

Crisis management in public–private partnerships: lessons from the global crises in the XXI century

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Abstract

Purpose – Global crises have become increasingly recurrent events that jeopardize public-private partnerships (PPPs). In this context, the purpose of this paper is to expose the PPP-crisis research agenda by combining bibliometric and network analyses.

Design/methodology/approach – The PPP literature associated with global crises between the 2008 global financial crisis and 2022 was analyzed in three stages: (1) paper selection and screening for the inclusion/exclusion of articles relevant to this research, (2) semantic network development for examining thematic relationships among selected papers by considering the co-occurrence of keywords within the chosen studies and (3) calculation of network metrics for analysis.

Findings – The paper identified six research avenues for the PPP-crisis agenda: public interest, relational governance, risk management, user-pay PPPs, crisis management and financial performance. The PPP-crisis literature has spread significantly in the last five years driven by the case study approaches on a national or regional basis. Conversely, non-crisis periods generate room to strengthen user-pay PPPs and relational governance. The pandemic and post-pandemic times shared the priorities of the 2008 financial crisis but also strengthened the management of the risks and the structural drivers of the global crisis.

Originality/value – This study demonstrates that during global crisis periods, the public interest and financial performance gain relevance in a detriment of structural solutions to social legitimacy erosion of PPPs because of the urgency of giving tools to the public and private sectors to tackle the financial issues, which steer future issues for PPPs.

Keywords COVID-19, Public interest, Relational governance, Risk management, User-pay PPPs, Financial performance

Paper type Literature review

1. Introduction

The implementation of public-private partnership (PPP) infrastructure projects has grown significantly in both developing and developed nations (Hodge and Greve, 2016).



These projects are a valuable tool to address simultaneously the heterogeneous needs and demands of the wide arrangement of internal and external stakeholders (Khallaf *et al.*, 2024).

However, the continuity of these projects is endangered by unprecedented challenges derived from extraordinary global crises that occur periodically. PPPs must deal with these crises while guaranteeing the necessary financial government resources demanded throughout their life cycle, reduce the potential impacts on ecosystems (i.e. downstream water pollution, resource distress, ecological affectation) and ensure optimal levels of social satisfaction (Castelblanco *et al.*, 2023b).

In the last 4 decades, PPPs have spread around the world constituting one relevant way of procuring, operating and maintaining public-sector megaprojects (Hodge and Greve, 2016). During this period, the world has experienced two major global crises: the 2008 global financial crisis and the COVID-19 pandemic, constituting the most significant since the 1929 Great Depression (Castelblanco and Guevara, 2022). Global crises have become recurrent events that jeopardize the overall sustainability of PPP projects and programs.

The global affectations on macroeconomic variables produced by the global financial or COVID-19 crises exacerbate uncertainty and endanger PPP megaprojects. The aftermath of these crises generates structural issues that these long-term projects need to tackle in order to survive. Simultaneously, PPP users are dealing with rising unemployment and inflation, concessionaires are struggling because of the increased uncertainty on demands and market conditions and governments are growing budgetary pressure and public debt (Akomea-Frimpong *et al.*, 2020). As a result, each of these crises triggered several repercussions on PPPs by affecting global financial markets, eroding bank lending to the private sector, decreasing the demand for user-pay PPPs, increasing decision-makers' risk aversion and disrupting supply chains. To address the complex environment triggered by global crises, PPPs require appropriate responses to governments' budgetary constraints, concessionaires' need for reliable life-cycle revenues and users' expectations of provisions of public services and employment.

Despite the recent surge of interest among scholars in investigating the effects of global crises on PPPs, the existing literature remains predominantly focused on analyzing the impact of a single crisis, either the global financial crisis or the COVID-19 pandemic (McGee and Mayer, 2021; Nikolić *et al.*, 2020). However, there is still a significant gap in the literature in terms of a comprehensive and longitudinal analysis that would integrate the effects on PPPs of multiple global crises that have occurred over the past two decades, including but not limited to the global financial crisis, COVID-19, global supply chain disruptions, Ukraine's war and global inflation increases.

To contribute to filling this gap, this paper seeks to expose the PPP-crisis research agenda by combining bibliometric with network analysis to deepen comprehension of its main elements, highlighting knowledge contributions and gaps in order to propose research avenues to facilitate a better understanding of both the current and future crises.

2. Points of departure

In the past 15 years, the world has encountered two significant global crises, the Global Financial Crisis (GFC) in 2008 and the COVID-19 pandemic that started in 2020. The impact of these crises on the public-private partnership (PPP) sector has been profound. The COVID-19 pandemic, in particular, has caused unprecedented challenges worldwide, including disruptions to the global supply chain. Other issues, such as the war in Ukraine and the global increase in inflation, have also affected the infrastructure sector. Despite multiple studies conducted on each of these crises, there is a lack of research focused on analyzing them from an integrated perspective. Therefore, this section presents the most relevant points of departure in the current understanding of each of these crises and their impact on PPPs. It is crucial to consider these events and their relationship with the infrastructure sector.

