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MAPPING THE NEXUS OF SHADOW ECONOMY, TECHNOLOGY, AND INSTITUTIONAL QUALITY: A BIBLIOMETRIC ANALYSIS

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Abstract:
This bibliometric analysis maps the thematic structure of the scientific literature at the intersection of the shadow economy, technology, and institutional quality. Using Bibliometrix/Biblioshiny on Web of Science(WoS) data, 383 articles were analysed. The results reveal a significant increase in scientific interest, particularly after 2011, peaking in 2024. Dominant themes include corruption, institutional quality, governance, and economic growth, while emerging terms such as digitalization, machine learning, and CO2 emissions signal a reorientation towards sustainability and technology. Factor analysis identified four conceptual clusters, suggesting that while bilateral analyses remain prevalent, a more integrated framework is beginning to emerge. China leads in publications and international collaborations, while Central and South-Eastern Europe and other emerging economies remain underrepresented. By providing a pioneering mapping of this triple nexus, the study identifies four conceptual clusters, exposes integration gaps, and charts priority directions for future research on the shadow economy.

Key words: *Shadow Economy, Institutional Quality, Technology, Bibliometric Analysis*

1. Introduction

In the current context of accelerated digital transformations, sustainability pressures, and the need for effective governance, scientific research has increasingly turned to phenomena such as the shadow economy, technological innovation, and institutional quality. Recent crises, from pandemics to political instability and the green transition, have further amplified interest in how these dimensions interact.

This paper aims to explore the thematic structure of the scientific literature around the triangle formed by these three dimensions, including associated concepts such as governance, administrative efficiency, and digitalization. Specifically, it maps the existing body of research, examines how these concepts are positioned within the international literature, and identifies research gaps for future studies. The analysis employs Bibliometrix and its Biblioshiny interface on bibliographic data extracted from the Web of Science(WoS), applying both quantitative and qualitative analytical tools to visualize dominant and emerging thematic clusters and trace the evolution of academic interest over time.

The results reveal four conceptual clusters (institutional and political, technological and sustainability, regulatory efficiency and innovation, and administrative transparency) with institutional quality serving as the gravitational centre of the field. The analysis identifies three significant thematic gaps. These are the absence of integrated frameworks linking all three dimensions, the underdeveloped treatment of technology's dual role, and the strong reliance on panel data methods. The study contributes to the international literature by providing a novel integrated bibliometric mapping at this triple nexus, filling the gap left by fragmented bilateral analyses and setting a research agenda focused on the multidirectional interactions between the shadow economy, technology, and institutional quality.

2. Literature review

2.1.The Shadow Economy, Institutions, and Macroeconomic Dynamics

The shadow economy, a complex phenomenon without a single definition (Dell'Anno, 2021), is generally understood as legal activities hidden from authorities to avoid taxes or regulations (Schneider, 2021). Bibliometric analyses (Clement et al., 2023; Aivaz et al., 2024) highlight its economic, institutional, and social causes, while Zolkover and Terziev (2020) noted a shift from general estimation toward the informal-formal transition, underscoring the need for interdisciplinary approaches.

Institutional quality and governance are widely recognized as primary determinants of the shadow economy's scale. Higher institutional quality reduces informality in developing countries (Torgler and Schneider, 2007; Ameer et al., 2025), yet in developed economies it can paradoxically coincide with continued informal activity (Ameer et al., 2025; Munteanu et al., 2024). Wu and Schneider (2019) identified a U-shaped correlation with GDP per capita, indicating that formalization policies must be adapted to each country's institutional stage. Institutional quality also functions as a mediator. Higher governance can mitigate the shadow economy's negative impact on economic growth (Nguyen et al., 2024) and is essential in models for assessing investment potential (Lyulyov and Moskalenko, 2020).

The macroeconomic consequences of the shadow economy remain debated. In the short run, informal activity may ease poverty and provide economic relief during crises (Hoinaru et al., 2020), while it also correlates with GDP fluctuations and public debt dynamics (Agiropoulos et al., 2024). Asymmetric investment-output linkages further shape

macroeconomic trajectories in related contexts (Jula et al., 2026). Over time, however, it distorts markets, weakens institutions, and suppresses sustainable growth (Hoinaru et al., 2020). Strong institutions, as a foundation for sustainable development, stimulate economic growth, attract investment and innovation (Uddin et al., 2023; Barbier and Burgess, 2021), while freedom of expression and government effectiveness further advance progress toward the Sustainable Development Goals (SDGs) (Barbier and Burgess, 2021). Mini et al. (2025) support the nonlinear relationship between institutional quality and economic complexity in Africa, depending on country-specific characteristics, while Dada et al. (2026) further confirm asymmetric effects of economic complexity on shadow economy size across African countries.

2.2.The Dual Role of Technology: Transparency Tool or Facilitator of Informality

Technology has a dual and contested role in the evolution of the shadow economy. On one hand, digital governance and ICT can reduce shadow economy by increasing transparency, administrative efficiency, and state-citizen traceability, a process further supported by the synergy between digitalization and research and development investments at the EU level (Aivaz and Tofan, 2022). However, the success of these mechanisms depends heavily on the institutional context (Ajide and Dada, 2023; Nguyen et al., 2025). On the other hand, technology simultaneously facilitates a digital shadow economy, driven by consumer preference for lower prices and enabled by reduced regulatory oversight in digital spaces (Gasparenienė et al., 2016), with blockchain-based financial instruments representing a further dimension of this complexity (Aivaz et al., 2023). This sophisticated and bidirectional interaction requires adaptive policies that address both sides rather than treating digitalization as a uniformly formalizing force.

In this context, recent literature increasingly highlights the interdependence between technology, institutional quality, and the performance of educational systems. Studies emphasize both the role of digital transformation and psychological factors in driving innovation in higher education (Du et al., 2023; Râlea et al., 2026), as well as the disruptive effects of the COVID-19 pandemic on educational processes (Aivaz & Teodorescu, 2022). These are in line with evidence on the role of governance and technological innovation in fostering entrepreneurship (Suliman & Adedokun, 2025). Zhang et al. (2023) find that both factors jointly shape energy use, with solid institutions amplifying technology's sustainability gains. In emerging Asia, green innovation reduces emissions and boosts growth, yet improved governance can coincide with higher emissions, hinting at continued non-renewable reliance (Zhang, et al., 2025). These findings call for coordinated green-technology investment, renewable energy expansion, and simultaneous institutional strengthening. This is a policy logic that applies equally to the shadow economy context.

2.3.The Triple Nexus: A Gap in Integrated Research

Previous studies have addressed the relationships between the shadow economy, institutional quality, and technology predominantly in pairwise combinations. Bilateral analyses, whether examining corruption and governance, or ICT and shadow economy, or institutional quality and economic growth, dominate the literature. This fragmentation limits a comprehensive understanding of how institutional and technological factors jointly shape the dynamics of the shadow economy and its consequences for sustainable development. Several studies implicitly treat technology as exogenous to governance capacity or analyse institutional quality independently of digital infrastructure, leaving the three-way interaction conceptually underdeveloped despite its practical relevance for policy design in the digital age.

This bibliometric analysis addresses this gap by mapping the relevant literature to provide a comprehensive overview of the complex interconnections at this triple nexus. By drawing together the shadow economy, technology, and institutional quality as a unified analytical frame, it uncovers dominant and emerging thematic clusters, exposes key conceptual and methodological gaps, and sets a research agenda focused on the multidirectional interactions between these dimensions.

3. Methodology

3.1.Analytical Framework, Research Questions, and Hypothesis

Bibliometric analysis enables systematic conceptual mapping of a research field through both quantitative and qualitative evaluation of scientific production (Passas, 2024), requiring a clearly defined analytical purpose, rigorous source selection, and appropriate computational tools (Öztürk et al., 2024). The process involves structured data collection and preprocessing, followed by co-citation, co-occurrence, and factorial analyses that collectively identify dominant themes, emerging directions, and structural gaps.

This study employs Bibliometrix and Biblioshiny, an integrated R-based package and graphical interface developed by Aria and Cuccurullo (2017). Bibliometrix provides a comprehensive suite of descriptive and advanced analyses within a single reproducible framework, making it particularly suitable for simultaneous structural mapping and longitudinal thematic analysis (Passas, 2024; Öztürk, Kocaman and Kanbach, 2024). Compared to VOSviewer, which excels in network visualization, Bibliometrix stands out for its analytical depth and integrated output.

