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A scientometric review on literature of macroprudential policy

Zhenpeng Tang, Tingting Zhang , Chongshan Liu and Junchuan Wu

School of Economics and Management, Fuzhou University, Fuzhou, China

ABSTRACT

Macroprudential policy is closely related to financial stability, systemic risk and the procyclicality of the financial sector, and has attracted considerable attention of scholars after the 2008 global financial crisis. Based on the 467 documents together with 14,597 references collected from the Web of Science core collection for the period of 2005–2018, this article conducts a scientometric analysis of macroprudential policy. The article applies basic analysis, co-citation analysis, cluster analysis, citation burstness detection, scientific research cooperation analysis and co-occurrence analysis of keywords. Through the document co-citation analysis, the article shows the key themes of macroprudential policy research which include: the effectiveness of macroprudential policies, financial market intermediaries, containment of systemic risks, monetary policy and liquidity. The article identifies influential scholars, documents, research institutions, journals and research hotspots in the field of research on macroprudential policy. The scientometric analysis in the article presents an objective perspective of the inheritance and evolution of scientific knowledge at different levels in the field of macroprudential policy.

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E50; E60; G10; G28

1. Introduction

The 2008 global financial crisis highlighted some deficiencies of the then prevailing regulatory framework, specifically its inability to address the stability of the financial system as a whole. Macroprudential policy, as an attempt to address this concern, has become a focal point of interest for policymakers, central banks and researchers (Gauthier et al., 2012). There is a general consensus among policymakers that a macroprudential approach to regulation and supervision should be adopted (Galati & Moessner, 2013; Hanson et al., 2011).

Macroprudential policy is closely related to financial stability, systemic risk and the procyclicality of the financial sector (Ebrahimi Kahou & Lehar, 2017; Galati & Moessner, 2013). Macroprudential policy uses prudential means to enhance system-

CONTACT Tingting Zhang  n180710032@fzu.edu.cn

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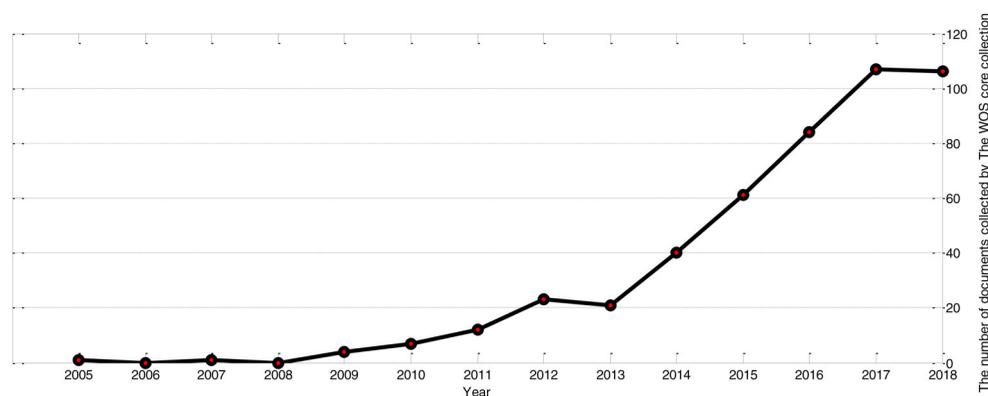


Figure 1. The distribution of the 467 documents during 2005–2018. Source: The Authors.

wide financial stability, with a view to limiting macroeconomic costs from financial distress (Galati & Moessner, 2018), and is a supplement and balance to the micro-prudential policy for maintaining financial stability (Allen & Gu, 2018; Borio, 2003; IMF, 2011).¹

Macroprudential policy requires a capacity to identify systemic risks early enough so timely action can be taken to support financial stability (IMF, 2011). In the research on measurement of systemic risk after the global financial crisis, the research focuses on: (1) the development of indicators to measure the systemic risk of the entire financial system (Altunbas et al., 2018; Borio & Drehmann, 2009); (2) identify the contribution of individual institutions to overall systemic risk (Brownlees & Engle, 2017; Diebold & Yilmaz, 2014). A variety of indicators and quantitative models/tools are developed, including macro, micro and sectoral variables ranging from bank capital and performance to market liquidity and household indebtedness. Some indicators, like credit-to GDP gap, equity price gap and property price gap, could potentially help informing assessments of the build-up of risks of future banking distress in an economy (Borio & Drehmann, 2009). Quantitative models on measuring systemic risk include approaches of interbank network as a contagion channel (Diebold & Yilmaz, 2014; Gauthier et al., 2012), conditional value-at-risk of spillover effects on the financial system (Adrian & Brunnermeier, 2016), and systemic expected shortfall on the downside risk of an individual institution conditional on the whole system being in financial difficulties (Acharya et al., 2010).² Also, a great deal of works researched on time-dimension and cross-sectional dimension of financial stability (Acharya, 2009; Lorenzoni, 2008; Repullo et al., 2010)³; effectiveness of macroprudential policy (Carreras et al., 2018; Cerutti et al., 2017; Kannan et al., 2012), available macroprudential instruments (Ebrahimi Kahou & Lehar, 2017; IMF, 2011), coordination between macroprudential policy and monetary policy (Gertler & Karadi, 2011; Rubio & Carrasco-Gallego, 2014) and liquidity shock and contagion risk (Allen & Gu, 2018; Brunnermeier, 2009).

Macroprudential policy has attracted a lot of attention of scholars after the 2008 global financial crisis, and the number of publications on macroprudential policy has increased dramatically (Figure 1). It is of great significance to undertake a scientometric review on the literature of macroprudential policy and summarise the existing

research results and trace the important context, and to present an objective perspective of the inheritance and evolution of scientific knowledge at different levels in the field of macroprudential policy.⁴

Scientometrics is a subfield of bibliometrics and concerns itself with measuring and analysing scientific literature. Co-citation analysis is one of the major quantitative techniques in science studies to map the structure and dynamics of scientific research (Braam et al., 1991). Science mapping, one of the most useful tools to visualise the scientific structure, helps to identify scientific themes, and discover the implications hidden in a vast amount of information and trace development frontiers (Hjørland & Albrechtsen, 1995; Lu & Wolfram, 2012).