2.1 Global financial crisis

The Global Financial Crisis (GFC) triggered a severe liquidity crisis among some of the world's largest banks, leading to government interventions to prevent their failure (Davies, 2015). The crisis was caused by excessive leveraging among banks with subprime mortgages, such as Lehman Brothers, which limited the financial sector's ability to absorb losses relying on equity (Tsai, 2017). As the valuation of bank assets dropped, banks became insolvent, and government bailouts were necessary due to the public sector's reluctance to allow banks to fail (Davies, 2015). These events also triggered the European sovereign debt crisis, with several Eurozone countries declaring their inability to pay their public debts (Ćirilović *et al.*, 2018).

The impact of the GFC on PPP markets resulted in declining bank lending, illiquidity, and difficulties in achieving financial closure of PPPs tendered after the crisis due to a lack of private debt availability (Haran *et al.*, 2013). This led to reduced debt/equity ratios and increased costs of debt for several PPPs, and in extreme cases, scope reduction (Davies, 2015). The insurance industry also became more risk-averse, reducing bond issuances and impacting the insurance wrap for PPP projects (Haran *et al.*, 2013). Financial institutions started to prioritize short-term loans over long-term private debt for PPP projects to reduce risk exposure (Ćirilović *et al.*, 2018). The decline in traffic volumes due to negative trends of GDP-related indicators also impacted transportation PPPs (e.g., airports and toll roads) in multiple countries, leading to an increase in demand- and revenues-associated risks (Vassallo *et al.*, 2012). In effect, there is a highly correlated tendency between the state of the economy, traffic growth, and project revenues for this PPP typology, making this decline in traffic a critical concern. The relationship between traffic volumes and macroeconomic conditions is also relevant for availability-based PPP, where governments bear the demand risks. Low-demand performance indicators in PPPs lead policymakers to prioritize improving the conditions for these roads rather than investing in new corridors (Nikolić *et al.*, 2020).

The impacts of the GFC on PPPs were not limited to North America and Europe but extended to regions such as Asia, Africa, Oceania, Central, and South America (Queiroz *et al.*, 2013; Regan *et al.*, 2017). In Asia, the crisis led to a significant economic slowdown, particularly in export-dependent countries like Japan, South Korea, and Taiwan. In Africa, the impacts of the crisis were less severe, but it still led to a decline in commodity prices, foreign investment, and aid flows to the region. Oceania, particularly Australia and New Zealand, experienced a sharp drop in exports and commodity prices, leading to a recession. In Central and South America, countries like Brazil and Mexico experienced a significant decline in foreign investment and exports, leading to economic slowdowns. In countries such as India, South Africa, Brazil, and Mexico, the crisis led to a decline in private-sector financing for PPP projects, as banks and other financial institutions became risk-averse and reduced lending (Queiroz *et al.*, 2013). As a result, governments in these regions faced challenges in securing funding for PPP projects, leading to delays or cancellations of planned projects in countries such as Indonesia and Mexico (Wibowo *et al.*, 2012). Additionally, the crisis had an impact on the demand for PPP infrastructure given that the economic slowdown led to a decline in economic activity and lower traffic volumes on transportation infrastructure (Vassallo *et al.*, 2012).

2.2 Global crises between 2020 and 2023

The COVID-19 pandemic originated from the initial outbreak of the coronavirus in Wuhan, China in December 2019, and was later declared a global pandemic by the World Health Organization. As of March 10, 2023, the pandemic had caused over 676 million infections and nearly seven million deaths worldwide.

The pandemic shares similarities with the Global Financial Crisis, including significant global economic impacts comparable to those of the Great Depression of 1929. Firstly, both crises were triggered by abnormal exogenous shocks, which led to unprecedented levels of uncertainty, severely impacting global financial markets and international supply chains

(Santacreu and Labelle, 2022). To address market investors' short-term panic, multiple jurisdictions implemented quantitative easing policy measures (Zhang *et al.*, 2020). Secondly, both crises resulted in significant reductions in the private sector's liquidity. The Global Financial Crisis caused commercial finance scarcity, while the pandemic resulted in revenue scarcity (McGee and Mayer, 2021). To counter this, governments provided unprecedented financial support and grants to low-income individuals and private companies, leading to increases in expenditures subsidy-related and reduced revenues from taxes (Didier *et al.*, 2021). Moreover, both crises negatively impacted the global pipeline of PPPs, with many governmental institutions delaying or canceling procurement processes due to the reduction in worldwide economic activities (Casady and Baxter, 2020).

