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MAPPING THE RESEARCH LANDSCAPE OF RESIDENTIAL PROPERTY MARKET EFFICIENCY: A BIBLIOMETRIC REVIEW

Masitah Zulkepli^{1*}, Noor Azinuddin Ahmad¹, Wu Ziou Hon¹, Mohd Shahril Abdul Rahman²,
Siti Zaleha Daud², Nor Fatihah Mazlam³, Zainab Toyin Jagun⁴, Idatul Farita Mohamad
Toha⁵

¹Faculty of Business and Management, Southern University College, Malaysia.

 masitah@sc.edu.my

 <https://orcid.org/0009-0002-1115-9108>

 noorazinuddin@sc.edu.my

 <https://orcid.org/0009-0001-1214-0399>

 zhwu@sc.edu.my

 <https://orcid.org/0009-0003-8236-0578>

²Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Malaysia.

 mshahril.ar@utm.my

 <https://orcid.org/0000-0002-2837-2872>

 sitizalehadaud@utm.my

 <https://orcid.org/0000-0003-4724-9789>

³Faculty of Engineering & Information Technology, Southern University College, Malaysia.

 noorfatihah@sc.edu.my

 <https://orcid.org/0009-0003-1284-5908>

⁴School of Built Environment, Engineering and Computing, Leeds Beckett University City Campus,
Leeds, United Kingdom

 z.t.jagun@leedsbeckett.ac.uk

 <https://orcid.org/0000-0002-7441-7138>

⁵Bahagian Perancangan Perumahan, Kementerian Perumahan dan Kerajaan Tempatan, Putrajaya,
Malaysia.

 idatul@kpkt.gov.my

 <https://orcid.org/0009-0003-4846-4007>

*Corresponding Author

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Abstract:

There has been a significant amount of work done about the efficiency of the market in financial economics, and the question of how to implement and develop this in residential property markets is strewn across fields and time. The volume of empirical and theoretical research on information efficiency, price dynamics and market behavior in housing markets still increases, but systematic knowledge about the intellectual structure, research trends and changes in the themes of the field is still lacking. This study will address this gap by conducting a

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comprehensive bibliometric review of the academic literature that focuses on the concept of market efficiency in the residential property market. A total of 394 relevant documents from 1967 to January 2026 were identified and analyzed from the Scopus database as the primary source of data. The methodology employs the following tools: the descriptive tool for the performance analysis is Scopus Analyzer, while the data cleaning and standardization tool is OpenRefine and the visualization tool for bibliographic coupling, co-authorship and co-citation patterns and the keywords co-occurrence is VOSviewer. The results show that there has been a steady growth of publications, particularly since the early 2000s, reflecting the academic interest in this issue due to the volatility of the housing market, the financial crisis and the increasing availability of data. The United States, the United Kingdom, and China are the most active in publications and citations. The keyword analysis shows that the themes housing price changes, informational efficiency, behavioural issues and market integration are dominant. New research topics point to spatial analysis, sophisticated econometric tools, and housing sustainability problems. Overall, this bibliometric review provides a systematic demonstration of the knowledge base, influential works, and research fronts, as well as insight into unexplored areas. This can be useful to academics, policymakers, and practitioners interested in promoting research on efficiency in residential property markets.

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Housing Market, Market Efficiency, Residential Property.



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Introduction

The Efficient Market Hypothesis (EMH) was originally suggested by Eugene Fama in 1970, who argues that asset prices are completely and immediately sensitive to all existing information. Hence, it is impossible to make consistent abnormal returns (Nunes et al., 2024; Li, 2024; Kumar & Neha, 2025; Zhu, 2024). This theory, which is highly grounded in neoclassical economic doctrine, classifies the concept of market efficiency into three types (weak, semi-strong, and strong), which are characterized by the degree of information used in prices (Nunes et al., 2024; Li, 2024). A weak-form efficient market is an area where prices are based on all historical trading data, which means that past price and volume data cannot be used to predict future prices (Nunes et al., 2024; Kumar & Neha, 2025). Semi-strong form efficiency implies that all publicly available information would imply that fundamental analysis was ineffective as well (Nunes et al., 2024; Kumar & Neha, 2025). The most stringent is the strong form, which states that prices represent all the information, both public and private, and makes insider information useless in bringing about consistent excess profits (Nunes et al., 2024; Kumar & Neha, 2025). Although the EMH has been widely researched in financial markets, the applicability of the theory in residential property markets faces distinct complexities and challenges because of the nature of real estate (Jarecki & Kucharska, 2025;

Cho & Jung, 2024). Residential property markets are heterogeneous, rarely traded, with high search and transaction costs, and illiquid, with large information asymmetries that do not adhere to the fundamental properties of rational expectations, rapid arbitrage, and continuous price adjustment specified by the EMH (Jarecki & Kucharska, 2025). These structural frictions depart from the methodology developed in liquid financial markets and require a context-dependent consideration to analyze efficiency in these housing markets. Recent studies suggest that although information aggregation and market competition via arbitrage make financial markets efficient (Mahyudin & Lamsah, 2024), spatial dependence, regulatory policies and behavior are characteristic of real estate markets (Jarecki & Kucharska, 2025; Cho & Jung, 2024), which have unique dynamics.

The market efficiency conceptual framework is not limited to conventional financial assets. Nonetheless, it provides a universal reasoning approach to explaining competition and prediction in a wide range of sectors, including real estate (Li, 2024). The residential property market is, however, special in its inefficiencies as it is a multidimensional market that is economic, institutional, sociological, spatial and behavioral (Jarecki & Kucharska, 2025). Psychological understanding of cognitive constraints and of the influence of emotions on decision-making is often problematic to traditional economic assumptions about rationality in real estate (Jarecki & Kucharska, 2025; Renigier-Biłozor et al., 2024; Devi et al., 2024). Both rational and irrational variables affect investors in the residential real estate business, with investment satisfaction mediating reinvestment intentions (Devi et al., 2024). An example is behavioral biases, which include loss aversion and focal point tendencies, which have a major impact on the housing sales price in the sense that the influence of the need to face a loss is more effective on eventual sales prices, among those with focal point tendencies in their mortgage choice (Ross & Zhou, 2024). Moreover, satisfactory solutions may be emphasized in the human mental functioning of real estate decision-making, which may encounter limited information processing capacity and knowledge due to limited knowledge (Renigier-Biłozor et al., 2024). Market sentiment and investor expectations can also play a big role in price movement, such as in weak markets where sentiment has a unidirectional effect on option pricing, especially when sentiment is elevated (Yan & Zhao, 2024). Such rational and irrational actions of the actors within the market, developers, consumers, and brokers, may result in phenomena such as overconfidence, herding behavior, and the availability bias that have a role in price swings of houses (Cho & Jung, 2024). These behavioral elements undermine the concept of a perfectly efficient market and are indicative of the need to incorporate behavioral finance theories to fully understand residential property market issues (Zhu, 2024; Datta, 2024; Arya & Singh, 2025). Notably, population decline is unpredictable in its effects on house prices, and micro-level effects do not necessarily translate into macro-level effects, reflecting the complexity added by various factors of influence (Xie et al., 2024).