In recent years, many researchers have conducted scientometric analysis in different subject fields. CiteSpace, a JAVA-based software, is a powerful tool and has been widely used in academia. In CiteSpace, (a) the nature of an intellectual base is algorithmically and temporally identified by emergent research-front terms, (b) the value of a co-citation cluster is explicitly interpreted in terms of research-front concepts, and (c) visually prominent and algorithmically detected pivotal points substantially reduce the complexity of a visualised network (Chen, 2006).⁵ CiteSpace has allowed some of the traditionally labor-some burdens to be shifted to computer algorithms and interactive visualisations (Chen, 2019). In economics, finance and management, for example, Song et al. (2016) reviewed the emerging trends in global PPP (public--private partnership) research and identified that risk allocation, performance evaluation, renegotiation of concession contracts, real option evaluation and contract management were the new research frontier then in the field of PPP research. Massaro et al. (2016) undertook a structured literature review in accounting and presented accounting researchers a basis for developing future research agendas in the field. Zhou et al. (2019) conducted a scientometric study of financial bubble research, and found that 'Ledoit-Sornette financial bubble model', 'European Union emission trading scheme' and 'agent-based model' were three hot topics in the field. Wang et al. (2020) conducted a bibliometrics analysis of publications in the Economic Research-Ekonomiska Istraživanja and illustrated science mapping analysis using CiteSpace and VOSviewer.⁶

This article uses CiteSpace, supplemented with VOSviewer,⁷ to conduct a scientometric study in the field of macroprudential policy. The rest of the article is arranged as follows: Section 2 presents the methodology and data used in the study. Section 3 presents the results of the basic analysis, the co-citation analysis, cluster analysis, citation burstness detection, the scientific research cooperation analysis and co-occurrence analysis. Section 4 of the article presents conclusions.

2. Methodology and data

2.1. Introduction of analysis method

This article aims to objectively analyse the research dynamics of macroprudential supervision using CiteSpace. The CiteSpace version used in this article is 5.4.R 3 updated on 17 May 2019 (<https://sourceforge.net/projects/citespace/>). In addition, VOSviewer is also used for generating Figures 7 and 8.

2.2. Data collection and processing

The data source used in this article is the Web of Science (WOS) core collection. WOS is considered to be the world's largest and most comprehensive academic information resource (Bajwa & Yaldram, 2013; Cui & Zhang, 2018). The WOS core collection retrieves world-class academic journals, books and conference proceedings in the science, social sciences, arts and humanities. This article aims to study the evolution and research dynamics of macroprudential policy on a global scale and to grasp the core research trends and hotspots. Therefore, the core collection of WOS can well meet the research needs of this article.

This article uses subject keywords to search and collect literature data in the WOS core collection. The subject keywords used for this article pertaining to macroprudential policy are, specifically, 'macroprudential policy', 'macroprudential regulation', 'macroprudential supervision' and 'macroprudential tool'. These keywords cover the main core content in the field of macroprudential policy. The content imported from the WOS core collection includes all the records of titles, abstracts and citations.

The publication dates of the documents are from 1 January 2005 to 31 December 2018. There were a total of 512 documents extracted. In order to improve the data quality of the extracted documents, six types of data, namely 'editorial materials', 'book review', 'book chapter', 'comments', 'correction' and 'data', were deleted, totaling 45 documents. Of the 467 filtered records, all records belong to the type of 'article', while 16 records belong to both 'article' and 'proceeding paper'. Table 1 shows the basic characteristics of these 467 documents. The literature sources involved 63 countries (based on countries of first author's affiliated institutions) and 187 journals, respectively. The 467 documents cited 20,710 references in total. There remain 14,597 cited references after manual removal of duplicated references.

Figure 1 shows the distribution of the 467 documents during 2005–2018. There were only 6 published documents in total during 2005–2009. The annual publications have been continuously increasing since 2010, except small dips in 2013 and in 2018, and reached the peak in 2017.

3. Results

The results of this article can be divided into the following parts: the basic analysis of articles, the document co-citation analysis (DCA), author co-citation analysis, journal co-citation analysis, the analysis of scientific research cooperation and co-occurrence analysis of keywords. In view of the available space, this article presents the key results of the analysis. Further details of the analysis and results can be found in a working paper of Tang et al. (2019).

3.1. Basic analysis of articles

The basic analysis includes authors with high number of published articles, highly cited articles, institutions and periodicals with high number of published articles. This part of the analysis relies on statistics prepared by the authors.

Table 1. The characteristics of data.

Years: 2005–2018

Number of countries: 63

Number of journals: 187

Number of cited references: 20,710

Number of cited references (after removal of duplicated references): 14,597

Note: The countries refer to the located countries of first authors' affiliated institutions.

Source: The Authors.

Table 2. The top 10 authors with the highest number of publications during 2005–2018, ranked by the first author of the article.

Number of articles	Author	Employer institution	Department
10	Rubio, M.	Nottingham University	
6	Baker, A.	Queen's University Belfast	School of Political International Studies and Philosophy
5	Brzoza-Brzezina, M.	National Bank of Poland	
5	Ghosh, S.	Reserve Bank of India	Centre for Advanced Financial Research
4	Agenor, P.R.	Manchester University	School of Social Sciences
4	Olszak, M.	University of Warsaw	Wydział Zarządzania
4	Sarlin, P.	Hanken School of Economics	
3	Cerutti, E.	International Monetary Fund	
3	Bianchi, J.	University of Wisconsin-Madison	
3	Gelain, P.	Norges Bank	

Source: The Authors.

Table 3. The top 10 articles with the highest citation.

No.	Citation frequency	Year	Author	Document title	Source
[1]	39	2011	Hanson et al.	A macroprudential approach to financial regulation	<i>Journal of Economic Perspectives</i>
[2]	34	2017	Cerutti et al.	The use and effectiveness of macroprudential policies: New evidence	<i>Journal of Financial Stability</i>
[3]	31	2012	Kannan et al.	Monetary and macroprudential policy rules in a model with house price booms	<i>B.E. Journal of Macroeconomics</i>
[4]	23	2014	Quint and Rabanal	Monetary and macroprudential policy in an estimated DSGE model of the euro area	<i>International Journal of Central Banking</i>
[5]	20	2014	Rubio and Carrasco-Gallego	Macroprudential and monetary policies: Implications for financial stability and welfare	<i>Journal of Banking and Finance</i>
[6]	16	2013	Gelain et al.	House prices, credit growth, and excess volatility: Implications for monetary and macroprudential policy	<i>International Journal of Central Banking</i>
[7]	16	2013	Baker	The new political economy of the macroprudential ideational shift	<i>New Political Economy</i>
[8]	14	2014	Smets	Financial stability and monetary policy: How closely interlinked?	<i>International Journal of Central Banking</i>
[9]	12	2012	Ostry et al.	Tools for managing financial stability risks from capital inflows	<i>Journal of International Economics</i>
[10]	11	2015	Bailliu et al.	Macroprudential rules and monetary policy when financial frictions matter	<i>Economic Modelling</i>

Source: The Authors.

Table 2 shows the top 10 authors with the highest number of published articles in the field of macroprudential policy during 2005–2018. Table 3 shows the top 10 articles with the highest citation frequency among the 467 articles. The citation frequency refers to the total number of times the article was cited in the bibliography of these 467 articles. Table 4 shows the top 5 journals with the highest number of

Table 4. The top 5 journals with the highest number of publications during 2005–2018.