The crisis initiated in 2020 has exposed the vulnerability of the current global value chain to global shocks (Yagi, 2021). Global supply chain disruptions, triggered by the pandemic, have significantly affected prices in the whole construction industry via inflation (Santacreu and Labelle, 2022). Supply chain disruptions have led to exacerbated inflation due to the limited availability of specific components, technologies, and resources for PPP development (Allam *et al.*, 2022). The exposure to foreign bottlenecks through the global value chain played a crucial role in transmitting the effects of supply chain disruptions to prices (Santacreu and Labelle, 2022). The combination of demand and supply shocks and the heterogeneous exposure to these shocks across industries has further worsened the situation. Shipping costs have also more than doubled compared to previous costs, leading to high products cost and increasing inflation. Notably, many Western countries are experiencing high rates of inflation, affecting PPP development globally (Allam *et al.*, 2022).

3. Research methodology

To synthesize and examine the PPP literature associated with global crises, the authors focused on the two most important critical events since the 1929 Great Depression: the 2008 financial crisis and the COVID-19 pandemic. The analysis comprised three main phases: (1) paper selection and screening, (2) semantic network development, and (3) calculation of SNA quantitative network metrics. Phase 1 established the framework for the inclusion/exclusion of articles relevant to this research. Thanks to that, relevant articles were identified and subsequently reviewed. Phase 2 and 3 focused on examining thematic relationships among selected papers from a qualitative and quantitative lens, respectively. This was done by considering the co-occurrence of keywords within the chosen studies and implementing semantic network procedures.

Overall, VosViewer and quantitative SNA have been widely used in countless papers, however, the intersection between both techniques is an incipient approach that has not been employed in the PPP body of knowledge yet. Therefore, the methodological approach developed in this paper constitutes a novel approach that integrates the benefits of VosViewer to create networks easy to interpret for readers and the methodological robustness of quantitative network metrics of SNA (i.e., degree, closeness, eigenvector, and betweenness).

3.1 Paper selection and screening

The Web of Science (WOS) was selected as the main instrument to identify relevant papers for this research, as this is a comprehensive database commonly used for bibliographic studies and literature reviews within the PPP domain (Castelblanco *et al.*, 2021). The search query focused on titles, abstracts, and keywords; and included multiple boolean operators and terms, as follows:

TITLE-ABS-KEY (“public private partnership”OR PPP OR p3 OR “public private partnerships” OR “build operate transfer” OR “build-operate-transfer” OR “private finance initiative” OR “PFI” OR “PFI” OR “toll road”) AND (crisis).

The initial search returned 380 records and the authors only considered papers published from 2008 (when the financial crisis started) until September 2022; resulting in removing 24 documents written between 1993 and 2007. From the remaining 356 records, 22 papers were removed due to being written in non-English languages. Considering the 344 publications left, unrelated subject areas (i.e., geography, sociology) were not considered, and only manuscripts within the scope of economics, business finance, management, business, engineering civil, public administration, and transportation were included. After this filter, 169 papers were excluded and only 165 were kept. Lastly, the titles and abstracts were read to identify unconnected topics, resulting in the removal of 21 manuscripts. Accordingly, 144 publications were considered for this study.

3.2 Semantic network development

Once the WOS search was completed, the records were downloaded and used as inputs to develop an interrelated network of keywords extracted from the selected papers. This was done by using VOSviewer, as this software package is useful for transforming data co-occurrence in the bibliometric registers into similarities matrices (Ortiz-Mendez *et al.*, 2023). In this way, such arrangements were converted into networks in which keywords were represented by nodes connected through links in case of being present in the same manuscript; a short distance between any two nodes indicated a high level of relatedness between them, and vice versa (Marcellino *et al.*, 2022). In total, 77 author keywords were obtained from the chosen publications, and the minimum number of occurrences was established to a default value of 2.

3.3 Calculation of SNA quantitative network metrics

To calculate the SNA network metrics, a reference matrix was created, where the rows represented the keywords, and the columns represented the papers. In the matrix, the relationship between a keyword and a paper takes a value of 1 if when this keyword appeared in that specific and 0 if not. The adjacency matrix was obtained by multiplying the reference matrix with its transpose using the R software, resulting in a network where all the keywords were interrelated. Using NetDraw within UCINET 6 software, the adjacency matrix was plotted to calculate the main node-based metrics for each of the keywords in the main network (Table 1). The metrics calculated are the following: Degree centrality reflects the number of relationships a keyword had with the rest of the PPP body of knowledge (Salazar *et al.*, 2024). Betweenness centrality measures the intermediary role of a keyword for other terms (Fenoaltea *et al.*, 2023). Closeness centrality quantifies the tendency of keywords to form relationships with other words based on their shared features (Rojas *et al.*, 2023). Eigenvector centrality assesses a keyword's ability to connect with other central terms (Castelblanco *et al.*, 2023a).