Over the past few decades, economic cycles have shifted dramatically, and governments have stepped up their policy interventions in the housing market, while new technologies have changed thinking. These advances have constantly forced the efficiency of the real estate market (Ahiadu et al., 2024; Hou & Selvaratnam, 2024). Pricing errors and investor biases exposed many weaknesses during the Global Financial Crisis. They led to policy responses, including regulatory and macroprudential reforms that effectively limited risky lending activities and reduced systemic risks without adversely affecting low-income groups' access to housing (Cokayne et al., 2024). Moreover, economic policy uncertainty, such as the Global Financial Crisis, Brexit and the COVID-19 pandemic, has affected commercial property returns in all sectors through the channels of capital value-rental rate (Ahiadu et al., 2024a; Ahiadu et

al., 2024b). In other contexts, the volatility of China's real estate market has also manifested a corresponding influence on regional development and economic growth, thus explaining the closer relationship between the overall condition of the economy and real estate-linked (Hou & Selvaratnam, 2024). Moreover, monetary policy is important in the housing market through house prices and residential transaction activity. That implies that the housing market is extremely responsive to external economic changes (Fiorelli et al., 2024). Furthermore, both regulations and policies, along with market forces, have driven a greater emphasis on energy efficiency in residential real estate. This trend impacts pricing and decision-making frameworks for investment in the sector (Welikala et al., 2025; Walacik & Chmielewska, 2024). Market segmentation may be due to several factors, including the value of green buildings, such as increased house prices, reduced energy costs and associated environmental benefits (Baerroom et al., 2025). The Property Assessed Clean Energy (PACE) financing program at the local level, which aids in green home improvements, is a program that eases borrowing for households. It might also be a contributing factor to house prices in certain areas (Millar & White, 2024). Nevertheless, cities vary in the price premium they provide for energy performance due to market size and strength. This presents an issue in terms of fairness and possible equity in the green energy transition (Micelli et al., 2024). Finally, location and infrastructure accessibility still play a role in valuations of residential properties and highlight that this market is still localised and fragmented (Amsalu et al., 2024).

The empirical analysis of market efficiency in residential real estate markets is indeed complex and often provides conflicting results. This is due to the limitations of existing methods and the variety of real estate data (Y. M. et al., 2024). Most studies also utilize aggregate indices, fail to account for important within-group variance (e.g., small firms), and may conflate price increases due to quality improvements with demand increases (Soltani & Lee, 2024). For instance, studies of emerging markets have shown that most of these markets are only weakly efficient, in which prices reflect available information but not public or private information (Y. M. et al., 2024). The most obvious example is the Chinese stock market, where increasing mispricing has been reported to lead to increased property prices, implying market inefficiencies (or spillovers) (Yang et al., 2024). In addition, the efficiency of market dynamics is usually characterised by various metrics such as entropy, the Hurst measure and fractal dimension to examine patterns of randomness, memory and price fractals (Karahan et al., 2024; Mahyudin & Lamsah, 2024). This approach has been built for financial markets by explaining why market efficiency does not fully capture the non-linear behavior of the real estate market, specifically at the regional level. To overcome this, more advanced machine learning techniques have been added (Soltani & Lee, 2024). Furthermore, the link between price information efficiency and individual rationality has been closely studied, ranging from zero intelligence to Bayesian learning to different levels of rationality in market efficiency (Giachini et al., 2024). Market liquidity and volatility have been shown to influence market efficiency (Abou Tanos & Badr, 2024), including in the cryptocurrency market, where price responses to information are delayed by economic shocks such as COVID-19. Finally, more research on the efficiency of the residential real estate market would need to be undertaken more holistically. This incorporates a multi-faceted approach to information efficiency, allocative efficiency and dynamic efficiency assessed at various spatial and institutional settings (Bangura & Lee, 2024). This is vital to better understand the actual dynamics of the residential real estate market and ultimately guide policy and investment decisions (Barreto et al., 2024; Resin et al., 2024).

Literature Review

The efficiency of residential real estate markets has been a matter of long-standing debate in the literature. In this regard, earlier studies have modified financial economics models like EMH to apply them to the real estate domain by incorporating unique constraints such as information asymmetry, high transaction costs, search frictions and institutional factors that separate housing markets from corporate securities markets (Nunes et al., 2024; Kumar & Neha, 2025). However, the residential real estate market does not seem to be as efficient as financial theory suggests. For instance, the short-run house price and house return series are found with positive autocorrelation and serial dependence, which is not a random series, but rather has some element of predictability (Gatzlaff & Tirtiroglu, 2009). The evidence that markets are not completely informationally efficient is also substantiated by the fact that in the long run, returns often display mean reversion (Gatzlaff & Tirtiroglu, 2009). Further, a number of early studies have shown that the income-producing segment of the market is more efficient than the owner-occupied market. Both, however, are less efficient than the stock markets (Nunes et al., 2024; Kumar & Neha, 2025). The institutional view is that real estate markets are only efficient to a certain degree, under certain circumstances, and for certain groups of market participants. This implies that a market can be efficient for the highly informed investor, but not for the average household with limited information. Furthermore, the level of efficiency also varies with current social and economic conditions (Keogh & D'Arcy, 1999). Recent studies have emphasized that perfect information efficiency is theoretically impossible to achieve (the Grossman-Stiglitz paradox) and difficult to test empirically due to the problem of joint hypotheses. Therefore, the focus of research has shifted from assessing whether or not a market is absolutely efficient to assessing how quickly, accurately, and consistently prices adjust to new information (Broxterman et al., 2022; Maier & Herath, 2024). Finally, findings from meta-analyses suggest that the results regarding real estate market efficiency are mixed and highly context-dependent. The results are largely influenced by the type of data and research design used, rather than showing a clear trend towards increasing or decreasing efficiency (Herath & Maier, 2015; Maier & Herath, 2024). Overall, the literature suggests that residential real estate markets typically achieve only weak-form efficiency, while semi-strong-form efficiency is often not observed.