Number of articles	Proportion (%)	Journal title	IF
33	7.066	<i>Journal of Financial Stability (J FINANC STABIL)</i>	2.2.301
27	5.781	<i>International Journal of Central Banking (INT J CENT BANK)</i>	0.0.793
27	5.781	<i>Journal of Banking and Finance (J BANK FINANC)</i>	2.2.205
15	3.211	<i>Journal of Money Credit and Banking (J MONEY CREDIT BANK)</i>	1.1.782
13	2.783	<i>Journal of International Money and Finance (J INT MONEY FINANC)</i>	1.1.780

Notes: 'Proportion (%)' represents the percentage of 467 articles published by different journals. 'IF' represents the impact factor of the journal in 2018.

Source: The Authors.

publications in the field of macroprudential policy during 2005–2018. Among the research journals in the field of macroprudential policy, the *Journal of Financial Stability* is the most published Journal in the period from 2005 to 2018, followed by *International Journal of Central Banking* and *Journal of Banking and Finance*. These statistics provide intuitive perspective and basic information in the field of macroprudential research.

3.2. Document co-citation analysis

DCA refers to a co-citation relationship of two documents (including references) appear together in the bibliography of the third document (Small, 1973). The data for the function of co-citation analysis in CiteSpace are based on the 467 documents and their bibliographies. The co-citation relationship between documents reflects the accumulation and inheritance of knowledge in this field.

3.2.1. Analysis of co-citation clusters

Figure 2 shows a cluster diagram of the document co-citation network (DCN). Figure 3 is Timeline view of DCN. Nodes with a centrality value of more than 0.1 are marked with purple circles. The name extraction source of each cluster formed in the DCN was the abstract of the document. Cluster names were based on log-likelihood ratio (LLR) algorithm. The number of nodes (or documents) in clustering reflects the importance of this clustering field. Among the 10 clusters formed, cluster #0 has the largest scale, while clusters #8 and #9 have the smallest scale. The values of 'Modularity Q' and 'Mean Silhouette' of the partition are 0.6997 and 0.5341, respectively. These are considered within the valid range, indicating the rationality of the DCN clustering.

Table 5 shows the top 20 documents/references with the highest citation frequency in the DCN. Since clusters #1, #2, #7, #8 and #9 are not represented by these 20 documents, representative documents are selected from each of the clusters #1, #2, #7, #8 and #9. These representative documents are listed in Table 5 as No. 21 to No. 25. Table 5 also shows the betweenness centrality of each article and its detailed publishing information. These articles with high citation frequency are noteworthy articles in the field of macroprudential supervision. It is noted that Table 3 ranks citation frequencies of the 467 documents based on authors' manual calculations, while Table 5 ranks citation frequencies of the 467 documents and their bibliographies based on CiteSpace calculation of the DCN.

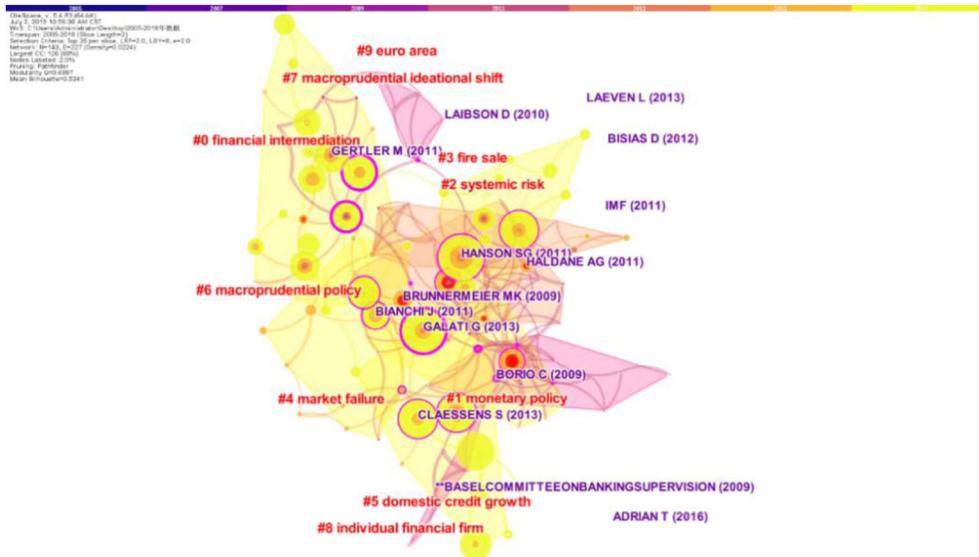


Figure 2. Cluster view of the DCN generated by CiteSpace.

Nodes with a centrality value of more than 0.1 are marked with purple circles.

Timespan: 2015–2018, slice length = 2; selection criteria: Top 35 per slice; pruning: pathfinder; network: $N = 143$, $E = 227$; modularity $Q = 0.6997$, mean silhouette = 0.5341. Source: The Authors.

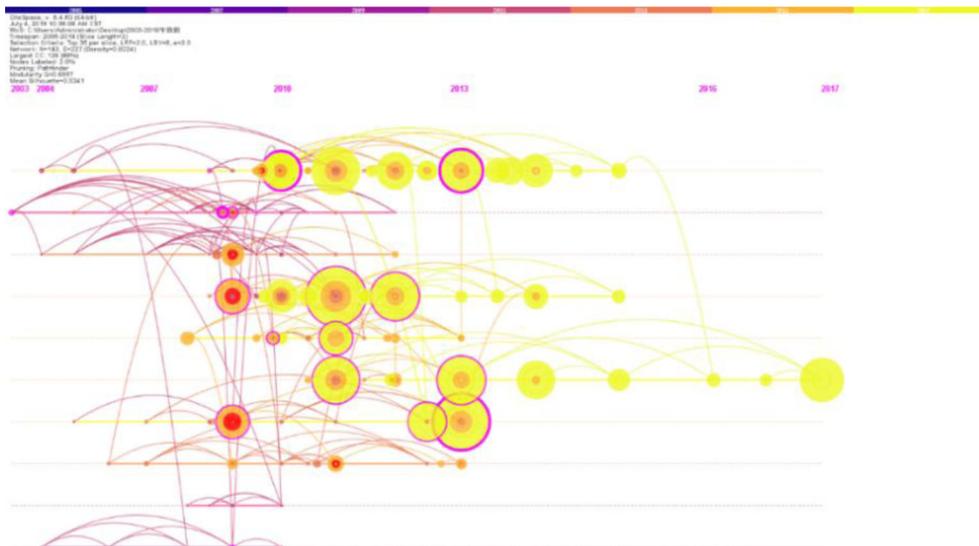


Figure 3. Timeline view of document co-citation network generated by CiteSpace.

