender and welcomed new private freight companies into the market. While the government kept control of the key infrastructure, some liberalization allowed for more efficiency and a wider variety of services without outright selling off assets (Knieps, 2013).
- India: Even though Indian Railways is owned and operated by the government, they've been testing out some public-private partnerships since the 2000s. This includes things like rebuilding stations, creating dedicated freight lines, and trying out private trains on certain routes. These collaborations have helped attract private investment to modernize parts of the system, like when they revamped Habibganj station in Bhopal, and they've even used performance-based contracts to keep things running smoothly. While they haven't fully privatized the entire asset, these steps show a gradual move toward more private involvement in running services and upgrading infrastructure (Pereira, et. al., 2018).
- New Zealand: Back in 1993, New Zealand decided to privatize its government-owned rail company, New Zealand Rail Ltd, selling it off to a private group as part of a big push to cut public spending. The idea was to make things work more efficiently and lighten the government's financial load. At first, freight transportation got a boost in productivity, but because they didn't put enough money into maintaining the tracks and upgrading the network, the condition of the rails started to decline. This led to safety issues over time. By

2008, the government stepped in again and took back control, creating KiwiRail, because they realized that simply privatizing without proper oversight could threaten the long-term safety and quality of service (Eichengreen, 1995).

1.2. Challenges and Controversies Surrounding Railway Privatization

Table 2: Key Challenges in Railway Privatization

Issue	Description	Examples/Impacts
Service Quality	Profit-driven operators sometimes neglect service standards	Delays, overcrowding, and reduced rural connectivity; UK regional lines suffered significant deterioration (McCartney & Stittle, 2017)
Regulatory Failures	Weak frameworks fail to enforce safety, competition, or minimum service levels.	Monopolistic behavior on unprofitable routes (Król, 2010)
Affordability	Fare increases by private operators can price out low-income and rural users.	Sharp fare hikes in the UK and Japan (Harmony, 2018)
Public Opposition	Resistance from labor unions, passengers, and civil society over job losses and access reductions	Strikes and mass protests in Argentina, the UK, and India (Ortiz, et. al., 2022)
Equity & Accessibility	Private firms prioritize profitable lines, abandoning remote or low-traffic services.	Widespread rural route closures (Kaiser, et. al., 2022)
Transparency	Opaque bidding and contract allocation processes	Corruption allegations in PPP projects (Kulevich, 2025)
Accountability	Fragmented responsibilities hinder swift action on accidents or service failures.	Railtrack collapse in the UK (Johnson, 2014)

The rise of privatization in public infrastructure isn't just about economic stuff; it's part of a bigger shift in how governments work. Instead of just running things themselves, states are now more like facilitators and regulators, shaping policies from behind the scenes (Eisenkopf et al., 2006). This trend shows how neoliberal ideas — which push for market-based solutions rather than government control — have spread all over the world. And even now, as we deal with big issues like climate change, city growth, and widening inequalities, this way of thinking keeps fueling debates about fairness, responsibility, and what's sustainable long-term (Jupe & Funnell, 2015).

1.3. Justification for A Combined Bibliometric and Systematic Review

The investigation into railway privatization is frequently disjointed. A multitude of studies focus on nations, discrete policy measures, or sector-specific alterations within unique political and economic frameworks. This makes it challenging to develop a unified understanding or to identify consistent research trends globally. Researchers approach the topic from various angles—such as economics, public administration, transportation policy, or infrastructure management—adding to the complexity of drawing broad conclusions. To better organize and evaluate the existing literature, combining bibliometric analysis with a systematic review is essential. Bibliometric methods allow us to statistically analyze research patterns, emphasizing publication trends, influential authors, key journals, major institutions, and collaboration networks. This helps visualize how ideas and information have developed and spread over time and across regions. However, bibliometric analysis alone doesn't capture the depth, context, or quality of the studies. That's why a thorough literature review is so important. It offers a qualitative perspective, providing a detailed synthesis of the research topics, methods, and findings, which helps deepen our understanding of the areas of agreement and disagreement within the field.

Integrating these two approaches provides a balanced view, blending a broad overview with in-depth analysis. The bibliometric review emphasizes overall patterns and trends across large datasets, giving us a big-picture perspective. Meanwhile, the systematic review dives into specific content, theoretical frameworks, and empirical results, offering detailed insights. By combining both methods, we enhance our objectivity and scholarly thoroughness. The bibliometric technique minimizes selection bias through a transparent, data-driven process for including studies, while the systematic review applies predefined criteria to assess relevance and quality. Together, they help identify gaps in research, emerging areas of interest, and overlooked topics such as the social impacts of privatization, regional disparities, labor concerns, and the effectiveness of regulatory frameworks. This integrated approach is particularly valuable when shaping policies and practical strategies around infrastructure transformation. Privatizing railways involves complex, sensitive considerations influenced by broader economic policies, institutional strengths, and stakeholder interests. Having a comprehensive understanding that pairs statistical trends with contextual analysis is key to developing well-informed, personalized policy recommendations. In short, combining bibliometric and systematic reviews is both a solid methodological choice and a practical strategy for addressing the versatile issues and opportunities in railway privatization.

1.4. Research Question

RQ1: What have been the publication trends and emerging directions in global research on railway privatization over the past decade?
Aims to chart the growth trajectory, annual output, and potential future hotspots in the literature.
RQ2: Which articles and journals have exerted the greatest scholarly impact in the field of railway privatization?
Seeks to identify the most-cited papers and outlets that have shaped this research domain.
RQ3: Which countries, institutions, and individual authors lead the scholarly conversation on railway privatization?
Maps the geographic and institutional distribution of research output, highlighting key contributors.
RQ4: What major thematic clusters and keyword co-occurrence networks emerge from VOS mapping of the railway privatization literature?
Uses a VOS viewer to visualize and interpret the conceptual structure, showing how topics interrelate.
RQ5: How has the intellectual focus of railway privatization & benefits of doing privatization on the rail network?
Examines shifts in dominant themes, methodological approaches, and policy concerns across successive periods.

2. Research Methodology

2.1. Research Design

This study takes a qualitative approach, combining bibliometric mapping with a systematic review of the literature to use the strengths of both quantitative and qualitative research. The bibliometric part offers a broad, data-driven overview of the field by tracking publication

volumes, citation patterns, collaboration networks, and thematic groupings. On the other hand, the systematic review dives deeper into individual studies, providing interpretive insights into their content, arguments, and methodological choices. By bringing a qualitative approach, the research design ensures that the big-picture patterns and underlying structures identified through mapping are complemented and enriched by the detailed context, detailed understanding, and critical insights gained from thematic analysis. This combined approach not only increases the rigor and reproducibility of the review but also deepens our understanding of how research on railway privatization has developed over time across different conceptual, methodological, and geographical perspectives.

2.2. Data Source & Search Strategy

The principal data source for this research is the Scopus database, selected for its extensive coverage of peer-reviewed publications in the social sciences, economics, and engineering fields. Scopus was the primary database selected for the study due to being a database encompassing peer-reviewed literature concerning computer science, education, psychology, and policy studies—disciplines directly relevant to AI in educational research. As one of the largest abstracting and indexing databases in a multidisciplinary field, Scopus indexes journals from more than 27,000 peer-reviewed sources with recognized publishers (Yan & Zhiping, 2023). Updated content, quality-controlled, and given to the researcher with credible sources, is offered. The advanced search operations, citation tracking, and analytical tools in Scopus allow for comprehensive literature reviews, trend analyses, and impact analyses, making it worthy of high-quality, evidence-based academic publications (Elouaourti et al., 2025). A systematic search string was developed to include all relevant material on railway privatization:
(TITLE-ABS-KEY ("rail*" OR "railway" OR "rail sector" OR "rail PPP") AND TITLE-ABS-KEY ("private*" OR "deregulation" OR "liberalization"))
This study looks at how rail-related terms pop up in titles, abstracts, and keywords, especially when talking about privatization, deregulation, or liberalization. Using the wildcard “rail*” makes sure we catch variations like “rail,” “rails,” and “railway.” All searches were done in May 2025 to keep the info current, and the results were saved as CSV files, including details like the authors, abstracts, keywords, citations, affiliations, and references.

2.3. Screening and Selection

The following filters and selection criteria helped to guarantee the relevance, quality, and manageability of the dataset:

- Publication Year: 1991–2025, encapsulating the contemporary neoliberal epoch of infrastructure reform. Between 1991 and 2025, India saw an important shift in its infrastructure policies driven by neoliberal reforms that began with broader market liberalization. Inspired by models like the UK's Railways Act of 1993 and Sweden's approach of vertical separation, the country gradually welcomed public-private partnerships and regulatory reforms. This period marked a move towards greater efficiency, increased competition, and attracting private investments in sectors traditionally under state control. Notable privatization milestones in the 1990s and 2000s, along with recent innovations and adjustments made in reforms. The 1991 LPG reforms restructured the Railway Board, granting it more financial and administrative independence and leading to reduced freight costs. The formation of the Indian Railway Finance Corporation in the mid-1990s was a strategic move to alleviate financial pressures on the system. In the early 2000s, efforts focused on testing public-private partnerships, modernizing major stations, and enabling private freight services. The launch of the Dedicated Freight Corridor project in 2006 considerably improved capacity and strengthened logistics infrastructure. Initiatives like Mission Raftar in the 2010s aimed at modernizing stations, deploying digital ticketing solutions, and transforming production divisions into more corporatized entities.
- Document Type: Articles only (“ar”), thereby excluding conference proceedings, reviews, book chapters, and editorials.
- Language: English, to maintain consistency in semantic analysis and to leverage established thematic coding frameworks.
- Subject Areas: Business, Management & Accounting (BUSI) and Economics, Econometrics & Finance (ECON), ensuring disciplinary alignment with privatization and policy analysis.
- Publication Stage: Final publications only, thereby focusing on fully peer-reviewed, complete studies.