Bibliographic metadata were extracted from the Wos Core Collection via the E-nformation platform. WoS was selected as the sole data source given its multidisciplinary coverage, selectivity, and citation tracking capacity (Pranckutė, 2021). The inclusion of the Emerging Sources Citation Index (ESCI) further ensures rigorous quality standards across disciplines (Pranckutė, 2021), making it the most appropriate single-database source for a study spanning institutional economics, digital governance, and development economics. Three research questions and a hypothesis were formulated to guide the analysis:

RQ1: What are the dominant themes and conceptual clusters formed around the relationship between the shadow economy, technology and institutional quality?

RQ2: How has scientific interest in this interdisciplinary area evolved in recent years and what thematic gaps can be identified?

RQ3: Does the recent scientific literature maintain bilateral analyses between these concepts, or has an integrated approach, combining both technology and institutional quality when addressing the shadow economy?

H1: Scientific interest in this field has expanded beyond the mere presence of digitalization, increasingly addressing its specific impact on the shadow economy in relation to sustainability and public policies, while significant gaps in the deep integration of all three dimensions, shadow economy, technology, and institutional quality, within a unified analytical framework remain identifiable.

3.2.Data Gathering and Processing

Data collection was conducted through a single structured query in the WoS Core Collection, using Boolean operators to capture publications across the three analytical dimensions. The query was designed to ensure broad thematic coverage while maintaining relevance through the explicit inclusion of the shadow economy as a focal concept. By introducing the shadow economy into the queries, being a niche topic, a smaller number of documents that can be included in the analysis was expected.

Query:

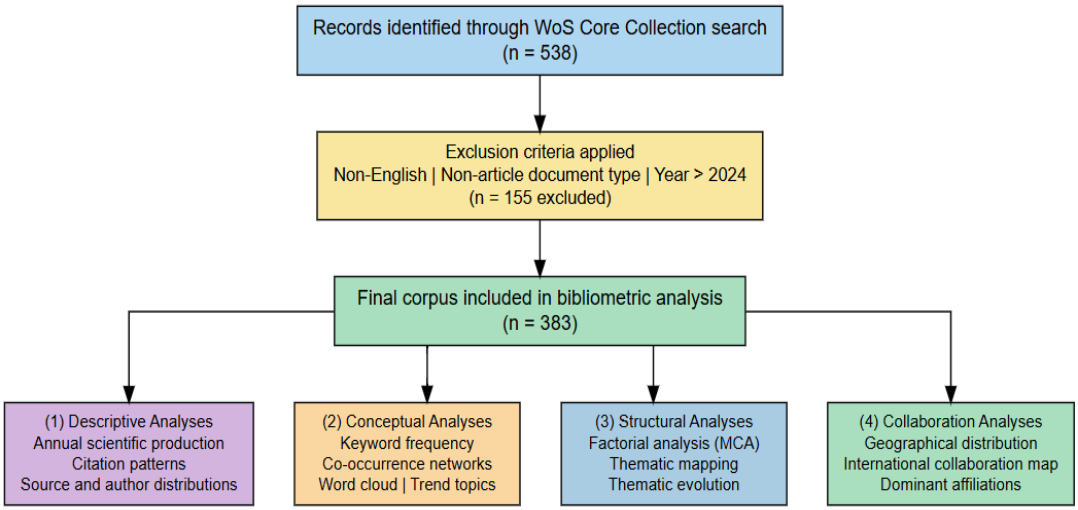
TS = ("shadow economy" OR "informal economy" OR "grey economy" OR "gray economy" OR "undeclared work" OR "tax evasion" OR "financial fraud" OR "economic fraud" OR corruption) AND (technology OR digitalization) AND (institution OR "institutional quality" OR governance OR "governance quality") AND (quality OR effectiveness)

The initial retrieval yielded 538 results(Figure 1). The data selection and screening process was conducted systematically, following a structured inclusion and exclusion protocol. Records were retained if they met all of the following criteria. They were published in English, classified as scientific articles in the WoS document type field, and published up to and including 2024. Records not meeting any of these criteria were excluded. This protocol ensures transparency and replicability, consistent with best practices in bibliometric research(Aria and Cuccurullo, 2017; Öztürk et al., 2024).

The bibliographic data were processed in Biblioshiny through the following sequential analytical steps: (1) descriptive analyses with annual scientific production, citation patterns, source and author distributions, (2) conceptual analyses with keyword frequency, co-occurrence networks, word cloud, and trend topics, (3) structural analyses with factorial analysis via Multiple Correspondence Analysis (MCA), thematic mapping, and thematic evolution, and (4) collaboration analyses with geographical distribution, international collaboration mapping, and dominant institutional affiliations. MCA was employed to reduce the dimensionality of the keyword co-occurrence matrix, allowing for

the mapping of the conceptual structure through the proximity of terms in a two-dimensional Euclidean space.

Figure 1.Data Collection, Screening, and Analytical Framework



Source:Own processing via RStudio

Analytical validity is supported by three features of the research design. First, the study relies on the WoS Core Collection as a high-quality and standardized data source. Second, the query construction follows a systematic and reproducible approach based on controlled Boolean logic. Third, the use of the Bibliometrix and Biblioshiny platform ensures transparency, replicability, and methodological control across all analytical steps. The sequential structure of the analysis moves from descriptive to structural and then to interpretive stages. This approach follows established best practices in bibliometric research(Aria and Cuccurullo, 2017; Öztürk, Kocaman and Kanbach, 2024).

4. Results

This section reports the bibliometric findings for the 383 WoS articles retrieved via the thematic query. All selected studies examine, explicitly or implicitly, the links between the shadow economy, technology/digitalization, and institutional quality.

Table 1 summarizes the database (1992-2024). The corpus encompasses 383 documents across 268 sources, with an annual growth rate of 14.76% and an average document age of 4.81 years, indicating that the literature is relatively young and rapidly expanding. The field's collaborative nature is reflected in 3.5 co-authors per article and 39.69% international co-authorships. With 20.88 average citations per document, the corpus carries substantial academic influence, while the breadth of 268 sources confirms its interdisciplinary character.

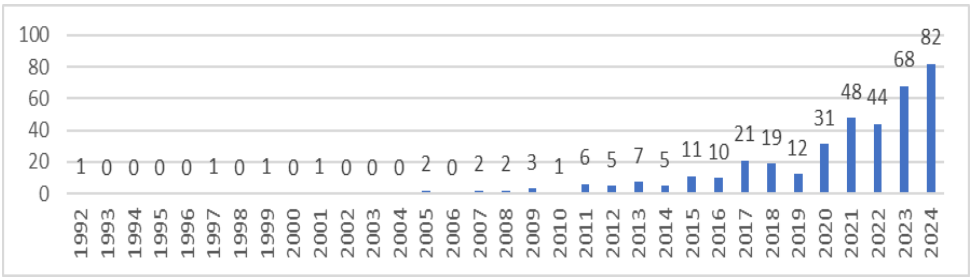
Table 1.Main Information About Database

MAIN INFORMATION ABOUT DATA		AUTHORS	
Timespan	1992:2024	Authors	1254
Sources(Journals, Books, etc)	268	Authors of single-authored docs	43
Documents	383	**AUTHORS COLLABORATION**	
Annual Growth Rate%	14,76	Single-authored docs	43
Document Average Age	4,81	Co-Authors per Doc	3,5
Average citations per doc	20,88	International co-authorships%	39,69
References	21699	**DOCUMENT TYPES**	
DOCUMENT CONTENTS		article	368
Keywords Plus(ID)	901	article; book chapter	2
Author's Keywords(DE)	1320	article; early access	9
		article; proceedings paper	4

Source:Own processing BiblioShiny

Figure 2 displays the trajectory of scholarly output. After near-stagnation from 1992 to 2010, publications climbed steadily from 2011, accelerated sharply after 2017, and reached a record of 82 articles in 2024. The post-2017 surge coincides with the intensification of global debates on sustainable development following the adoption of the SDGs, the digital governance revolution, and the multiplication of systemic crises that prompted interdisciplinary research on institutional reform and the reduction of informality through digital means.