Bursty nodes are marked with red in the graph.

Timespan: 2015–2018, slice length = 2; selection criteria: Top 35 per slice; pruning: pathfinder; network: $N = 143$, $E = 227$; modularity $Q = 0.6997$, mean silhouette = 0.5341. Source: The Authors.

In the exploration of the research front of the field, the co-cited documents/references contained in the cluster constitute the intellectual base. Table 6 shows the detailed information of the top 10 clusters, where the ‘Year (mean)’ represents the average value of published years of documents/references included in the cluster;



Table 5. The top 20 cited documents; 5 representative documents of clusters #1, #2, #7, #8, #9.

No.	Citation frequency	Betweenness centrality	Author	Publication year	Document title	Source	Document type	Cluster ID
[1]	42	0.18	Hanson et al.	2011	A macroprudential approach to financial regulation	<i>Journal of Economic Perspectives</i>	Journal article	#3
[2]	39	0.30	Galati and Moessler	2013	Macroprudential policy – A literature review	<i>Journal of Economic Surveys</i>	Journal article	#6
[3]	35	0.07	Gertler and Karadi	2011	A model of unconventional monetary policy	<i>Journal of Monetary Economics</i>	Journal article	#0
[4]	34	0.13	Claessens et al.	2013	Macroprudential policies to mitigate financial system vulnerabilities	<i>Journal of International Money and Finance</i>	Journal article	#5
[5]	34	0.20	Schularick and Taylor	2012	Credit booms gone bust: Monetary policy, leverage cycles, and financial crises, 1870–2008	<i>American Economic Review</i>	Journal article	#3
[6]	33	0.11	IMF	2011	Macroprudential policy: What instruments and how to use them? Lessons From country experiences	IMF Working Papers	Journal article	#5
[7]	32	0.04	Cerutti et al.	2017	The use and effectiveness of macroprudential policies: New evidence	<i>Journal of Financial Stability</i>	Journal article	#5
[8]	29	0.22	Angeloni and Faia	2013	Capital regulation and monetary policy with fragile banks	<i>Journal of Monetary Economics</i>	Journal article	#0
[9]	28	0.00	Aiyar et al.	2014	Does macroprudential regulation leak? Evidence from a UK policy experiment	<i>Journal of Money, Credit and Banking</i>	Journal article	#5
[10]	27	0.07	Kannan et al.	2012	Monetary and macroprudential policy rules in a model with house price booms	<i>B.E. Journal of Macroeconomics</i>	Journal article	#0
[11]	27	0.15	Lambertini et al.	2013	Leaning against boom–bust cycles in credit and housing prices	<i>Journal of Economic Dynamics and Control</i>	Journal article	#6
[12]	26	0.35	Iacoviello and Neri	2010	Housing market spillovers: Evidence from an estimated DSGE model	<i>American Economic Journal: Macroeconomics</i>	Journal article	#0
[13]	25	0.02	Gerali et al.	2010	Credit and banking in a DSGE Model of the Euro area	<i>Journal of Money, Credit and Banking</i>	Journal article	#0
[14]	24	0.09	Adrian and Shin	2010	Liquidity and leverage	<i>Journal of Financial Intermediation</i>	Journal article	#3
[15]	24	0.17	Brunnermeier and Pedersen	2009	Market liquidity and funding liquidity	<i>The Review of Financial Studies</i>	Journal article	#3
[16]	24	0.08	Angelini et al.	2014	The interaction between capital requirements and monetary policy	<i>Journal of Money, Credit and Banking</i>	Journal article	#0
[17]	23	0.18	Reinhard and Rogoff	2009	This time is different: Eight centuries of financial folly	Princeton University Press	Edited book	#6
[18]	23	0.16	Bianchi	2011	Overborrowing and systemic externalities in the business cycle	<i>American Economic Review</i>	Journal article	#4
[19]	20	0.01	Quint and Rabanal	2014	Monetary and macroprudential policy in an estimated DSGE model of the Euro area	<i>International Journal of Central Banking</i>	Journal article	#0
[20]	18	0.00	Rubio and Carrasco-Gallego	2014	A macroprudential and monetary policies: Implications for financial stability and welfare	<i>Journal of Banking & Finance</i>	Journal article	#0
[21]	5	0.25	Adrian and Shin	2009	Money, liquidity, and monetary policy	<i>American Economic Review</i>	Journal article	#1
[22]	17	0.06	Brunnermeier	2009	Deciphering the liquidity and credit crunch 2007–2008	<i>Journal of Economic Perspectives</i>	Journal article	#2
[23]	12	0.08	Haldane and May	2011	Systemic risk in banking ecosystems	<i>Nature</i>	Journal article	#7
[24]	2	0.00	Morris and Shin	2008	Financial regulation in a system context	<i>Brookings Papers on Economic Activity</i>	Journal article	#8
[25]	2	0.01	Gambacorta and Mistrulli	2004	Does bank capital affect lending behavior?	<i>Journal of Financial Intermediation</i>	Journal article	#9

Source: The Authors.

Table 6. The characteristics of clusters.