4. Findings

4.1 Annual research production

The crisis-driven PPP literature has evolved in a non-linear way since 2008, as shown in Figure 1. Two peaks in research were reached in 2017/2018 and 2021/2022, with a particular focus on case studies at the national or regional level. The first peak was especially focused on lessons learned from the impact of the 2008 financial crisis on PPPs in the mid-term. Conversely, the second peak demonstrates that research on PPPs during the COVID-19 pandemic gained momentum with unprecedented speed, resulting in the growth of papers published between 2020 and 2022. Furthermore, this short-term effort is reflected in the significant increase in the proportion of Open Access papers in 2020, representing almost 60% of published papers, which contrasts with the average of 31% over the last ten years.

Thematic Drivers	Dominant Period	Cluster Colors	Representative Topics	Degree	Closeness	Eigenvector	Betweenness
1. Public Interest	GFC & Pandemic	Red Brown Pink	State	0.118	0.289	0.278	0.111
			Policy	0.072	0.265	0.041	0.067
			Sustainability	0.041	0.268	0.108	0.021
			Economic development	0.036	0.272	0.112	0.037
			New public management	0.036	0.27	0.1	0.032
			Guarantees	0.018	0.251	0.071	0.002
			Procurement	0.018	0.24	0.006	0.008
			Australia	0.015	0.244	0.018	0.004
			Incentives	0.018	0.224	0.002	0.012
			Time	0.018	0.194	0.001	0
			Market	0.015	0.243	0.025	0
			Subsidies	0.008	0.19	0	0
Politics	0.01	0.22	0.002	0			
2. Relational Governance	Post-GFC	Green	Governance	0.056	0.275	0.263	0.036
			Accountability	0.028	0.25	0.012	0.012
			Stakeholders	0.018	0.374	0.024	0.002
			Turkey	0.018	0.25	0.011	0.009
3. Risk Management &	Post-GFC & Pandemic	Blue Salmon	Real options	0.041	0.249	0.135	0.009
			Risk management	0.038	0.249	0.033	0.011
			Finance	0.036	0.244	0.015	0.009
			Allocation	0.031	0.259	0.076	0.024
			Valuation	0.008	0.126	0	0
Credit risk	0.005	0.209	0.002	0			
4. User-pay PPPs	Post-GFC	Olive Cyan	Toll roads	0.059	0.252	0.043	0.035
			Privatization	0.049	0.27	0.127	0.02
			UK	0.046	0.252	0.062	0.011
			Investment	0.038	0.269	0.143	0.026
			Spain	0.031	0.253	0.077	0.018
			Local government	0.031	0.243	0.047	0.006
			Demand elasticities	0.023	0.219	0.014	0
			Dynamic panel data	0.023	0.219	0.014	0
			Services	0.023	0.252	0.01	0.011
			Transport infrastructure	0.003	0.125	0	0
Model	0.005	0.126	0	0			
5. Crisis Management &	Post-GFC & Pandemic	Purple	Covid-19	0.113	0.271	0.036	0.136
			Crisis management	0.072	0.264	0.038	0.061
			China	0.036	0.27	0.084	0.042
			Vulnerability	0.018	0.232	0.004	0.005
6. Financial performance	GFC & Pandemic	Orange Emerald	Financing	0.074	0.278	0.292	0.069
			Performance	0.056	0.276	0.113	0.049
			Economic crisis	0.049	0.262	0.19	0.039
			Investment	0.038	0.269	0.143	0.026
			Ireland	0.013	0.243	0.119	0
			Public investment	0.01	0.126	0	0
			Cost	0.01	0.253	0.019	0
transaction costs	0.005	0.221	0.007	0			

Source(s): Table by authors

Table 1. Cluster interpretation and SNA network metrics: General network

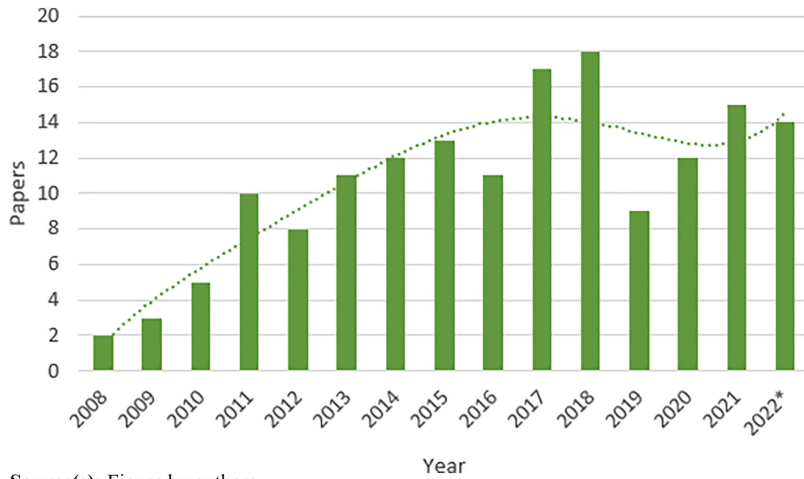


Figure 1.
Chronological
evolution

Source(s): Figure by authors

4.2 Geographical distribution

The epicenters of the PPP-crisis literature have been transformed in the last ten years. Initially, in the early 2010s, this research was steered by Eastern Europe and Asian countries such as Greece, Romania, Scotland, India, and Japan (Figure 2). Researchers in these countries were focused on gathering lessons from the 2008 Global Financial Crisis.

