

Applications of Housing Affordability Measurement Approaches Used in Planning Affordable Housing: A Systematic Review

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How to cite this paper: Ezennia, I.S. and Hoskara, S.O. (2022) Applications of Housing Affordability Measurement Approaches Used in Planning Affordable Housing: A Systematic Review. *Journal of Building Construction and Planning Research*, 10, 1-36.
<https://doi.org/10.4236/jbcpr.2022.101001>

Received: July 21, 2021

Accepted: March 27, 2022

Published: March 30, 2022

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Abstract

Housing affordability measurement is a recurring subject in planning literature. Research evidence suggests that in planning for affordable housing, planners typically apply the normative (ratio and residual income) measures to all variants of affordability stress. Hence, proffering intervention strategies that often fail to address peculiar situations in their towns. This systematic review synthesizes empirical evidence in the literature relating to various applications of housing affordability measurement approaches. To ascertain the various application fields/domains, present findings, specify relevant literature gaps, and propose future research themes. The review findings demonstrate that the accurateness of conclusions reached, about the severity of the housing affordability problem is highly dependent on the measurement approach used. The study concludes that the application of appropriate methods to specific situations leads to better planning outcomes.

Keywords

Planning Affordable Housing, Housing Affordability, Planning Outcome

1. Introduction

Measuring housing affordability has become a vital area in planning education and research. Towards making adequate planning guidance for proper and focused affordable housing interventions, which is an essential step in housing policy response for low-medium-income families. As a subject area, housing affordability measurement has a relatively long history, from the 1970s through the 1990s when the foundations of modern measures were laid (see Hancock [1];

Stone [2]; Hulchanski [3]). In planning affordable housing, planners typically base their intervention strategies on empirical evidence predicated upon normative affordability standards (see, Adegoke & Agbola, [4]). However, these normative standards have been shown to superficially measure some variants of housing affordability stress [5] [6]. Several approaches for measuring different variants of housing affordability stress have been suggested by researchers of diverse orientations. However, the key methodological challenge that has occupied researchers and planners for decades is the question of how to appropriately measure housing affordability; which is yet unresolved. Each approach as suggested is unique, but conceptually very similar since they are fundamentally formulated on household income and its relationship with housing price levels. However, small differences (such as the inclusion of certain criteria like transportation cost, and location efficiency, among others) make each class more appropriate for different applications. In recent years, academic research on housing affordability measurement (HAM) approaches increased extensively and has seen an incredible amount of use. More so, their role in diverse application areas has grown considerably, particularly as new methods are proposed or developed, and older ones improved.

Despite this intensive development worldwide, no study has performed a systematic literature survey on the various applications of housing affordability measurement approaches. This assertion is concretized by a recent study that revealed the lack of rigorous systematic reviews in the planning field [7]. Thus, this review attempts to fill this literature gap and aims to systematically review the applications of various approaches used in the measurement of housing affordability; as put forward by researchers and scholars for planning purposes, with context-specificity to low- and medium-income groups. To be clear, this article is neither a review of the concept nor trends of housing affordability, which have been attempted e.g. Haffner & Hulse [8]; Ezennia & Hoskara [9]. The purpose of this study is to show, through systematic literature analysis, how HAM approaches have been applied in the various housing affordability analysis over an 18-year period.

In this regard, six major online databases (ScienceDirect, Wiley Online Library, Sage Journals, Emerald Insight, Taylor & Francis Online, and Springer) were selected, and the PRISMA methodology was proposed based on Moher *et al.* [10]. Therefore, a review of 160 scholarly articles published in 47 academic journals indexed in the Web of Science Core Collection between 2000 and 2018 was collected to achieve an extensive review of HAM approaches and their applications. Relying on experts' knowledge-based opinions, articles were classified based on the type of study (HAM utilizing study, HAM developing study, and HAM proposing study). Furthermore, six (6) application fields/domains namely, rental housing affordability (RHA), home-ownership affordability (HOA), combined housing and transportation affordability (CHTA), housing and mortgage market affordability (HMMA), and individual household affordability (IHA)

were identified with expert knowledge-based categorization; based on which, a database of common applications of various HAM approaches for different and specific situations were established.

The study argues that the informed application of appropriate affordability measures in the specific context of affordability problems leads to better planning outcomes. However, the methodological framework and choices for evaluating decisions are still ongoing. This study narrates the situation with a review of HAM approaches and their applications based on the main research question: How have the different HAM methodologies/techniques been applied in planning affordable housing, over the last few decades? From this, the following three sub-questions emerge: 1) What type of research has been performed regarding these HAM approaches? 2) Which of the 6 application domains/fields (rental housing affordability and others) have employed HAM approaches more? 3) What types of HAM approaches were used over an 18-year period based on 6 domains/fields?

The answers to these sub-questions will present sound evidence on the relations between various applications and diverse measures of HAM, as well as the suitability of each approach to the specific application. This will permit a clear explanation of various applications of HAM approaches. The rest of this study is structured; accordingly, the second section explains the study methodology and research protocol. The third section deals systematically with review results in accordance with the research questions and objectives. Forth section deals with study findings and research contribution, while the fifth section deals with the research agenda for future studies. Finally, the sixth section presents the research contribution, and the last section presents the conclusion and study recommendations.

2. Research Methodology

This study was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist as reference methodology [10]. PRISMA consists of systematic reviews and meta-analyses. A systematic review describes a review of well-thought-out questions that employ explicit and systematic methods [11]. Meta-analysis describes the application of statistical techniques in a systematic review to blend the results of selected articles [10]. PRISMA checklist guides researchers to conduct transparent reporting of a literature review [12]. According to De Bruijn and Gerrits [13], systematic reviews of scholarly publications reports are imperative for acquiring a deeper understanding of a concept, its approaches, and applications. A systematic quantitative research method allows researchers to comprehensively identify what is known and not known on a subject, establish and understand the inconsistencies among research findings, and help ascertain whether findings can be applied to specific situations [10] [11] [14]. This systematic review is quantitative because it quantifies a wide collection of research related to the subject and reveals the gaps in the

research. This methodology has seen wide applications in diverse research areas such as housing and health-related studies [12]; housing research [15]; and urban planning studies [13]. Therefore, to undertake a PRISMA methodology in this research, three key protocols must be completed. These protocols comprise literature search, eligible papers selections, and extraction and summarizing of data.

2.1. Literature Search

Six (6) electronic databases were selected in this stage, to provide an extensive application of HAM approaches. These databases include Science Direct, Wiley Online Library, Sage Journals, Emerald Insight, Taylor & Francis, and Springer. Journal article publications by these six databases are perceived to be reliable and worthy of comment. The search for relevant literature was conducted in accordance with the following descriptors: “Housing affordability measurement methods and application” as well as their combinations. Because research on the HAM approach is continuous and evolving, the period of time restrictions was not considered by the authors. Hence, article collection ranged from 2000 to 2018. In summary, about 17,808 academic articles were extracted and 237 potentially relevant articles remained, after subtracting duplicate articles with redundant information. Then titles and abstracts were vetted, and irrelevant papers were removed, leaving behind a total of 160 potentially relevant articles (see **Figure 1**).