Cluster ID	Year (mean)	Size	Silhouette	Cluster labels (log-likelihood ratio)	Representative document in the cluster (with highest centrality or citation frequency)	Most representative citing document (with the highest number of articles in the cluster contained in its bibliography)	Cluster labels (combined)
#0	2011	23	0.799	Financial intermediation (62.23); capital adequacy regulation (41.63); risky bank lending (41.51)	Gertler and Karadi (2011), <i>Journal of Economic Surveys</i> (35, 1st; 0.07, 5th); Iacoviello and Neri (2010), <i>American Economic Journal: Macroeconomics</i> (26, 4th; 0.35, 1st)	Paries et al. (2011), <i>International Journal of Central Banking</i> , 'Macroeconomic propagation under different regulatory regimes: Evidence from an estimated DSGE model for the euro area' (p. 10)	Financial intermediation
#1	2008	18	0.808	Monetary policy (83.07); new consensus (79.5); central bank (64.08)	Borio and Drehmann, 2009, <i>BIS Quarterly Review</i> (7, 1st; 0.17, 2nd); Adrian and Shin (2009), <i>American Economic Review</i> (0.25, 1st; 5, 2nd)	Gauthier et al. (2012), <i>Journal of Financial Intermediation</i> , 'Macroprudential capital requirements and systemic risk' (p. 6)	Monetary policy
#2	2009	16	0.696	Systemic risk (110.13); short-term wholesale funding (72.45); macroprudential capital requirement (55.19)	Brunnermeier (2009), <i>Journal of Economic Perspectives</i> (17, 1st; 0.06, 3rd) Acharya and Yorulmazer (2007), <i>Journal of Financial Intermediation</i> (2, 7th; 0.09, 1st)	López-Espinosa et al. (2012), <i>Journal of Banking and Finance</i> , 'Short-term wholesale funding and systemic risk: A global CoVaR approach'	Systemic risk
#3	2011	14	0.774	Fire sale (93.11); credit crunches (46.39); using data (38.67)	Hanson et al. (2011), <i>Journal of Economic Perspectives</i> (42, 1st; 0.18, 2nd); Schularick and Taylor (2012), <i>American Economic Review</i> (34, 2nd; 0.20, 1st)	Fendoğlu (2017), <i>Journal of Banking and Finance</i> , 'Credit cycles and capital flows: Effectiveness of the macroprudential policy framework in emerging market economies'	Fire sale
#4	2011	12	0.738	Market failure (48.88); behavioural finance (48.88); financial sector (42.32)	Bianchi (2011), <i>American Economic Review</i> (23, 1st; 0.16, 1st)	Quint and Rabanal (2014), <i>International Journal of Central Banking</i> , 'Monetary and macroprudential policy in an estimated DSGE model of the euro area' (p. 4)	Market failure
#5	2013	11	0.877	Domestic credit growth (82.62); bank ownership (58.11); macroprudential policy shock (58.09)	Claessens et al. (2013), <i>Journal of International Money and Finance</i> (34, 1st; 0.13, 1st)	Beime and Friedrich (2017), <i>Journal of International Money and Finance</i> , 'Macroprudential policies, capital flows, and the structure of the banking sector' (p. 3)	Domestic credit growth
#6	2009	11	0.843	Macroprudential policy (64.14); monetary policies (53.2); macro effect (52.81)	Galati and Moessler (2013), <i>Journal of Economic Surveys</i> (39, 1st, 0.30, 1st)	Mayes (2011), <i>Empirica</i> , 'The future of financial markets: Financial crisis avoidance' (p. 6)	Macroprudential policy

(continued)

Table 6. Continued.

Cluster ID	Year (mean)	Size	Silhouette	Cluster labels (log-likelihood ratio)	Representative document in the cluster (with highest centrality or citation frequency)	Most representative citing document (with the highest number of articles in the cluster contained in its bibliography)	Cluster labels (combined)
#7	2010	11	0.834	Macroprudential ideational shift (91.75); third order change (60.12); macroprudential idea (60.12)	Haldane and May (2011), <i>Nature</i> (12, 1st; 0.08, 1st)	Riccetti et al. (2013), <i>Journal of Economic Dynamics and Control</i> , 'Leveraged network-based financial accelerator' (p. 4)	Macroprudential ideational shift
#8	2009	5	0.967	Individual financial firm (35.07); financial market (27.29); financial crisis avoidance (18.09)	Basel Committee on Banking Supervision (2009), BIS (3, 1st; 0.02, 2nd); McDonald (2010), Working Paper (2, 2nd; 0.10, 1st)	Mayes (2011), <i>Empirica</i> , 'The future of financial markets: Financial crisis avoidance' (p. 4)	Individual financial firm
#9	2007	5	0.948	Euro area (14.43); various financial friction (13.85); oligopolistic banking sector (13.85)	Angeloni and Faia (2009), Working Paper (2, 1st; 0.13, 1st)	Pariès et al. (2011), <i>International Journal of Central Banking</i> , 'Macroeconomic propagation under different regulatory regimes: Evidence from an estimated DSGE model for the Euro area' (p. 4)	Euro area

Notes: The clusters are ranked by 'size'.

Source: The Authors.

the ‘Size’ represents the number of nodes contained in the cluster; the ‘Cluster labels (LLR)’ is selected from abstract of documents/references in the cluster; the ‘representative document’ of each cluster refers to the node with the highest centrality or the highest citation frequency in the cluster; the ‘most active citing document’ refers to the node with the highest number of documents/references in the cluster contained in its bibliography. The ‘most active citing document’ may not be in the cluster.

Cluster #0 is the largest cluster in the DCN, which contains 23 nodes with a mean silhouette value of 0.799. The cluster labels extracted from the abstract of the documents/references based on the LLR algorithm are ‘financial intermediation’, ‘capital adequacy regulation’ and ‘risky bank lending’. The representative documents of cluster #0 are Gertler and Karadi (2011) ranked first in citation frequency and Iacoviello and Neri (2010) ranked first in centrality. Gertler and Karadi (2011) constructed a quantitative monetary Dynamic Stochastic General Equilibrium (DSGE) model to evaluate the impact of the central bank’s use of unconventional monetary policies against simulated financial crises, and studied the quantitative effects of macroprudential policies aimed at offsetting risk-taking incentives. Iacoviello and Neri (2010) analysed the sources and consequences of the fluctuations of the American real estate market in the whole business cycle based on the estimated DSGE model. The most representative citing document of cluster #0 is Pariès et al. (2011). This article takes the eurozone as the research object and based on closed-economy DSGE model examines the macroeconomic impact of various financial frictions on credit supply and demand.

Clusters #1–#9 contain nodes various from 5 to 18. The mean silhouette values range from 0.696 to 0.967. Further information of clusters #1–#9 are presented in the working paper of Tang et al. (2019).

Through the detailed analysis of clustering, we can conclude that the research topics in the field of macroprudential supervision mainly include the following five aspects: (1) the effectiveness of macroprudential policies; (2) financial market intermediaries; (3) containment of systemic risks; (4) monetary policy; (5) liquidity. Among them, the DSGE model is widely used in research. Iacoviello and Neri (2010), Galati and Moessner (2013), Angeloni and Faia (2013), Schularick and Taylor (2012), Hanson et al. (2011) are the articles with both high citation frequency and high centrality.

3.2.2. Citation burstness detection

Table 7 shows the relevant information of the top 16 documents/references with strong citation bursts according to the citation burst starting time sequence from 2005 to 2018. It includes the document title, the author, the year of publication, burst-strength, the year when the outbreak began and the year when it ended. The citation frequency of these nodes rose rapidly within the corresponding duration of the outbreak. Through the analysis of the results of citation bursts, the research hot-spots in the field of macroprudential supervision in different periods can be tracked. Of these documents/references in Table 7, Brunnermeier and Pedersen (2009) and Reinhart and Rogoff (2009) are both with high citation frequency (Table 6) and burst

Table 7. The top 16 references with the strongest citation bursts during 2005–2018.