(TITLE-ABS-KEY ("rail*" OR "railway" OR "rail sector" OR "rail PPP") AND TITLE-ABS-KEY ("private*" OR "deregulation" OR "liberalization")) AND PUBYEAR > 1991 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBSTAGE , "final"))
After deduplication and title/abstract screening, full texts of 636 articles were retrieved for in-depth review. The study limited retrieval to Open Access materials to provide full-text accessibility for repeatable extraction and to facilitate the deposition of PDFs and extraction files in an open repository.

2.4. Tools and Analysis Techniques

This study uses VOSviewer and Biblioshiny for bibliometric mapping and summary data. VOSviewer generates visual representations of co-citation, bibliographic connections, author collaborations, and keyword clusters, while Biblioshiny (part of R Bibliometrix) provides insights into publishing patterns, leading authors/institutions, citation metrics, and sophisticated analysis (e.g., factorial studies, subject development). A systematic review complements these quantitative maps by coding each publication for aims, theory, methodology, results, and policy significance, while also conducting a quality rating. The approaches integrate extensive, data-driven mapping with profound, interpretative synthesis to discern consensus, contention, and research deficiencies.

Table 3: The Criteria for Inclusion and Exclusion

Criterion	Inclusion	Exclusion
Publication Type	Articles	Reviews, Editorials, Letters, Notes, Books, Errata, Editorial
Thematic Areas	All thematic areas relevant to “Privatization of Railways”	Irrelevant thematic areas (e.g., unrelated fields)
Geographical Scope	All countries/territories	None
Language	English	Non-English languages
Timeframe	The study considers the research from January 1991 to May 2025	Before January 1991 and after May 2025

Source: Author's Elaboration.

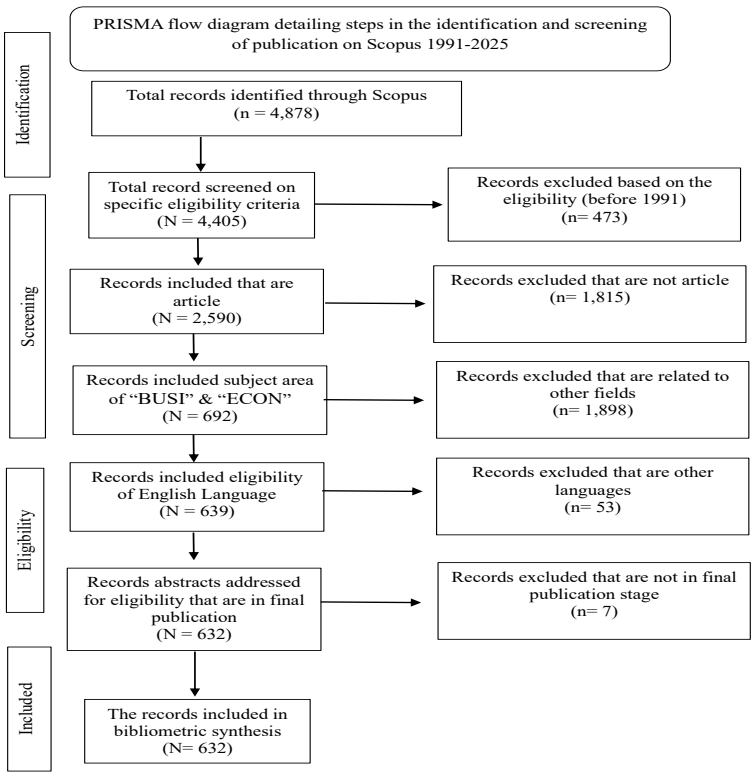

Fig. 1: Flowchart of Screening.

Source: Author's Elaboration.

Document pre-processing was performed to remove duplicates and address missing values in the metadata of articles from the Scopus database. The dataset has 632 articles at the end. CSV data were acquired, and Microsoft Excel with Microsoft 365 was then used to handle the data. VOSviewer 1.6.20 was used for the actual analysis that followed the data treatment. A powerful tool for making, displaying, and examining scientific maps is VOSviewer. Additionally, the study offers graphical maps that make it easier to understand and analyze the networks connecting different nations, organizations, journals, authors, and keywords. The study restricted retrieval to Open Access resources to ensure full-text availability for reproducible extraction and to enable the submission of PDFs and extraction files in an open repository. The dataset for the systematic literature review comprises 159 open-access papers. These articles are appropriately analyzed based on themes derived from the co-occurrence of keywords.

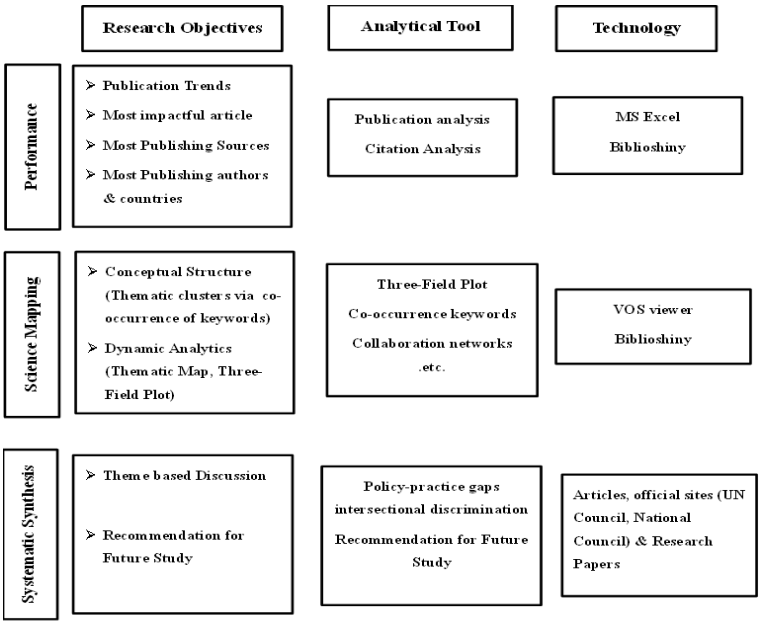

Fig. 2: "Overview of Methods".

Source: Author's Elaboration.

3. Results

This section provides a concise overview of the research's results. The primary discoveries are discussed, and recommendations for future investigation are provided. Table 4 displays a concise overview of the outcomes.

Table 4: Summary of Data

Outcomes	Total Number
FINAL SAMPLE (PAPERS)	632
AUTHORS	
Authors	1242
Authors of single-authored docs	175
Sources	279
DOCUMENT CONTENTS	
Keywords Plus (ID)	1555
Author's Keywords (DE)	1729
CITATIONS	11178
COUNTRIES	52
AFFILIATIONS	484

Source: Author's Elaboration.

The final sample includes 632 papers authored by 1,242 researchers, with 175 single-authored documents. These papers were published across 279 sources. The dataset features 1,555 Keywords Plus and 1,729 Author Keywords. Collectively, the works received 11,178 citations and originated from 52 countries and 484 institutional affiliations.

3.1. Publication Trends

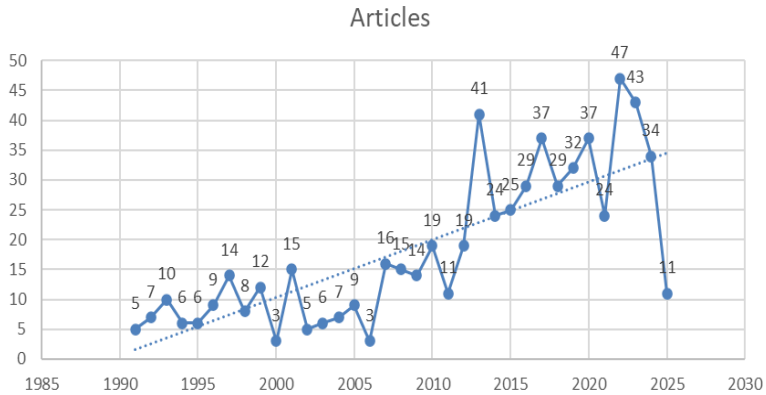

Fig. 3: Publication Trends.

Source: Author's Elaboration.