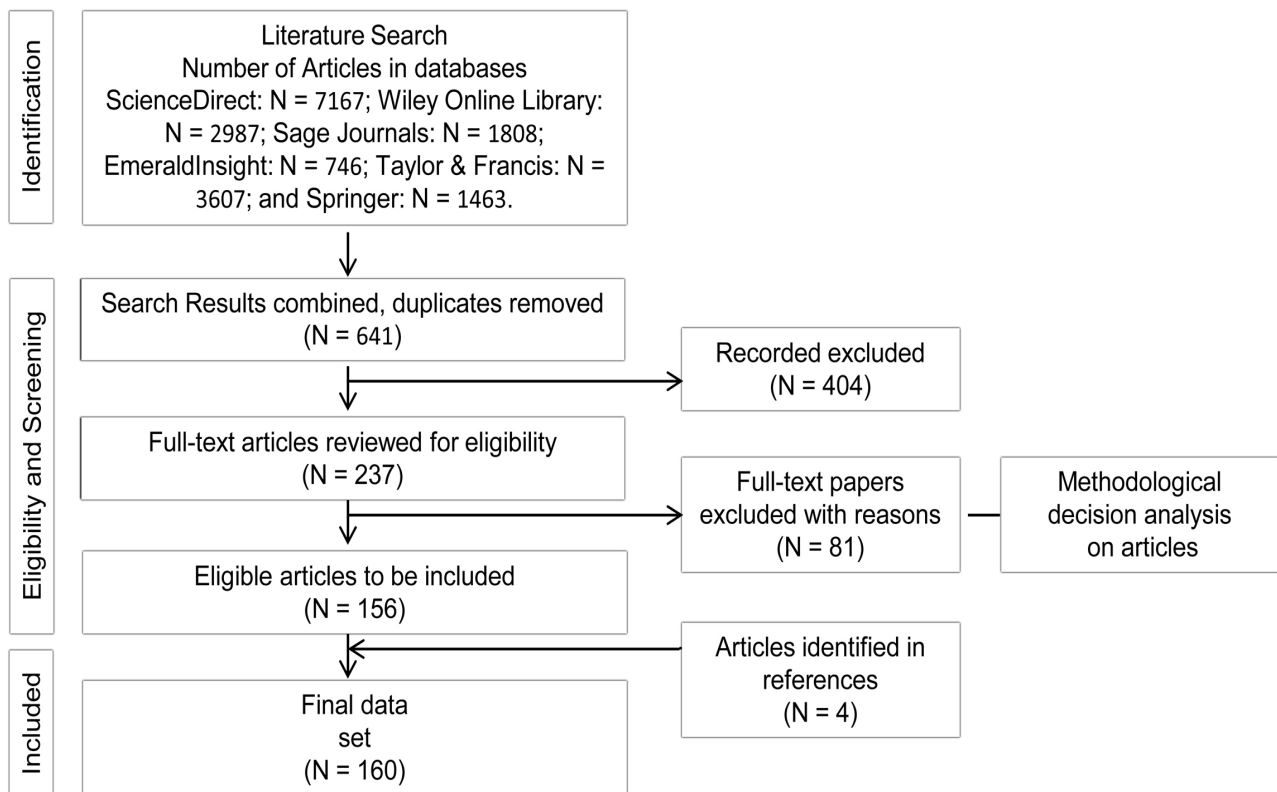


Figure 1. Flow diagram of the systematic search, indicating the numbers of excluded and included articles in the review.

2.2. Study Selection and Eligibility (Inclusion and Exclusion) Criteria

Here the full text of extracted articles from the prior stage was independently reviewed by the authors for eligibility purposes. A clear rationale was formulated for paper selection to arrive at a consensus. Articles that had used HAM approaches and techniques in affordability and related problems were chosen. Grey literature searches using Google searching sites like (gov. or edu. and file type: Pro Quest, pdf, Open Grey, WHOLIS, and Med Nar) were completely avoided. Textbooks, master and doctoral dissertations, unpublished working papers, book chapters, abstract only papers, and non-English articles, were also excluded as shown in **Table 1**. In addition, Housing affordability indexes (HAI) were excluded because they are not readily used in housing and planning research (as no empirical study published under Web of science adopted these indexes).

Selecting only peer-reviewed empirical studies guarantees that the methodologies and techniques of relevant articles assessed, had already been evaluated within its discipline. Hence, the authors did not independently assess the reliability of relevant articles because doing so would be tantamount to questioning the appropriateness of diverse research methods, thereby raising epistemological issues, particularly in a phrase like housing affordability, where studies have been undertaken in several disciplines. Furthermore, no meta-analysis was conducted due to the diverse designs and aims of the empirical studies.

The first author using a predesigned protocol, extracted essential characteristics of the articles, as illustrated in **Table 1**. The second author cross-checked this information, all titles and abstracts were independently vetted by both authors. Four experts in parallel screened the quality of selected studies and informed the classification framework, based on data extraction form. These experts were selected based on two major criteria. First, experts who had broad research on housing affordability and/or industrial experience in affordable housing were selected. Second, experts who have in-depth knowledge and had contributed to existing housing affordability literature were selected. Considering these selection criteria for experts, it is believed that these experts will offer insight into the classification scheme.

3. Literature Search Results

The term “housing affordability” has come into popular usage in the last two decades, replacing “housing need” at the center of a debate about the provision of adequate housing for all. Affordability has become the key term in housing policy in both developed countries and those in transition.

3.1. Application of Housing Affordability Concept and Measurement

Hulchanski's [3] review expounded on the applications of the expenditure-to-income ratio. In the ensuing 24 years, housing researchers have

Table 1. Review design.

