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RETIREMENT PREDICTION MODELLING: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

The topic of retirement has been the subject of much debate in previous literature. However, there has been limited exploration within the specific context of retirement funds modelling. Therefore, this paper aims to offer insights into the relevance of consumption in retirement modelling through a systematic literature review. The study utilized the Preferred Reporting Items for Systematic Reviews (PRISMA) method for collecting journal articles, focusing on publications from January 2000 to January 2023. From a pool of 1,822 articles sourced from Scopus and WoS, only ten were selected for an in-depth review. This paper emphasizes the methodologies employed in the selected articles and the predictor of retirement planning. The analysis revealed that three articles incorporate consumption in their retirement modelling. However, only one article within the reviewed literature has implicitly suggest the possible effect of consumption as an indirect antecedent for retirement modelling. Considering the significance of consumption, especially its potential drastic changes post-retirement, this aspect proves essential in influencing the overall amount required for retirement planning.

Keywords: Retirement, predictive analytic, consumption pattern, systematic literature review.

INTRODUCTION

The rapid evolution of technology in recent years has facilitated a remarkable transformation in our way of life. It has also played a pivotal role in reducing mortality rates and extending life expectancy (Cervellati and Sunde, 2005), signifying a profound paradigm shift. This transformative progress,

attributed to advances in healthcare, technology, and evolving lifestyles, has induced a significant demographic shift on a global scale. As individuals experience longer lifespans, the challenges associated with an aging population and retirements become increasingly pronounced. According to a United Nations' (2019) projections, by the year 2050, one out of every six individuals will be aged 65 and above, posing multifaceted challenges. This includes a strain on healthcare systems, the imperative need for robust social support networks, and potential economic implications stemming from a shrinking workforce.

Effectively addressing these challenges is not just advisable but critical to ensuring a sustainable and inclusive future for the aging population. The decline in the number of young individuals entering the workforce in the last 30 years to pursue higher education has increased economic inactivity (Crowley, 2024). This raises legitimate concerns about the ability of future generations to adequately provide for the growing elderly population's needs. The conventional pension system, which has historically relied on a defined benefit plan, now faces sustainability issues due to a scarcity of younger workers available to sustain the increasing number of elderly retirees. Crowley (2024) discussed the changing landscape of the youth labor market, emphasizing how declining workforce participation rates impact pension sustainability. This highlights the urgent need for alternative financial strategies in retirement planning. Therefore, an urgent exploration of alternative solutions and the development of innovative strategies becomes not just advisable but imperative for safeguarding the welfare and financial stability of both present and future generations.

The Global Pension Index 2020 serves as a comprehensive document that sheds light on the prevailing substantial disparities in retirement savings adequacy on a global scale. This reveals that numerous nations are confronted with the formidable challenge of ensuring a satisfactory income for their citizens during retirement, a challenge further exacerbated by the concurrent factors of aging populations, resource strain, and the relentless upward trend in life expectancy. However, amidst this intricate landscape, certain nations stand out as exemplars of effective retirement income systems, showcasing their prowess in navigating these challenges. These countries, including but not limited to the Netherlands, Denmark, and Australia, have distinguished themselves by implementing formidable social security systems and pension plans. This, thereby, provides their citizens with robust safety nets that alleviate the financial burden associated with retirement and foster a profound sense of security and tranquillity among retirees.

In Malaysia, a distinctive scenario unfolds as a noteworthy segment of the workforce, aged 54 and above, finds itself in possession of retirement savings falling below the threshold of RM250,000 (World Bank Group, 2020), indicative of a pressing concern. The nation, according to projections, is poised to transition into an aging society by the year 2044, magnifying the exigency for prompt and comprehensive measures to navigate the imminent challenges associated with an increasingly elderly population. This demographic shift is underscored by economic challenges evident in employment statistics for individuals aged 55 to 64, wherein a mere 45.2% are engaged in formal employment. This amplifies apprehensions regarding the country's capacity to support and sustain its burgeoning aging population effectively.

The ubiquitous challenge of the cost of living exerts a shared concern across diverse nations, manifesting its impact on the adequacy of retirement savings. This concern is not unique to Malaysia. Similar challenges reverberate in the Netherlands, where 31% of households confront a lower gross replacement rate than the optimal 70%, as evidenced by the study conducted by Knoef et al. (2016). Likewise, the United States had to grapple with insufficiencies in retirement savings, as a staggering

51% of households found themselves inadequately prepared (Pang and Warshawsky, 2014). This predicament is not confined to specific regions. It is a global issue that necessitates concerted attention and continuous efforts for improvement in the realm of retirement savings adequacy.