Document title	Author	Publication year	Burst strength	Beginning	End	Burst/2005–2018
This time is different: Eight centuries of financial folly	Reinhart and Rogoff	2009	4.3288	2011	2016	---
Assessing the risk of banking crises – Revisited	Borio and Drehmann	2009	2.9276	2011	2014	---
A framework for assessing the systemic risk of major financial institutions	Huang et al.	2009	3.2319	2012	2014	---
Deciphering the liquidity and credit crunch 2007–2008	Brunnermeier	2009	3.9294	2012	2016	---
Market liquidity and funding liquidity	Brunnermeier and Pedersen	2009	4.5259	2013	2016	---
Implementing a macroprudential framework: Blending boldness and realism	Borio	2011	3.2041	2013	2014	---
Systemic risk in banking ecosystems	Haldane and May	2011	3.9340	2013	2015	---
Credit spreads and monetary policy	Cúrdia and Woodford	2010	3.0367	2013	2015	---
Stories of the twentieth century for the twenty-first	Gourinchas and Obstfeld	2012	3.5244	2014	2016	---
Collective moral hazard, maturity mismatch, and systemic bailouts	Farhi and Tirole	2012	3.2613	2015	2016	---
Managing credit booms and busts: A Pigouvian taxation approach	Jeanne and Korinek	2010	2.7920	2015	2016	---
Econometric measures of connectedness and systemic risk in the finance and insurance sectors	Billio et al.	2012	2.7920	2015	2016	---
Monetary policy as financial stability regulation.	Stein	2012	2.7920	2015	2016	---
The role of bank capital in the propagation of shocks	Meh and Moran	2010	2.7920	2015	2016	---
A survey of systemic risk analytics	Bisias et al.	2012	2.7920	2015	2016	---
Inefficient credit booms	Lorenzoni	2008	4.6756	2015	2016	---

Notes: Each blue line corresponds to a year from 2005 to 2018, and the portion marked with red represents the years of the citation burst. Source: The Authors.

occurrence. Brunnermeier (2009) and Haldane and May (2011) are also in Table 6 since they are representative documents of cluster #2 and cluster #7, respectively.

In terms of burst-strength, Lorenzoni (2008) ranks the first, with a burst-strength of 4.6756, bursting during 2015–2016. This is followed by Brunnermeier and Pedersen (2009) with a burst-strength of 4.5259, bursting during 2013–2016. Reinhart and Rogoff (2009) rank the third with a burst-strength of 4.3288, bursting during 2011–2016. Haldane and May (2011) and Brunnermeier (2009), respectively, ranks the fourth, bursting during 2013–2015, and the fifth, bursting during 2012–2016. Through these works of strong citation bursts, we would summarise, admittedly with some degrees of subjectivity, that research hotspots include, among others, measurements of systemic risk⁸; theoretical modelling that underlines the needs for macroprudential supervision (such as correlated risk exposures of banks; credit boom and financial fragility; externality associated with excessive private money creation; ‘super-spread institutions’ in banking ecosystems; the link of bank capital to an economy’s ability to absorb shocks); debt accumulation, systemic banking crises and sovereign defaults; amplification mechanisms and liquidity crisis in the global financial crisis; optimal monetary policy in response to financial disturbances; a Pigouvian tax on borrowing to manage credit booms and busts endogenously; implementation of macroprudential framework.

3.3. Author co-citation analysis

Author co-citation analysis uses the set of documents associated with an author as the content of a node. Co-citation of authors counts the number of citations when any work by an author along with any work by another author are cited in a document by the third author. Figure 4 is the author co-citation network (ACN) constructed by CiteSpace, showing 7 clusters of the ACN. According to the ranking of nodes included in each cluster, it can be inferred that the research topics of the co-cited authors mainly include ‘individual financial firm’, ‘house price’ and ‘macroprudential policies’. Notably, the International Monetary Fund and the Basel Committee on Banking Supervision are important international organisations in ACN.

3.4. Journal co-citation analysis

The journal co-citation network (JCN) by CiteSpace is shown in Figure 5. Through the analysis of citation frequency, the most influential journals in the field of macroprudential policy are *American Economic Review*, *Journal of Money Credit and Banking*, *Journal of Monetary Economics*. Comparing highly cited journals to those journals with high volume of publications (as listed in Table 4), it indicates that in the research field of macroprudential policy, the publication volume of journals is not directly proportional to its influence in the field.

3.5. Analysis of research power network

A research power network built using CiteSpace is to illustrate the cooperation between institutions and countries in the field of macroprudential policy (as shown

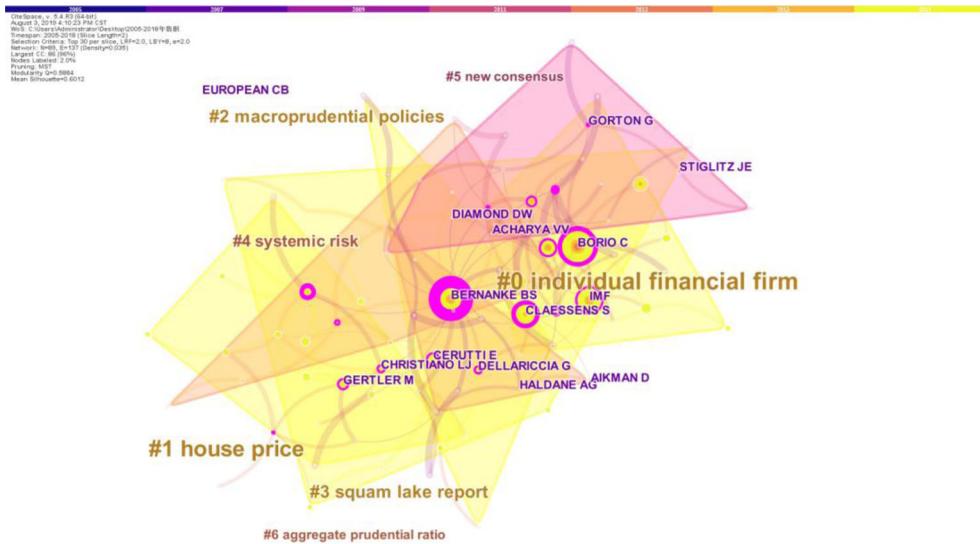


Figure 4. Cluster view of the author co-citation network generated by CiteSpace. Nodes with a centrality value of more than 0.1 are marked with purple circles. Timespan: 2015–2018, slice length = 2; selection criteria: top 30 per slice; pruning: MST; network: $N = 89$, $E = 137$; modularity $Q = 0.5884$, mean silhouette = 0.6012. Source: The Authors.