	Criteria for Exclusion and Inclusion		
	Exclusion	Inclusion	Rationale
Timeline	<ul style="list-style-type: none"> • Not Within 2000-2018. • Published online after review period (November 2018 onwards) 	<ul style="list-style-type: none"> • Within 2000-December, 2018 • 2000 (inclusive) until October 2018 (inclusive) 	<ul style="list-style-type: none"> • The selected timeline reveals the state of knowledge on the subject. • Synonymous with the development of measures for assessing housing needs, problems and the calculation of affordable housing areas; which are the hallmark of Millennium Development Goals (MDGs) Target 11 of Goal 7.
Nature of Publication	<p>Book Chapters, Book Reviews, Non-Empirical articles, Review Papers, commentary, Literature reviews, Monographs, News items, Short case study Brief report, studies electronically unavailable or by other medium, Duplicates, Editorials and Encyclopedia articles.</p>	<ul style="list-style-type: none"> • Reports of Empirical Studies • Paper accepted • In print. • Online journal. 	<ul style="list-style-type: none"> • Selecting only peer-reviewed studies, guarantees that the methodologies and conclusions of relevant articles assessed, had already been evaluated within its discipline, hence appropriate and deserving of publication in academic literature.
Peer-review	<ul style="list-style-type: none"> • Editorial peer-reviewed • No documented peer-review 	<ul style="list-style-type: none"> • Article underwent documented peer-review process 	
Theme	<ul style="list-style-type: none"> • Housing affordability Indexes (HAI) formulated by professional bodies and associations. • Not dealing explicitly on housing affordability and measurement methods. 	<ul style="list-style-type: none"> • Normative methods, Basic Measurements Approaches and Concepts of Housing Affordability, as well as Mathematical Models (basically adaptations from the basic approaches with more robust methodologies). • Explicitly dealing on housing affordability and measurement methods. 	<ul style="list-style-type: none"> • HAI—fails to accurately reveal housing affordability problems of households with very low-income, as they merely integrate average figures. • Article is selected if it discussed a validation of existing method or utilized or proposed or developed a method of housing affordability analysis
Language	Non-English Publications	English or Translated in English	<ul style="list-style-type: none"> • English is the dominant language for reporting scientific results of scholarly publications to wide academic audience. • Authors' lingua franca.

Continued

Interdisciplinarity	<ul style="list-style-type: none"> • Other disciplinary descriptions of certain search terms (e.g. housing stability, housing vacancy rates). • Housing affordability measurement constitutes a marginal portion of the study. 	<ul style="list-style-type: none"> • Studies from diverse disciplines potentially relevant to housing affordability. • Multidisciplinary and Wide-ranging. 	<ul style="list-style-type: none"> • To accommodate various authors on the subject with diverse orientation.
Research score	<ul style="list-style-type: none"> • Rents or trends in housing prices or the increments of both. • Determinants of housing affordability. • Effects of housing policy on affordability. 	<ul style="list-style-type: none"> • Measurement of affordability; rather than reviewing and recommending housing related policies. • Applications of affordability measures. • Housing cost burden. 	<ul style="list-style-type: none"> • Affordability description based on Rents or trends in housing prices or the increments of both, only poses anecdotal value, and are no indicator of affordability without any form of comparison to incomes.
Search method	Verbatim, Boolean and Word Combination		
Data source	Print (Hard); Online (Soft).		
Data Collection Technique	Title, Abstract, Keywords, Key arguments, Research methodologies, Conclusions and Findings.		
Selected Databases	Web of Science Core Collection (Social Sciences Citation Index; Arts & Humanities Citation Index; Science Citation Index Expanded; Scopus and Emerging Sources Citation Index)		

successfully established that the housing expenditure-to-income ratio as an affordability metric does not adequately measure the six applications as described by Hulchanski [3]. Therefore, other alternative measurement methods have been proposed in other to improve the weakness of the housing expenditure-to-income ratio. For instance, in an often-cited study, Stone [16] made a case for the residual income method as an alternative approach.

3.2. Fields/Domains of Category—Problem Context-Based Classification

As a result of the wide applications of HAM approaches in the real affordability problems, there is a need to classify these applications across several domains/fields. The papers that used HAM approaches are classified into three groups: HAM approach utilizing study, HAM approach developing study, and HAM approach proposing study. In cases where an article falls into several categories, relying on the article's objectives as determined by the targeted audience, the most suitable option was chosen. This enabled the elimination of possible duplication of studies in the classification scheme. In subsequent sections, themes (fields/domains) are presented in brief and further summarized with corresponding tables. In every table, studies are summarized and described

in accordance with their intent and reporting technique. These studies used different methods for different applications, it was observed that each method possesses its unique features in providing the best outcome. **Table 2** shows articles distribution based on application domains/fields.

3.2.1. Rental Housing Affordability (RHA)

RHA is the difficulties experienced by households in accessing rental housing and/or the financial burden imposed on households for securing accommodation in either the private or public housing sector. Several scholars have explored this area using several HAM techniques and approaches which include sub-categories of econometric/regression modeling such as logit regression model [17] [18] [19] [20], hedonic price equations [21], regression models [22]-[27], simulation methodology [28], partial regression plots [29], Canonical Spatial Equilibrium model [30]. Other methods are the residual income method [31]; ratio-based method [32]-[38]. Wegmann, [39] modified ratio measure to a replacement metric called the subsidy per housing affordability equivalent (SHARE) ratio; subjective method [5] [40] [41] [42] [43]; composite method [44] [45] [46] [47] [48]; Gini coefficient method [49] [50]. A total of 35 articles have applied HAM approaches and techniques, in this field of application.

3.2.2. Home-Ownership Affordability (HOA)

HOA is the difficulties experienced by households in accessing their own housing and/or the financial burden imposed on households for securing accommodation in the housing and mortgage market. In the domain/field of

Table 2. Summary of applications of HAM approaches and techniques used in varied affordability stress.

HAM approaches and techniques	RHA	HOA	PRA	CHTA	HMMA	IHA	Frequency of application	Percentage
Conventional Approaches								
1) Ratio-based Method	07	05	01	-	13	12	38	23.75
2) Residual Income Method	02	03	01	01	02	03	12	7.5
3) Composite Method	05	02	-	02	08	01	18	11.25
4) Econometric/Regression Modeling and Simulation Methodology	14	05	02	13	18	08	59	36.87
Scarcely Used Approaches								
5) Behavioral Method	-	01	01	-	01	-	03	1.87
6) Subjective Method	05	02	-	01	05	03	16	10
7) Location Affordability Index	-	-	-	02	-	-	02	1.25
Emerging Novel Approaches								
8) Scenario Technique	-	-	-	-	01	-	01	0.62
9) MultiCriteria Decision Making (MCDM) Method	-	-	-	-	03	-	03	1.87
Method								
10) Data Envelopment Analysis (DEA) Method	-	-	01	01	-	-	02	1.25
11) Gini Coefficient Method	02	-	-	-	02	-	04	2.5
12) Mobility Probability Plot (MPP) Method	-	-	-	-	02	-	02	1.25
Total	35	18	06	20	54	27	160	100

Source: Authors' summation.

HOA, some prior articles developed and/or utilized HAM approaches and techniques. For instance, in the case of the econometric model [51] [52], and its subset like ordinary least square regression [53], hedonic house price model [54], multivariate regression [55]. In the case of residual income method [56] [57] [58], subjective method [59] [60], ratio-based method [61] [62] [63] [64] [65], behavioral method [66] and composite method [67] [68]. HOA domain/field had second to the lowest ranking with 18 previous scholars (11.25%) have applied only 5 out of the 12 identified HAM approaches and techniques.