In the mid-term after the 2008 Global Financial Crisis, most of the countries with the highest number of articles published on PPP crises gained relevance. This literature was steered during the mid-2010s by developed countries such as England, Germany, Italy, and the US with an eloquent exception (Russia).

Finally, it should be noted that in recent years, researchers from non-traditional PPP leader countries have emerged, showing interest in analyzing the implications of crises for their

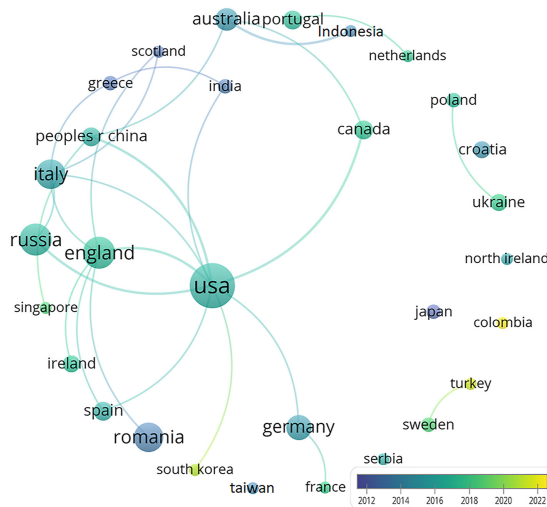


Figure 2.
Geographical
distribution

Source(s): Figure by authors

respective jurisdictions. This trend has brought developing nations like Turkey, South Korea, and Colombia into the spotlight, despite their lack of previous links to the traditional global cluster network. Furthermore, two Asian countries have been successfully integrated into the main cluster during this period, with Singapore gaining preponderance since the late 2010s, thanks to its links with China, and South Korea achieving the same result, leveraged by the US.

4.3 Research evolution between 2008 and 2022

In the last 15 years, two milestones have transformed the understanding of the crises under the PPP lens, namely: the global financial crisis and the COVID-19 pandemic. Between these milestones, three periods were identified because of the dominance of specific research drivers. The networks related to each of the three periods are shown in [Figure 3](#) presenting the constituent keywords. To interpret the clusters of each of the networks, the corresponding research avenues are presented in [Table 1](#). The colors of the nodes identify the clusters that constitute each of the research avenues.

The first period comprehends the development of the global financial crisis between 2008 and 2013 ([Figure 3a](#)). The second period is a transition between the global financial crisis and the start of the COVID-19 pandemic between 2014 and 2019 ([Figure 3b](#)). The last period starts with the COVID-19 declaration in early 2020 up to date (2022) and comprehends not only the pandemic aftermath but also global issues such as the war in Ukraine ([Figure 3c](#)).

4.4 Network representation

The main network between 2008 and 2022 is shown in [Figures 4 and 5](#). Network analysis revealed that the PPP research agenda driven by crisis could be unbundled on six research avenues, as shown in [Table 1](#).

5. Clusters' discussion

The findings of this study reveal that during global crisis periods (i.e., 2008–2013 and 2020–2022), public interest and financial performance gain more relevance, whereas non-crisis periods (i.e., 2014–2019) offer opportunities to strengthen user-pay PPPs and relational governance.

The authors observe that it seems challenging to promote the development of user-pay PPPs during global crises because of their potential to inconvenience social stakeholders and erode the social legitimacy of projects. In this regard, the literature shows that solutions to improve these issues are discouraged due to the urgency of addressing the financial issues associated with the crises.

In the context of the pandemic and post-pandemic times (i.e., 2020–2022), studies focus on public interest and financial performance, similar to the priorities during the 2008 financial crisis. However, the pandemic crisis also provided an opportunity to observe more investigations related to the management of risks and other structural drivers of the global crisis that became more prominent after the 2008 financial crisis.

Overall, the evolution of the PPP-crisis literature relies on the six research avenues shown in [Table 1](#), which are further elaborated as follows:

5.1 Public interest

Global crises put the public sector to the test, challenging its ability to respond to societal concerns and uncertainties in a timely manner. Responses to such crises are often controversial, such as the provision of public rescue packages to private corporations or the imposition of restrictions on people's mobility.