The COVID-19 pandemic, declared a global health crisis by the World Health Organization on March 11, 2020, prompted the Malaysian government to implement financial aid packages, including the i-SINAR scheme, allowing individuals to withdraw up to 10% of their savings from the Employee Provident Fund (EPF). While providing temporary relief, the long-term consequences, especially on retirement savings, must be considered. The pandemic has not only impacted financial concerns but has also transformed consumer behaviour. From panic-induced buying to the acceleration of e-commerce adoption, consumers have shifted their preferences and methods of acquiring goods and services. This shift challenges traditional establishments and underscores the enduring legacy of the pandemic on consumer behaviour.

In March 2023, amid an overarching reduction in inflation to 3.4%, specific sectors, notably food, non-alcoholic beverages, restaurants, and hotels, demonstrated a resilient persistence in maintaining elevated inflation rates (Department of Statistics Malaysia, 2023). This economic phenomenon accentuates the profound impact on essential daily household necessities, accentuating the imperative for meticulous financial planning, particularly for socioeconomically vulnerable groups such as the B40 (Bottom 40%, income classification in Malaysia) category. The realm of retirement planning takes centre stage as an indispensable financial concern, with the strategic decisions made in this sphere wielding considerable influence over both the overall financial well-being and the nuanced consumer behaviour of individuals. Noteworthy research endeavours, exemplified by the comprehensive work conducted by Grace et al. (2010), substantiate the intrinsic connection between retirement planning and various facets of consumer behaviour, encompassing pivotal elements such as savings proclivities, expenditure patterns, and lifestyle decisions. These empirical studies reveal the intricate interplay wherein retirement planning shapes the percentages earmarked for savings and delineates allocation strategies, influences spending dynamics, and moulds lifestyle preferences. This, ultimately, elucidates the far-reaching implications of retirement decisions on the broader financial and behavioural landscape.

In conclusion, this study explores the predictors or determinants of retirement models through systematic analysis and comparative modelling analysis. The need for proactive measures, innovative solutions, and robust social security systems becomes increasingly evident in ensuring a secure and sustainable future for individuals in their post-work years.

LITERATURE REVIEW

In a dedicated effort to enrich the already extensive knowledge archived on the subject, this comprehensive study delves into previously conducted research and specifically focused on predictive modelling in retirement planning. Employing a structured approach, this review provides both scholars and industry professionals with invaluable insights into the existing methodology and modelling techniques as well as predictor variables for retirement planning. The aim is to facilitate a deeper understanding of predictive modelling and its implications in the realm of retirement planning. Furthermore, it examines the existing literature, identifying any significant gaps that may exist and address for future research in this field. Through a thorough evaluation, this research sheds light on achievements and advancements, particularly focusing on comprehending the substantial empirical and theoretical impact on cognitive, psychological, and environmental effects. Moreover, by delving into

these aspects, this investigation seeks to enhance our understanding and provide valuable insights for further exploration in this domain.

Retirement planning has emerged as an increasingly pressing financial concern for countless individuals in recent years. The decisions surrounding retirement can reverberate throughout a lifetime, significantly impacting overall financial health. According to Grace et al. (2010), retirement planning remarkably influences consumer behaviours. These behaviours encompass a wide range of aspects, including the level of savings, spending propensities, and even choices pertaining to one's lifestyle. Notably, devising a retirement plan holds tremendous power in shaping our financial landscape.

As indicated by a recent study by Lee et al. (2023), the process of retirement planning exerts a substantial influence on consumer behaviour, encompassing not only the quantum of savings, but also the strategic allocation of those savings. Lee et al. (2023) further highlighted that retirement planning behaviour is influenced by various determinants, including psychological and financial factors, and has significant outcomes on consumers' financial well-being. Generally, individuals who actively engage in comprehensive retirement planning demonstrate a heightened inclination to set aside a more substantial proportion of their income, showcasing a proactive commitment to securing their financial future during their post-work years. Fang et al. (2022) suggested that financial advice and financial literacy complemented each other in guiding individuals toward better retirement-saving decisions. Their study indicated that those with higher financial awareness were more likely to engage in structured retirement planning, ensuring better financial security. This heightened awareness and strategic consideration in investment decisions showcase the direct correlation between the intricate process of retirement planning and the conscious decision-making of consumers. This finding underscored the pivotal role that retirement planning plays in shaping not only the immediate financial landscape, but also the long-term financial security and overall well-being of individuals. In addition, it accentuated the profound impact of such planning on the trajectory of one's financial journey, highlighting how a thoughtful and strategic approach to retirement preparation can significantly contribute to ensuring a stable and prosperous post-retirement life. In essence, the study underscored the crucial link between proactive retirement planning and the holistic financial health and well-being of individuals, emphasizing the far-reaching implications of such conscientious financial decision-making.