3.2.3. Purchase and Repayment (Amortization) Affordability (PRA)

PRA is the ability of a household to borrow adequate funds for a house purchase and the stress undergone by a household to repay. According to this review in the field/domain of PRA, only 7 studies out of 160 selected studies used 5 out of 12 identified HAM approaches and techniques. These include the regression model [69] and its other form such as multinomial logit estimation [70]. Other examples are ratio-based measures [6] [71], residual income method [72], behavioral method [73], and data envelopment analysis [74].

3.2.4. Combined Housing and Transportation Affordability (CHTA)

The concept of CHTA holds that actual housing affordability must include transportation costs as a substantial and related household cost burden. Such that housing is perceived as affordable if less than 45% of household income is spent on combined H + T costs. Some scholars have applied various HAM approaches and techniques in this domain/field such as econometric model [75] [76] [77] [78], and its subset like microstimulation [79], logistic regression [80], hedonic approach [81], monocentric modeling [82], multi-level regression models [83] [84] [85] [86], least-squares regression models [87]. Luckey [88] proposed a location-sensitive residual income (LSRI) approach. In the case of subjective method [89], data envelopment analysis method [90], location affordability index [91] [92], and composite method [93] [94], the results of **Tables 3-14** indicated that 20 articles were published in this field/domain.

3.2.5. Housing and Mortgage Market Affordability (HMMA)

HMMA describes the affordability of housing stock, the housing assistance available, household's eligibility, and forecasts the profitability of erecting and sales of new houses in an area. Therefore, could aid in determining new areas for developing affordable housing, and areas in dire need of housing subsidy. Results of **Tables 3-14** showed that, in field/domain of HMMA 59 articles out of 160 selected articles applied 9 out of the 12 identified HAM approaches and techniques. Residual income method [16] [95] [96], econometric modeling [97] [98] [99] [100] [101], quantitative model-based simulation method [28] [102] [103], Markov-switching (MS) model [104] [105], autoregressive distributed lag [106], probit model [107], hedonic pricing parameters [108] [109] [110] [111]. Others are subjective method [59] [112] [113] [114] [115], composite method

Table 3. Article distribution based on ratio-based method.

Authors	Year	Study type	Intent and Techniques
[137]	2011	HAM proposing research	Presented a methodology (ratio of lifetime income to house price) to compute lifetime income from predicted annual household earnings.
[6]	2018	HAM proposing research	Implemented the ratio of cost-burdened households for the evaluation of housing affordability.
[125]	2011	HAM utilizing research	Used the PIR to calculate the housing stress levels.
[155]	2018	HAM proposing research	Introduced a new normative measure that adjusts for normative variation in housing consumption.
[126]	2012	HAM utilizing research	Applied the ratio-based measure on the housing market.
[35]	2017	HAM utilizing research	Utilized ratio measures to calculate rent proportion.
[130]	2005	HAM developing research	Developed a model-based measure of access to owner occupation and intermediate housing market.
[158]	2004	HAM utilizing research	Tabulated and mapped the spatial distribution of households spending large portions of their income on rent.
[136]	2001	HAM utilizing research	Examine the in-house prices and affordability trends using ratio measures.
[62]	2011	HAM utilizing research	Analyzed developments in house prices using long-term approach based on ratio measures.
[129]	2013	HAM utilizing research	Used PIR to investigate two living scenarios (basic and comfortable).
[32]	2016	HAM utilizing research	Employed the ratio of rent to income to analyze the impact of housing affordability on the permanent migration will.
[170]	2009	HAM developing research	Extended the PIR to consider the whole income and house prices distribution.
[45]	2010	HAM utilizing research	Calculated expenditure-to-income ratios of average cost of housing for tenants and homeowners.
[134]	2011	HAM utilizing research	Employed PIR to address the variations in affordability between local housing market areas (HMAs).
[172]	2013	HAM proposing research	Proposed an index based on ratio measure that is peculiar to Estonian housing market.
[128]	2001	HAM utilizing research	Compared and contrasted housing affordability by housing prices and income ratios, using standard measurement criteria.
[132]	2012	HAM developing research	Defined the dynamic upper boundary of PIR via Engel's coefficient to estimate the housing affordability severity.
[65]	2011	HAM utilizing research	Determined affordable areas for moderate single income earners and percentage of suburbs affordable to key workers.
[61]	2006	HAM utilizing research	Utilized (PIR) to gauge housing affordability.
[150]	2014	HAM utilizing research	Examined housing affordability using price-to-income ratio (PIR).

Continued

[38]	2008	HAM utilizing research	Used the standard “rule of thumb” to examine the incidence of housing stress for renters and owners separately.
[135]	2005	HAM proposing research	Proposed a tabulation-based measure via ratio measures.
[149]	2004	HAM utilizing research	Used the PIR to describe changes in the number of low-income households dissipating over 50% of their income on housing.
[34]	2003	HAM utilizing research	Evaluated the rental experiences of migrant groups using a housing career strategy.
[151]	2010	HAM utilizing research	Examined the comparative effects of several affordability definitions on the ratio of households in housing stress.
[63]	2008	HAM developing research	Computed the homeownership affordability rates using ratio-based measures.
[133]	2018	HAM utilizing research	Used the PIR to investigate the housing sector situation and affordability issues.
[33]	2004	HAM utilizing research	Utilized the ratio measure to assess housing assistance programs.
[156]	2002	HAM utilizing research	Analyzed housing affordability using the upper boundaries of both income and rent bands via ratio measures.
[79]	2013	HAM developing research	Extended housing stress measure proposed by Chaplin and Freeman (1999) to incorporate the 30/40 rule.
[152]	2013	HAM utilizing research	Identified the time lapse in which low-income households can afford a unit when resold using the ratio measures.
[131]	2018	HAM proposing research	Presented the interest-to-income ratio (IIR) concept to establish a simple affordability model.
[39]	2014	HAM proposing research	Proposed the subsidy per housing affordability equivalent (SHARE) ratio as a replacement metric.
[28]	2006	HAM utilizing research	Examined housing affordability trends across income groups using customized matrices.
[36]	2005	HAM utilizing research	Evaluated how the availability and supply of low rent housing aid affordability problems via ratio measures.
[37]	2000	HAM utilizing research	Accessed housing un-affordability using the ratio of rent paid to gross household income.

Source: Authors’ summarization.

[116]-[123], scenario technique [124], ratio-based measures [125]-[137], behavioral method [138], MPP [139] [140], Gini coefficient method [141] [142], MCDM [143] [144] [145].

3.2.6. Individual Household Affordability (IHA)

For most households with limited income, every housing stock is unaffordable until offered at no cost. While for most with high income, every housing stock is affordable regardless of the cost. These phenomena are referred to as IHA, it is

Table 4. Articles distribution based on residual income method.