Figure 2.Annual Scientific Production-Number of Articles

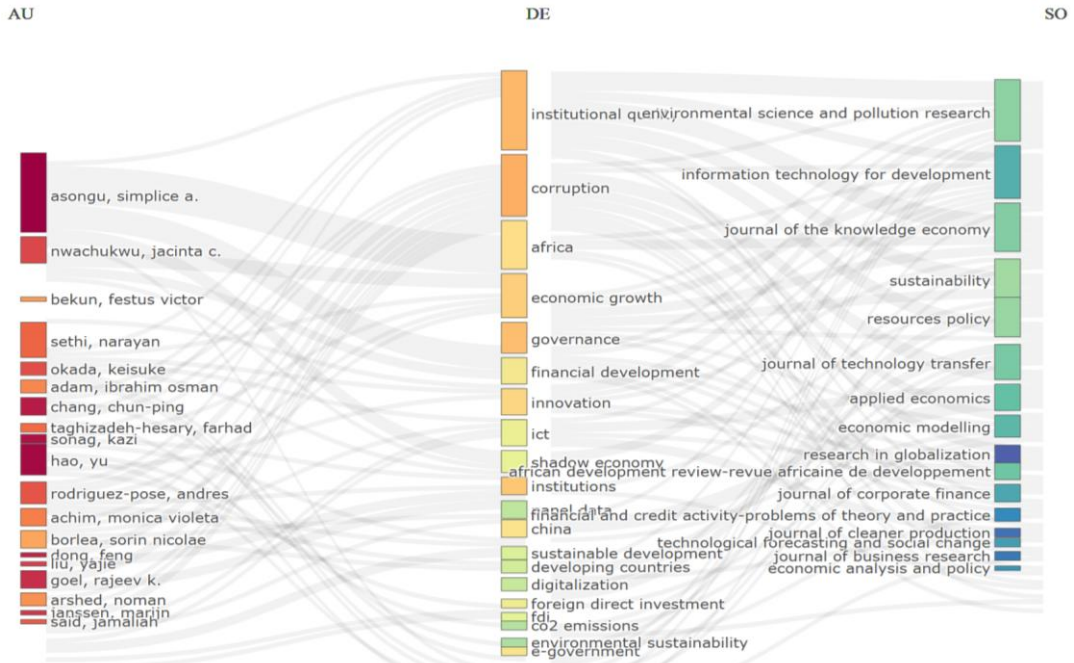


Source:Own processing via BiblioShiny

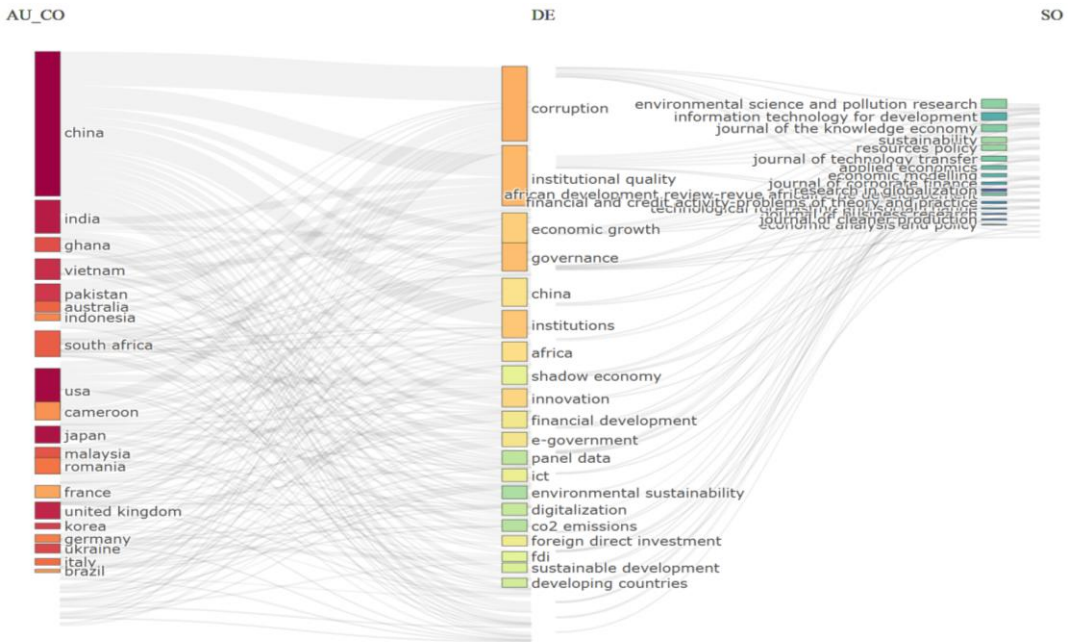
The Three-Field Plot (Figure 3a) provides a visual representation of the thematic and geographical connections in the database. Active authors such as Asongu and Nwachukwu frequently address themes such as institutional quality, corruption, economic growth, shadow economy, innovation and ICT, publishing predominantly in interdisciplinary journals. Asongu and Nwachukwu form a distinct research core focused on corruption, institutional quality and Africa, suggesting a systemic approach to the informal economy from a governance and economic development perspective in the sub-Saharan region, with an emphasis on institutional, not purely technological, aspects.

Figure 3.Three Field Plot (a)Author Keyword Source; (b)Country Keyword Source

(a)



(b)



Source:Own processing via BiblioShiny

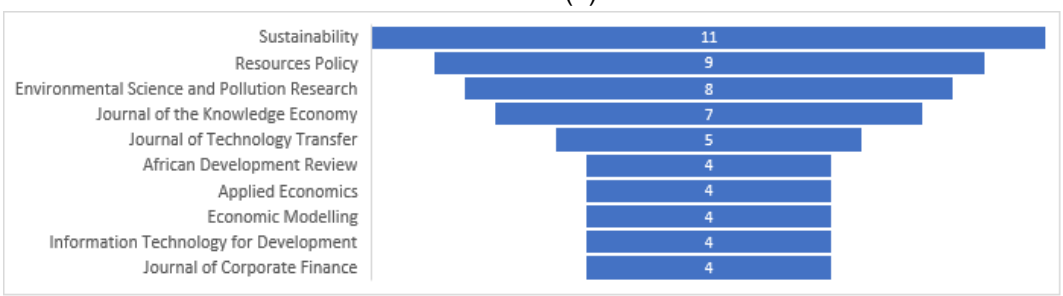
Figure 3b illustrates the geographical distribution of research interests. Active countries such as China, India, Ghana, Vietnam and Pakistan focus on corruption, institutional quality, financial development, e-governance and sustainable development, indicating a concern for administrative modernization and the reduction of the informal economy through digital/institutional means. Regionally, Asian countries focus on digitalization and technology integration, while African countries focus on corruption, institutional quality, and sustainable development. Romania, with a modest number of articles, focuses on governance, innovation, and economic growth, suggesting an applied perspective and conceptual alignment with Europe.

Figures 4a and 4b provide complementary perspectives on the structure of the literature, distinguishing between publication volume and intellectual influence. Figure 4a presents the most productive sources, highlighting the field's strong interdisciplinary orientation. Sustainability leads with 11 articles, followed by Resources Policy (9) and Environmental Science and Pollution Research (8), indicating a growing interest in governance and the shadow economy within environmental and resource-related contexts. Journals such as the Journal of the Knowledge Economy and the Journal of Technology Transfer further emphasize the role of technological change, while outlets like African Development Review reflect region-specific analyses.

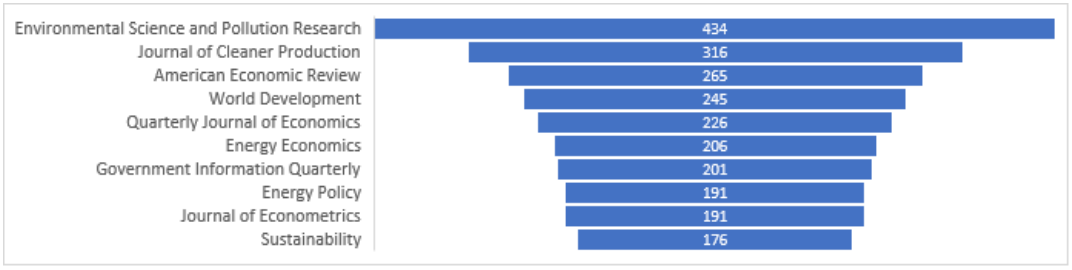
In contrast, Figure 4b captures the most locally cited sources, reflecting the theoretical and methodological backbone of the field. Environmental Science and Pollution Research (434 citations) and Journal of Cleaner Production (316 citations) dominate, followed by leading economics journals such as American Economic Review, World Development, and Quarterly Journal of Economics. This distribution highlights a strong anchoring in development economics, institutional analysis, and sustainability-related research.