Empirical tests of the efficiency of residential real estate markets have used a variety of methods, both through time series and cross-sectional analysis, to assess whether returns are random and to what extent past information can systematically predict prices. In general, classic tests based on Fama's EMH use approaches such as autocorrelation tests, runs tests, and variance ratios to assess weak-form efficiency. The literature provides similar, mixed evidence regarding housing market efficiency: less efficient housing markets—e.g., Istanbul—display autocorrelation in the short run, indicating that past prices can predict future price movements. Meanwhile, later reactions from Canada and New Zealand may be knocking at the long-run efficiency door, viewing it more as a return to equilibrium than as a target area for buying (Gatzlaff & Tirtiroglu, 2009; Sunjo & Yilmaz, 2017; Grimes et al., 2004). In addition, studies on price discovery across asset classes have also challenged semi-strong efficiency in housing markets. For example, in the United Kingdom, residential property returns can be predicted from stock market performance up to two years in advance. This suggests that public information in the capital market is only slowly and not fully absorbed into house prices (Barkham & Geltner, 1996). Findings from meta-analyses show that conclusions about market efficiency are strongly influenced by the type of data and research methods used. In particular, studies using individual-level data or stock market data tend to support the existence of market

efficiency. In contrast, analyses based on aggregate data more often find evidence of inefficiency. Interestingly, there is no strong evidence of publication bias or long-term trend changes in these findings. As a result, it highlights the importance of study context and data granularity for concluding market efficiency (Herath & Maier, 2015). In summary, the literature synthesis suggests that although some market sub-segments and periods resemble efficiency. Most evidence in serial return predictability builds a case against the efficient housing market. Nevertheless, such predictability is not always exploitable for risk-free profit opportunities (Gatzlaff & Tirtiroglu, 2009; Maier & Herath, 2024).

Information is important in the EMH. Hence, recent studies focus on how limited or imperfect information, as well as digital tools, affect house prices. In private negotiations and less-transparent markets, for instance, research indicates that house price changes still occur when new information is disclosed after the fact, such as a natural disaster, environmental shock, or foreclosure event. Nevertheless, this is a short-term effect because of “market memory”, which is short and investors do overreact to past events (Broxterman et al., 2022). This indicates that although prices are responsive to information, short-term deviations from market efficiency may occur due to behavioral factors and a limited time Horizon. On the micro level, the advent of online Automated Valuation Models (AVMs) like Zillow’s “Zestimate” has posed new types of public information signals that have the potential to make the price discovery process better. In the United States, there is some evidence that biases in AVMs may affect the pricing decisions of the sellers. For instance, sellers with inflated Zestimates might set the asking price too high, and then cut it, causing a delay in the selling process. However, they may be able to get higher-end prices than sellers with lower estimates. Meanwhile, the overestimation pricing approach also leads to the properties being withdrawn from the market (Chung, 2022). This implies that greater information availability through AVMs can impact allocative efficiency in the short term based on the assumption that the information made available is not perfect. Moreover, the literature has been centered on the degree of energy efficiency and sustainability attribute pricing in the residential markets. A large study, based on hedonic and quantile models, in Portugal revealed a significant price premium for energy-efficient houses, estimated at 5-6% for houses and 13% for apartments. This premium does not vary with price levels and increases in periods of weak markets (Evangelista et al., 2020; Evangelista et al., 2022). In addition, scoping studies in Europe also show a positive premium for Energy Performance Certificate (EPC) ratings. It is important to note that there are country-specific differences in the magnitude and that it is influenced by neglected variable issues (Ou et al., 2025). Moreover, an Italian study that applied an evolutionary polynomial regression approach revealed that the ‘green premium’ can be more than 40% for very energy-efficient homes, proving that the capitalization of ‘green value’ is significant when the institutional support and market information are adequate (Massimo et al., 2022). There are several studies that have focused on the fact that energy efficiency perception among households is not uniform and context-specific. In Flanders, for instance, homeowners appreciate energy-efficiency measures more when they are made about their homes, while renters make their appreciation manifest in a reduction in costs. This has led to the suggestion to re-adapt the EPC label to make the information signal more effective (Gerassimenko et al., 2024).

The relationship of market efficiency with institutional context is very apparent in housing markets in emerging and developing nations. In systemically studying emerging financial markets, it is found that these economies generally exhibit only weak-form efficiency. This is because of several crucial limitations, including low transparency, weak regulation and private (insider) trading, which hinders effective incorporation of public and private information and

leads to pricing anomalies (Y. M. et al., 2024). Studies in the residential real estate sector also support this finding. For example, the housing market in Istanbul exhibits non-random price behavior, which is inconsistent with the concept of weak-form efficiency. At the same time, the literature emphasizes that most empirical studies on real estate market efficiency remain focused on advanced economies. Thus, there is a significant knowledge gap in understanding markets in developing and transition economies (Sunjo & Yilmaz, 2017). The institutional analysis approach suggests that real estate markets should not be interpreted as a frictionless exchange process but rather as a set of processes within a legal, regulatory and professional framework (Keogh & D'Arcy, 1999). In this view, efficiency is not a constant and even varies between distinct market actors. For instance, institutional investors, with access to more information, tend to be more efficient than households that rely on brokers, rules of thumb, and/or limited information. Additionally, market efficiency is an evolving system as institutions change. For example, energy efficiency studies in emerging markets (Chile and Latvia) have demonstrated that willingness to pay for energy-efficiency features is influenced by information, regulation, income, and education. Overall, this means that housing market efficiency is determined by prices, information, and regulation (Encinas et al., 2018; Welikala et al., 2025). Implementing better data systems, disclosure mechanisms (in the form of EPCs), and practices by real estate professionals can mitigate misalignment between information availability and price signals from actors in housing markets as well as reduce behavioral biases (Ou et al., 2025; Walacik & Chmielewska, 2024); Jalas & Rinkinen, 2020). In real life, perfect market efficiency is impossible due to high transaction costs, property homogenization, limited rationality and institution complexity. This has led to the broader view that residential markets are at best partially efficient, and that there is always room for improvement in both information and resource allocation through various policy and technological interventions, but also some inevitable frictions in these markets.

Research Question

RQ1: How has the development of scholarly publication output related to market efficiency in the residential real estate market changed from 1967 to January 2026?

RQ2: Which publications are the most influential in the field of market efficiency in the residential real estate market, based on citation impact?

RQ3: Which countries are the main contributors to market efficiency research in the residential real estate market in terms of publication volume and citation performance?

RQ4: What are the main themes in the literature on market efficiency in the residential real estate market, as well as new themes that can be identified through author keyword analysis?

RQ5: What is the pattern of international research collaboration in the field of market efficiency in the field of market efficiency in the residential real estate market, based on author collaboration networks at the country level?