As individuals approach the juncture of retirement, their financial priorities come to the forefront, propelling them to engage in thoughtful contemplation of lifestyle choices aimed at curbing expenses and securing a future marked by comfort and financial stability. This contemplative process often entails strategic measures, such as downsizing their current residence, opting for relocation to more economically viable areas, and adopting a frugal mindset to manage and optimize their expenditures carefully. Recent research highlights the critical role of financial literacy in shaping these retirement decisions. According to Gallego-Losada et al. (2022), individuals with higher financial awareness are more likely to engage in structured retirement planning, which influences key financial behaviors such as downsizing, reallocating assets, and adjusting consumption habits. Their bibliometric analysis underscored the significance of early financial education. It demonstrates that individuals who proactively plan their finances are better equipped to adapt their spending habits to ensure long-term financial security. In this intricate web of financial decision-making, retirement planning emerges as the linchpin that holds the key to a transformative shift in consumer behaviour. It acts as a catalyst for individuals to undertake a comprehensive re-evaluation, not only of the quantum of their savings but also of the strategic allocation of those savings and the recalibration of their lifestyle choices. This transformative power of retirement planning extends far beyond the immediate financial considerations, exerting a profound and enduring influence on the trajectory of how consumers navigate and negotiate

their financial journey. Kutlu-Koc et al. (2017) discovered that individuals adjust their consumption patterns in response to retirement planning, reducing discretionary expenditures while prioritizing financial stability in essential categories like healthcare and housing. In essence, retirement planning becomes a transformative journey in and of itself, setting the stage for an economically secure retirement. The multifaceted nature of these strategic financial decisions, as underscored by the insights gleaned from Grace et al. (2010), forms the cornerstone of a well-informed approach toward achieving financial stability and a comprehensive and enduring state of economic security as individuals transition into their retirement years.

Extensive research in recent years has delved deeply into the potential economic ramifications associated with deferred retirement planning. A particularly nuanced study concentrated on individuals aged 65 to 74 contemplating a return to the workforce, which has brought to light the considerable financial setbacks intertwined with procrastination in retirement planning. These individuals frequently find themselves grappling with substantial financial losses due to their inability to reclaim earnings and Social Security benefits that would have otherwise been accessible to them (Wargo-Sugleris et al., 2018; Nurmeksela et al., 2023). Consequently, the ripple effect of delayed retirement planning extends beyond individual consequences, permeating into a broader societal context. Research by Fang et al. (2022) further supported this, demonstrating that individuals who postponed retirement without a structured financial plan were more likely to experience economic instability. Their findings indicated that those with lower financial literacy often delayed crucial decisions, leading to suboptimal investment strategies and reduced retirement savings. Indeed, the growing dependency on post-retirement employment contributes to broader economic challenges, such as labor market imbalances and increased government spending on social welfare programs. This underscored the need for comprehensive financial education and proactive retirement planning to mitigate these effects (Crowley, 2024).

The deferred consideration of retirement planning ultimately engenders a discernible decrease in overall financial security, thereby contributing to an augmented prevalence of individuals residing in poverty within this specific age demographics. The fiscal losses incurred due to the postponement of retirement planning, while seemingly immediate, cast a far-reaching and lasting impact on the economic well-being of those navigating this crucial life stage. Recent studies have highlighted that individuals who delayed financial preparation faced higher economic vulnerability, with many falling below the poverty line post-retirement (Jun, 2020). According to Low (2024), those who failed to plan for retirement proactively often resorted to last-minute financial decisions, leading to suboptimal savings and poor investment choices, further exacerbating economic instability. The reliance on social welfare programs and family support has also increased among retirees with inadequate savings, putting additional strain on government resources and younger working populations (Alphonse et al., 2024). Amani and Fussy (2023) emphasized that financial illiteracy was a major contributor to delayed retirement planning, as individuals without structured financial strategies were more likely to experience long-term insecurity. Furthermore, Rasiyah et al. (2022) argued that insufficient retirement preparedness impacted individual retirees and contributed to broader economic instability, affecting labor market dynamics and pension sustainability. It has become imperative for individuals to adopt a judicious and contemplative approach, meticulously contemplating the potential economic implications of their retirement planning decisions. Such conscientious decision-making is fundamental not only to safeguarding their financial interests, but also to collectively fortifying the economic security of this age group. As individuals weigh the multifaceted facets of their retirement planning decisions, they must consider choices that align with their long-term interests, fostering an environment conducive to improved overall economic well-being and resilience.