Figure 4.(a)Most relevant 10 Sources (b)Most local cited 10 sources

(a)



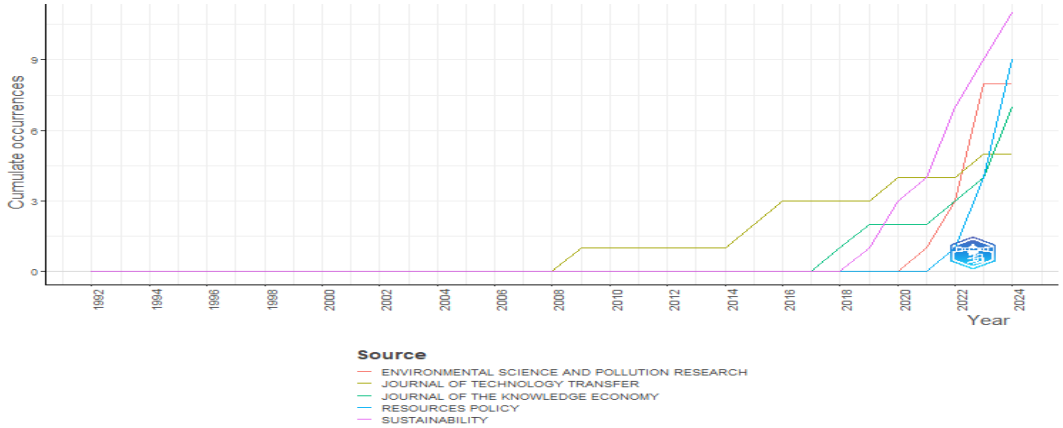
(b)



Source:Own processing via BiblioShiny

Figure 5 tracks output in the five most active journals of the database. After sparse contributions before 2010, publication counts rose sharply post-2015 and surged again after 2020, signalling a maturing field and heightened focus on digital governance, sustainability, and informal-economy issues. Notably, the Journal of the Knowledge Economy and the Journal of Technology Transfer emerge as key venues for integrative work at the crossroads of economics, technology, and policy.

Figure 5.Sources production over time top 5 sources

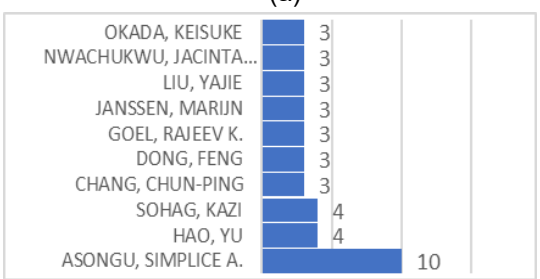


Source: Own processing via BiblioShiny

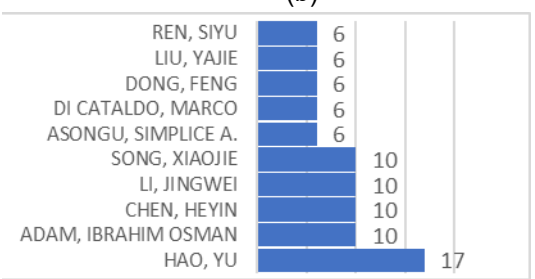
Figure 6a and 6b provides a complementary perspective on the impact of authors in the Database, comparing the number of published articles (a) with the number of citations received (b). In Figure 6a, Asongu Simplice A. stands out clearly with 10 articles, confirming his central role in research on the informal economy, institutions and development, while other authors (e.g. Sohag Kazi, Hao Yu) have 3-4 appearances. In Figure 6b, Hao Yu is the most frequently cited locally (17 citations), surpassing even prolific authors. It is notable that some authors (e.g. Ren Siyu, Di Cataldo Marco) register a high impact through citations, even with a lower quantitative presence. This dissociation between prolificity and influence highlights the diverse nature of contributions. Some authors are volume engines, others theoretical reference points.

Figure 6.(a)Most relevant top 10 Authors; (b)Most local cited top 10 Authors

(a)



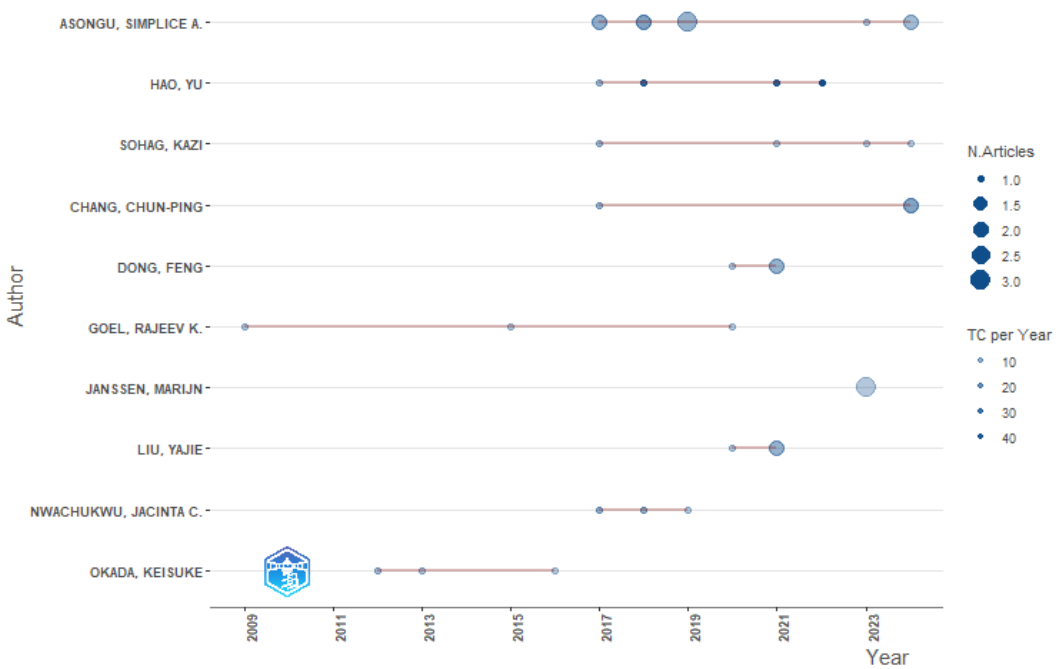
(b)



Source:Own processing via BiblioShiny

Figure 7 illustrates the evolution of the production of top authors, highlighting the frequency of publication and the average annual impact (TCpY). Asongu Simplice A. confirms himself not only as the most prolific, but also as one of the most influential authors, with constant activity between 2017 and 2024. His thematic portfolio is coherent, focused on governance, ICT, institutional quality and sustainability, especially in the context of Sub-Saharan Africa. The authors articles reached high annual citation values. Other authors, such as Hao Yu, Sohag Kazi and Liu Yajie, present a recent intensified activity, especially after 2020, the research being focused on digital governance, sustainability and economic development. This dynamic underlines the expansion of the research direction and the attraction of new contributors, reinforcing the hypothesis of increasing thematic integration between digitalization, institutions and the informal economy.

Figure 7.Top 10 Authors production over time



Source:Own processing via BiblioShiny

Table 2 provides a geographical perspective on the distribution of corresponding authors. It highlights the central role of China, with 108 articles (28.2% of the total) and almost 40% international collaborations, reflecting its investments in digitalization and governance. The USA and India are next. Countries such as Australia (66.7%), Indonesia and Malaysia (over 60%) stand out for their high degree of international collaboration.

Table 2.Top 20 Corresponding Authors Country

Country	Articles	Articles %	SCP	MCP	MCP %
China	108	28.198	66	42	38.88
Usa	32	8.355	22	10	31.25

India	22	5.744	18	4	18.18
Japan	14	3.655	9	5	35.71
Vietnam	14	3.655	9	5	35.71
Ukraine	13	3.394	10	3	23.07
Australia	12	3.133	4	8	66.66
Korea	12	3.133	8	4	33.33
Ghana	10	2.611	7	3	30
Italy	10	2.611	7	3	30
United kingdom	10	2.611	6	4	40
South africa	9	2.349	5	4	44.44
Cameroon	8	2.088	4	4	50
Indonesia	8	2.088	3	5	62.5
Malaysia	8	2.088	3	5	62.5
Romania	8	2.088	7	1	12.5
Brazil	5	1.305	0	5	100
Pakistan	5	1.305	2	3	60
Spain	5	1.305	3	2	40
Tunisia	5	1.305	3	2	40

Source:Own processing via BiblioShiny

Tables 3a and 3b provide a dual perspective on scientific participation at country level. In Table 3a, China's dominance is confirmed, followed by the USA, Japan and India. Romania ranks 15th, reflecting a steady involvement. The presence of other Central and Eastern European and emerging countries (e.g. Ukraine, Germany) suggests a shared interest in digitalization, the informal economy and institutions. Table 3b nuances the quality and influence of research. Although China has the most total citations (2,775), the United Kingdom (66.1) and Sweden (105) stand out with average citations per article, indicating high-impact works. Canada (84 citations/article) also has a remarkable impact. This differentiation shows that countries with mature scientific systems prioritize quality, while emerging countries aim for quantitative visibility.