Methodology

Bibliometric analysis refers to the process of collecting, organizing, and systematically examining bibliographic data obtained from scholarly publications (Verbeek et al., 2002; Assyakur & Rosa, 2022; Alves et al., 2021). In addition to basic descriptive metrics such as publication sources, publication trends over time, and influential authors (Wu & Wu, 2017), bibliometric studies now also use more advanced analytical techniques. For example, citation analysis with documents is used to identify and understand the intellectual structure of a field of research in more depth. In addition, systematic literature reviews are iterative and based on

a clear methodology. This process includes selecting appropriate keywords, conducting extensive database searches, and performing intensive analyses. Literature search was carried out in the Scopus database using a search string with a predefined combination of keywords pertaining to the efficiency of the residential property market. These search terms encompassed the words “housing”, “residential”, “property”, “real estate” with “market”, “economy”, “trade”, “sales”, and “transactions” and with “efficiency”, “effectiveness”, “performance”, “optimization”, and “productivity”. The search was also used to narrow down the results by combining related concepts with Boolean operators such as AND and OR. The entire search string is shown in Table 1. The search was limited to articles published in English within the Scopus database to improve consistency and ensure relevance. This way, a good bibliometric background will be developed, and greater research rigor and replicability will be achieved (Fahimnia et al., 2015). Thus, attention in this study is paid to the high-impact publications as they provide useful information on the theoretical and conceptual underpinnings of a research stream. Scopus Elsevier database was chosen due to the fact that it is the primary source of data as described in the literature (Di Stefano et al., 2010; Khiste & Paithankar, 2017; Al-Khoury et al., 2022) for a rich data set that focuses on data accuracy, consistency and coverage. As per research guidelines, only peer-reviewed journal articles are used in this study and books and lecture notes are excluded to assure a high level of confidence (Gu et al., 2019). Last but not least, based on the highly developed indexing capabilities, all relevant publications from 1967 to January 2026 have been systematically gathered to analyse them for the purposes of science mapping and bibliometric analyses.

Data Search Strategy

The present study is a bibliometric one, based on systematic, transparent data collection procedures to investigate scholarly work on market efficiency in the residential real estate market. An advanced search strategy was applied by restricting the search to publications indexed under the article title field, which resulted in data being accurate and relevant. Next, the search string was developed based on three main conceptual components. Firstly, the words housing, dwelling, real estate, and property are related to housing. Secondly, the terms “market,” “economy,” “trade,” “sales” and “transaction,” as they relate to the market. Thirdly, constructs related to efficiency, such as efficiency, effectiveness, performance, optimization, and productivity, were also used in this study. In order to identify studies that directly relate to the efficiency aspects of the residential real estate market, and to minimize the number of studies that include conceptually irrelevant literature, the following combination of terms was used. In addition, the search was restricted to English-language documents and only peer-reviewed journal articles were included to ensure the quality and consistency of the data. For this reason, conference papers, books, and lecture notes were not included to ensure a higher level of academic rigor. This restriction is consistent with best practice in bibliometric studies, which can lead to more reliable, comparable and high-quality data sets analyzed. This structured search resulted in 394 relevant publications being identified for further analysis.

The 394 articles that were finally included in the data set were judged to be methodologically sound and suitable for the purpose of the study, as the scope of each article was clear. The use of strict inclusion criteria, including only relevant publications in the analysis, ensured that only relevant articles were selected. In the case of bibliometric analysis, the amount of data analysed was a critical factor in determining the quality of the analysis and factors such as relevance, coherence and topic play more critical roles in the creation of knowledge maps. Hence, by focusing on article titles, this study was based on articles that specifically centred

around the concept of market efficiency. This process helped improve construct validity and avoid “noise” or irrelevant information. Moreover, the language and source type filters helped exclude publications that were not peer-reviewed journal articles, thus enhancing the trustworthiness of the study. However, 394 articles were reasonable for conducting further bibliometric analyses such as performance analysis, co-author mapping, co-citation analysis and keyword analysis. These methods generally need 200-500 documents to generate a stable network. Note that the sample covers a long period of time – decades. By doing so, this study can track trends in publication, identify major players, and trace research thinking and interest in the residential real estate market efficiency literature. To summarise, this collection of 394 articles is a representative, sufficiently large, and narrowed down sample which reflects the primary patterns, clusters and trends of research development that underpin the academic conversation about the efficiency of the residential real estate market.

Table 1: The Search String.

Scopus	TITLE (((("housing" OR "residential" OR "property" OR "real estate") AND ("market" OR "economy" OR "trade" OR "sales" OR "transactions") AND ("efficiency" OR "effectiveness" OR "performance" OR "optimization" OR "productivity")))) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j"))
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Source: Scopus database.

Table 2: The Selection Criteria for Searching.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Source type	Journal	Proceedings, Book, Chapter, Review

Source: Scopus database.

Data Analysis

VOSviewer is a widely used bibliometric analysis and visualisation software (Van Eck & Waltman, 2017; Van Eck & Waltman, 2010) created by Nees Jan van Eck and Ludo Waltman from the Centre for Science and Technology Studies (CWTS) at Leiden University, The Netherlands. The program supports in-depth analyses and provides tailored support for literature mapping, including techniques that enable network visualizations, entity clustering, and the visualization of scientific structures using density maps. This flexibility enables the analysis of different bibliometric relationships, such as co-author, co-citation, and keyword co-occurrence networks, allowing for a comprehensive analysis of the intellectual structure of a specific field of research. Through its interactive user interface and continuous software development, the VOSviewer program provides effective, dynamic data exploration of large bibliometric datasets. This valuable analysis tool for academic research can calculate bibliometric indicators, personalize output, and import data from a range of sources.

One of the key features of VOSviewer is its ability to transform data into meaningful, easy-to-understand visual maps. This tool can be used to conduct network-based analyses such as keyword co-occurrence, clustering items in a network, and density visualization of research.