Authors	Year	Study type	Intent and Technique
[146]	2015	HAM developing research	Developed an Ordered Probit model that identifies factors which forecast housing and financial stress in household types through residual stress measure.
[148]	2013	HAM utilizing research	Presented the application of budget standards in two countries.
[171]	2005	HAM proposing research	Introduced the housing-induced poverty concept to examine situations that emerge when after paying for housing, a household cannot afford non-housing goods.
[57]	2017	HAM utilizing research	Examined the impact of housing affordability via Residual Income Affordability model (RIA) complemented by Housing Affordability Time (HAT) analysis.
[88]	2018	HAM developing research	Evaluated the benefits and impacts linked to transportation decisions by proposing a location-sensitive residual income (LSRI) approach.
[147]	2012	HAM utilizing research	Examined possible residual racial differences associated with housing affordability.
[31]	2016	HAM utilizing research	Operationalized residual income method to specify affordable market rental housing.
[16]	2006	HAM utilizing research	Analyzed the potential utility and implications of the residual income method in mortgage underwritings.
[95]	2006	HAM utilizing research	Demonstrated how the shelter poverty version of residual income concept can be operationalised using non-housing elements.
[58]	2008	HAM developing research	Developed a “residual income” whose value is calculated using a hedonic price equation.
[72]	2011	HAM utilizing research	Compared the residual measure against the ratio measure results realized from down payment and amortization affordability assessment.
[96]	2014	HAM utilizing research	Used the residual income method to measure housing affordability.

Source: Authors' summarization.

important to determine because uncontrollable emotion or over the excitement of perceived fall in house prices, as well as individual weakness of never to be outpriced could force households to secure apartments beyond their capacity to sustain. However, research is limited in this area, [146] [147] [148] employed the residual income method to assess this field/domain, [149]-[158] used ratio-based measures. [159]; used the composite method. [160] [161] [162] used the subjective method. [163] [164] [165] [166] [167]; used regression model. Other regression techniques used are ordinary least squares (OLS) regression [168], logistic regression [169], and bivariate probit models [170], residual income method [171].

Table 5. Articles distribution based on composite method.

Authors	Year	Study type	Intent and Techniques
[146]	2015	HAM developing research	Employed a composite of budget standard, household disposable income and the Consumer Price Index to model a measure that identifies households' types suffering affordability stress and its duration.
[68]	2009	HAM utilizing research	Adopted lending multipliers (loan-to-income ratios) while utilizing a secondary residual income test.
[116]	2012	HAM utilizing research	Used subjective evidence of material hardship and payment problems to validate ratio measures while residual measures play supporting role.
[94]	2017	HAM developing research	Modeled a composite index of car dependence and housing affordability (CDHA) using indices of oil vulnerability associated with housing affordability and car travel.
[47]	2018	HAM utilizing research	Used the composite of ratio and residual measures to explain housing affordability trends in the private rental sector (PRS).
[119]	2011	HAM utilizing research	Applied PIR and housing affordability index (HAI) approaches to measure housing affordability.
[45]	2015	HAM utilizing research	Utilized the ratio measure to assess housing affordability of tenants and the residual measure to identify households with housing and energy affordability stress.
[117]	2011	HAM utilizing research	Combined the concepts of short-term and long-term affordability to evaluate financial accessibility and payment ability for housing.
[93]	2015	HAM utilizing research	Combined multilevel modeling, location affordability index (LAI) and metropolitan compactness index to determine urban sprawl affordability after transportation costs consideration.
[46]	2002	HAM utilizing research	Combine RIR and residual measure to prove that application of different affordability measure yields contrasting results.
[122]	2010	HAM utilizing research	Examined housing price bubbles via combination of housing market prices, rational expectation price, mortgage loans, PIR and RIR.
[118]	2011	HAM utilizing research	Analyzed interrelationships between mortgage liquidity and housing affordability using PIR, access, deposit gap and residual measure.
[121]	2008	HAM utilizing research	Used the composite of PIR and HAI model to measure housing affordability.
[120]	2018	HAM developing research	Used multiply affordability indicators to capture households, investors and system-wide factors.
[123]	2018	HAM utilizing research	Employed Income and Living Conditions survey to examine the housing affordability through ratio, residual income, and subjective methods.
[44]	2012	HAM utilizing research	Combined RIR and residual income standards to maximize their strengths and complement their weaknesses in rental affordability measurement.
[48]	2003	HAM developing research	Combined residual measure, housing consumption and quality-based measure to determine over consumption and overpayments of housing services
[67]	2006	HAM utilizing research	Examined homeownership affordability via composite of ratio measure, housing accessibility, housing mismatch and residual approach.

Source: Authors' summarization.

Table 6. Article distribution based on econometric/regression modeling.

Authors	Year	Study type	Intent and Techniques
[76]	2017	HAM developing research	Presented a novel measure of affordability that combines housing and transportation cost (CNT).
[18]	2016	HAM utilizing research	Analyzed rental housing affordability using descriptive statistics and multinomial logit analyses.
[27]	2018	HAM utilizing research	Used an estimated model to stimulate rental rates reactions to an exogenous increase of housing units in a neighborhood.
[166]	2014	HAM utilizing research	Used regression analysis to examine the strength of local planning towards affordable housing and its relationship with accompanying changes in housing affordability.
[101]	2015	HAM utilizing research	Determined via econometric model the range of household's cohorts moving between unaffordable and affordable housing states ("slippers"), and those that experience long-term ("stickers").
[81]	2018	HAM developing research	Used the hedonic approach to estimate prices of normative consumption bundles in a superstar city.
[163]	2016	HAM utilizing research	Evaluated changes in people's mental health traced to unaffordable housing using econometric model.
[30]	2018	HAM developing research	Developed a version of the Canonical Spatial Equilibrium model to test the situation in which ongoing HCV program design maybe deemed problematic from perspective of welfare.
[20]	2015	HAM utilizing research.	Utilized logistic regression model and a survey of former assisted properties to determine their post subsidy trajectories.
[24]	2018	HAM utilizing research	Modeled the possibility of rental subsidies contributing to affordability problems, while helping recipients afford expensive properties.
[52]	2011	HAM utilizing research	Utilized the acquisitions, payments, and the use approach to measure the cost of owner-occupied housing.
[54]	2017	HAM utilizing research	Applied a hedonic house price model to examine the effect of infrastructure charges on housing affordability.
[108]	2011	HAM developing research	Extended hedonic pricing parameters and compared low income housing tax credit (LIHTC) ceiling rents and predicted market rents.
[109]	2017	HAM utilizing research	Investigated the reactions of urban housing markets to war and migration which increases housing demand using a new hedonic index.
[98]	2010	HAM developing research	Refined static measures (point-in-time) via a dynamic analysis to develop a method that identifies patterns of affordability.
[82]	2018	HAM utilizing research	Used a monocentric model to show that capping housing burden drives low-income households toward suburban areas, where they suffer high transportation cost.