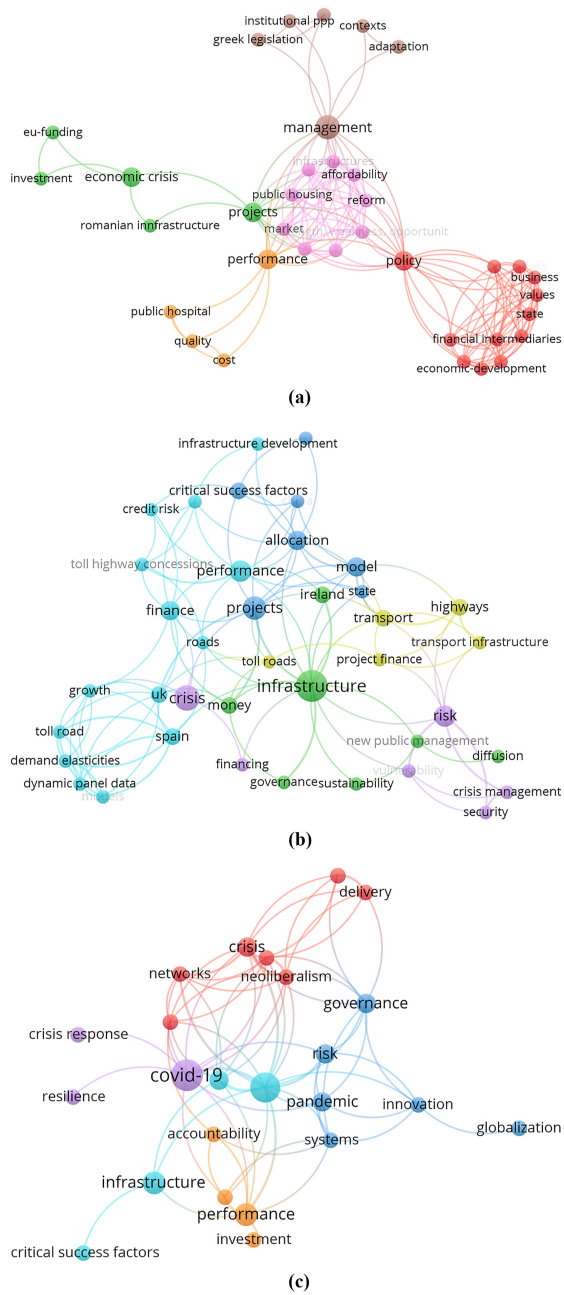


Figure 3.
(a) 2008–2013 network.
(b) Network between 2014 and 2019.
(c) Pandemic period network 2020–2022

Source(s): Figure by authors

5.3 Risk management

After the 2008 global financial crisis, uncertainties associated with exogenous risks in PPP gained importance. Traditionally, developed and large developing countries had confidence in macroeconomic stability, leading them to assign some exogenous economic risks to the private sector. For instance, countries like Australia, the UK, the US, China, and India allocated risks related to financing costs, inflation, poor financial market, and interest rates to the private sector (Hodge, 2004; Kalidindi and V Thomas, 2002; Ke *et al.*, 2010; Nguyen *et al.*, 2018). However, decision-makers realized after the crisis that macroeconomic stability cannot be taken for granted. Especially when macroeconomic instability has intensified since 2020, resulting in multiple renegotiations regarding exogenous risks that were originally allocated to the public sector (Castelblanco *et al.*, 2022). As a result, risk allocation patterns should increasingly promote the public sector's responsibility for exogenous risks, even in developed countries, to protect the private sector from market volatility.

Traditionally, risk literature emphasizes that fair risk allocation is essential for preventing disputes (Osei-Kyei *et al.*, 2022). This study complements this understanding by exposing that exogenous risk allocation fairness and the better party to handle those risks may change during and after global crises. Future research should devote increasing efforts to preventing and managing this risk at regional and project levels.

5.4 User-pay PPPs

User-pay PPPs are demand-based projects that are highly correlated with macroeconomic conditions (Vassallo *et al.*, 2012). The COVID-19 pandemic has led to significant disruptions in PPP demand due to lockdowns and travel restrictions, which have continued for almost three years after the pandemic declaration, particularly in countries such as China. These unprecedented demand disruptions in user-pay PPPs have led to renegotiations when this risk was not fully allocated to the public sector and may also lead to underinvestment in maintenance and operation in the medium term for concessionaires focused on maximizing liquidity in uncertain times. To prevent detrimental consequences for governments and users, the public sector must strengthen monitoring efforts and increase contract flexibility. Therefore, contractual governance flexibility is beneficial to prevent suboptimal risk allocation and ex-post renegotiations to address uncertainty. In this regard, a useful mechanism may be flexible-term contracts that allow for increasing the concession period if the demand is lower than expected, which has been successfully implemented in airport and highway PPPs in multiple countries (Engel *et al.*, 2018).

The existing literature on user-pay PPPs has highlighted their value creation potential, particularly through the integration of complementary resources among private and public partners, reducing government fiscal pressure, and enhancing cost efficiency from a life-cycle perspective (Hodge and Greve, 2016). However, the user-pay cluster identified in this study shows persistent concerns regarding the social value creation of these projects. Therefore, future research should focus on proposing viable alternatives to increase social value creation in user-pay PPPs, particularly in developing countries where communities are more sensitive to user fees and annual increases.