The software was designed to be user-friendly, easy to interpret, and to help researchers perform a systematic search for research themes and concentrations. Continual enhancements keep VOSviewer in line with new developments in bibliometric visualization and provide a variety of analysis features for different kinds of data, such as author networks, citation networks, and keyword networks. The bibliographic information from publications—including year of publication, article title, author information, the journal where the article was published, and the number of citations it received by each journal—was downloaded from Scopus as an Excel (CSV) spreadsheet between January 1967 and January 2026, and authors' keywords were also obtained. VOSviewer version 1.6 20 is used to analyze all data. By applying Visualization of Similarities (VOS) mapping and clustering techniques, the software facilitated the construction and systematic examination of bibliometric networks. Unlike conventional Multidimensional Scaling (MDS), VOSviewer positions items in a low-dimensional space such that the distance between any two items reflects their degree of relatedness (Van Eck & Waltman, 2010). Although conceptually related to MDS (Appio et al., 2014), the VOS approach employs normalization methods specifically optimized for co-occurrence data, including the association strength (AS_{ij}), calculated as follows (Van Eck & Waltman, 2007).

$$AS_{ij} = \frac{C_{ij}}{w_i w_j},$$

which is proportional to the ratio between the observed frequency of co-occurrence of items i and j and the expected frequency of their co-occurrence under the assumption of statistical independence” (Van Eck & Waltman, 2007).

Result and Discussion

RQ1: How Has The Development Of Scholarly Publication Output Related To Market Efficiency In The Residential Real Estate Market Changed From 1967 To January 2026?

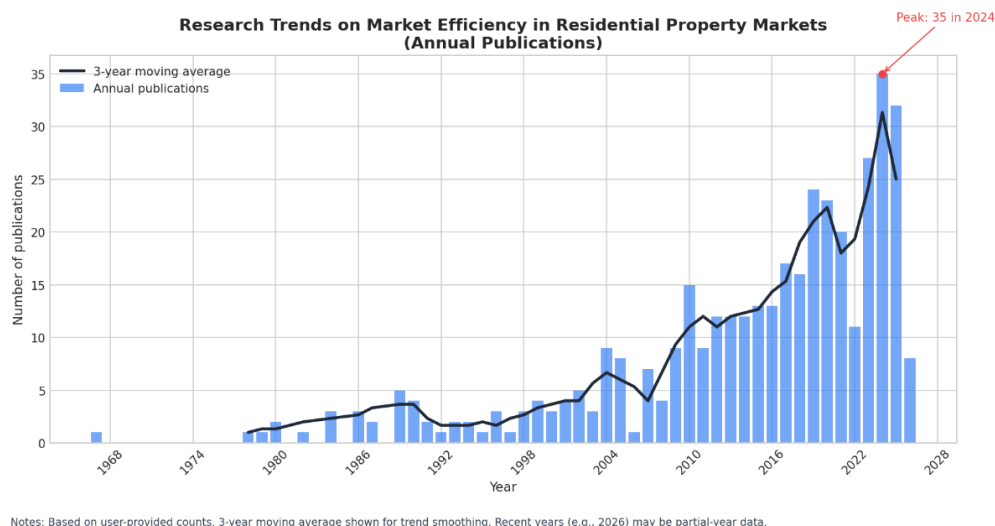


Figure 1: Trend of Research on Market Efficiency in Residential Property Markets by Years.

Source: Scopus database.

**Table 3: Trend of Research on Market Efficiency in Residential Property Markets
Impact by Years.**

Year	Number of Publications	Percentage (%)	Year	Number of Publications	Percentage (%)
2026	8	2.03	2003	3	0.76
2025	32	8.12	2002	5	1.27
2024	35	8.88	2001	4	1.02
2023	27	6.85	2000	3	0.76
2022	11	2.79	1999	4	1.02
2021	20	5.08	1998	3	0.76
2020	23	5.84	1997	1	0.25
2019	24	6.09	1996	3	0.76
2018	16	4.06	1995	1	0.25
2017	17	4.31	1994	2	0.51
2016	13	3.30	1993	2	0.51
2015	13	3.30	1992	1	0.25
2014	12	3.05	1991	2	0.51
2013	12	3.05	1990	4	1.02
2012	12	3.05	1989	5	1.27
2011	9	2.28	1987	2	0.51
2010	15	3.81	1986	3	0.76
2009	9	2.28	1984	3	0.76
2008	4	1.02	1982	1	0.25
2007	7	1.78	1980	2	0.51
2006	1	0.25	1979	1	0.25
2005	8	2.03	1978	1	0.25
2004	9	2.28	1967	1	0.25

Source: Scopus database.

Figure 1 and Table 3 demonstrate clear longitudinal publication trends from 1967 through to what we predict for a burst of scholarly interest in our special issue (to appear later in 2026), suggesting that the applied use of theory reflects both theoretical evolution and changing economic climates over time. In the first stage (1967-1999), publication numbers were low and fluctuating, mostly less than five papers per year and each year's share was less than 1.5% of total publications. This indicates that market efficiency was not yet a specific or main research stream. Rather, residential property studies (during this period) were more focused on valuation methods, housing supply and demand and "the institutional framework for the analysis of residential property" (Ball, 1975). Partly, this low level of empirical activity can be explained by data challenges and limited computational tools. Nonetheless, it could also be due to the real estate field's evolving understanding of market efficiency, as reflected in tests of the EMH mostly on financial markets. Since the 2000s, there has been a gradual but noticeable increase in awareness of housing markets as information-sensitive, complex systems. This occurs during a time when housing market transactions are more accessible and econometric techniques more advanced (Shang et al., 2021), with an increased recognition of price dynamics, predictability and volatility, key characteristics of market efficiency in housing research.

There is a clear surge in output after 2010, particularly after 2019, with the highest values in 2024 (8.88%) and 2025 (8.12%). Critically, more than 50% of the publications are from 2018 to 2026, which speaks to recent research and the impetus for this research. This can be attributed to global housing market volatility following the Global Financial Crisis, the COVID-19 pandemic, and subsequent post-pandemic adjustments, which have increased attention to housing market efficiency, robustness, spillovers effects and information transmission. The upward trend in publications also reflects a general methodological shift toward using cutting-edge time-series modelling, spatial econometrics, and bibliometric-inspired methods to analyse efficiency in a variety of housing submarkets. The 2026 percentage (2.03%) may be relatively low when compared to previous years, but this is probably just a natural progression of the data available and is not a complete cycle, as it is limited to publications up to early 2026. Overall, the trend is evident: at the regional/metropolitan level, the concept of market efficiency is becoming increasingly important, and is moving from a sideline issue to a major and increasingly popular research interest, a development reinforced by the global economic crisis, availability of data and increasing policy relevance.

This can be attributed to global housing market volatility following the Global Financial Crisis, the COVID-19 pandemic, and subsequent post-pandemic adjustments, which have increased attention to housing market efficiency, robustness, spillovers effects and information transmission.

RQ2: Which Publications Are The Most Influential In The Field Of Market Efficiency In The Residential Real Estate Market, Based On Citation Impact?