Retirement, often considered a monumental life milestone, necessitates thorough contemplation, given its potential to profoundly influence individuals' financial stability and way of life. The onus is on us to engage in meticulous planning, crafting, and sustaining a well-thought-out retirement strategy that considers indispensable factors such as targeted savings, the continually evolving demographic landscape, inflationary pressures, and judicious investment strategies. As Hartley et al. (2024) highlighted, inflation significantly erodes the purchasing power of retirement funds, necessitating proactive investment in inflation-protected assets to ensure financial security. Furthermore, this strategic approach must adeptly grapple with the profound implications arising from varied spending behaviours and expenditure patterns during the golden years, gracefully incorporating specific savings objectives to ensure a fulfilling and secure retirement. Krishnaveni et al. (2024) emphasized that balancing savings with strategic earnings through diversified financial instruments was crucial to mitigating inflation's impact on purchasing power. Failing to navigate these intricacies may jeopardize the attainment of the comfortable retirement one aspires to achieve. By understanding these potential impacts and adopting structured retirement planning strategies, as Anawanakak et al. (2024) suggested, retirees can steer clear of financial challenges in their retirement years and bask in enhanced financial security throughout their golden years.

This study has examined several prediction modelling methods utilized in retirement planning, along with their determinants, to predict retirement models. However, the key focus lies in recognizing the role of consumption as one of the crucial determinants in the predictive model of retirement. The findings bear significant implications in advancing prediction modelling, establishing a critical groundwork for accurately assessing retirement requirements. By shedding light on consumption patterns, this research contributes to the evolution of retirement planning strategies, ensuring a more secure and prosperous future for retirees. Considering the significant changes in how people consume and the unpredictable inflation fluctuations caused by the COVID-19 pandemic, it has become crucial to accurately anticipate and prepare for retirement needs. This entails understanding the intricate dynamics at play and incorporating them into predictive models to provide individuals and institutions with the tools they need to plan for their future effectively. This not only ensures financial stability, but also protects against unforeseen financial obstacles. Through this approach, we are empowering people to navigate retirement with confidence and peace of mind.

MATERIALS AND METHODS

To comprehensively explore the multifaceted realm of retirement and pension, a meticulously executed systematic electronic search was undertaken, encompassing a broad spectrum of studies published from 2000 to January 2023. The thoroughness of this exploration was fortified by leveraging the capabilities of two extensive databases, namely Scopus and Web of Science (WoS). The search string, meticulously curated, incorporated a diverse array of relevant keywords such as retirement, pension, retire, retiring, *pencen*, *bersara*, *pesara*, *persaraan*, prediction modelling, predicting model, and predictive modelling.

This study adopted an inclusive approach by incorporating literature published in both English and Malay, thereby facilitating a more comprehensive and contextually grounded evaluation of the subject matter. In constructing this review, the analysis delves into the domain of retirement planning and its determinants, drawing upon a diverse array of studies employing various methodological designs. The pursuit of a holistic understanding is underpinned by the critical examination of both cross-sectional and longitudinal research, enabling a nuanced exploration of temporal and contextual factors influencing retirement outcomes.

The dedicated focus resides exclusively on predictive modelling developed specifically for retirement planning, assuring the delivery of the most current and relevant information to our audience. To fortify the veracity of our findings, we judiciously included articles that drew upon both primary and secondary data sources, thereby guaranteeing a robust and well-rounded analysis of this vital subject matter. In the intriguing landscape of database searching, the omnipotent Boolean string takes center stage, serving as the key to unlock a vast realm of information. The adept extraction of this string, utilizing the remarkable capabilities of the Microsoft Excel application, results in the creation of a meticulously structured table.

The data, gathered with precision from the esteemed databases of Scopus and WoS, undergoes an apt compilation, leaving no room for redundancy. The harmonious merger of captivating headers, including titles, abstracts, and keywords, ensures a refined and cohesive collection. By eliminating duplication, its offering clarity and depth to our audience. The indispensable initial step in conducting a systematic review involves a comprehensive screening process, meticulously evaluating titles, abstracts, and keywords to ensure the inclusion of articles directly pertinent to the required criteria. Those that fall short of meeting the necessary criteria are promptly and judiciously removed from consideration.

Subsequently, all remaining articles undergo a thorough assessment through full-text reading to ascertain their eligibility for inclusion in the review. Finally, the selected articles, recognized as vital for the systematic review, will be exhaustively discussed in the next section, contributing to the academic discourse on this intricate and pivotal subject matter.