5.5 Crisis management

Global crises may result in detrimental decisions for PPPs, as exemplified by Portugal during the 2008 global financial crisis. To receive financial aid from the International Monetary Fund, the European Central Bank, and the European Commission in 2011, the Portuguese government was required to reduce future payments to the toll road PPP program by 18%. This reduction was achieved by reducing major repairs during the lifecycle and decreasing service levels, resulting in long-term negative impacts (Reis and Sarmiento, 2019).

Under crisis scenarios, decision-makers prioritize dismantling its structural causes, which has become a key driver after the 2008 global financial crisis (Table 1). Recently, the aftermath of COVID-19 triggered multiple non-synchronous shocks that affected global supply chains and production (McGee and Mayer, 2021). These shocks resulted in significant cost overruns and time delays for projects due to the lack of resilience in construction supply chains (Santacreu and Labelle, 2022). To face these challenges, governments are shifting globalization paradigms to develop more resilient strategies relying on national supply chains, especially in strategic products such as oil derivatives, energy, and steel. The increasing significance of supply chain issues on construction and the PPP market due to the COVID-19 pandemic and Ukraine's war aftermath requires academics to increase research efforts on strategies to prevent supply chain disruptions and support more resilience, particularly with regards to exogenous risks. In recent years, firms have developed practical strategies such as resilience, agility, and lean frameworks to maintain construction supply and demand processes, as evident in the literature (Mahdavishtarif *et al.*, 2022). One significant exogenous risk revealed by the most recent global crisis is related to voluntary and involuntary supply chain disruptions, which requires increased research efforts from scholars.

5.6 Financial performance

Both global crises have highlighted the significance of financial performance, as indicated in Table 1. The 2008 global financial crisis caused a decline in long-term bank lending, which led to increased illiquidity for concessionaires due to the difficulty in securing financial closure for PPPs and reduced debt/equity ratios in the medium term (Davies, 2015; Haran *et al.*, 2013). To prevent these issues during the COVID-19 pandemic, a global countercyclical monetary policy was implemented. Strategies such as slashed policy rates, interventions in exchange markets, bridge and direct loans, purchasing financial securities in capital markets, and subsidizing unemployed and wage payments were employed (Didier *et al.*, 2021). However, this global policy, combined with supply chain disruptions and, more recently, the war in Ukraine, resulted in exacerbated inflation and unprecedented price increases in key construction raw materials, such as steel, leading to increased debt for both the public and private sectors (Allam *et al.*, 2022).

Previous literature reviews have emphasized the dominance of economic and financing features on the PPP body of knowledge (de Castro Silva e Neto *et al.*, 2019). Conversely, this study demonstrates that this dominance is manifested during global crisis periods and transfers its dominant role to non-financial aspects (e.g., relational governance) when the crisis has been overcome.

6. Implications

This study offers significant implications for both academics and practitioners in the field of public-private partnerships (PPPs). First and foremost, while previous studies have focused predominantly on the impact of a single global crisis, this study provides a comprehensive and longitudinal analysis of multiple global crises that have occurred over the past two decades. This provides a more nuanced understanding of the effects of crises on PPPs, which can inform future research and policy decisions.

Second, this study identifies specific research paths that public sector practitioners can use to design PPP policies and institutional environments that enhance the resilience of PPPs during times of heightened uncertainty, which is essential for achieving the long-term sustainability of PPP programs.

Third, private sector practitioners can use the research avenues identified in this study to increase efforts in innovative risk management tools, such as the use of artificial intelligence

models to predict and mitigate risks more accurately. This can help PPPs better prepare for and manage crises, ultimately contributing to their long-term success.

Fourth, this study makes a significant contribution to the PPP-crisis literature by identifying six research avenues that can guide future research in this area. By focusing on these research paths, academics and practitioners can deepen their understanding of the theoretical and practical lessons that can be learned from PPPs during times of crisis.

7. Conclusions and future research avenues

This paper provides an overview of the research agenda on PPPs during crises, using bibliometric and network analysis. The study identified the main drivers, knowledge contributions and gaps in the literature. Results show a significant increase in PPP-crisis research in the past five years, with a focus on case studies at the national or regional level. The literature has been driven by the lessons learned from the 2008 global financial crisis and the short-term effects of the 2020 COVID-19 pandemic.

The PPP-crisis literature was divided into three periods: the first period (2008–2013) focuses on the development of the global financial crisis, the second period (2014–2019) highlights a transition period between the global financial crisis and the COVID-19 pandemic and the last period (early 2020 to present) encompasses not only the pandemic aftermath but also global issues such as supply chain disruptions, the war in Ukraine and unprecedented inflation levels. These findings provide valuable insights for future research in the field of PPP-crisis management.