Empirical methods, cross-asset analytical frameworks, and core economic theory are fundamental in shaping research on the market efficiency of residential and real estate markets, as evidenced by the top 10 most cited articles. They are the most cited paper of Hamed Al-Yahyaee et al. (2018) (In principle, they are bitcoin-based but with by far the most powerful testing engines, such as multifractality, long-memory, etc., to validate the setup of real estate or housing markets). The growing number of citations indicates that the researchers of property markets have come to draw on methods from financial economics in order to overcome these inefficiencies in illiquid and heterogeneous markets. Influential papers published in leading economics and insurance journals, like papers by Benjamin and Brandt (2002) and Choi and Weiss (2005), highlighted a number of institutional arrangements, property rights and market organisation as the key factors impacting efficiency. These studies are still cited as empirical evidence for a theoretical basis for the apparent lack of responsiveness of residential property markets to changes in demand, which is expected to give rise to significant institutional inertia and regulatory intervention that prevent prices from fully accommodating rapidly changing demand. Finally, seminal works on urban and regional studies by Keogh and D'Arcy (1999) as well as Capozza & Seguin (1996) have contributed to our understanding of why we might expect inefficiencies in property markets—revolving around cyclical euphoria, expectations, information asymmetry, etc. — issues that remain a common theme within current housing research.

At the same time, the relative increase in citations of studies on energy efficiency and market performance indicates a more applied, policy-relevant interpretation of housing market efficiency. The popularity of hedonic pricing studies with many citations, such as De Ayala et al. (2016), indicates the level of awareness and regulatory pressure on environmental issues, as highlighted by household data showing willingness to pay for energy-efficient housing

attributes. Fisher et al. (2007) emphasized the advantage of transaction-based indices for empirical assessments of efficiency in largely illiquid and non-transparent real estate markets. Early theoretical work, including Dubey et al. (1980), remains applicable in various market settings due to their axiomatic representation of efficiency, which informs subsequent empirical research. Importantly, the work of Min et al. (2016), published in an energy materials journal, further corroborates the interdisciplinary diffusion of the efficiency concept and suggests that methodological and conceptual spillovers from science and engineering now play a greater role in informing housing- and property-market analysis. In general, the citation patterns show that the most impactful studies provide transferable theory, rigorous empirical techniques, and major policy significance, rather than being strictly limited to residential property markets.

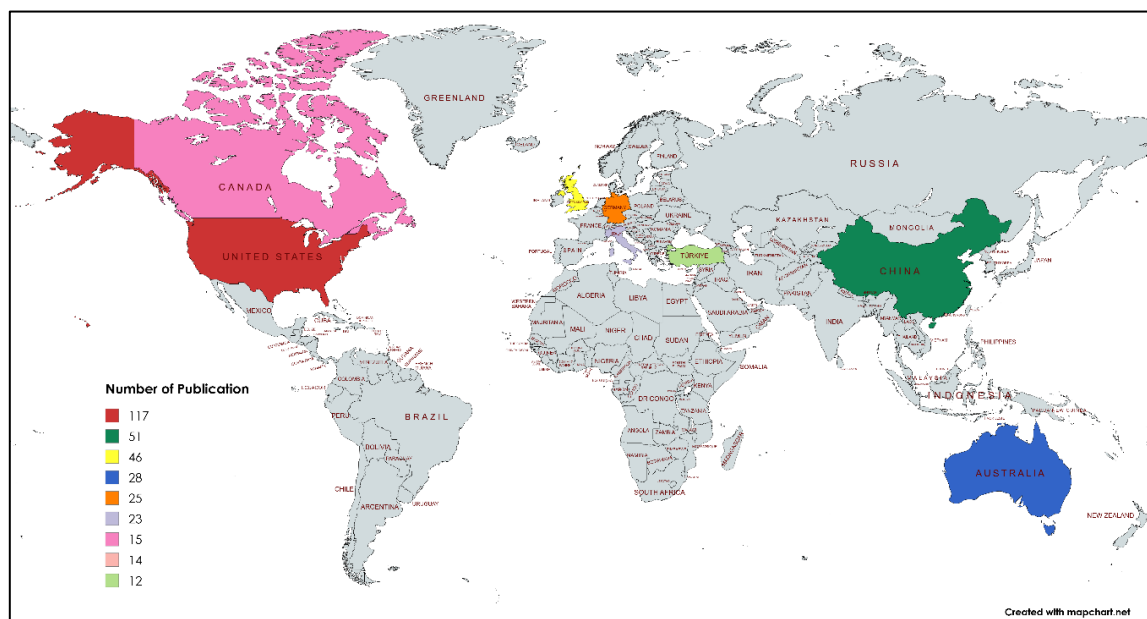
Table 4: Most Cited Authors Driving Research Trends in Market Efficiency in Residential Property Markets.

No	Authors	Title	Year	Source title	Cited by
1	Hamed Al-Yahyaee et al.	Efficiency, multifractality, and the long-memory property of the Bitcoin market: A comparative analysis with stock, currency, and gold markets	2018	Finance Research Letters	230
2	Benjamin and Brandt	Property rights, labour markets, and efficiency in a transition economy: The case of rural China	2002	Canadian Journal of Economics	156
3	Choi and Weiss	An empirical investigation of market structure, efficiency, and performance in property-liability insurance	2005	Journal of Risk and Insurance	132
4	De Ayala et al.	The price of energy efficiency in the Spanish housing market	2016	Energy Policy	102
5	Keogh & D'Arcy	Property market efficiency: An institutional economics perspective	1999	Urban Studies	99
6	Fisher, J. et al.	A quarterly transactions-based index of institutional real estate investment performance and movements in supply and demand	2007	Journal of Real Estate Finance and Economics	93
7	Dinan and Miranowski	Estimating the implicit price of energy efficiency improvements in the residential housing market: A hedonic approach	1989	Journal of Urban Economics	90
8	Dubey et al.	Efficiency properties of strategies market games: An axiomatic approach	1980	Journal of Economic Theory	85
9	Capozza and Seguin	Expectations, efficiency, and euphoria in the housing market	1996	Regional Science and Urban Economics	81
10	Min, J. et al.	Side-Chain Engineering for Enhancing the Properties of Small Molecule Solar Cells: A Trade-off Beyond Efficiency	2016	Advanced Energy Materials	78

Source: Scopus database.

RQ3: Which Countries Are The Main Contributors To Market Efficiency Research In The Residential Real Estate Market In Terms Of Publication Volume And Citation Performance?