Table 3.(a)Top 20 Country Scientific Production - total number of publications by authors from that country; (b)Top 10 most cited countries

(a)		(b)		
Country	**Frequency**	**Country**	**TC**	**Average Article Citations**
China	325	China	2775	25.7
Usa	87	United kingdom	661	66.1
Japan	47	Usa	544	17
India	44	India	438	19.9
Uk	41	Japan	362	25.9
Vietnam	38	Ghana	236	23.6
Pakistan	33	Australia	213	17.8
South korea	30	Sweden	210	105
Ukraine	30	Cameroon	184	23
Ghana	27	Canada	168	84

Malaysia	27	Ireland	167	83.5
South africa	27	Singapore	156	78
Australia	26	Tunisia	154	30.8
Italy	21	Vietnam	152	10.9
Romania	19	Korea	138	11.5
Germany	17	Malaysia	137	17.1
Indonesia	17	Spain	120	24
Cameroon	15	South Africa	117	13
Brazil	13	Romania	107	13.4
France	13	Indonesia	105	13.1

Source:Own processing via BiblioShiny

In terms of most globally cited documents in the database (Table 4a), Chen (2018, 285 citations) on sustainability, Rodríguez-Pose (2015, 272 citations) on regional development, and Han (2023, 193 citations) on frontier computational methods lead the ranking. Notably, these highly cited works do not directly target the shadow economy but build transversal conceptual frameworks around sustainability, regional development, and technological integration, thus validating the importance of interdisciplinary research linking economic performance to institutional quality and technology. At the local citation level, Adam (2020, 10 local citations) on e-governance and Chen (2018, 10 local citations) emerge as key internal references, while older works such as Garcia-Murillo (2013) and Krishnan (2012) function as conceptual anchors connecting ICT to governance outcomes. The presence of Asongu in the local citation ranking reconfirms the centrality of the African governance and digital development perspective in shaping the field's current discourse.

Table 4.Top 10 Most (a)global cited documents; (b)local cited documents

(a)

Paper	DOI	Total Citations	TC per Year	Normalized TC
CHEN HY, 2018, J CLEAN PROD	10.1016/j.jclepro.2018.05.206	285	35.625	5.61
RODRÍGUEZ-POSE A, 2015, J ECONGEOGR	10.1093/jeg/lbu023	272	24.727	5.24
HAN ZB, 2023, IEEE T PATTERNANALYSIS	10.1109/TPAMI.2022.3171983	193	64.333	13.77
REN SY, 2021, J ENVIRON MANAGE	10.1016/j.jenvman.2021.113686	184	36.8	6.62
LIN YJ, 2021, J CORP FINANC	10.1016/j.jcorpfin.2021.101919	182	36.4	6.55
REN SY, 2022, RESOUR POLICY	10.1016/j.resourpol.2022.102587	176	44	11.78
TAWIAH VK, 2021, SCI TOTAL ENVIRON	10.1016/j.scitotenv.2020.143603	167	33.4	6.01
CRESCENZI R, 2016, J REGIONAL SCI	10.1111/jors.12264	165	16.5	5.25
HARFORD J, 2018, J CORP FINANC	10.1016/j.jcorpfin.2017.09.022	163	20.375	3.21

EKENER-PETERSEN E, 2013, INT J LIFE CYCLE ASS	10.1007/s11367-012-0442-7	110	8.461	2.45

(b)

Document	DOI	Year	Local. Cit.	Global. Cit.	Ratio	Norm. Local. Cit.	Norm. Global. Cit.
CHEN HY, 2018, J CLEAN PROD	10.1016/j.jclepro.2018.05.206	2018	10	285	3.50	8.63	5.61
ADAM IO, 2020, TECHNOL SOC	10.1016/j.techsoc.2020.101245	2020	10	82	12.19	15.5	3.31
RODRÍGUEZ-POSE A, 2015, J ECON GEOGR	10.1093/jeg/lbu023	2015	5	272	1.83	6.11	5.24
KRISHNAN S, 2012, J AM SOC INF SCI TEC	10.1002/asi.22660	2012	4	69	5.79	2.5	1.88
GARCIA-MURILLO M, 2013, INFORM TECHNOL DEV	10.1080/02681102.2012.751574	2013	4	36	11.11	7	0.80
KAYALVIZHI PN, 2018, EMERG MARK REV	10.1016/j.ememar.2017.11.007	2018	4	63	6.34	3.45	1.24
REN SY, 2021, J ENVIRON MANAGE	10.1016/j.jenvman.2021.113686	2021	4	184	2.17	8.72	6.62
FAN QJ, 2021, J BUS RES	10.1016/j.jbusres.2021.06.062	2021	4	36	11.11	8.72	1.29
ASONGU SA, 2018, J KNOWL ECON	10.1007/s13132-015-0322-z	2018	3	43	6.97	2.59	0.84
SCHOPF JC, 2019, TELECOMMUN POLICY	10.1016/j.telpol.2019.01.001	2019	3	13	23.07	6	0.44

Source:Own processing via BiblioShiny

Table 5 reveals the theoretical and methodological foundations of the field. Institutional economics dominates. Mauro (1995) leads with 39 citations for corruption-performance analysis, followed by North (1991, 31 citations) on the role of institutions and Acemoglu et al. (2001, 24 citations) on the colonial origins of institutional quality. The methodological backbone is equally clear. Arellano and Bond (1991), Blundell and Bond (1998), and Roodman (2009) collectively confirm the widespread reliance on panel data models. Kaufmann (2011) anchors the governance measurement framework through the Worldwide Governance Indicators.

Table 5.Top 10 Most Cited Local References

Cited References	Citations
MAURO P, 1995, Q J ECON, V110, P681, DOI 10.2307/2946696	39
ARELLANO M, 1991, REV ECON STUD, V58, P277, DOI 10.2307/2297968	31
NORTH DC, 1991, J ECON PERSPECT, V5, P97, DOI 10.1257/JEP.5.1.97	31
BLUNDELL R, 1998, J ECONOMETRICS, V87, P115, DOI 10.1016/S0304-4076(98)00009-8	30
KAUFMANN D, 2011, HAGUE J RULE LAW, V3, P220, DOI	28

10.1017/S1876404511200046	
ACEMOGLU D, 2001, AM ECON REV, V91, P1369, DOI 10.1257/AER.91.5.1369	24
ARELLANO M, 1995, J ECONOMETRICS, V68, P29, DOI 10.1016/0304-4076(94)01642-D	24
KNACK S., 1995, ECONOMICS POLITICS, V7, P207, DOI HTTPS://DOI.ORG/10.1111/J.1468-0343.1995.TB00111.X, DOI 10.1111/J.1468-0343.1995.TB00111.X	24
ROODMAN D, 2009, STATA J, V9, P86, DOI 10.1177/1536867X0900900106	23
IM KS, 2003, J ECONOMETRICS, V115, P53, DOI 10.1016/S0304-4076(03)00092-7	20

Source:Own processing via BiblioShiny

The visual Word Cloud map (Figure 8) synthetically represents the thematic intensity. The size of the words reflects the frequency, highlighting the prominence of themes related to corruption and institutional quality. At the same time, it brings to the fore terms that indicate emerging research directions (digitalization, shadow economy, machine learning, renewable energy, transparency, governance quality or green innovation). This semantic structure suggests an increasing interest in studying the intersection of governance, digital transformations and sustainability, especially in the context of transition or institutionally vulnerable economies.

Figure 8.Word Cloud



Source:Own processing via BiblioShiny

In Figure 9, the Tree Map representation provides an additional visual perspective on the distribution of terms, clearly highlighting the preponderance of thematic categories related to corruption and the quality of institutions. Also notable is the frequency of terms such as shadow economy (10), foreign direct investment (10), sustainable development (9) or climate change (4), which anchor the discussion in the broader context of sustainable development and current global challenges.