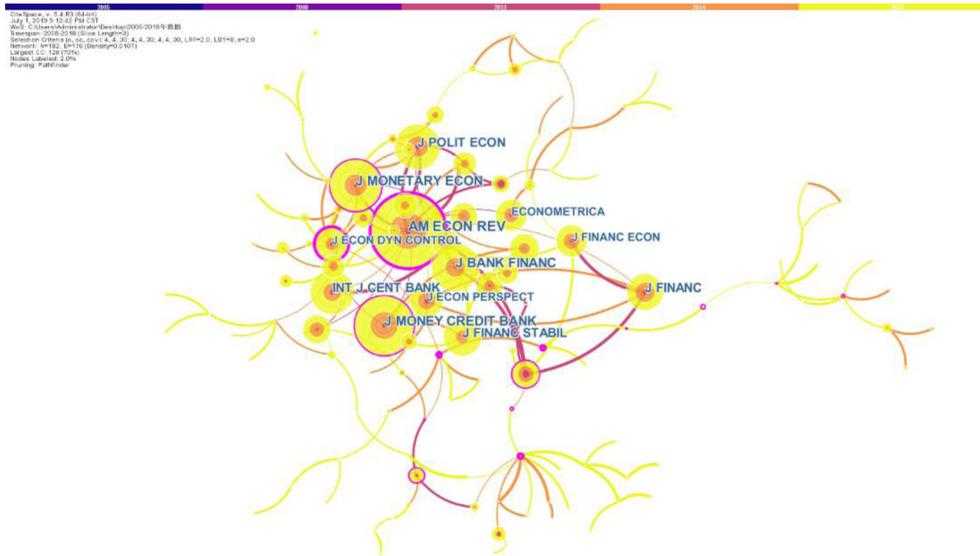


Figure 5. The visualisation of journal co-citation network generated by CiteSpace. Nodes with a centrality value of more than 0.1 are marked with purple circles. Timespan: 2015–2018, slice length = 3; selection criteria (c, cc, ccv): 4, 4, 30; 4, 4, 30; 4, 4, 30; pruning: pathfinder; network: $N = 182$, $E = 176$. Source: The Authors.

in Figure 6). Figure 7 is the density visualisation of the research power network displayed by VOSviewer. The institution with the highest cooperation frequency is the International Monetary Fund, followed by the European Central Bank, the Center for Economic and Policy Research, Deutsch Bundesbank and the Bank for International

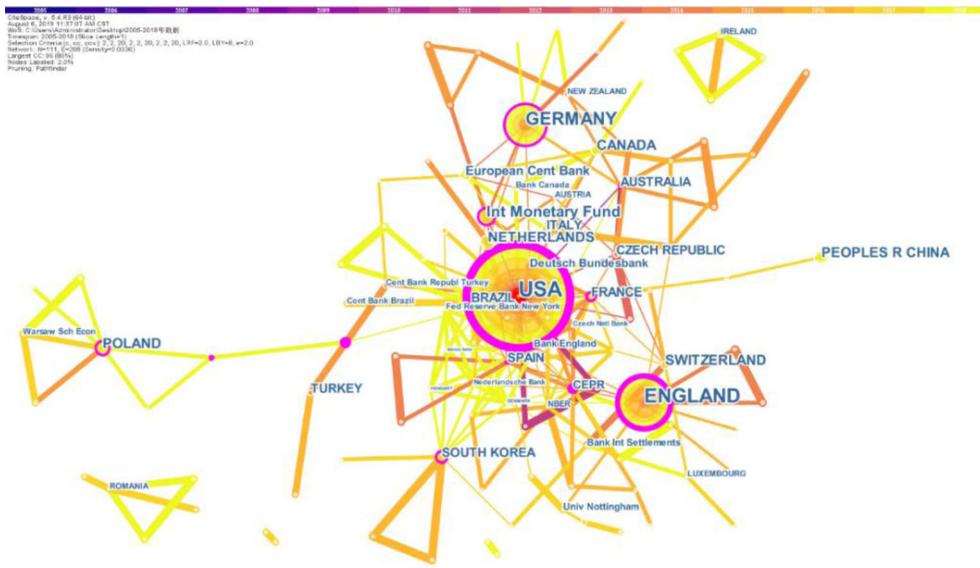


Figure 6. Research power network, with 111 nodes and 205 links generated by CiteSpace. Nodes with a centrality value of more than 0.1 are marked with purple circles. Timespan: 2015–2018, slice length = 1; selection criteria (c, cc, ccv): 2, 2, 20; 2, 2, 20; 2, 2, 20; pruning: pathfinder; network: $N = 111$, $E = 205$. Source: The Authors.

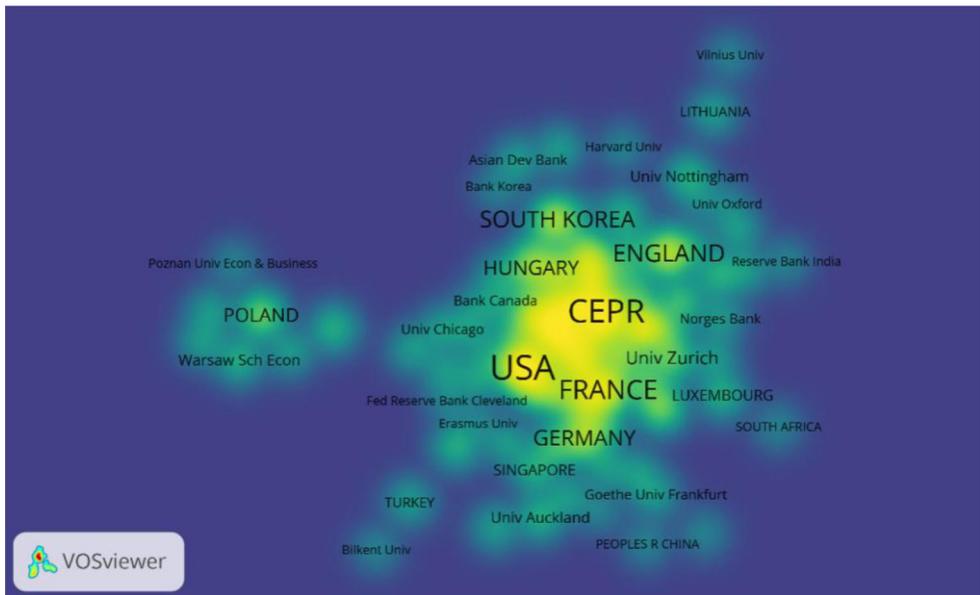


Figure 7. The density view of the research power network generated by CiteSpace. Some of the items in CiteSpace’s original research power network are not connected to each other. The density view of the research power network is the largest set of connected items consists of 96 items using VOSviewer. It marks with different colours according to the centrality of each node. The colour scheme ranges from yellow to blue–green in the vicinity of each node representing the continuous attenuation of node centrality. Items: 96; clusters: 16; links: 193; weights: links. Source: The Authors.