The dominance of the United States, with 117 publications (23.45%), reflects this country's highly developed ecosystem for real estate research, facilitated by abundant, well-standardized housing and transaction data from universities and by extensive academic experience combined with financial markets and policy institutions. Article continues after advertisement. The United States (US) housing market has been a proving ground for applying theories of market efficiency over the last few decades. It has sustained academic interest, given the capital flows following major events such as housing booms, busts, and ensuing financial crises. Relatedly, China ranks second with 51 publications (10.22%), due to rapid urbanization megatrends, large-scale housing market reforms, and structural inefficiencies stemming from traditional transition and emerging-market economic dynamics. Its traits also seem to create an ideal empirical context in terms of price discovery, information asymmetries, and institutional frictions, thus explaining its high publication record. This focus is complemented by the United Kingdom (9.22%) and Australia (5.61%), which have more advanced and market-oriented housing systems with clear available data and an active property investment market that allows for empirical evaluation of housing system efficiency. European countries with national institutional housing systems, such as Germany (5.01%) and Italy (4.61%), are countries that have given regular contributions to allow for comparing the price dynamics in regulated and liberalized trade markets. Less significant, but nevertheless of interest, are the contributions from Canada, Hong Kong and Turkey, where attention was focused on distinct market attributes, including high financialization of urban housing markets, and rapid development and policy-sensitivity. Overall, the findings indicate that nations with dynamic and large data-rich housing markets and excellent academic research infrastructures will be more inclined to lead the way in research on the efficiency of residential property markets, whereas the emerging and transitional economies will increasingly be represented for their policy relevance and structural complexity.

**Figure 2: Top 10 Countries Based on the Number of Publications.**

Source: Scopus database.

RQ4: What Are The Main Themes In The Literature On Market Efficiency In The Residential Real Estate Market, As Well As New Themes That Can Be Identified Through Author Keyword Analysis?

Co-occurrence analysis of author keywords in VOSviewer is a bibliometric technique that examines the frequency of co-occurrence of the author keywords in the study, and thus forms the conceptual framework and thematic relationships within the research field. Now each keyword represents a node in the network and links between the nodes show that two keywords co-occur in one or more documents. The strength of these links will depend on how often these “key words” are found together, and will be interpreted as a proxy for the semantics or relative similarity of concepts in literature. VOSviewer locates words in a low-dimensional space using the VOS mapping technique. Hence, keywords with strong associations are relatively close together, while others are less closely related. Bigger node sizes indicate higher keyword frequencies, and bolder links indicate stronger co-occurrence relationships. The VOS mapping technique used in VOSviewer positions keywords in a low-dimensional space. Thus, strongly related keywords are located close to one another and less relevant keywords are positioned further away. Larger node sizes represent a higher frequency of the keyword, while thicker links indicate a stronger co-occurrence relationship. Such visual and quantitative representations take researchers beyond counting occurrences of specific phrases and help uncover themes that dominate certain areas or signal emerging topics or patterns in a field of research, as defined by how authors frame their projects through keyword choice.

The map was generated using the full-counting method, which counts each occurrence of a keyword in a document equally, regardless of how many other keywords appeared in that paper. At this stage, topics are no longer assigned fractions, which would dilute the weights of each topic. Therefore, each is required to make a totally important and visible contribution to the literature. This was set with a minimum threshold of five occurrences, both to avoid the noise introduced by keywords that were rarely used or had idiosyncratic use, and to visualize only those concepts that had a meaningful presence within the corpus. Out of 1,042 unique author keywords identified in the dataset, only 27 are above this threshold — providing evidence of a relatively small core of recurring ideas. Setting the minimum cluster size to one also meant that even small or niche thematic groupings could emerge without being forced into larger clusters. The clusters were generated based on these parameters. Therefore, the words in each number cluster co-occur more often with one another and less often with other keywords.

This structure extends the knowledge base using empirical evidence to show how interdependent yet separable emerging research themes construct research around the themes of real estate, housing, and energy. The frequency of the terms ‘energy efficiency’, “housing market”, “real estate”, and “energy performance certificate”, as well as the high stability of their occurrences, indicates that there is a significant academic community focusing on energy issues in the property sector. On the other hand, other clusters that link concepts like market efficiency, information asymmetry, transaction costs and hedonic pricing reflect the still prevailing economic and valuation lines of research, whereas the geographically referenced keywords “United Kingdom”, “Hong Kong”, and “China” suggest more empirically-focused research streams. Overall, the results offer a conceptual map of the intellectual landscape, define the relationships between different research themes, and identify dominant research pathways and gaps for future research and theory building in the domain.

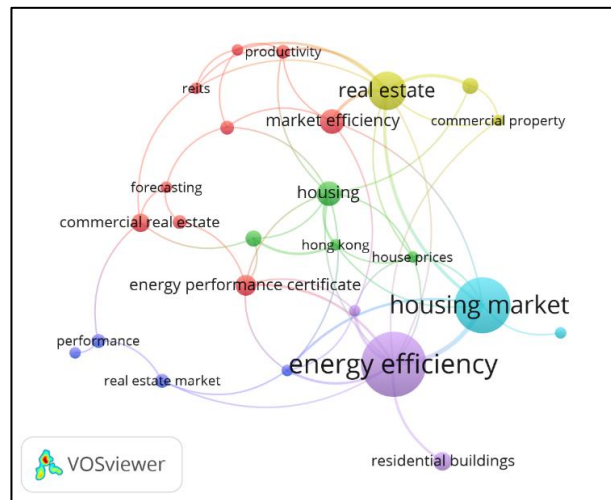


Figure 3: Network Visualization Map Of Keywords' Co-Occurrence.

Source: Scopus database.

RQ5: What Is The Pattern Of International Research Collaboration In The Field Of Market Efficiency In The Field Of Market Efficiency In The Residential Real Estate Market, Based On Author Collaboration Networks At The Country Level?

The co-authorship-by-country analysis in VOSviewer is a bibliometric method for analysing international research collaboration patterns by studying how authors from different countries co-author scientific publications. In this analysis, each country is represented as a node, and when two countries have formed a link, at least one publication has been co-authored by researchers affiliated with institutions in these countries. The intensity of collaboration is represented by the total link strength, defined in VOSviewer as the sum of weights for each authored document, where weight is determined by the number of papers co-authored by both authors and affiliations. In the network, larger node sizes indicate higher research output in the dataset, while nearby countries show strong collaboration. Using VOS mapping, VOSviewer spatially arranges nations by highlighting strong collaborative relations, enabling researchers to identify major entities, marginal contributors, and clusters of closely interacting countries. Theoretically, this analysis shifts the lens of productivity from an individual level to a collective perspective on global knowledge production, demonstrating how research is constituted through cross-national collaborations and regional networks, and how it varies with power distributions held across nations.