Continued

[168]	2018	HAM utilizing research	Used an Ordinary Least Squares (OLS) regression model to examine housing affordability stress (HAS) and material deprivation effects on mental health.
[87]	2015	HAM utilizing research	Used three-stage least-squares models to analyze CHTA.
[29]	2016	HAM utilizing research	Compared trends in housing affordability over time within countries using partial regression plots.
[22]	2017	HAM utilizing research	Used the housing services model and the hedonic price model to measure rents and housing consumption.
[102]	2008	HAM utilizing research	Used simulation method to examine a government's policy impact on housing supply.
[103]	2018	HAM proposing research	Predicted the future housing supply effects on the residential space affordability using quantitative model-based simulation method.
[21]	2009	HAM developing research	Extended hedonic price equations to assess location-related quality housing, affordable to different households.
[107]	2018	HAM proposing research	Modeled an original application of probit model with a double sample selection to show how housing allowance recipients cope with financial difficulties.
[83]	2016	HAM utilizing research	Utilized MLM to assess housing affordability of low-income renter households and its relationships to travel outcomes and transportation cost.
[85]	2018	HAM utilizing research	Followed Hamidi <i>et al.</i> (2016) study utilizing a rigorous methodology which consists of solid transportation cost modeling with disaggregated data available at property level for housing assistance programs.
[86]	2018	HAM utilizing research	Probed household cost burdens and its relationship with CHTA multi-level regression models.
[99]	2010	HAM utilizing research	Conducted an econometric analysis to explore long-run housing prices determinants and impact of structural changes.
[80]	2018	HAM utilizing research	Tested the relationship between housing cost and transit access using descriptive statistics and logistic regression.
[167]	2012	HAM utilizing research	Examined through an ordered logistic regression common forces affecting people in various rural communities (monthly housing costs and income).
[26]	2014	HAM utilizing research	Utilized first-difference models of tract-level data to examine the relation between poverty rates, student populations, and housing affordability metrics.
[53]	2014	HAM utilizing research	Applied ordinary least squares (OLS) regression to assess the effectiveness of the First Home Owner Grant (FHOG) scheme in improving housing affordability.
[56]	2000	HAM utilizing research	Examined the utility of the multifamily housing sector via household tenure decision models.

Continued

[25]	2018	HAM utilizing research	Used regression models to evaluate how less affordable rental housing is for households of Extremely Low-Income (ELI).
[23]	2007	HAM utilizing research	Applied a method based on the estimation of economic quasi-norms on rent levels in rent-controlled (social) housing.
[110]	2014	HAM utilizing research	Used hedonic regression and spatial econometrics to explore an urban growth boundary (UGB) impact on land and housing prices.
[77]	2014	HAM developing research	Examined combined housing and transport (CHTA) affordability by utilizing disaggregate zonal data.
[51]	2008	HAM developing research	Developed an alternative economic model that better suits the post-Barker era, covering both tenure choice and household formation.
[100]	2011	HAM utilizing research	Examined long-run affordability as affected by different levels of housing construction on via econometric model of regional housing market.
[19]	2016	HAM utilizing research	Applied Ordinary least squares and logit regression analysis to estimate household health tradeoffs occasioned by housing affordability stress.
[75]	2004	HAM utilizing research	Applied travel cost models and transportation network assignment models to compute average annual travel and housing expenditures.
[55]	2017	HAM utilizing research	Conducted a multivariate assessment of affordability dynamics, to trace households gaining ownership of housing.
[164]	2018	HAM developing research	Developed a quantile regression models for households in the top, median and bottom quartiles of the housing affordability stress spectrum.
[105]	2017	HAM proposing research	Modified the house price self-correction pattern (SCP) of [104] to propose a pattern for the housing affordability cycle.
[83]	2016	HAM utilizing research	Utilized Multilevel modeling (MLM) to examine how CHTA differ in fixed-route transit station areas.
[157]	2015	HAM proposing research	Investigated the extent ratio measure (30/40 HAS) reflects broader financial stress and housing stress.
[111]	2018	HAM utilizing research	Estimated the hedonic price function using ordinary least squares (OLS) and Box-Cox functional forms to estimate the implicit prices of housing characteristics.
[69]	2016	HAM utilizing research	Utilized the econometric model to show how financial health of the mortgaged families has deteriorated.
[170]	2004	HAM developing research	Extended bivariate probit models to predict the combined probability that households housing cost exceeds half of their income, which is below poverty line.
[169]	2008	HAM utilizing research	Used Rare event logistic regression to measure the prevalence and correlates of housing affordability stress among community-dwelling older persons.

Continued

[104]	2018	HAM utilizing research	Applied Markov-switching (MS) model to estimate the duration of increasing severity and mitigation of the housing affordability problem.
[173]	2013	HAM utilizing research	Used spatial microsimulation technique to show how the outcome of housing stress measure that integrates transport costs paints a different picture of housing stress from a measure that neglects cost of transport.
[17]	2011	HAM utilizing research	Applied logistic regression using the dependent variable CBALL, a dummy variable that indicates if households experience cost burden exceeding 30% of their gross monthly income.
[165]	2011	HAM utilizing research	Explore research issues on housing affordability dynamics using econometric model.
[172]	2005	HAM utilizing research	Examine the efficacy of housing-demand component in addressing housing affordability within a new microsimulation model.
[28]	2006	HAM utilizing research	Employed microsimulation model estimate to stimulate the potential impacts on housing market of low-income housing tax credit (LIHTC).
[106]	2013	HAM utilizing research	Used autoregressive distributed lag (ARDL) approach to model housing affordability measured by the housing price-earnings multiplier (HPE) and the Housing Industry Association's Housing Affordability Index (HAI).
[97]	2004	HAM utilizing research	Explored how regional variation in house prices could lead to affordability problem using regression model.
[70]	2005	HAM utilizing research	Utilized Multinomial logit estimation to model the likelihood of an existing rental housing maintaining the same real rent value, or filters down or up, or exits the private rental market over a given period.
[78]	2017	HAM developing research	Presented a modeling approach based on point estimates as an improved housing affordability measure that accounts for CHTA.

Source: Authors' summarization.

3.3. Article Distribution Based on HAM Approaches and Methods

Table 2 presents the frequency of applications of identified HAM approaches and techniques invariants of housing affordability stress. Based on the results, a total of 160 articles have used 12 HAM approaches and techniques. The table reveals that econometric/regression modeling (36.87%) has been used more than other methods and techniques. The second in this ranking is the ratio-based method (23.75%) and the composite method (11.25%) is the third. The frequency of other approaches and techniques is also shown in **Table 2**. **Tables 3-14** show the implementation of each HAM approach and technique. Selected articles are sorted alphabetically in all tables by author name.

Table 7. Article distribution based on behavioral method.