During global crises (2008–2013 and 2020–2022), attention is given to topics related to public interest and financial performance over those linked to user-pay PPPs. This reflects the challenges associated with inconveniencing social stakeholders and eroding social legitimacy. Structural solutions to social legitimacy erosion, such as relational governance, are discouraged because of the urgency of examining tools to tackle financial issues in PPPs arising from the crisis. Conversely, non-crisis periods (2014–2019) present opportunities to strengthen user-pay PPPs and relational governance.

The network during the pandemic and post-pandemic times (2020–2022) demonstrated shared priorities with those during the 2008 financial crisis in terms of public interest and financial performance. However, this crisis emphasizes the need to investigate topics related to risk management and the structural drivers of the global crisis as both themes gained representativeness after the 2008 financial crisis.

Research trends during crises and non-crises periods in PPPs only reflect the convergent interests of academia and may not necessarily reflect the interests of PPP users, policymakers and impacted stakeholders. There exists a divergence between stakeholders' and policymakers' concerns about PPPs and the interests of academia in PPP-related topics. This divergence may limit the interest, impact and policy relevance of some PPP research topics, especially when research funding is also misaligned with practitioners' interests. Therefore, it is crucial to bridge the gap between academia and stakeholders to address the policy implications of PPPs and ensure their effectiveness and sustainability.

This paper identified six research avenues for managing global crises effects in the PPP market based on the analysis conducted:

- (1) *Public interest* is crucial in PPPs during times of crisis. Governments may implement measures like public rescue packages and stakeholder restrictions, leading to a decline in public perception of PPPs. This may create political opposition, given that politicians care about their voters' attitudes. During global crises, governments must ensure the financial continuity of PPP projects while maintaining the environment and social legitimacy. Sustainability measures in PPPs should be advanced through

enforceable performance indicators. Such indicators should be compatible with multidimensional sustainability. Future PPP literature must focus on developing measurable performance indicators within contractual structures.

- (2) *Relational governance* issues arise due to the misalignment between the goals of social stakeholders and PPP objectives, mainly in user-pay projects. Such misalignment can lead to lower demand, social pressure and blackmail against concessionaires, affecting project performance. Future research can explore how structural relationships influence various control practices or trust in PPPs. Moreover, scholars may analyze the impact of contractual mechanisms on the nature of interactions between stakeholders to enhance project performance and sustainability.
- (3) Scholars studying PPP *risk management* should use both quantitative and qualitative approaches to develop dense knowledge of risk mitigation strategies. Future studies can explore the use of artificial intelligence models to predict and mitigate risks more accurately, especially as the PPP industry moves towards Industry 5.0 with rapid digital transformation. AI can monitor, identify, evaluate and predict potential risks in PPPs, providing valuable insights to guide responsible stakeholders toward risk mitigation. This proactive approach can help prevent risks from occurring rather than reacting to them after the fact.
- (4) *User-pay* PPPs are sensitive to macroeconomic changes and demand disruptions, as seen during the COVID-19 pandemic, which may lead to renegotiations and underinvestment in maintenance by concessionaires. To prevent such issues, future research should focus on contract flexibility and models that accurately estimate user volume in PPPs, including the impact of alterations in concession price. Alternative renegotiation strategies under guaranteed contracts like Viability Gap Funding and Minimum Revenue Guarantee could be explored. Additionally, models that incorporate multiple renegotiation strategies will allow for evaluating concession renegotiation under different revenue conditions. These strategies will prevent suboptimal risk allocation and ex post renegotiations and ensure optimal performance of PPP projects.
- (5) Effective *crisis management* is vital for decision-makers to address resilience issues in construction supply chains caused by structural factors. The recent global crisis prompted governments to develop more resilient strategies, relying on national supply chains for strategic products like oil derivatives, energy and steel. Despite these efforts, the outbreak significantly impacted the construction supply chain management process, revealing weaknesses in existing strategies to protect PPPs from supply chain price increases and uncertainties. To mitigate potential risks, PPPs should adopt a strategic and systemic supply chain framework. Future research should explore the intersection between resilience and sustainability in the construction supply chain, which remains a significant gap requiring prompt attention.
- (6) *Financial underperformance* during global financial crises can be a significant concern for PPPs. It can make it challenging for such initiatives to achieve financial closure and may result in lower debt-to-equity ratios in the medium term. However, current literature on financial risk management models that control these risks in PPPs is limited. Future research must focus on developing holistic financial risk management models that address all aspects, including assessment, allocation and control measures. Moreover, there is a lack of studies on financial risk management in PPPs from developing economies, particularly in South America and Africa.

Additionally, external factors like regional competitiveness, diversity, international geopolitical conflicts, greenhouse gas emission standards, project sustainability and climate change and their impact on PPP financial risk management must be explored.

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