Figure 9.Tree Map

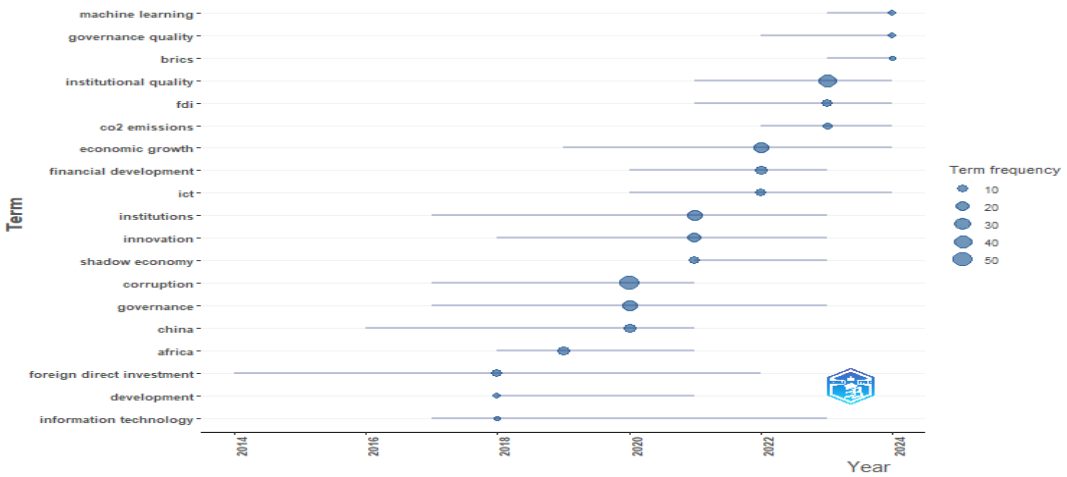


Source:Own processing via BiblioShiny

Figure 10 highlights the temporal evolution of the most frequently used terms in the specialized literature. Thus, providing an image of the dominant and emerging research directions. It is observed that the scientific interest in terms such as corruption, governance, institutions and institutional quality has experienced a sharp increase since 2017, reaching a peak in the period 2021-2023.

At the same time, the emergence and intensification in recent years of terms such as machine learning, governance quality, shadow economy or co2 emissions indicate a repositioning of the research agenda towards themes that reflect the intersection between digitalization, sustainability and institutional integrity. These terms, although emerging, were quickly integrated into the specialized literature. They signal a tendency to reconceptualize the issue of economic development in a multidimensional framework, which recognizes the influence of new technologies and environmental factors on governance and institutional efficiency.

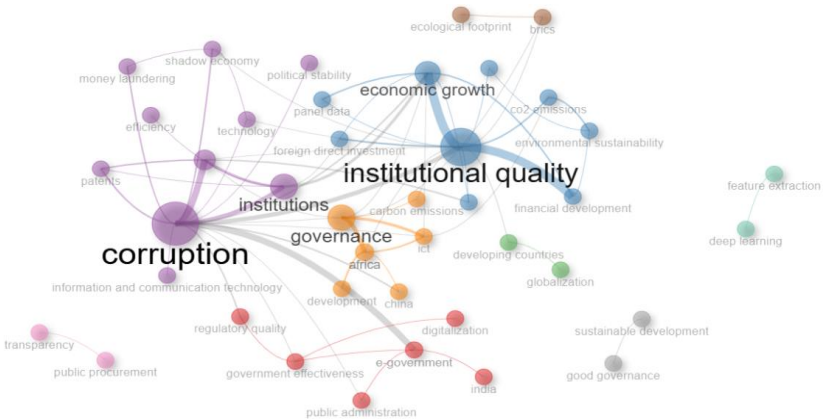
Figure 10.Trend Topics



Source:Own processing via BiblioShiny

Figure 11 maps the semantic networks between the main concepts in the specialized literature, reflecting the degree of thematic interconnection through keyword co-occurrence. Corruption, institutional quality, governance, and economic growth occupy central positions as pivot nodes in the field's conceptual architecture. The purple corruption cluster is dense and extensive, anchoring studies on institutions, shadow economy, money laundering, technology, and political stability. Through this, the idea that corruption is predominantly analysed within an institutional and governance-deficiency framework is reinforced. The blue institutional quality cluster functions as an intermediate node connecting economic growth, sustainable development, and environmental policies (CO_2 emissions, renewable energy), indicating an extension of institutional analysis toward sustainability concerns. Peripheral terms such as digitalization, regulatory quality, BRICS, and deep learning reflect either lower frequency or emerging status not yet integrated into the dominant conceptual core, though their connections to central nodes signal strong potential for thematic integration in future research.

Figure 11.Co-Word Network

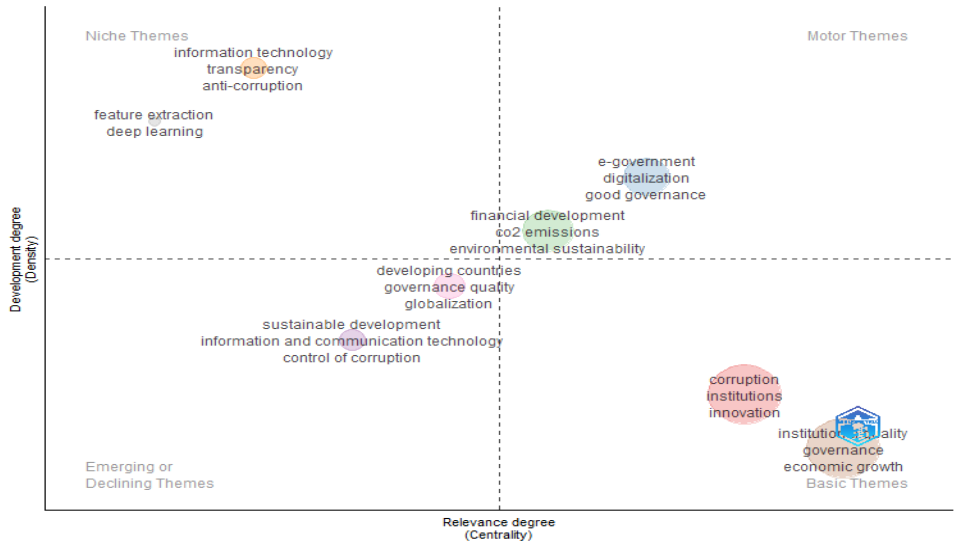


Source:Own processing via BiblioShiny

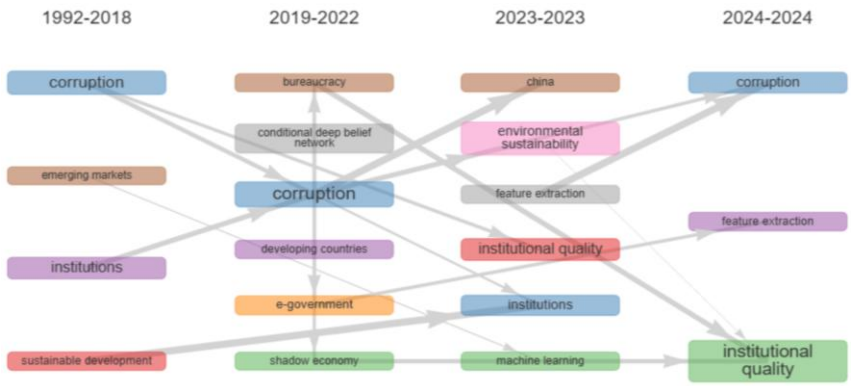
The thematic map (Figure 12a) highlights four types of themes, depending on centrality (conceptual relevance in the network) and density (degree of internal development). Themes such as corruption, institutions, governance, economic growth and institutional quality are firmly positioned in the Basic Themes quadrant, suggesting that they not only structure the literature analysed, but also function as nodal points in the research network. In contrast, terms such as e-government, digitalization and good governance appear in the Motor Themes quadrant, indicating well-developed themes, with the potential to guide future research directions. In contrast, themes in the Niche Themes quadrant (e.g., deep learning, feature extraction, transparency) are specific and technical, but less conceptually connected, while topics such as control of corruption or ICT are found in the Emerging or Declining zone, which may signal a reduction in interest or an early stage of development.