This systematic review adhered to the esteemed framework and guidelines established by the Preferred Reporting Items for Systematic Reviews (PRISMA), thereby ensuring a thorough and robust analysis. PRISMA encompasses four pivotal phases, namely identification, screening, eligibility, and inclusion, each intricately delineated in Figure 1. The initial phase, identification, entailed an exhaustive exploration of two reputable databases, Scopus and WoS, to pinpoint pertinent articles. To achieve this, the researchers had employed Boolean Operators and formulated a meticulous search string tailored specifically for the Scopus and WoS databases, as illustrated:

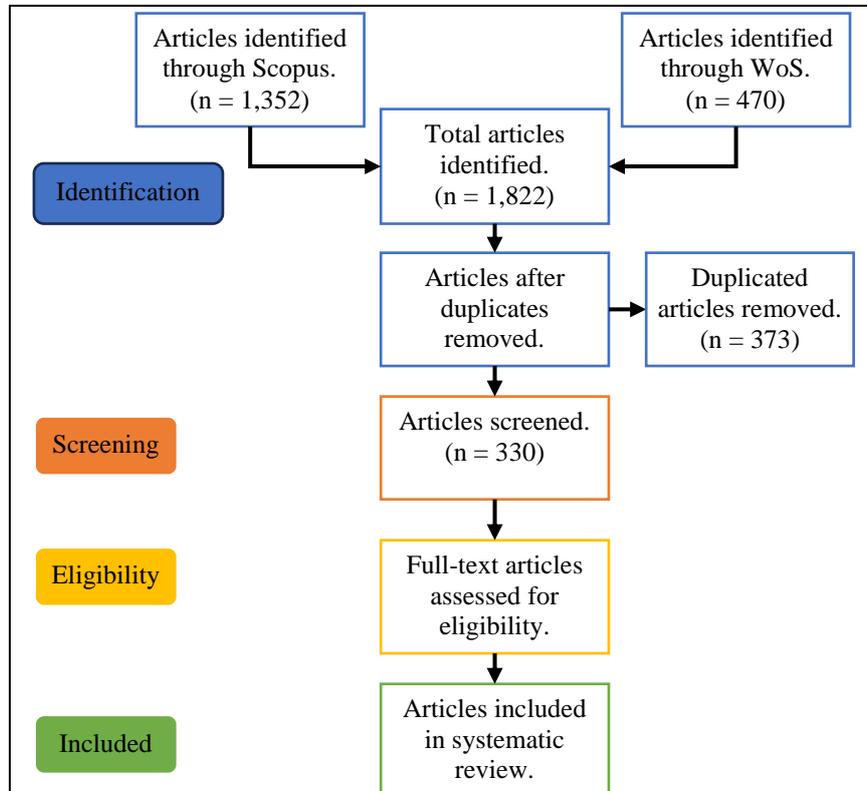
1. Search string for Scopus: TITLE-ABS-KEY (“retirement” OR “pension” OR “retire” OR “retiring” OR “pencen” OR “bersara” OR “pesara” OR “persaraan”) AND (“prediction” OR “predicting” OR “predictive” OR “forecasting” OR “forecast” OR “peramalan” OR “ramalan” OR “meramal” OR “ramal” OR “menjangka” OR “jangka” OR “jangkaan”) AND (“model” OR “modelling”)
2. Search string for WoS: (“retirement” OR “pension” OR “retire” OR “retiring” OR “pencen” OR “bersara” OR “pesara” OR “persaraan”) AND (“prediction” OR “predicting” OR “predictive” OR “forecasting” OR “forecast”) AND (“model” OR “modelling”)

The search yielded 1,822 articles, which 1,352 from Scopus and 470 from WoS. After removing 373 duplicates, 1,449 articles remained for further screening. The article screening process was guided by clearly defined inclusion criteria designed to support the main objective of this review i.e. identifying models and relevant predictors for retirement modelling, with a particular focus on consumption as a financial determinant. Articles were selected if met the following criteria: (1) applied a predictive modelling technique (e.g., regression, ARDL, option value, or logistic models); (2) examined retirement planning or prediction with an emphasis on financial or economic variables; (3) included consumption-related data or discussed its influence on retirement outcomes; and (4) provided statistical analysis or

model-based findings relevant to pre-retirement or post-retirement decision-making. From the 1,449 screened articles, 330 were shortlisted based on their titles and abstracts. Following a full-text review, only 10 articles met all inclusion criteria and were selected for analysis because they directly contributed to the understanding of how predictive models incorporate economic factors, particularly consumption, in retirement planning.

Figure 1

PRISMA Flow Diagram



The articles selected provided the empirical basis to identify key variables, statistical techniques, and model structures relevant to retirement prediction. This informed the conceptual development of a future model that more directly incorporates consumption as a critical determinant of retirement adequacy, particularly in developing country contexts such as Malaysia. The PRISMA flow diagram (Figure 1) illustrates the identification, screening, eligibility, and inclusion stages of this systematic review process-

The selected articles are further analyzed in the following section to identify publication trends, publishing country, citation analysis, modelling techniques, variables used, and the treatment of consumption as an implicit determinant in retirement prediction models.