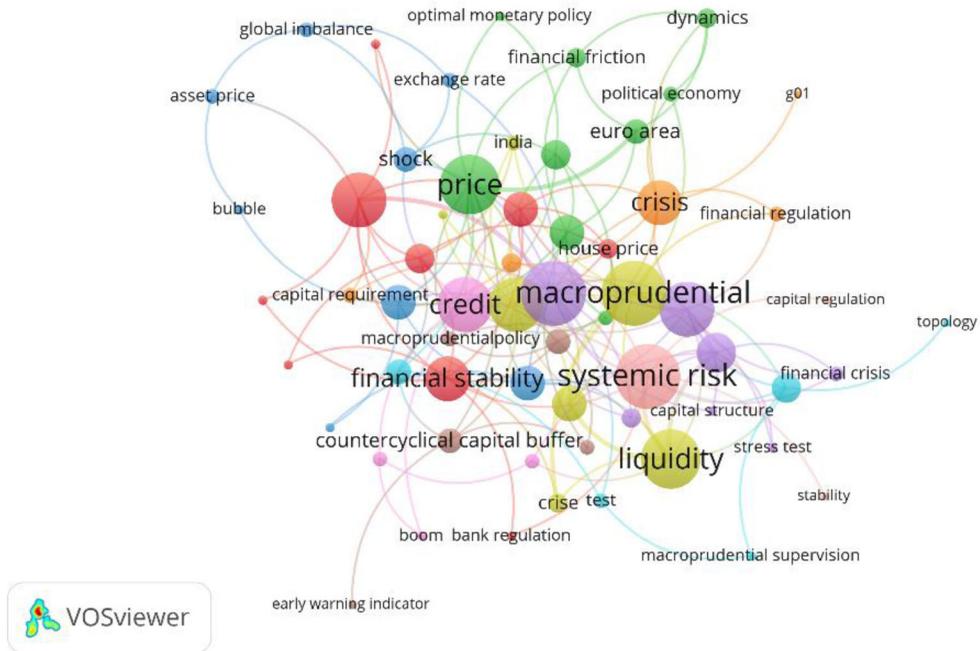


Figure 8. The co-occurrence network map of keywords in macroprudential policy during 2005–2018.

Some of the items in CiteSpace's original keywords co-occurrence network are not connected to each other. The visualisation of keywords co-occurrence network is the largest set of connected items consists of 62 items using VOSviewer. These connected items are partitioned into 10 clusters, associated with 10 different colours, according to VOSviewer. Items: 62; clusters: 10; total link strength: 153; weights: total link strength. Source: The Authors.

Settlements. In addition, the country with the highest cooperation frequency in the research power network is the United States, followed by England, Germany, Switzerland, Canada, Poland and China.

3.6. Co-occurrence analysis of keywords

Figure 8 is a co-occurrence diagram that visualises the largest set of connected items of the keyword co-occurrence network using VOSviewer. Among them, macroprudential policy, monetary policy, systemic risk, credit, financial stability, liquidity are nodes with both high citation frequency and high centrality.

4. Conclusions

Based on the literature data (467 documents together with 14,597 references) from WOS core collection for the period of 2005–2018, this article conducts a scientometric analysis of macroprudential policy. This study uses CiteSpace, supplemented with VOSviewer, to identify emergent research-front terms and concepts, and to detected pivotal points with high betweenness centralities in research networks. This article applied basic analysis, DCA including cluster analysis and citation burstness

detection, author co-citation analysis, journal co-citation analysis, the scientific research cooperation analysis and co-occurrence analysis of keywords.

The results of basic analysis show authors with high number of published articles, highly cited articles, institutions and periodicals with high number of published articles. Among the research journals in the field of macroprudential policy, the *Journal of Financial Stability* is the most published journal in the period from 2005 to 2018, followed by *International Journal of Central Banking* and *Journal of Banking and Finance*.

Based on DCA and cluster analysis, it can be inferred that the key themes of macroprudential policy which include: the effectiveness of macroprudential policies, financial market intermediaries, containment of systemic risks, monetary policy and liquidity. Through the analysis of the results of citation bursts, the study tracked the research hotspots in the field of macroprudential policy in different periods. Through the 16 documents with strong citation bursts, we would summarise that research hotspots include, among others, measurements of systemic risk; theoretical modelling that underlines the needs for macroprudential supervision; debt accumulation, systemic banking crises and sovereign defaults; and implementation of macroprudential framework.

In addition, the results of author co-citation analysis show that the research topics of the co-cited authors mainly include ‘individual financial firm’, ‘house price’ and ‘macroprudential policies’. The journal co-citation analysis shows that the most influential journals in the field of macroprudential policy are *American Economic Review*, *Journal of Money Credit and Banking*, *Journal of Monetary Economics*. The analysis of the scientific research cooperation shows that the main cooperation institutions in the cooperative network are the International Monetary Fund, the Center for Economic and Policy Research, Deutsches Bundesbank, the European Central Bank and the Bank of England. The results of co-occurrence analysis of keywords show that macroprudential policy, monetary policy, systematic risk, credit, financial stability, liquidity are nodes with both high citation frequency and high centrality.

These results that identified influential scholars, documents, research institutions, journals, key themes and research hotspots, are valuable and provide objective metrics to researchers in the field of research on macroprudential policy. As macroprudential policy is still in the early stage of development, this scientometric review of the literature, complementing the traditional reviews, offers objective perspective of the interlinks and dynamics of the scientific research in the field.

Notes

1. The first mention of the term macroprudential can be found in the minutes of a Cook Committee meeting in 1979 (Clement, 2010).
2. Bisias et al. (2012) provided a comprehensive survey of various measurements of systemic risk.
3. The time dimension reflects a cumulative, amplifying mechanism (or procyclicality) that operates within the financial system, while the cross-sectional dimension reflects the distribution of risk in the financial system at a given point of time.
4. Galati and Moessner (2013) and Ebrahimi Kahou and Lehar (2017) undertook traditional reviews of the literature on macroprudential policy. A structured review of the literature would offer an empirical grounding and objectivity, compared with a traditional review.

5. Centrality metrics provide a computational method for finding pivotal points between different specialties or tipping points in an evolving network (Chen, 2006). A commonly used centrality metric is the betweenness centrality (Freeman, 1977).
6. In recent years, researchers applied bibliometric analyses in their study of business cycle and crises research (Kufenko & Geiger, 2016) and of the impact of poverty cycles on economic research (Qin et al., 2020).
7. A software tool for building and visualising bibliometric networks. <https://www.vosviewer.com/>
8. Billio et al. (2012) proposed early warning indicators for systemic risk, through measurement of connectedness of financial institutions based on principal-components analysis and Granger-causality networks, using market returns of the financial institutions. Gourinchas and Obstfeld (2012) suggested that domestic credit expansion and real currency appreciation have been the most robust and significant predictors of financial crises.

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ORCID

Tingting Zhang  <http://orcid.org/0000-0001-9478-9564>

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