Figure 12.Thematic (a)Map; (b)Evolution;

(a)



(b)

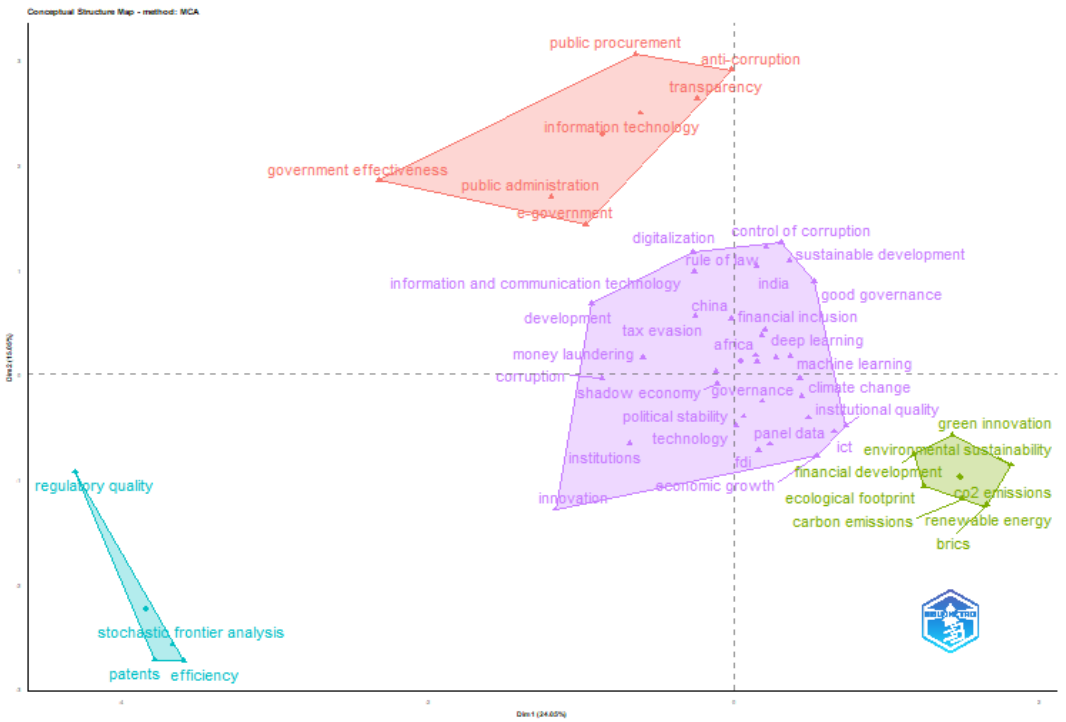


Source:Own processing via BiblioShiny

The thematic evolution (Figure 12b) reveals a significant conceptual transition. Between 1992-2018, corruption and institutions dominated (post-transition concerns). From 2019-2022, the themes expanded to e-government, developing countries and the shadow economy, integrating the digital context. After 2023, the focus shifted to institutional quality, environmental sustainability and machine learning, signalling methodological sophistication. In 2024, interest in corruption reemerges, closely linked to institutional quality and computational approaches, indicating a maturation towards predictive research.

Figure 13 presents the MCA results, identifying four significant clusters. The central purple cluster is the densest, connecting corruption, shadow economy, governance, institutional quality, innovation, and economic growth. Thus, reflecting a mature research agenda in which institutional quality is analysed in close relation to economic development and informality control. The green cluster groups environmental sustainability, carbon emissions, green innovation, and renewable energy, signalling a growing integration of institutional analysis with environmental concerns. The red cluster brings together transparency, anti-corruption, e-government, and public procurement, reflecting increased interest in public administration efficiency and integrity. The light blue cluster, containing regulatory quality, efficiency, and stochastic frontier analysis, represents a more technical and methodological dimension focused on measuring institutional performance econometrically. Together, these four clusters suggest the existence of well-defined but interconnected sub-domains within research on institutional quality and governance.

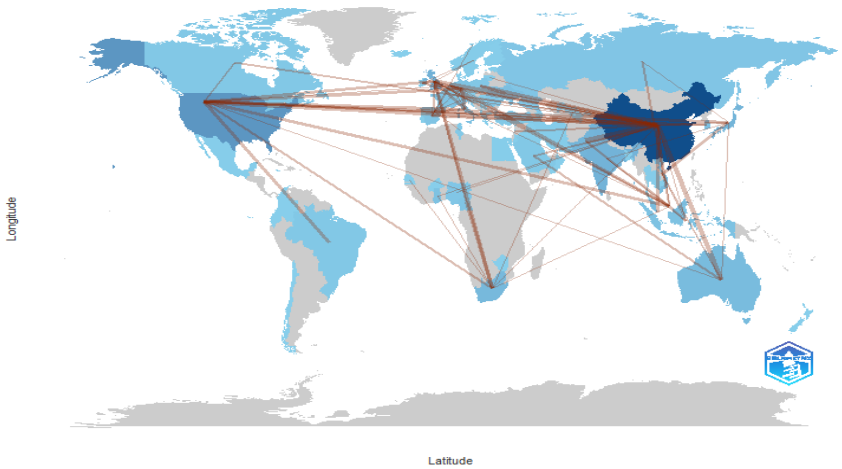
Figure 13.Factorial Analysis (MCA)



Source:Own processing via BiblioShiny

The map of international collaborations (Figure 14) highlights a significant concentration of research networks around China and the United States, which act as central poles in the dissemination of knowledge. China stands out through extensive partnerships (e.g. with the USA, the United Kingdom, Pakistan), showing an openness to South-South and East-West collaborations. The USA, as a global academic hub, is involved in collaborations on all continents, including with countries in Latin America and Africa.

Figure 14.Collaboration World Map



Source:Own processing via BiblioShiny

The network is relatively polarized around these great academic powers. Romania appears with a single international connection (the Republic of Moldova), indicating a low level of integration and a possible national focus of research. Central and South-Eastern Europe is poorly represented, with occasional collaborations, suggesting structural barriers to regional integration in academic circuits dominated by the West and East Asia.

5. Discussions

5.1. Dominant Themes and Conceptual Clusters (RQ1)

The first research question sought to identify the dominant themes and conceptual clusters at the intersection of the shadow economy, technology, and institutional quality. The MCA (Figure 13) revealed a four-cluster structure: (1) institutional and political, (2) technological and sustainability, (3) regulatory efficiency and innovation, and (4) administrative transparency. The co-word network (Figure 11) confirmed that corruption, institutional quality, governance, and economic growth function as pivot nodes, with the corruption cluster being the densest. This structure reflects a field in which institutional quality serves as the gravitational centre, linking governance concerns to sustainability, digital transformation, and administrative modernization, an architecture consistent with

prior evidence that institutional quality mediates the shadow economy's impact on growth (Nguyen et al., 2024) and shapes investment potential (Lyulyov and Moskalenko, 2020).

The identification of four distinct but interconnected clusters is the study's central empirical contribution, exposing a field architecture that bilateral analyses have left invisible. The central purple cluster's dominance confirms the institutional-economic nexus as the primary organizing principle. However, the green cluster (environmental sustainability) indicates diversification beyond the traditional institutional focus, while the red cluster (administrative transparency and e-government) shows that policy-oriented governance research has matured into a recognizable sub-domain. The methodological blue cluster further indicates that scholars are developing specialized analytical tools, particularly around econometric measurement of institutional performance.

The relationship between the Three-Field Plot (Figure 3) and the MCA (Figure 13) provides additional insight. Asongu's work on African governance appears prominently in both, exemplified by his analysis of mobile phone penetration and banking in Sub-Saharan Africa (Asongu, 2018), which integrates ICT diffusion, institutional quality, and financial inclusion within a unified frame, indicating a research stream conceptually embedded in the field's core, not merely prolific. China's prominence in the country-keyword mapping (Figure 3b) and the centrality of economic growth in the MCA together suggest that China's contribution is both quantitatively dominant and thematically aligned with the field's most developed areas.

The theoretical foundations (Table 5), dominated by institutional economists (North, Acemoglu, Kaufmann, Mauro) and panel data methodologists (Arellano, Blundell, Roodman), confirm the field's grounding in institutional economics and reliance on panel data approaches. The continued centrality of Mauro (1995) on corruption's drag on growth and North (1991) on institutions as the rules shaping economic performance demonstrates that contemporary work on the shadow economy still draws its analytical scaffolding from these foundational frameworks, even as the empirical questions have evolved toward digital governance and sustainability. The citation landscape (Table 4) reinforces this, with sustainability and regional development works leading global citations while governance papers dominate local citations. This anchoring provides rigor but may limit the incorporation of innovation studies, environmental science, or computational social science, fields that trend topics analysis (Figure 10) shows are becoming increasingly relevant. Machine learning and deep learning remain peripheral in the co-word network and niche in the thematic map, suggesting the field's methodological evolution lags behind its conceptual broadening. This gap is notable given that foundational empirical work such as Chen et al. (2018), examining the joint impact of environmental regulation, shadow economy, and corruption in China, already demonstrates the analytical payoff of treating these dimensions jointly rather than in isolation.

5.2. Evolution of Scientific Interest and Thematic Gaps (RQ2)

Trend topics analysis (Figure 10) revealed a clear post-2020 intensification of interest in institutional quality, governance, and technological innovation, with annual production rising from under 20 articles before 2015 to 82 in 2024 (Figure 1). This growth

links to challenges triggered by the 2008 financial crisis and later the COVID-19 pandemic, which amplified concerns about transparency, accountability, and systemic risk management. The thematic evolution (Figure 12b) traces this trajectory with corruption-dominated research before 2018, integration of e-government and developing-country perspectives in 2019-2022, and a focus on institutional quality, environmental sustainability, and machine learning from 2023 onward.