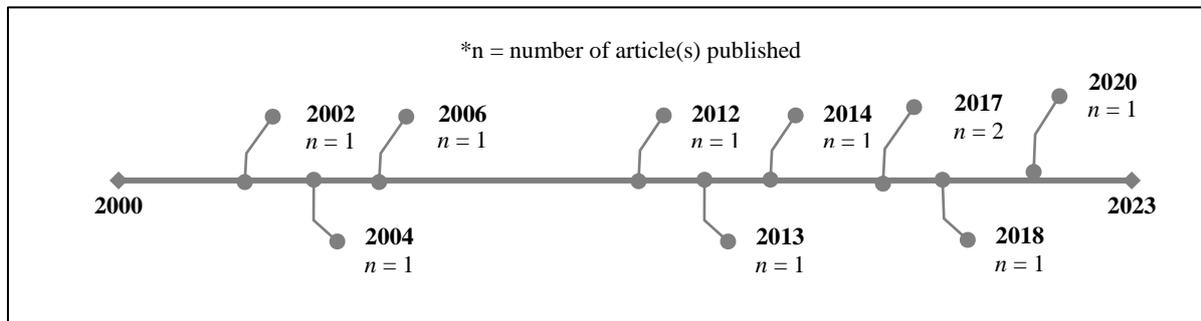
RESULTS

Demography

The comprehensive data collection process strictly focused on publications from January 2000 to January 2023, resulting in the study’s sample of 46 research articles. However, stringent selection criteria as discussed in the previous section, deemed only ten articles worthy of inclusion. All selected articles were published in English, with the year 2017 featuring the highest number of articles, i.e., two articles. Table 1 offers an overview of the selected articles, presenting their titles, publishers, countries of origin, and years of publication. Figure 2 visually represents the range of scholarly journals published from 2000 to 2023. This diagram provides valuable insights into the multitude of academic publications emerging within this timeframe, attesting to the continual growth of knowledge and research across fields of study. It offers a glimpse into the intellectual pursuits and advancements achieved throughout this period.

Figure 2

Number of Articles Published



A comprehensive series of studies was undertaken across seven countries, focusing on the publication of academic articles. Notably, the United States of America emerged as the most prolific contributor, publishing a total of three articles. This global-scale research provided valuable insights into the international landscape of publishing, reaffirming the significance and impact of scholarly output from the United States. The dissemination of articles related to the research topic, as delineated in Table 1, spans a diverse array of nations. In addition to the United States, the Netherlands, United Kingdom, Italy, Kazakhstan, Mexico, and Germany had each contributed individual research articles. This cross-national perspective highlights the broad reach and collaborative nature of academic contributions in the field.

Table 1

Selected Articles for the Systematic Literature Review

Author(s)	Year Published	Country Published	Journal
Holden S., VanDerhei J.	2002	USA	<i>EBRI Issue Brief</i>
Blake D.	2004	United Kingdom	Applied Financial Economics
Hopkins C.D., Roster C.A., Wood C.M.	2006	USA	Journal of Consumer Marketing

(continued)

Author(s)	Year Published	Country Published	Journal
Belloni M., Alessie R.	2013	Italy	Oxford Bulletin of Economics and Statistics
Bonsang E., Klein T.	2012	German	Journal of Economic Behavior & Organization
Alonso J., Alfredo D.	2014	Mexico	Journal of Pension Economics & Finance
Scharn M. et al.	2017	Netherlands	Scandinavian Journal of Work, Environment & Health
Kutlu-Koc V. et al.	2017	USA	De Economist
Slipsager S	2018	USA	Scandinavian Journal of Work, Environment & Health
Junusbekova G., Zhaumitova M.	2020	Kazakhstan	Journal of Open Innovation: Technology, Market, and Complexity

Table 2 presents the total citation of the selected articles from 2000-2023. The article by Bonsang and Klien (2012), titled "Retirement and subjective well-being", published in Journal of Economic Behavior & Organization, was the most cited, with 109 total citations and a citation rate of 9.91 citations per year. This was subsequently followed by the work of Holden and VanDerhei (2002), who analyzed retirement savings, and Hopkins et al. (2006), whose study on the retirement transition has received 67 and 52 citations, respectively. While the remaining articles have fewer than 30 citations each, they nonetheless contribute valuable insights into retirement behaviour by exploring its financial and occupational dimensions.