Figure 3 shows publication trends from 1991 to 2025; rail-related academic output shows a steady global increase, from around 5 articles in 1991 to peaks in the dozens by 2025. This reflects growing global interest in rail systems, driven by widespread policy shifts, infrastructure programs, and regulatory debates. Nearly every country studied exhibits rising scholarly attention as railways become central to national agendas, from privatization initiatives to high-speed network rollouts. Since 1991, the US has substantially diversified into rail-related publications, starting with six in 1991 and expanding to over 230 projected in 2025. This rise traces key policy milestones and evolving priorities in transportation. The Staggers Rail Act of 1980 and the 4R Act of 1976 deregulated the freight rail industry and became a key pivot among the others, permitting contract rates and rejuvenating the field (Marc Scribner, 2022). The 1995 abolition of the Interstate Commerce Commission (ICC) and the consolidation of Class I railroads further pared down operations and improved profitability (United States, 1995). Post-2000 debates for high-speed rail funding—including numerous proposals and expansions of Amtrak, to name a few—ensured attention and notoriety to the sector, as did high-profile safety incidents like the 2024 East Palestine derailment. Further forces driving the increase in research, next to environmental regulations, include attention to supply-chain resilience after the 2008 financial crisis and proposed Executive Orders aimed at relaxing oversight by the Federal Railroad Administration (FRA) and Department of Homeland Security (DHS) (Sheib, 2025, March 24). In the early 1990s, China placed little academic emphasis on rail-related publications. However, scholarly interest began to surge following significant policy and infrastructure developments. The launch of the country's high-speed rail system—beginning with the Beijing–Tianjin line in 2008 and rapidly expanding to over 25,000kilometers—gave rise to academic interest (Burt et al., 2019, April 16; Lawrence et al., 2019). Structural reforms, which included the dismantling of the Ministry of Railways and the creation of the China State Railway Group, triggered studies into governance, financial sustainability, and organizational change. Public scrutiny increased after high-profile incidents such as the Wenzhou crash in 2011 and the corruption scandal involving Liu Zhijun, calling into question oversight and accountability (Osnos, 2012). Further spark for analyses concerned the economic feasibility and long-term planning of China's rail expansion, with concerns about soaring debt and the rise of underutilized "ghost stations."

The UK mirrors a consistent upward trend from 3 in 1992 to 121 in 2025. Its sharp rise from the late '90s and 2000s crowns the period of privatization of British Rail (1994–1997), followed by continuous deregulation and fragmentation, which has given nourishment to many case studies and evaluations (Kopicki, et. al., 2024). Another rise in the 2010s arose from studies about the long-term impact of fragmentation, subsidy issues, and performance after 20 years of private sector operation. Thus, the UK has experienced a steady increase in research output since Privatization (1994–1997), mainly fueled by inquiries into fragmentation, labor relations, public–private operations, subsidy models, and concession errors. The academic peaks fit well with major rail franchise and service disruption events—pylon strikes, timetable chaos, and Brexit-related transport policy reviews. Australia shows an increase from practically nothing to more than 70 papers by 2025, with some acceleration occurring after 2007, probably owing to reforms in state networks and public-private partnerships in urban transit. Italy follows a similar curve: there is little output till the late '90s, then from 2009 onwards, it rises steadily. Such trends may reflect European railway liberalization directives (e.g., EU rail packages), funding frameworks, and regional infrastructure investment cycles. Both countries had slow growth until EU rail liberalization packages, national PPP plans, and urban transit boom (e.g., Melbourne and Sydney metro systems; post-2009 growth of the Italian high-speed network). Eventually, the research scope broadened to include regulatory comparison, regional impact, and service optimization (Brose, 2015). Some countries have not been able to fully privatize, and there have

been demands from the public to have fuller considerations in semi-privatization or PPPs, like the U.K., where complete privatization has not put an end to calls for renationalization; these critics suggest plummeting valuations in rail stock and underperformance of franchises. Australian PPPs were geared towards metro and freight corridors, using world research as leverage for reforms. Italy works with regional concessions, and some regions are even contemplating privatization under pressure from the EU to improve efficiency. The debate, both public and academic, when full privatization has not occurred, refers to whether reforms can deliver cost efficiencies and encourage private investment, particularly when shares in national rail lag in stock performance.

Germany shows a long-held respect for privatization that contrasts with the Indian approach to rail privatization and has given rise to myriad old and ongoing, well-chronicled problems afflicting the railway system. Ground realities are seldom published with proper data; yet such issues and grievances have attracted wide public attention. A major area of dysfunction has been rampant corruption in rail catering and pantry services. In April 2025 on Gitanjali Express and in May 2025 on Hemkunt Express, there were allegations that the pantry staff assaulted passengers over price-related complaints, and social media reactions further intensified public outrage (Online, 2025, May 8). Sometimes penalties were imposed-an example being a ₹1-lakh fine for selling water at ₹20 against an official price of ₹15 (Online, 2024, November 25), but violations have continued to happen, thus showing weak enforcement. Bottled water and pantry meals have been overcharged by up to ₹80 more than the actual cost (System, 2025, June 23). Systemic failure in the enforcement of official price lists only shows the deeper management issues. Price gouging is rampant, and problems arising from employee malpractices-having to do with hidden commissions, timetable manipulations, and shoddy hygiene standards, eat away at passenger trust. Reddit reveals that undue revenue from pantry cars can amount to as much as ₹6 lakh in a month; thus, the unofficial economy appears quite deep-rooted. Investor confidence has been shaky in the sector as well. Stock prices of Indian Railways Finance Corporation (IRFC) and Rail Vikas Nigam Limited (RVNL) have been volatile, with short rallies followed by steep declines, signaling that there is unease about the extent of the sector's performance and its governance (Shivangini, 2024, August 5). Even disbursing huge budget allocations, for example, ₹11.2 lakh crore for 2025-26, has failed to avoid investor skepticism, mainly due to stalled reforms and underinvestment for years in modern signaling technology (Singhal, 2025, February 3). Indian Railways remains an international term of fallback in performance, safety, and customer service. These long-standing inefficiencies give a strong case to semi-private or PPP models in the country. Globally, these reforms have helped in introducing transparency, attracting investment for infrastructure, and improving operational efficiencies. If those remain absent, then India will only look at further stagnation with growing corruption and poor quality of services, financial losses, and dwindling investor interest.

3.2. Top 10 Most Cited Publications

According to the Scopus criteria for "highly cited papers," these are the most-cited publications. Here are the top 10 most cited papers:

Table 5: Top 10 Articles According to Citations

Paper	Year	Title	Source Title	Total Citations
Ng A.; Loosemore M.	2007	Risk allocation in the private provision of public infrastructure	International Journal of Project Management	362
Xu B.; Lin B.	2015	Factors affecting carbon dioxide (CO2) emissions in China's transport sector: A dynamic nonparametric additive regression model	Journal of Cleaner Production	204
Gu T.; Kim I.; Currie G.	2019	To be or not to be dockless: Empirical analysis of dockless bikeshare development in China.	Transportation Research Part A: Policy and Practice	199
Iyer K.C.; Sagheer M.	2010	Hierarchical structuring of PPP risks using interpretative structural modeling	Journal of Construction Engineering and Management	183
Billings S.B.	2011	Estimating the value of a new transit option	Regional Science and Urban Economics	175
Baum-Snow N.; Kahn M.E.	2000	The effects of new public projects to expand urban rail transit	Journal of Public Economics	164
Diao M.; Leonard D.; Sing T.F.	2017	Spatial-difference-in-differences models for the impact of a new mass rapid transit line on private housing values	Regional Science and Urban Economics	156
Olusola Babatunde S.; Opawole A.; Emmanuel Akinsiku O.	2012	Critical success factors in public-private partnership (PPP) on infrastructure delivery in Nigeria	Journal of Facilities Management	148
Kim S.; Ulfarsson G.F.; Todd Hennessy J.	2007	Analysis of light rail rider travel behavior: Impacts of individual, built environment, and crime characteristics on transit access	Transportation Research Part A: Policy and Practice	143
Oum T.H.; Waters II W.G.; Yu C.	1999	A survey of productivity and efficiency measurement in rail transport	Journal of Transport Economics and Policy	142

Source: Author's Elaboration.

Table 5 shows the most cited transport infrastructure papers of the past 20 years. Foremost works such as those by Oum et al. (1999) and Baum-Snow & Kahn (2000) informed research into rail productivity and urban development, with a total of more than 300 citations. This methodological basis galvanized interest in PPP risk allocation analysis, with Ng & Loosemore (2007) topping the chart with 362 citations, followed by Iyer & Sagheer (2010) and Babatunde et al. (2012), who dealt with PPP issues in developing countries. Valuation studies like those done by Billings (2011) on commuter preferences and Diao et al. (2017) on the effect of transit on housing offered a fillip to the consumer-welfare and geospatial traditions. The environmental visibility and welcome mobility functions got the attention of Xu & Lin (2015) and Gu et al. (2019) in their studies of emission and bikesharing in the Chinese context. Meanwhile, in the intersection of urban planning, we saw Kim et al. (2007) concerning crime and light rail. Taken together, they point to the shift of transport research impact from large-scale efficiency perspectives into in-depth interdisciplinary studies on risk, environment, and shared mobility over the past 25 years.