This evolution reflects a reconceptualization of the shadow economy from a phenomenon driven primarily by weak institutions to one embedded in broader dynamics of digital transformation, environmental governance, and global economic integration. Three significant thematic gaps emerge. First, while individual studies address the shadow economy-sustainability nexus, a comprehensive framework linking informality, institutional quality, technological transformation, and environmental outcomes remains absent. The positioning of environmental terms in the niche quadrant of the thematic map (Figure 12a) confirms their limited connectivity to the conceptual core. Second, the dominance of panel data methods such as GMM (Table 5) leaves substantial room for machine learning, natural language processing, and mixed-methods designs. Third, the dual role of technology, both reducing and facilitating shadow economy, is not yet reflected as a distinct thematic cluster, with concepts like digital shadow economy (Gasparenienė et al., 2016) absent as significant nodes despite growing practical relevance. This is compounded by the field's tendency to treat corruption as a proxy for the shadow economy, an assumption that conflates two related but analytically distinct phenomena. Corruption reflects governance failure, while the shadow economy encompasses a broader range of informal economic activities that persist even under relatively low corruption conditions (Dell'Anno, 2021; Schneider, 2021). Even high-impact contributions such as Adam (2020), which traces e-government's effect on corruption through ICT and institutional quality in Africa, stop short of extending the integrative pathway into shadow economy outcomes proper.

5.3. From Bilateral to Integrated Approaches (RQ3 and H1)

The third research question examined whether the literature maintains bilateral analyses or has developed an integrated approach. The thematic evolution (Figure 12b) shows a gradual transition from corruption-dominated research towards institutional quality and computational methods, while the MCA (Figure 13) reveals four distinct but interconnected clusters. Integration is underway but incomplete. The field is moving beyond bilateral analyses (e.g., corruption-governance, technology-shadow economy), yet a unified framework encompassing all dimensions has not crystallized. The transition from corruption dominance (pre-2022) to institutional quality as the organizing concept (from 2023) suggests researchers are shifting from diagnosing problems toward analysing mechanisms through which shadow economy can be reduced. However, the continued separation of the environmental cluster from the institutional core indicates that sustainability integration remains at an early stage, even as influential studies such as Ren et al. (2021) on government corruption, market segmentation, and renewable energy

innovation in China demonstrate that bridging these dimensions empirically yields meaningful insight.

Hypothesis H1 was supported. Scholarly interest has expanded beyond the mere presence of digitalization to address the specific impact of ICT, financial development, and sustainability on the shadow economy (Figure 10), validating the expected broadening of the research agenda. Simultaneously, the persistence of integration gaps, particularly the absence of consolidated frameworks linking all dimensions, confirms that substantial research opportunities remain.

5.4. Geographical Imbalances and Policy Implications

The collaboration map (Figure 14) and country data (Table 2) reveal a strongly polarized network. China and the United States dominate as central poles, while Australia, Indonesia, and Malaysia stand out for high international co-authorship relative to their output. Central and South-Eastern Europe remains structurally marginal. Romania's 12.5% international co-authorship rate (8 articles) contrasts sharply to countries with similar article output levels but higher international co-authorship, such as Ghana (30% MCP), Italy (30%), or Indonesia (62.5%). This gap between topical relevance and network absence represents both a limitation and an opportunity, as research capacity exists but remains insufficiently leveraged. Regional perspectives on governance and shadow economy remain underrepresented in the dominant academic circuits, precisely where their policy value would be highest. Evidence from Rodríguez-Pose and Di Cataldo (2015) on European regional government quality, alongside findings on institutional quality and economic complexity in Africa (Mini et al., 2025), suggests that subnational institutional variation carries significant explanatory weight, an analytical layer largely absent from the country-level frameworks dominating the corpus.

From a policy perspective, the centrality of institutional quality and governance underscores that addressing the shadow economy requires institutional reform alongside technological solutions. The thematic evolution towards sustainability (Figure 12b) suggests that anti-informality policies should be coordinated with environmental and digital transformation agendas. For emerging and transition economies, integrated frameworks simultaneously addressing institutional strengthening, digital governance, and economic formalization are necessary. Stimulating international collaborations, particularly from Central and South-Eastern Europe, could enhance both the visibility and policy impact of regional contributions.

Across all discussion areas, the findings paint a consistent picture of a field that has achieved substantial conceptual density and is broadening thematically, but has not yet translated this into deep cross-dimensional integration. The transition from corruption to institutional quality as the organizing concept, the emergence of sustainability and computational themes, and persistent geographical imbalances together describe a field mature in its foundations but still developing its integrative ambitions.

6. Conclusions

This study addresses a gap in the literature by mapping the intersection of the shadow economy, technology, and institutional quality through a bibliometric analysis in Bibliometrix/Biblioshiny. Using 383 WoS articles spanning 1992-2024, the field's structure, dynamics, and trends were examined across three decades of scholarly production.

Regarding RQ1 (dominant themes and conceptual clusters), the analysis revealed four conceptual clusters: (1)institutional and political, (2)technological and sustainability, (3)regulatory efficiency and innovation, and (4)administrative transparency. This structure points toward a multidimensional approach to the shadow economy, though integration across clusters remains incomplete. The co-word network and MCA both identified institutional quality as the gravitational centre connecting governance, corruption, sustainability, and digital transformation concerns.

Regarding RQ2 (evolution of interest and thematic gaps), a clear intensification of scholarly interest post-2020 was observed in institutional quality, governance, and technological innovation, while traditional themes such as corruption and institutions continued to occupy central positions. Three significant thematic gaps were identified. The first is the absence of comprehensive frameworks linking shadow economy, institutional quality, technological transformation, and environmental outcomes. The second is the underdeveloped treatment of technology's dual role, both in reducing and facilitating informality. The third is the strong reliance on panel data approaches, with limited use of computational and qualitative methods.

Regarding RQ3 and H1 (bilateral relations vs. integration), the evidence suggests a gradual transition from bilateral to more integrated approaches, though a unified framework has not yet crystallized. The field is aware of its cross-cutting themes but continues to operate primarily within thematic silos. Hypothesis H1 was supported. Scholarly interest has expanded beyond the mere presence of digitalization, addressing its specific impact on the shadow economy in relation to sustainability and public policies, while significant integration gaps persist.

The results of this research not only provide us with a clear picture of the current state of knowledge, but also open new horizons for future studies:

Deepening integration: Further research is needed to explore models and theoretical frameworks capable of integrating even more deeply the role of all three dimensions holistically, not just bilaterally.

Duality of Technology: A promising direction is to analyse the dual nature of technology, namely how it can reduce the shadow economy through transparency and efficiency, but also how it can facilitate new forms of shadow economy in the digital space.

Regional Collaboration and Integration: The low visibility of some regions, such as Central and South-Eastern Europe, highlights the need to stimulate scientific collaboration and integrate researchers into international networks. Thus, local perspectives and case studies can transcend national borders, contributing to the formulation of more effective public policies to combat the shadow economy, adapted to specific contexts but recognized globally.

Specific impacts and policies: Future research could deepen the links between the shadow economy, digitalization, institutional quality and specific aspects such as sustainability (e.g. impact on carbon emissions) or the effectiveness of public policies to reduce informality.

Innovative methodologies: The combined use of bibliometric analyses with other methodologies (e.g. econometric analyses, qualitative case studies) could provide a more complex and nuanced understanding of the phenomena studied.

This bibliometric review clarifies current knowledge on the shadow economy and its drivers, charts priority paths for future research, and provides a foundation for crafting effective governance strategies and fostering sustainable economic growth.

7. Research Limitations

Several limitations should be acknowledged. First, the analysis relies on metadata (titles, abstracts, keywords) rather than full-text content, capturing macroscopic trends but not the nuanced arguments within individual publications. Second, the exclusive use of WoS may omit relevant works indexed in other databases such as Scopus, particularly from regions with lower WoS coverage, potentially affecting the geographical findings. Third, Biblioshiny's predefined time intervals for thematic evolution, shaped by uneven publication dispersion, may obscure finer temporal dynamics. Fourth, results are directly influenced by the search query. Different formulations could yield different samples and thematic structures. These limitations open avenues for future research, including multi-database comparative analyses, natural language processing of full-text corpora, and qualitative studies complementing the macroscopic bibliometric view.

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