Table 2

The Total Citation for Selected Articles (2000–2023)

Author(s)	Title	Source	Total Citation	Citation/ Year
Bonsang, E, Klein, T	Retirement and subjective well-being	<i>Journal of Economic Behavior & Organization</i>	109	9.91
Holden S., VanDerhei J.	Can 401(k) accumulations generate significant income for future retirees?	<i>EBRI Issue Brief</i>	67	3.19
Hopkins C.D., Roster C.A., Wood C.M.	Making the transition to retirement: Appraisals, post-transition lifestyle, and changes in consumption patterns.	<i>Journal of Consumer Marketing</i>	52	3.06
Blake D.	The impact of wealth on consumption and retirement behaviour in the UK.	<i>Applied Financial Economics</i>	24	1.26

(continued)

Author(s)	Title	Source	Total Citation	Citation/ Year
Scharn M. et al.	Predicting working beyond retirement in the Netherlands: an interdisciplinary approach involving occupational epidemiology and economics.	<i>Scandinavian Journal of Work, Environment & Health</i>	22	3.67
Alonso J., Alfredo D.	A model for the pension system in Mexico: Diagnosis and recommendations.	<i>Journal of Pension Economics & Finance</i>	12	1.33
Belloni M., Alessie R.	Retirement Choices in Italy: What an Option Value Model Tells Us.	<i>Oxford Bulletin of Economics and Statistics</i>	7	0.70
Junusbekova G., Zhaumitova M.	The Efficacy of the Retirement Pension Provision System: Modeling and Assessing of the Case of Kazakhstan.	<i>Journal of Open Innovation: Technology, Market, and Complexity</i>	3	1.00
Kutlu-Koc V. et al.	Consumption Behavior, Annuity Income and Mortality Risk of Retirees.	<i>De Economist</i>	2	0.33
Slipsager S	The real risk in pension forecasting.	<i>Scandinavian Actuarial Journal</i>	2	0.40

The selected articles have been meticulously curated from a diverse array of internationally renowned and esteemed publishers, lending them a stamp of credibility and excellence. These publications span a broad spectrum of disciplines and are globally recognized for their rigorous review processes, ensuring the inclusion of only the most cutting-edge research and valuable insights. Typically, the majority of selected articles originate from journals with a notable H-index, underscoring their high impact and relevance in their respective fields. This correlation is pivotal, signifying that these journals consistently publish articles of exceptional quality and significance.

The selected articles are sourced from various high esteem journals as shown in Table 3. Notably, the Scandinavian Journal of Work, Environment & Health, with an H-index of 115 and impact factor of 1.4, which published two articles related to retirement financial modelling between 2000 and 2023. Although the Journal of Economic Behavior & Organization and the Journal of Consumer Marketing have the highest H-index scores, 144 and 122 respectively, each has published only one article related to retirement planning. Similarly, the remaining journals such as Applied Financial Economics, Oxford Bulletin of Economics and Statistics, Journal of Open Innovation: Technology, Market and Complexity, De Economist, Journal of Pension Economics & Finance, and EBRI Issue Brief had each published selected articles offering invaluable insights into retirement planning. The wealth of knowledge encapsulated within these prominent journals has significantly contributed to the continuous evolution

of economic behaviour, consumer marketing, statistics, financial economics, open innovation, economic analysis, and pension finance.

Table 3

H-Index, Impact Factor and Cite Score for Selected Journal

Journal Name	H-index	Impact-Factor	Cite Score
Journal of Economic Behaviour & Organization	144	2.3	4.4
Journal of Consumer Marketing	122	3.3	6
Scandinavian Actuarial Journal	115	1.4	3.4
Applied Financial Economics	98	2.1	4.1
Oxford Bulletin of Economics and Statistics	88	1.4	3.5
Journal of Open Innovation: Technology, Market and Complexity	50	1.2	14
De Economist	36	2.3	1.5
Journal of Pension Economics & Finance	33	1.3	3.5
EBRI Issue Brief	13	n/a	n/a

DISCUSSIONS AND IMPLICATIONS

Data and Statistical Technique

Embarking on the research journey necessitates a pivotal decision between opting for primary or secondary data collection, each accompanied by a distinct set of advantages and disadvantages that inherently mould the trajectory of a successful investigation. The gathering of primary data, sourced firsthand from original outlets, yields unparalleled authenticity and exclusivity, yet demands considerable time, effort, and resources. Conversely, secondary data extracted from pre-existing sources offers advantages in terms of speed, convenience, and cost-effectiveness, albeit with potential drawbacks related to bias and relevance.

Throughout the process of conducting this systematic review, a discernible pattern emerged as most selected research articles, with a singular exception, relied heavily on the utilization of secondary data derived from previously conducted questionnaires or surveys. This collection of valuable information spanned diverse time frames, encompassing both cross-sectional and longitudinal data, underscoring the breadth of our dataset. The robust reliance on this wealth of past research serves to reinforce the credibility and veracity of our findings.