3.3. Authors

According to the Scopus criteria for "highly cited papers," these are the most-cited publications. Here are the top 10 most cited authors:

Table 6: 10 Most Effective Authors

Rank	Author	TC	TP	University	h-index
1	Ng, Angie	401	2	Ahlia University, Manama, Bahrain	2
2	Loosemore, Martin	362	1	Uttaranchal University, Dehradun, India	42
3	Lin, Boqiang	252	2	Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka	111
4	Chunyan Yu	249	3	Bina Nusantara University, Jakarta, Indonesia	19
5	Oum, Tae-hoon	218	2	Bina Nusantara University, Jakarta, Indonesia	37
6	Xu Bin	204	1	Uttaranchal University, Dehradun, India	33
7	Currie, Graham	203	2	Peter the Great St. Petersburg Polytechnic University, Saint Petersburg, Russian Federation	51
8	Gu, Tianqi	199	1	Uttaranchal University, Dehradun, India	5
9	Kim, Inhi	199	1	Volgograd State Technical University, Volgograd, Russian Federation	22
10	Diao, Mi	198	2	National Forensic Sciences University, Gandhinagar, India	20

According to Table 6, we see the list of the top ten most-cited authors in transport infrastructure research, sorted by their total citations (TCs) versus total publications (TPs), with Scopus h-index values illuminating their wider scholarly clout in an even more general sense. Citation-wise, Angie Ng Coasted on two publications with 401 citations (TC/TP = 200.5), yet boasts an h-index of only 2, reflecting a very concentrated impact in PPP risk studies. On the other hand, Loosemore's lone paper has accrued 362 citations, yet he has an outstanding h-index ranking of 42, indicative of a wider and longer-lasting academic career. Boqiang Lin (252 TC, 2 TP) has an outstandingly high h-index of 111, indicating that, beyond transport, the man has written the book on energy economics. Chunyan Yu (249 TC, 3 TP; h-index 19) and Tae-hoon Oum (218 TC, 2 TP; h-index 37), respectively, and vice versa, are high-impact modeling and efficiency studies. Some other authors, like Bin Xu (204 TC, 1 TP; h-index 33) and Tianqi Gu (199 TC, 1 TP; h-index 5), have earned significant attention from their single well-placed studies on emissions and bikesharing, respectively. Three clusters emerge from institutional affiliations: Loosemore, Xu, and Gu are all career researchers of Uttaranchal University, India; Yu and Oum are based at Bina Nusantara University, Indonesia. Citation metric comparison with the h-index reveals the insight behind a comparison of these bibliometric parameters: high citations from a concentrated set of papers do not necessarily reflect long-term academic influence, which is better reflected through sustained presence in a wider set of publications.

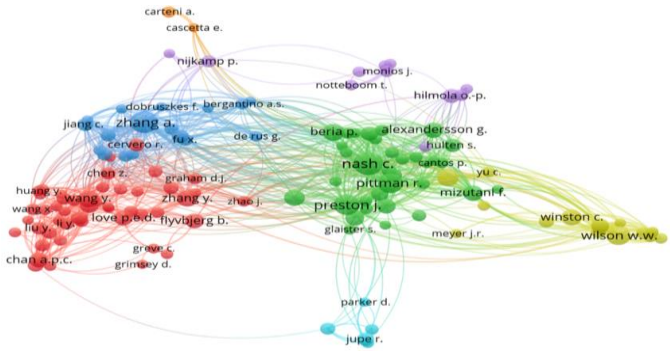

Fig. 4: Co-Citation Network.

Source: Author's Elaboration.

Figure 4 shows a co-citation network that reveals clusters of recognized authors in transportation research, the mark of key intellectual communities. European universities headed by Nijkamp and Monios, and Notteboom investigate port economics, logistics, and multimodal transport systems. Asian scholars under Zhang, Fu, and Jiang concentrate more on high-speed rail and infrastructure economics, specifically on the development of China's rapid transit. North American authors, such as Winston, Meyer, and Flyvbjerg, deal with cost-benefit analyses, megaproject governance, and transportation policy. European institutional economists relate themselves only to the Asian researchers on infrastructures due to their research on rail deregulation and pricing schemes across nations. Other authors appear to straddle niche impact research between policy and operations research, such as Preston and Hilmola. Mapping depicts three major competing paradigms: European transport economics, Asian infrastructure development, and North American policy analysis, with multidisciplinary linkages. However, the absence of Global South scholars suggests a geographic imbalance of citation power.

3.4. Journals

According to the Scopus criteria for "highly cited papers," these are the most-cited publications. Here are the top 10 most-cited journals:

Table 7: The Top 10 Publication Sources Based on the Number of Publications

Source	H Index	G Index	M Index	TC	NP	PY_start
Transportation Research Part A: Policy and Practice	16	30	0.64	1162	30	2001
Research In Transportation Economics	16	28	0.64	903	56	2001
Journal Of Cleaner Production	6	7	0.54545455	582	7	2015
International Journal of Project Management	3	3	0.15789474	473	3	2007
Regional Science and Urban Economics	4	4	0.23529412	427	4	2009
Research In Transportation Business and Management	11	18	0.84615385	393	30	2013
Cities	7	9	0.26923077	377	9	2000
Journal Of Transport Economics and Policy	6	11	0.21428571	368	11	1998
Transportation Research Part E: Logistics and Transportation Review	9	11	0.31034483	321	11	1997
Journal Of Construction Engineering and Management	6	8	0.33333333	267	8	2008

Table 7 lists the top 10 journals in terms of publishing transport infrastructure research, with bibliometric indicators. Transportation Research Part A tops in articles (30) and citations (1,162), maintaining continued influence since 2001 with a very strong h-index (16), g-index (30), and m-index (0.64). Research in Transportation Economics leads in article count (56) with 903 citations and identical h(g)- and m-indices of (16, 28) and 0.64, respectively, standing for steady yearly impact during the past 20 years. Emergent journals like Journal of Cleaner Production (with the first paper published in 2015) and Research in Transportation Business and Management (2013) show a rapid influence with acceptable values of g- and m-indices despite the relative paucity of the number of published papers, indicating that cross-disciplinary themes such as sustainability and transport business models quickly earn citations. In contrast, older journals such as Transportation Research Part E and Journal of Transport Economics and Policy, albeit older (established in 1997 and 1998), show quite modest outputs (11 papers each) with their h- and m-indices low and thus still accumulating slow impact. This shows how these dual trends operate: established journals keep holding strong to the traditional core of policy and economic research, whereas newer cross-disciplinary outlets rise to prominence through the relevance of ever-current thematic issues and the fast pace at which citations accrue.

3.5. Worldwide Publications

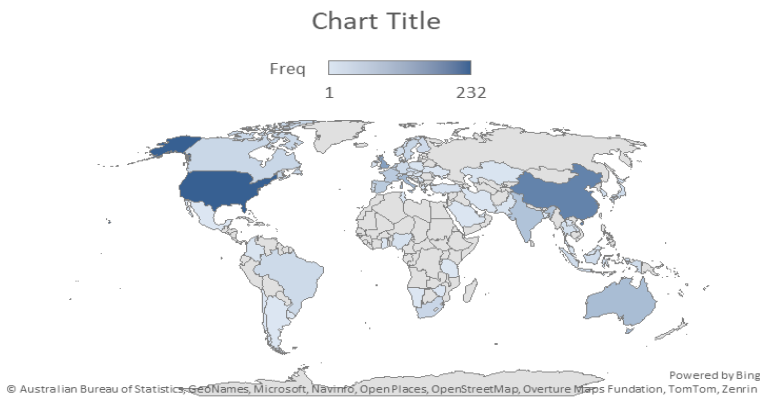

Fig. 5: Worldwide Publications.

Source: Author's Elaboration.

Figure 5 "Country Contributions" presents a comprehensive perspective of the research output and collaborative profiles in transportation-infrastructure research by national affiliation. The U.S.A. tops the chart with 74 papers (11.7 % of total publications), of which 66 are SCP and only 8 MCP, giving an MCP rate of 10.8%. Second is China (with 49 papers, 7.75%), but with a much higher collaboration value: 30 SCP versus 19 MCP, so approximately 39% of its output is co-authored by authors from other countries. The U.K. (with 36 papers, 5.7%) shows some modest collaboration (13.9% MCP), whereas Italy (23 papers, 3.64%) and Australia (20 Papers, 3.16%) display slightly above 30% work with multinational teams. Mid-sized contributors exhibit different patterns. Spain (17 papers, 2.69%) and Sweden (14 papers, 2.22%) stand well above 28% in collaboration rates, describing very strong ties between these countries and international research networks. Contrastingly, Finland´s 13 papers (2.06%) are firmly domestic (0% MCP), standing for a more localized research community. The Netherlands (13 papers, 2.06%) and Germany (10 papers, 1.58%) position themselves somewhere within, with MCP percentages of 23% and 20%, respectively. Smaller producers tend to show extreme collaboration profiles. Canada's 7 articles include only 3 SCP but 4 MCP (57% international), while Slovakia, United Arab Emirates, Georgia, and Israel—all with two or fewer papers—achieve 50–100% MCP rates. These high collaboration ratios with low output from some countries highlight how important international collaborations are to enable these researchers to contribute to the globally relevant transport-infrastructure scholarship.

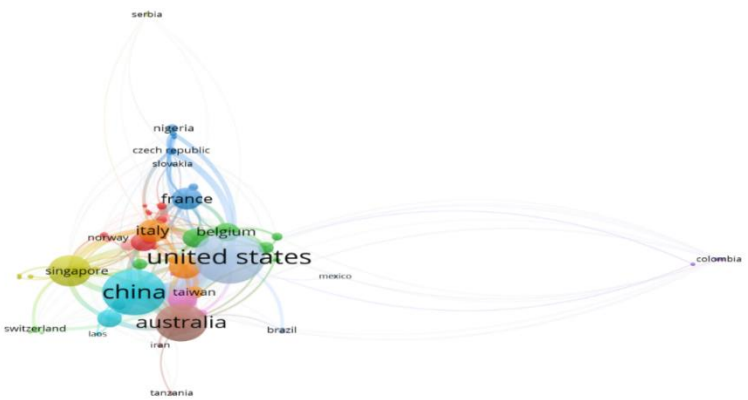

Fig. 6: Bibliographic Coupling.

Source: Author's Elaboration.