The map was created using the full counting method, which treats each document's co-authors as fully contributing to all involved countries rather than being divided fractionally. This setting focuses on the national representation and participation in international studies, identifying leading contributors to the discipline. To reduce the number of countries in which only a few documents had been published, a minimum threshold of five documents was applied, resulting in 21 of these countries meeting that criterion from the overall 61 countries. This was conducted to ensure that only countries with sustained levels of participation would be included in the visualization. The minimum cluster size of one was specified in the clustering parameters to allow relatively isolated countries or smaller collaboration groups to constitute their own cluster, rather than being absorbed into larger ones. With these parameters, a total of five clusters were extracted, all of which consist of groups of countries that cooperate more with

countries within the cluster than with those outside it. The findings contribute to the body of knowledge by clearly demonstrating the structured, interconnected patterns of international research collaboration in this field. The US is a leading hub in this field with the largest number of publications, citations, and collaborations. In contrast, the United Kingdom serves an important bridging function by linking other research communities within it. Meanwhile, China, Australia and Germany are also important primary second-tier contributors, supported by strong research bases and increasing international collaboration, but with much lower overall impact than the leading hubs. In contrast, smaller or emerging contributors such as Malaysia, Nigeria, and India seem more peripheral, with weak link strength across the network, making evident global imbalances in integration into research. Overall, this analysis enhances understanding of how knowledge is produced through international collaborations in the field, identifies both dominant and emerging contributors, and highlights cross-country partnerships as potential avenues for greater visibility, impact, and diffusion.

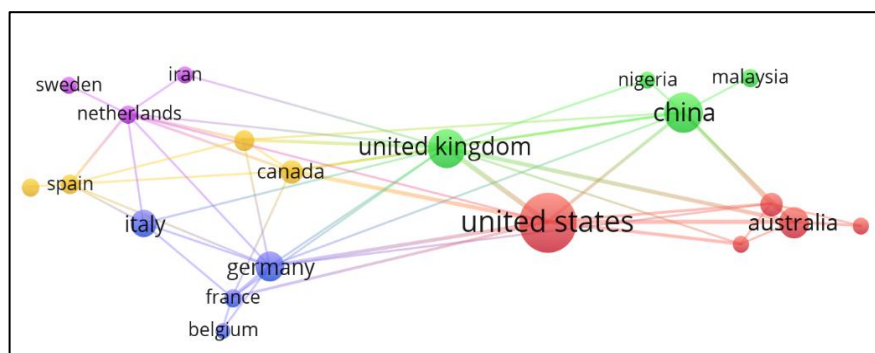


Figure 4: Co-authorship by Countries Collaboration.

Source: Scopus Database.

Conclusion

This bibliometric analysis aimed to identify and synthesise the structure, evolution and collaboration patterns of research on market efficiency in residential property markets, driven by five questions regarding publishing dynamics, significant publications, national contributions, thematic foci, and international co-authorship. The analysis was based on a Scopus dataset of 394 English-language journal articles from 1967 to January 2026, normalized using OpenRefine to create standard records that were profiled with respect to descriptive indicators (Scopus Analyzer) and the co-occurrence, co-authorship and related network measures used in science-mapping (the latter done in VOSviewer). The objectives and questions included: How did output change over a period of decades? Which research studies helped support the arguments in the text by being cited? Which countries helped increase visibility and reach? Which themes could be identified from the author's keywords that dominated, emerged, or were absent from the study, and how boundaries were enacted around this topic?

The analysis shows a long trough in publishing activity, followed by solid growth since the mid-2000s, with a heavy concentration of publishing activity in the past few years, reflecting high levels of interest in efficiency, information frictions, and the pricing process in the housing-market system. The results indicate that influential contributions are concentrated around good empirical approaches and policy-relevant topics, and around country performance as well as in the United States, which is best in both the number of publications and citations.

But the United Kingdom is also a critical player in this sector, and China and Australia are second-tier countries with well-established research systems. Co-occurrence analysis of the keyword offers a glimpse into pillars of literature, including housing price dynamics, information efficiency, valuation methods in real estate and energy-related housing characteristics. The second cluster is newer, and highlights the embeddedness of spatial analytics in sustainability, indicating that the discipline's scope and significance are slowly but surely growing. At the country level, the co-authorship patterns are more "hub-and-spoke," with some countries that have been long-standing contributors to knowledge production at the hub and newer countries at the periphery. This trend looks all the more indicative of persistent unevenness in participation amongst countries. Overall, the evolution of the field in terms of its scope and coverage, as well as in terms of the methodologies used, and the thematic areas it covers, shows that it is an expanding, heterogeneous field, both in its scope and in its methodology. However, there are large geographical variations in the level of research influence, visibility, and research collaboration intensity.

This study offers a new overview of the literature, identifying the areas of greatest concentration of evidence, areas of intersection for ideas and methods, and areas of persistent gaps. It highlights specifically underrepresented geographical areas and accentuates the importance of additional micro-level, data-based studies, which can capture property market heterogeneity well. The results also provide helpful recommendations, not only for public officials but for industry actors as well, at an operational level. These can include better data infrastructures, more transparent disclosure of property characteristics (including performance characteristics), and better knowledge sharing between countries and regions, which could lead to faster price discovery and better benchmarking opportunities in local market contexts. The limitations are the use of one index (Scopus), which may not cover publications in other languages, and the exclusion of relevant publications that may not be of great importance as far as efficiency is concerned. Future studies should consider adding science mapping to causal identification or quasi-experimental studies to explore efficiency changes over time as a result of institutional reforms and/or data innovations, with a design that is resource-efficient and triangulates across databases to add full-text mining. The overall findings underscore the potential of bibliometric analysis to explore the evolution of themes, influence and collaboration networks in the study of efficiency in the residential property market. Transparency in science mapping can assist in evidence-based policy-making, urban planning, housing authority planning, and future research planning by policy makers, urban planners, housing authorities, and funding agencies by highlighting research gaps, priorities for future research directions, and improving the allocation of resources.

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- Author Contribution Statement:** This manuscript has been developed through the efforts of all the authors. The study was conceptualized, methodologically designed and supervised by Masitah binti Zulkepli. Noor Azzinudin Ahmad and Mohd Shahril Abdul Rahman conducted data collection, analysis and interpretation of the obtained data. Wu Ziou Hon, Siti Zaleha Daud were involved in the literature review, manuscript drafting and manuscript critical revision. Additional support was given to the manuscript by the rest of the authors (Noor Fatihah Mazlam, Zainab Toyib Jagun and Idatul Farita Mohamad Toha) for data validation, critical review and manuscript refinement. None of the authors has attempted to manipulate data to get the results they desired. The authors have not fabricated data to support their findings.
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