Authors	Year	Study type	Intent and Techniques
[138]	2016	HAM utilizing research	Used critical discourse analysis to examine why negative gearing continues to enjoy political support though it is unfair, makes housing unaffordable and enables market distortion.
[66]	2010	HAM utilizing research	Utilized data collected from 1176 participants saving for home purchase to examine individual and program characteristics that are critical in explaining saving behaviors.
[73]	2016	HAM utilizing research	Used a data set of household-level survey to examine the essential social capital effects on house-purchasing decisions of households.

Source: Authors' summarization.

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Authors began proposing robust methodologies from other disciplines. For instance, two methodologies were borrowed from Operations research (MCDM and DEA).

4. Discussions

This research reviewed studies published in an 18-year period (2000-2018) regarding HAM approaches in 47 high-impact journals indexed in the Web of Science database system. It systematically reviewed studies relating to HAM approaches and applications. Consequently, 160 publications regarding HAM approaches were carefully and systematically selected. Based on the predefined objectives of this review, selected articles were summarized based on title, abstract, introduction, methodology, and conclusion. In this survey, the results obtained were acquired in line with three research questions, which are:

RQ1: Which HAM approaches have been used?

The review reveals the existence of a high number of HAM approaches and all of the identified methods can be applied in addressing one, or more, or other variants of affordability problems. Results collected also show that all HAM approaches are conceptually very similar, but little variations make each class more suitable for different applications. To answer question one, the results presented in **Table 2** are considered. It shows the number and percentage of identified HAM approaches. The table also shows that the econometric/regression modeling was the first in ranking amongst other methods with 59 studies, while the ratio-based method was ranked second with 38 articles. The growth in the application of econometric/regression modeling could come from convenience, simplification justification, and conventionality, instead of sound theoretical mathematical or logical justification or as a more robust and accurate method. It was also observed that the mobility and probability plot (MPP) and data envelopment analysis (DEA) had 2 articles each, while the scenario technique is the least method in use with 1 article. These could be because of their complexity, heterogeneity, and

Table 8. Article distribution based on subjective method.

Authors	Year	Study type	Intent and Techniques
[59]	2015	HAM proposing research	Case study approach employed data generated by two questionnaire surveys while using Binary Logistic Regression Model (BLRM) to analyze how over-crowding problem breeds amongst survey respondents.
[162]	2011	HAM utilizing research	Conducted a face-to-face, semi-structured and individual interview with randomly selected 10 youth housing workers to assess their pay and conditions, housing costs and experiences.
[113]	2012	HAM utilizing research	Utilized information from interviews, organizational case studies and documentation, to assess the drivers of hybridity growth in Not-for-Profit housing organizations
[60]	2018	HAM utilizing research	Surveyed the experiences of 91 respondents of community land trusts (CLTs) home-owners while using grounded theory approach for data analysis.
[174]	2013	HAM utilizing research	Utilized data from interviews and focus group discussions in a case study methodology to investigate experiences of a housing market failure.
[161]	2018	HAM utilizing research	Conducted survey interviews with 136 micro-flats residents to investigate their socio-economic background and their perceptions of living space.
[112]	2016	HAM utilizing research	Conducted 25 key informant interviews to demonstrate a range of policy responses that challenge affordable intermediate housing.
[115]	2018	HAM utilizing research	Examined the subjective experience of renters and home buyers.
[40]	2009	HAM utilizing research	Applied Amartya Sen's functionings and capabilities concepts using semi-structured interviews, to explore and compare the of older renters life experiences.
[43]	2009	HAM utilizing research	Explored the housing experiences of immigrant households and interviews from local community organizations representatives serving low-income and immigrant populations.
[41]	2017	HAM utilizing research	Examined the lived experiences of PhD students similar to the poorest segments of the housing market.
[5]	2006	HAM utilizing research	Exposed important issues and problems with sole reliance on quantitative analyses of housing affordability and examined how low income private renters perceive their housing situation, focusing on affordability.
[160]	2016	HAM utilizing research	Assessed the distance between the outcomes of subjective evaluations and the objective measures of households affordability problems, using same EU-SILC data source.

Continued

[42]	2014	HAM utilizing research	Used focus groups with immigrants, informant interviews and semi-structured interviews from 15 professionals dealing with provision of housing services and immigrant settlement to examine housing experiences and coping strategies of low-income immigrants.
[89]	2016	HAM utilizing research	Utilized focus-group data and information from interviews to explore the challenges Housing Choice Voucher Program (HCVP) participants experience in searching for location-affordable housing.
[114]	2018	HAM utilizing research	Conducted semi-structured interviews with industry practitioners to explore the affordability of Malaysian housing market.

Source: Authors' summarization.

Table 9. Article distribution based on location affordability index.

Authors	Year	Study type	Intent and Techniques
[92]	2016	HAM utilizing research	Chose one urban and one suburban area to explore how potential changes in the exogenous variables might affect transportation choices and housing costs.
[91]	2014	HAM utilizing research	Used a survey of 900 households to measure the combined H + T costs in different areas of a city, using housing and transportation affordability index.

Source: Authors' summarization.

Table 10. Article distribution based on scenario technique.

Authors	Year	Study type	Intent and Techniques
[124]	2011	HAM proposing research	Employed the scenario technique to sketch a stimulation of possible continued rising housing prices and a sharp downward correction.

Source: Authors summarization.

Table 11. Article distribution based on Multi Criteria Decision Making (MCDM) method.

Authors	Year	Study type	Intent and Techniques
[143]	2016	HAM utilizing research	Investigated the applicability of six models within the MCDM methodological framework, for optimal housing affordability assessment.
[144]	2013	HAM proposing research	Proposed a novel concept of how affordability can be measured using COPRAS method of multi-criteria decision making (MCDM).
[145]	2017	HAM utilizing research	Employed the COPRAS model in the MCDM methodological framework to demonstrate the need for a shift towards sustainability quality affordability value from the common price income cost genre.

Source: Authors' summarization.

Table 12. Distribution based on data envelopment analysis method.

Authors	Year	Study type	Intent and Techniques
[90]	2018	HAM proposing research	Proposed a new method of ranking and measuring CHTA in various combinations of residential location and housing type using the Econometric Frontier Approach otherwise called Data Envelopment Analysis (DEA) method.
[74]	2014	HAM developing research	Modified housing affordability indicator to account for the impacts of household disposable income and urban population density on the ability of households' to afford a house.

Source: Authors' summarization.

Table 13. Article distribution based on Gini coefficient method.

Authors	Year	Study type	Intent and Techniques
[141]	2016	HAM proposing research	Proposed a new measure of housing affordability inequality based on the net income-to housing price ratio by computing the Gini coefficient of housing affordability inequality.
[50]	2017	HAM utilizing research	Examined the impact of income inequality and increases in GINI coefficient exact on rental affordability of low-income tenant households.
[49]	2008	HAM utilizing research	Modeled potential relationship that, income boom of the rich cause the poor problems of housing affordability.
[142]	2016	HAM utilizing research	Examined the impacts of income inequality on the PIR and housing vacancy rate to show that the income GINI coefficient is positively related to the housing vacancy rate and PIR.