Figure 6 shows a bibliographic coupling map of transport research throughout the world contains multiple regional clusters of different countries that work together on EU transport policies and high-speed rail networks- France, Italy, and Belgium. The US cluster extends to Australia and China/Taiwan for freight logistics and infrastructure financing. Other smaller clusters are found clustering among the Central European countries, African countries, and Latin American partners. Switzerland stands alone due to its very specialized research agenda on alpine transport systems. Research collaborations seem to be far more geographically or economically tied, with developed countries with advanced transport systems collaborating more. However, developing countries appear less connected, and therefore, another possibility of establishing more inclusive networks of research exists. Another cluster comprises North American contributors with expertise in

cost-benefit analysis, megaproject governance, and transportation policy. Proximity between European institutional economists and Asian infrastructure researchers on extraterritorial rail deregulation and pricing model development signals a considerable amount of transnational collaboration.

3.6. Top 10 Institutions

According to the Scopus criteria for "Topmost institution based on total production," these are the most publications. Here are the Top 10 institutions based on high production:

Table 8: The Top 10 Institutional Sources Based on the Number of Publications

Affiliation	Articles
Beijing Jiaotong University	19
Masaryk University	12
Curtin University	11
Delft University Of Technology	11
Lappeenranta University Of Technology	11
University Of Valencia	11
University Of Antwerp	9
Kobe University	8
North Dakota State University	8
Notreported	8

Source: Self-prepared by author.

Table 8 shows the top institutions, according to the total number of documents, based on the institution. The table highlights the organizational leaders of research in transport infrastructure. Beijing Jiaotong University is ranked first, with 19 articles, denoting a long-standing history of railroad engineering and urban transit expertise. Masaryk University comes second with 12 publications, showing an increased inclination toward transport-economic modeling and geospatial policy research. Technical universities like Curtin, Delft, Lappeenranta, and Valencia (each with 11 articles) take the baton for regional strengths in sustainable transport, logistics, and infrastructure planning. Delft and Lappeenranta concentrate more on methodological innovations, while Curtin and Valencia lean toward applied research on electric mobility and PPP frameworks. Masaryk draws from urban economics along with spatial analysis, while Kobe University (8 articles) bridges East-Asian perspectives into studies relating to bike sharing and high-speed rail efficiencies. North Dakota State University also stands out with 8 papers on rural transit and freight corridors, contrary to the otherwise urban emphasis of most institutions. Entries without institutional affiliations include eight from the database, which may suggest missing metadata or multi-institution authoring issues. The distribution portrays a mosaic of established research nuclei with emerging centers of excellence in different parts of the world, underlining the ever-articulated and ever-global character of transport infrastructure science.

3.11. Keyword Analysis

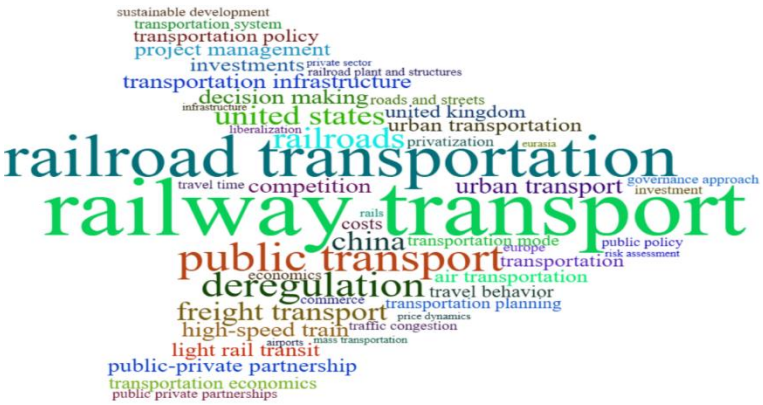

Fig. 7: Word Map.

Source: Author's Elaboration.

Figure 7 represents a word cloud that displays the dominant thematic strands in transport-infrastructure research by varying font size with term frequency. Sitting at the center, railway transport and railroad transportation, bearing the largest fonts, present an overriding attention to the theme of land-based mobility. Close clusters of terms around these include public transport, deregulation, and freight transport, thus implying that service modes and policy shifts (such as deregulation) garner a great deal of attention. Geographic labels of China, the United States, and the United Kingdom each command a prominent position, substantiating the worldwide orientation of the literature. On the other hand, medium-sized terms like competition, decision making, and project management highlight the business and managerial perspective of the sector, whereas smaller yet identifiable labels such as sustainable development and traffic congestion describe emerging environmental and urban problems.

Fig. 8: Word Tree Map.

Source: Author's Elaboration.

Figure 8 shows that the treemap offers the most detailed and area-proportional view of term frequencies, with each colored rectangle sized according to the raw count of occurrences. Dominated yet again by "railway transport" (60 occurrences, 9%) and "railroad transportation" (44, 6%), the treemap visually distinguishes these along with second-tier clusters—"public transport" (30, 4%), "deregulation" (26, 4%), and "railroads" (22, 3%). A row of medium-sized blocks (15-20 occurrences) groups terms like "urban transport," "competition," "decision making," and "high-speed train," highlighting research interest in policy, planning, and technological innovation. Smaller squares at the perimeter represent topics with lower frequency.

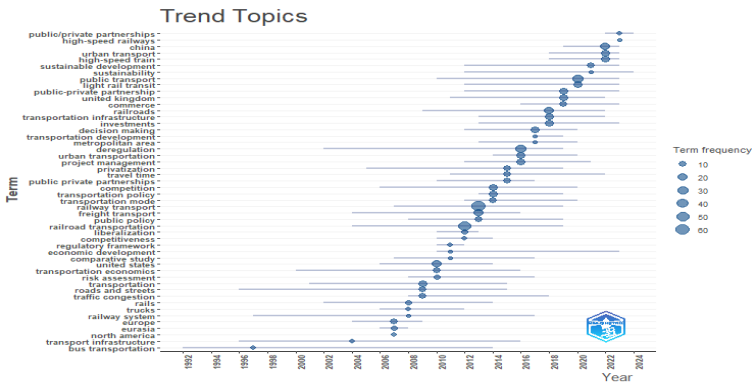

Fig. 9: Trend Topics.

Source: Author's Elaboration.

Figure 9 shows a timeline perspective; transport infrastructure research displays a clear cycle of focus. From the early 1990s to the mid-2000s, largely descriptive and network-based topics such as bus transportation and transport infrastructure were pursued. Between 2004 and 2007, geographic comparisons such as Europe and Eurasia and policy-laden terms such as deregulation and liberalization came into vogue, coincident with the increased attention to market reforms. The field, meanwhile, saw exponential growth in the years between 2005 and 2015, focusing strongly on rail and freight transport, with the emergence of terms like transportation economics, competition, and risk assessment that emphasize economic modeling and project governance. The creeping influence of public-private partnerships has evolved since 2012 from an obscure topic into a widely accepted and referenced one by 2019. Midway into the 2010s, tendencies toward sustainability, high-speed rail, and urban/shared mobility take over. The keyword sustainable development rose from 2012, and urban transportation peaked between 2016 and 2022 in dominating the discourse in more recent times. The rise of China (2019–2023) aptly indicates the transition of the discourse into megacity-scale studies. Recent keywords of travel time, investments, and commerce indicate a new user-oriented interest in financing and intermodal integration that defines the very cutting edge of present-day research.

3.12. Thematic Analysis

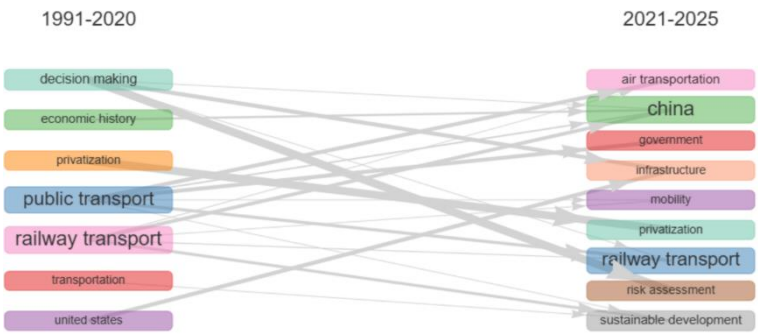

Fig. 10: Thematic Analysis.

Source: Author's Elaboration.

Figure 10 illustrates the evolution of key themes of transport infrastructure from 1991–2020 and 2021 to 2025. Two significant continuities can be identified: the Privatization cluster still stands central (Inc_index = 1.0), about public transport passing into the hands of private operators, whereas the Decision Making has somehow drifted into a different Risk Assessment theme (Inc_index = 0.5), now an independent discipline with its own methods. On the other hand, these big clusters have been creating new branches in newer areas. The predominant theme of Railway Transport (Occ = 46) now has a strong nexus with China (Occ = 35), Sustainable Development (Occ = 5), and somewhat with the classical railway themes. Public Transport (Occ = 13), in the recent period, has been splitting further into Railway, Air Transportation, Government, and Mobility, indicating a broader policy and modal integration. China and Infrastructure are new clusters (Inc_index = 0.5 each), standing for emerging emphases on national case studies and systemic infrastructure challenges. In the bigger picture, though, the field retains its core privatization, rail efficiency, and decision-based concerns, but now with a tilt toward sustainability, risk, and geopolitical specificity.

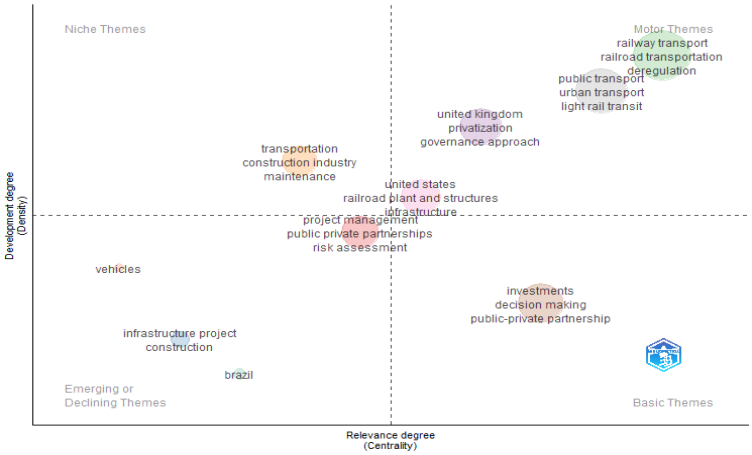

Fig. 11: Thematic Map.

Source: Author's Elaboration.

Figure 11 shows that motor themes like railway transport and public transport dominate the thematic structure of transport infrastructure research. They bring discussions of policy, technology, and economics. The subject partly reflects, of course, the disenchantment with privatization and the search for efficiency, yet some other tensions remain: the theme of deregulation shows some weakening in terms of internal cohesion, thus testifying that gaps must still be bridged between market reform and public accountability. Project management and risk assessment, as niche themes, are rich in technicalities but remain isolated from broader policy frameworks. Freight rail matters on the U.S. scale, and transport research in Brazil demonstrates internal strength but remains alien to global debates, underscoring the underrepresentation of the Global South. Basic themes tie the key concepts of finance, planning, and sustainability—PPPs and investment—but they fall short of fully exploring the dual questions of equity and measurable outcomes. UK-centric governance themes nonetheless operate near the core but remain strictly theoretical. By contrast, some marginalized clusters, such as vehicles and construction, remain technically relevant, although they never really forged strong ties with other clusters. All in all, the field favours efficiency and infrastructure rather than equity and inclusion. While dominant themes may look healthy, these are splitting apart and tipping toward geographic imbalance. Future research must bridge technical prowess and social accountability to bring coherence and inclusivity into relevance.

3.13. Factorial Analysis

Fig. 12: Factorial Analysis.

Source: Author's Elaboration.

Figure 12 shows factorial analysis placing strong emphasis on policy and operational efficiencies at the top of the transport research agenda; governance, privatization, and high-speed modes lie at the center of it all. As such, this top-down approach associates liberalization with infrastructure planning, ignoring risks and impediments to implementation at the local level. In this approach, infrastructure is considered just another market commodity, reflecting an Anglo-American profit-oriented view, neglecting equity and sustainability. It is a geopolitical bias: U.S. themes dominate, China rises as the major case for state-led models, and Africa and Latin America find near-complete absence. Urban mobility gets much attention, but freight, last-mile logistics, and rural access are neglected, pointing to fragmentation in the mobility

perspective. Factor analysis reveals disjointed clusters: risk management is closely linked to PPPs but distant from governance, indicating the absence of an integrated technical and policy framework. Indeed, topics related to labor, safety, and climate resilience are absent for the most part. The framework further opposes a hierarchy in which efficiency is more important than equity. Future research should seek to link governance and risk, diversify regional coverage, and integrate sustainability so as not to maintain a highly optimized system predicated on ignoring resilience and inclusive development.

3.14. Co-occurrence of Keywords

The keyword co-occurrence analysis, visualized using VOSviewer, yielded 143 keywords that met the threshold of a minimum of five occurrences, which were subsequently grouped into seven thematic clusters. These clusters reflect the diverse and multidimensional nature of global research on railway privatization, spanning topics from governance and infrastructure development to urban mobility and economic policy.

Cluster 1 (Red) centers on urban mobility and public transport policy. Keywords such as public transport, urban planning, travel behavior, modal shift, and transportation system illustrate an academic focus on the socio-spatial impacts of privatization. The inclusion of COVID-19 and carbon dioxide signals the growing relevance of environmental concerns and resilience planning in transportation discourse. Research in this cluster often addresses how privatized or deregulated rail systems intersect with urban accessibility, sustainability, and modal integration.

Cluster 2 (Green) emphasizes infrastructure development and governance through public-private partnerships (PPPs). Terms such as risk management, decision making, project management, and transport infrastructure highlight how privatization is operationalized through institutional frameworks. The focus here lies in assessing the effectiveness of PPPs in delivering rail projects, managing investment risks, and fostering sustainable development in transport infrastructure.

Cluster 3 (Blue) deals with the economic dimensions of railway privatization, particularly regarding competition and freight efficiency. Keywords including cost effectiveness, economic impact, competitiveness, and private investment suggest a body of research focused on evaluating the performance and market outcomes of liberalized rail services. Countries such as India, Brazil, and Sweden frequently appear in this context, indicating geographically varied case studies.

Cluster 4 (Yellow) revolves around high-speed rail systems and market liberalization. This cluster is marked by terms like economic growth, high-speed railway, vertical separation, and regression analysis. The studies grouped here explore how liberalization and structural unbundling (such as the separation of infrastructure and operations) influence service quality, market dynamics, and technological advancements, particularly in countries like China.

Cluster 5 (Purple) focuses on liberalization and restructuring in the European and Eurasian context. Keywords such as liberalization, restructuring, European Union, Germany, and Russia signal an interest in regional comparative studies that examine the political economy of railway reforms. Research in this cluster often discusses the evolution of competition policy, regulatory harmonization, and the outcomes of market liberalization across different governance models.

Cluster 6 (Sky Blue) captures institutional and regulatory dimensions of railway privatization. The presence of keywords like governance, ownership, regulation, and safety reflects scholarly attention to the broader legal and policy environment in which privatization occurs. Notably, the United Kingdom emerges as a significant focus, often serving as a case study for early and controversial privatization experiments.

Cluster 7 (Orange) represents intermodal competition and regional studies, especially in North America and parts of Europe. This smaller but distinct cluster includes terms like deregulation, intermodal competition, trucking, buses, and finance, suggesting research that compares rail transport to other modes under deregulated conditions. Case studies from the United States and Italy are prominent in this group.

Overall, the clustering analysis reveals that the discourse on railway privatization is inherently interdisciplinary, integrating elements of transport planning, public administration, economics, and regional development. It highlights a global research agenda concerned not only with efficiency and investment models but also with the broader implications for mobility, equity, and sustainability. These clusters offer a roadmap for future inquiry, especially in examining the comparative outcomes of different privatization trajectories and governance models.

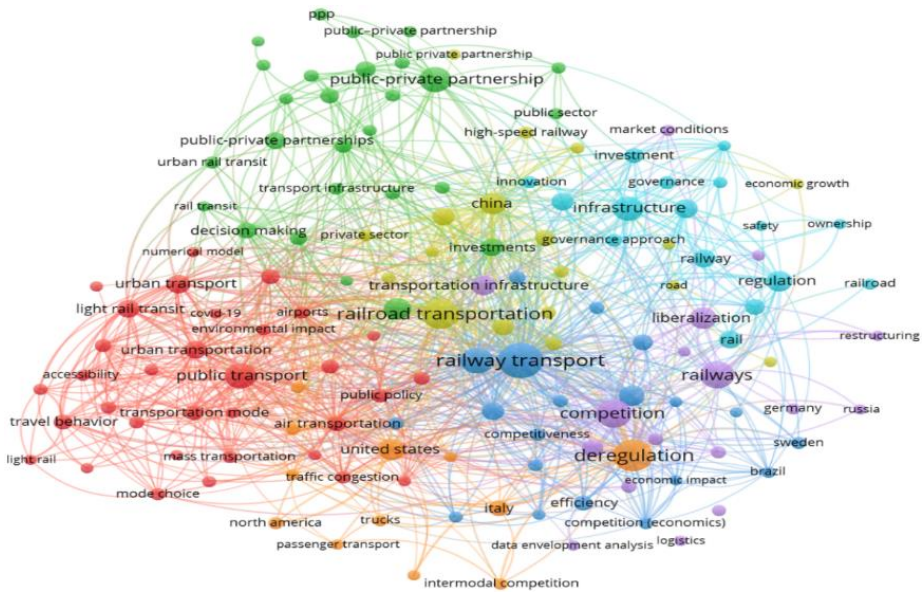

Fig. 13: Co-Occurrence of Keywords.

Source: Author's Elaboration.