Source: Authors' summarization.

Table 14. Article distribution based on Mobility Probability Plot (MPP) method.

Authors	Year	Study type	Intent and Techniques
[139]	2018	HAM proposing research	Proposed a recently developed framework called the mobility probability plot (MPP) which is based on the the stochastic kernel technique and Markov transition matrix approach, to assess city-level trends of housing affordability.
[140]	2017	HAM utilizing research	Employed the MPP method, to analyze the mobility of housing price growth in main urban areas and to evaluate the impact of enactment and withdrawal of home purchase restrictions (HPR) policy have on changes in housing price.

Source: Authors' summarization.

econometric expertise requirement, which may have weakened their uptake and loss of traction amongst researchers and planners.

RQ2: What type of study has been performed on these HAM approaches?

The authors carefully read the methodology aspect of individual studies and

classified them into three types, to answer this second question. According to these readings, some articles utilized already established HAM approaches to analyze affordability problems. Relying on discussions held with four housing affordability experts and authors' experience, this type of study was classified as the HAM approach utilizing research. Attempts were also made by some scholars to develop or modify HAM approaches. Thus, HAM developing research was used as the second type of study. In addition, some researchers proposed new approaches which were considered the third type of study and were called HAM proposing research, as indicated in **Table 15**.

RQ3 & RQ4: Which of the 6 domains/fields has used these HAM approaches more, and Which types of HAM approaches have been applied over 18 year period based on 6 domains/fields?

The third section and **Tables 2-14** present the answers to questions three and four. These tables reveal that out of selected 160 articles, HMMA was ranked first with 54 studies (33.75%), and many of the studies categorized in this area either developed or improved HAM approaches. Furthermore, out of the 6 application fields/domains, the RHA was ranked second with 35 articles (22.29%). More so, **Table 2** results show that prior papers used the econometric/regression modeling more as compared to other methods with 59 articles in these 6 applications fields/domains. The ratio-based method and composite method were second and third in rank with 37 and 18 articles, respectively. Moreover, the subjective method and residual income method had the fourth and fifth rank with 16 and 12 articles, respectively. In addition, MPP (2 articles), MCDM (3 articles), and DEA (2 articles) had the next subsequent ranks according to the findings in **Table 2**. More recent studies are concentrating on the emerging field of combined housing and transportation affordability. This review shows that there is a dearth of empirical research conducted on purchase (down-payment) and repayment (amortization) affordability and the possibility of measuring it through the application of more robust methodologies, particularly in developing economies characterized by underdeveloped housing market systems.

4.1. Implications for Practice and Research

The challenges of operationalising robust approaches (aside from ratio-based measures) as affordability standards with respect to their onerous data and expertise

Table 15. Distribution of articles based on research type.

Type of Research	Number of Articles	Percentage
HAM utilizing research	124	78
HAM developing research	19	12
HAM proposing research	17	10
Total	160	100

Source: Authors' summation.

requirements constrain their applicability, especially in most developing countries, where the availability of reliable data is a persistent challenge. The implication for research is therefore evident in the need to evolve a housing affordability metric that can reflect the practices of the housing market system in developing countries. This also implies that the governments in developing countries must set up machinery for the regular availability of up-to-date data on welfare and establish welfare systems that set minimum living standards.

4.2. Limitations of the Study and Future Research Direction

This survey suffers some limitations which could be suggested as future themes for research. First, the focus of this review is on various applications of different HAM approaches. Article publications of late 2018, if any, were excluded in this review due to the limited reporting time. Future surveys should expand the scope even further. Furthermore, this article also focused on 6 domains/fields. Thus, future research can utilize this study as a basis for further classification of other sub-fields and sub-areas, such as residual housing affordability [146] [159], price affordability, and mass housing affordability, amongst others. Another limitation was that information was obtained from high-impact journals, excluding non-peer-reviewed articles, textbooks, conference articles, master and doctoral dissertations, and unpublished studies relating to HAM issues. Therefore, future studies are encouraged to collect data from these scholarly grey literature and the results obtained can be compared with ours. Another limitation was that selected studies were found in English language journals only, journal article publications in the other languages were excluded in this study. It could suggest that this survey is not complete; however, it is the authors believe that most of the articles published in 47 high-ranking journals were comprehensively reviewed and included. In this view, this survey provides a deeper understanding of HAM approaches and their applications for early-career researchers and planners. It is also hoped that this study is used by scholars as a basis for studies further and by planners for making more precise decisions employing these approaches, and as a guide for researchers in enhancing HAM methodologies.

In addition, due to manpower and time limitations, the authors surveyed only journal article publications of six (6) major databases. Though, some important outlets may be found beyond this study's scope. Hence, as more comprehensive literature research, future reviews should cover other relevant databases. Finally, this review makes no pretense at covering all published scholarly research on housing affordability measurement and application, which met the authors' inclusion criteria. It is possible that a few studies may have slipped or erroneously excluded. However, it is the belief of the authors that this review extensively covers significant studies in this field of enquiry.

5. Conclusions and Recommendations

The findings of this study suggest that certain HAM approaches are better suited

for specific situations, while other applications should avoid certain methods entirely. Several methodological issues were observed in most of the articles studied, making it intricate to stipulate a precise pathway. However, the study recommends that future studies should include temporal and historical perspectives while answering salient research questions like 1) What differences are there between approaches and methods published in the early 2000s, and those of recent decades? 2) What changes are observed in this field within the last 18 years? Such a historical context may throw more light on the repackaging or recycling of older methods (e.g. residual income method into “new” ones, e.g. location-sensitive residual income [LSRI] method). In this view, understanding how models and concepts evolve over time and how these trajectories reshape and change the housing affordability concepts over the years would be of immense international interest.

Moreover, this review did not include methods developed and applied in books as well as housing affordability indexes (HAI) developed and applied by housing professionals and associations. However, it is worthy to note that the studies reviewed in this paper allow at least a partial representation of the structure of those HAM approaches, which are attracting wider application and acceptability. Recently developed modular and hybrid methods are becoming increasingly important such as the location-sensitive residual income (LSRI) method. Which are based on previously established and well-accepted normative methods, and their modification, as well as the combination of several other affordability indicators, to formulate an aggregated measure. Relatively, recently adapted MCDM and DEA methods, in addition to the newly developed MPP methods were speedily developed and used to address reoccurring problems of affordability. Although there is insufficient evidence in the studies using these emerging methodologies, due to their complexity, reporting technique, and heterogeneity. However, they may be effective and efficient methods for measuring housing affordability problems of low-income families. To assess the potential benefits of these methods most effectively, it will be important for future research to utilize these novel methodologies. Thus, it will be necessary for future reviews to publish on these issues. In conclusion, this research developed a repository of extant studies on housing affordability measurement, which scholars can use to develop theory and models, and by planners to assess intervention strategies they propose.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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