Table 9: Top Clustering

Cluster	Keywords	Derived Theme
Cluster 1 (red) 33 items	accessibility, air transportation, airline industry, airports, carbon dioxide, comparative study, covid-19, environmental impact, light rail, light rail, transit, mass transportation, mobility, modal shift, mode choice, numerical model, public policy, public space, public transport, public transportation, railroad cars, rapid transit, roads and streets, spain, traffic congestion, transportation mode, transportation planning, transportation system, travel behavior, travel behaviour, travel time, urban planning, urban transport, urban transportation.	Urban Transportation, Accessibility, and Environmental Sustainability
Cluster 2 (green) 27	australia, construction industry, decision making, economics, government, infrastructural development, infrastructure project, investments, ppp, project management, public private partnerships, public sector, public-private partnerships, public-private partnerships, public/private partnerships, public-private partnership, rail transit, railroad plant and structures, railway system, risk, risk assessment, risk management, sustainable development, transport, transport infrastructure, transportation, urban rail transit.	Infrastructure Development and PPP Governance in Railway Projects
Cluster 3 (blue) 20	brazil, competition (economics), competitiveness, cost effectiveness, economic and social effects, economic development, economic impact, efficiency, freight transport, freight transportation, india, price dynamics, private investment, railroads, railway transport, sustainability, sweden, traffic management, transportation economics, transportation policy.	Economic Efficiency, Competitiveness, and Market Performance
Cluster 4 (yellow) 18	china, commerce, costs, economic growth, high speed rail, high-speed rail, high-speed railway, high-speed railways, high-speed train, market liberalization, private sector, public private partnership, railroad transportation, rails, regression analysis, road, transportation development, vertical separation	High-Speed Rail and Structural Reforms in Liberalized Rail Markets
Cluster 5 (purple) 17	competition, data envelopment analysis, eurasia, europe, european union, germany, liberalization, liberalization, logistics, market conditions, productivity, rail freight, railways, restructuring, russia, transport policy, transportation infrastructure	Liberalization, Restructuring, and Regional Rail Market Dynamics
Cluster 6 (sky blue) 16	capital, governance, governance approach, infrastructure, innovation, investment, ownership, privatisation, privatization, rail, railroad, railway, regulation, regulatory framework, safety, United Kingdom	Regulatory Frameworks, Ownership Models, and Governance Approaches
Cluster 7 (orange) 12	bus transportation, buses, deregulation, finance, intermodal competition, Italy, North America, passenger transport, planning, trucking, trucks, United States	Intermodal Competition and Regional Case Studies of Deregulation

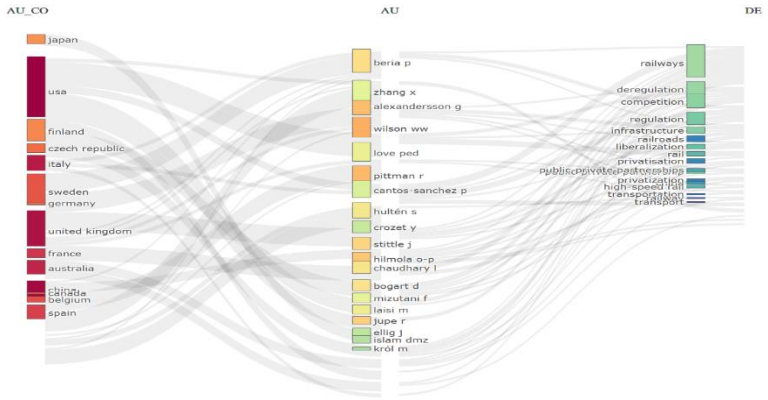

Fig. 14: Three-Field Plot.

Source: Author's Elaboration.

The three-field plot shows the linkages between contributing countries, influential authors, and central research topics in the field of railway privatization. It shows how countries such as the USA, the United Kingdom, Germany, Sweden, and Japan contribute foremost to research and thus actively participate in transport policy and infrastructure research. The influencers of this field would include Beria P, Zhang X, Alexandersson G, and Pittman R, who are often associated with foundational topics. The leading topics include railways, privatization, liberalization, competition, and public-private partnerships (PPP), indicating the focus of this research. This visualization portrays a unifying force for the contrasting bibliometric results of the analysis that describe a globally scattered yet thematically cohesive research arena concerning the governance, efficiency, and regulatory transformation of rail transport systems.

4. Discussion

Urban transportation, accessibility, and environmental sustainability have become focal issues as cities strive to forge a multimodal scenario of mobility, equity, and climate goals (Kalhoro et al., 2024; Tiznado-Aitken et al., 2024; Moinse et al., 2024). Ma et al. (2020) reveal the transition away from private cars fostered by bike-sharing in Delft and may reduce emissions and congestion. Meanwhile, De Bortoli and Christoforou (2020) show that the environmental benefits of e-scooters in Paris depend on the life span of vehicles and charging sources. According to Newman et al. (2018), private funding mechanisms such as the Entrepreneur Rail scheme present an opportunity for the revitalization of urban transit, but issues in market-based urban transit systems were revealed by a shock event such as COVID-19 (Majerčák et al., 2023). Gao et al. (2022) observe that in China, urban transport systems still discriminate against low-income groups, thus enhancing mobility inequality. Environmental assessment of the high-speed train in Spain shows that net benefits are conditional on operational efficiency (Kortazar et al., 2021). Safety comparisons across U.S. transport modes (Savage, 2013) and congestion cost modeling of Flanders (Struyf et al., 2022) represent the economic-environmental justification to divert demand to safer and cleaner modes. Generally, all these studies affirm how urban sustainability heavily depends on integration in planning and equity in access, tied together by systemic environmental considerations (Chen et al., 2022).

Growing complexity in the implementation of railway projects brings into focus infrastructure development and governance of PPPs. Ke et al. (2017) emphasize that properly structured risk sharing is key to attracting private investments into the rail sector of China. The early light rail PPPs brought political and contractual risk into the open as noted by Smith and Gannon (2008), leading to a more robust stakeholder engagement process. Aerts et al. (2017) insist that learning should be project-based for mega infrastructure projects to enhance their success (Teigiserova & Schraven, 2024; Ben Mabrouk et al., 2024). Chen et al. (2012) recommend hybrid subsidy models for making non-viable projects viable. Besides this, Cui et al. (2022) and Van Wieringen and Zajontz (2023) have shown that public perception of corporate social responsibility is now a factor contributing to PPP legitimacy, while Peda and Vinnari (2022) assert that the framing of uncertainty in public discourse can decide project approval. Rösler et al. (2021) contend that co-ownership arrangements should circumvent the limits of simple risk transfer, and Newlove-Eriksson (2020) demonstrates how fragmented governance, for example, in the Crossrail project, may impair transparency and responsiveness. These points underscore the need to cultivate robust, adaptive governance that weighs public interest and private operational capability.

Discussions on economic efficiency, competitive performance, and market structure dwell upon liberalization's effect on freight and logistics systems. Russian rail freight firms registered enormous disparities in efficiencies using DEA analyses (Maltseva et al., 2020), while congestion is put forward by American trucking firm executives as a primary cost driver (Golob & Regan, 2001). Elasticity analyses in Belgium confirm that even the smallest shifts into rail result in large returns (Troch et al., 2022). If large-scale policy fragmentation is addressed, blended transport networks in North America and Europe enjoy an advantage and scope for efficiency gains (Wiegmans et al., 2018). There have been rail modal shifts induced by policy in Central and Eastern Europe with a focus on grain transport that relate to the strategic role of public incentives (Pittman et al., 2020). On the other hand, Norway's liberalization of express coaches brought about mixed results related to low demand (Aarhaug et al., 2018). Empirical firm- and sector-level analyses further nuance these patterns (Tomikawa & Goto, 2025; Shin, 2024; Ben Mabrouk et al., 2024; Quach et al., 2024). These examples suggest that economic benefits created by competition must be reinforced by regulation, enhancement of the infrastructure, and intermodal coordination (Pienaar, 2016; Moinse et al., 2024).

High-speed rail and structural reforms in liberalized rail markets constitute a means for achieving higher-level objectives in infrastructure-driven growth. According to Jin et al. (2020) and Jin (2024), China's HSR lines have triggered IPOs and investment booms at the local level (Jin, 2024; Ma et al., 2024). Yan et al. (2019) suggest that firms located near HSR stations rush to deploy capital to take advantage of the benefits of time-space compression. In Spain, HSR competes with air travel based on terminal access and travel time, not mere speed (Martín et al., 2014). Kusuma et al. (2017) described that early users in Indonesia tend to value reliability over pure speed. However, according to Kortazar et al. (2021), HSR still needs to maintain high load factors and low-carbon energy sources if it is to achieve positive environmental outcomes. In sum, HSR reforms need to pair market liberalization with public interest oversight to guarantee financial viability and sustainability.

The complexity of liberalization, restructuring, and transregional rail-market dynamics is best explained through cross-national examples. EU reforms on open-access competition were very much wed to price-making and institutional capabilities (Eisenkopf et al., 2006; Beria et al., 2012). Russia's rail sector suffered from poor enforcement in spite of structural reforms (Pittman, 2003), whereas Poland had no regulator, and inconsistent service delivery was an outcome (Król, 2010). By contrast, with institutional support, South African state-owned Transnet imparted positive macro-logistics impacts (Havenga et al., 2023). Historical and long-run institutional analyses also highlight deep legacies shaping infrastructure outcomes (Colleoni, 2024; Klemann, 2024). Based on these examples, we may conclude that the consequences of liberalization are subject to local regulatory maturity, as well as institutional design, and are independent of competition introduction. Different frameworks can serve as an operational basis to strengthen governance in railway privatization.-COBIT for digital and data governance; ISO 55000, for structured asset Management; and Global Reporting Initiative, for environmental and social disclosure (Gomaa, 2025).

Historical and regulatory studies shed light on the regulatory framework, ownership models, and governance approaches shaping the infrastructure. Eichengreen (1995) underscored early implications concerning the risk balance in railway finance. Public and network competition policies of the EU, though ambitious, were confronted by institutional fragmentation (Pelkmans, 2001). The British privatization is widely regarded as flawed because of incentive misalignment and consultancy-driven decisions that adversely affected operational performance (Jupe & Funnell, 2015; McCartney & Stittle, 2017). Bogart and Chaudhary (2015) showed that state ownership, when well governed, can be more productive than its private counterpart. Mostert et al. (2017) argue that pricing reform incorporating externalities remains of paramount importance in shifting demand towards greener modes. The process of effective regulation ought to integrate the ownership structure, environmental objectives, and safety regulations under a single governance framework.

Lastly, intermodal competition and regional case studies of deregulation examine deregulated rail systems competing with buses, trucks, and private cars. U.S. freight deregulation decreased labor costs but at the expense of job security (Monaco et al., 2006; Davis & Wilson, 2003). Modeling from Lyles and Mallick (1990) shows how imbalances in modal share often go to the detriment of private vehicles unless there are integrated policy actions. Reforms in pricing led to a better-performing network at some political cost (Kilani et al., 2014). In Wales, however, deregulation served service innovation at the expense of rural communities (Preston, 2016). Competitive pressures in the Canadian agricultural sector facilitated the adoption of technology and modernization outside the freight corridor as well (Ferguson & Olfert, 2016). Short-haul flight bans and modal substitution simulations further show complex welfare and environmental trade-offs (Cantos-Sanchez et al., 2024). Policy experiments on fiscal-based modal shifting and micro-mobility integration reveal context-sensitive outcomes (Shiddiqi et al., 2024; Moinse et al., 2024; Tiznado-Aitken et al., 2024).

Rail passenger-kilometres (pkm) measure passenger volume (passengers × km); the EU reached ≈429 billion pkm in 2023 (up 11.2% vs 2022), signalling demand recovery but potentially masking unequal urban–rural rebounds (Statistics explained, 2024). Freight tonne-kilometres (tkm) capture goods movement scale; China's rail freight was roughly ~23 trillion tkm in 2022, indicating large logistical capacity but also possible regional bottlenecks and environmental externalities (Shao, 2024). Route length (total route-km) indicates physical network extent and baseline coverage; UIC and World Bank country series allow per-capita or per-area comparisons that reveal whether networks serve broad territories or concentrate on dense corridors (Statistics – UIC - International Union of railways, 2025; Glossary | DataBank, 2025). Punctuality and cancellations directly affect user welfare; UK ORR and rail factsheets (2023–24) report reliability problems—including cancellation episodes near ~4% for some operators—showing that volume growth alone does not guarantee everyday service quality (Passenger rail performance | ORR Data Portal, 2025; Rail factsheet, 2025). Public subsidy levels show the fiscal footprint of rail services; UK support rose from roughly £4 billion pre-pandemic to near £9 billion post-pandemic, suggesting privatization did not eliminate public funding responsibilities and raising efficiency and equity questions (Rail factsheet, 2025). Operator revenue and profitability indicate commercial viability; for example, Indian Railways reported earnings of ₹2,56,093 crore and net revenue of ₹3,260 crore for FY 2023–24, useful for comparing state and private outcomes (Indian Railways, 2023; Ministry of Railways, 2024). Productivity metrics (TFP, labour productivity such as freight ton-miles per labor unit) are core efficiency measures; series from BLS and STB show

varied trends and highlight why reconciling economy-wide TFP with firm-level efficiency is essential (Surface Transportation Board, 2025). Since the early 1990s a wave of railway concessions across Sub-Saharan Africa produced mixed outcomes—some concessions achieved network rehabilitation and traffic growth, while others collapsed or were renegotiated due to weak governance, financing shortfalls, and contract fragility (World Bank reviews of African railway concessions) (Pozzo Di Borgo, et al., 2006; Bullock, R. & The International Bank for Reconstruction and Development / The World Bank. 2009). In Latin America, Argentina's early-1990s railway concession program (and related regional reforms) rapidly transferred operations to private firms but often coincided with declining rural coverage and contested social outcomes, illustrating how privatization effects depend on contract design and regulatory capacity (Sharp, R. & The World Bank, 2005).

These examples underline the importance of intermodal success principles such as properly designed pricing, well-targeted subsidies, and policies fostering integration among modes. Overall, they weave a rich tapestry through these seven topics, ranging from the evolution of privatization models and governance under PPP to frontiers in sustainability and high-speed marking innovations and competition between intermodals. Whereas methodological rigor and cross-national comparisons have greatly advanced knowledge, certain gaps persist in: labor impacts, equity in service access, and resilience of privatized networks under shocks. Bridging these gaps will require greater interdisciplinarity integration, deeper Global South case studies, and governance designs balancing efficiency with social and environmental imperatives.

5. Conclusion

The study uses bibliometric analysis and systematic review methods to analyze 632 peer-reviewed papers about railway privatization from 1991 to 2025. The macro-analysis of publication trends shows sustained scholarly attention in areas like the United Kingdom, China, India, Japan, and Sweden, focusing largely on project management, PPPs, and transport economics. Simultaneously, thematic mapping identified four core clusters around: (i) economic efficiency and deregulation; (ii) risk management and governance in PPP projects; (iii) sustainability and urban accessibility; and (iv) high-speed rail under a liberalized market. Unequivocally, the discourse continues to congregate around market-related concerns- efficiency gains, investment structures, and risk mitigation seem to dominate the debates. Methodological sophistication has, however, been enhanced, with the appearance of specialized risk-assessment frameworks and infrastructure-governance models. Yet, the truly critical social dimensions remain far from being researched: labor challenges, rural connectivity, equitable access, and community well-being reside in peripheral positions. Environmental sustainability becomes a peripheral concern in most cases complementary rather than an integrated objective; and studies centering on the Global South are far less numerous.

Moving forward, research in railway privatization must take a wider gaze. Comparative case studies carried out in underrepresented regions may reveal unheard-of challenges innovations. Evaluations of participatory governance would enrich the policy assessment process with the voices of the marginalized. The need is present for integrated frameworks that integrate social justice and environmental stewardship with financial viability, to name a few. Utilizing interdisciplinary methods and broadening the geographical focus, future research will transcend the narrowly defined realms of efficiency. Such work will guarantee that privatization concepts support not only optimizing network performance but also fostering equity in access, protecting labor rights, and promoting sustainability in the long run. Viewing railway privatization as socio-technical change will thus give scholars and policymakers the foundation to create transport systems that are inclusive, resilient, and just for generations to come.

The findings from the present bibliometric and systematic review highlight not only established research trajectories in railway privatization but also critical thematic imbalances and underexplored niches that future studies must urgently address. While motor themes such as "railway transport," "public transport," and "deregulation" continue to dominate due to their high centrality and density, they often reinforce a technocratic and efficiency-driven view of privatization, sidelining the human, regional, and ecological dimensions. Niche clusters—such as "project management," "risk assessment," "railroad plant and structures," and even geographically isolated themes like "Brazil"—exhibit high internal coherence but remain disconnected from central policy or governance frameworks. This fragmentation underscores a need for greater thematic integration where risk modeling, for example, can inform policy discourses on safety, affordability, and social accountability. Similarly, themes in the lower-left quadrant (vehicles, construction industry, and regional maintenance practices) reflect a persistent disconnect between engineering innovation and socio-political imperatives. Future research must strategically bridge these gaps by embedding niche technical insights within larger socio-political frameworks, especially in contexts where privatization has triggered labor unrest, affordability crises, or rural marginalization.

This study shows that research on railway privatization has mostly been in relation to economic efficiencies and partnership structures, while making less of an attempt to draw upon accounting views that are key to the comprehension of fiscal transparency and financial sustainability. To lessen this gap, policy frameworks must contain accounting and reporting practices with respect to concession arrangements and disclosures of lease obligations, including the explicit assignment of lifecycle costs; activity-based costing for shared infrastructure; and regular reporting of contingent liabilities. An additional layer of impartial audit and accounting would enhance the so-called "transparency" of privatized rail systems, with international public sector accounting standards as the accounting reference. Parallel to this, governance can be reinforced through existing frameworks: for example, COBIT to direct digital and data governance, ISO 55000 for structured asset management, and the Global Reporting Initiative to provide an operational basis for environmental and social disclosure. Importantly, the policy debate must be further widened beyond efficiency to include sustainability and equity outcomes. Regulators may consider indicators that can be measured: accessibility (population within an agreed travel time from rail services), affordability (rail fares and household income), environmental impact (carbon emissions per passenger-kilometre), and labor conditions (coverage of collective agreements and wage comparability). Contractual obligations and the link between output payments and these indicators are the tools that can bring the findings of this study into enforceable action so that privatization does indeed bring efficiency gains without the loss of transparency, inclusiveness, or sustainability in the long run.

Moreover, the thematic evolution captured in the Sankey diagram points to promising but still emerging connections between core issues of privatization and sustainability, governance, and regional specificity—particularly in the case of China's high-speed networks and infrastructure-led growth. However, similar attention has not been extended to the Global South beyond selective references to India or Brazil. Africa, the Middle East, and Latin America continue to be peripheral in the global research ecosystem, despite their unique challenges of state capacity, inequality, and postcolonial infrastructural legacies. Future studies should thus deliberately expand geographic inclusivity while incorporating intersectional themes such as labor rights, environmental justice, gendered access, and technological equity. Additionally, a broader conceptual shift is needed—from studying privatization as a static policy tool to understanding it as a dynamic governance mechanism deeply interwoven with institutional capacity, stakeholder politics, and the ethics of public service delivery. The study uses only the Scopus database, that are limitation of this study. Integrating social impact assessments, participatory governance

models, and long-term sustainability indicators into future analyses can help reposition railway privatization research as a critical site for examining not just economic reform but the future of equitable and resilient public infrastructure systems.

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