While each article in the review introduced distinct variables, it was evident that income and age cohort emerged as the two most commonly addressed variables across all selected studies. This thematic consistency across various research works contributes to the coherence and comprehensiveness of our investigation, further enhancing the reliability of the conclusions drawn from the systematic review.

In the context of this systematic review, it is noteworthy that almost all the selected articles, barring one, exclusively relied on secondary research methods for data collection. This deliberate

methodological choice involves scrutinizing existing information gathered by other researchers or organizations, providing a valuable avenue for investigating the subject matter at hand. Opting for secondary research methods allows for a broader perspective and facilitates a more profound analysis, yielding insightful findings that significantly contribute to the body of knowledge on the topic.

Illustrating this approach are the studies conducted by Bonsang et al. (2012) and Belloni et al. (2013). Both research teams conducted extensive analyses, utilizing valuable secondary data extracted from surveys that comprised multiple past studies. These studies, compiled in an in-depth longitudinal manner, allowed the researchers to delve deep into underlying patterns and trends over time. For instance, Belloni et al. (2013) meticulously gathered work histories of Italian individuals spanning the years 1985 to 2004, while the research by Bonsang et al. (2012) delved into the German Socio-Economic Panel data, covering a substantial period from 1984 to 2021. Both studies, encompassing a significant sample size of 4,541 individuals, offer invaluable insights into the labour market dynamics of their respective countries.

In contrast, the pioneering research conducted by Kutlu-Koc et al. (2017) illuminated the intricate dynamics surrounding consumption and activities in the United States. Their meticulous examination utilized data extracted from the comprehensive Consumption and Activities Mail Survey, employing a cross-sectional methodology. Spanning the period from 2001 to 2009, their analysis delved into the multifaceted nuances of American society, revealing an array of enlightening patterns and trends in the realm of human behaviour and lifestyle choices. These gathered findings serve as an essential resource, offering invaluable insights into the nation's ever-evolving economic landscape. By bridging temporal gaps and analyzing employment trajectories, these datasets enable researchers to better understand the evolving socio-economic landscape in Italy and Germany as well.

In the research conducted by Scharn et al. (2017), a singular and invaluable article emerges, presenting a thorough examination of the complex subject matter surrounding transitions in employment, ability, and motivation. To gather primary data of utmost significance, the scholars skilfully employed a specially designed survey methodology, drawing inspiration from the esteemed Study on Transitions in Employment, Ability, and Motivation initiated by Statistics Netherlands. Through the utilization of surveys, the authors aptly explored the multifaceted dimensions of this pertinent research area, providing a rich resource for professionals, academics, and policymakers alike. The tabulation of data used in the respective selected articles is as organized in Table 4.

In the realm of research, a nuanced understanding of statistical methods is integral to the procedural framework. Each selected article employs distinct statistical methods tailored to the unique requirements of their respective studies. While two articles opted for the regression method, it did not emerge as the predominant statistical technique in most cases. Regression analysis, recognized as a prevalent predictive analytic method, particularly in financial prediction, stands out as a key approach within the broader spectrum of predictive analytics. Notably, Blake et al. (2004) utilized the autoregressive method, and Scharn et al. (2017) opted for logistic regression, highlighting the diversity of statistical methodologies employed.

Table 4

Statistical Method Used in Articles Reviewed

Author(s)	Data collection method	Statistical method
Blake D.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Autoregressive distributed lag (ARDL) model Merton model
Holden S., Van Derhei J.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Accumulation projection model Baseline model Multivariate analysis of variance (MANOVA)
Hopkins C.D., Roster C.A., Wood C.M.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Analysis of variance (ANOVA) Structural Equation modelling, Option value model conditional multiple-year OV model (CMY): single-year and multiple-year
Belloni M., Alessie R.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Random preferences for leisure (RL models)
Bonsang E., Klein T.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Fixed effected model
Alonso J., Alfredo D.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Generational Accounting model
Scharn M. et al.	<ul style="list-style-type: none"> Primary data 	<ul style="list-style-type: none"> Logistic Regression Model
Kutlu-Koc V. et al.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> The Singles Model The Couples Model
Slipsager S	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Markov process Kalman filter
Junusbekova G., Zhaumitova M.	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Multi-factor assessment model

Table 4 provides a comprehensive overview of a diverse set of statistical techniques used across the reviewed studies, including regression models, autoregressive distributed lag (ARDL) models, and structural equation modelling (SEM). However, it lacks a comparative discussion on why some methods were preferred and under what conditions they were able to perform optimally. For instance, regression models were widely used in predictive modelling due to their interpretability and statistical robustness (James et al., 2013). However, alternative methods like ARDL were particularly useful for analysing dynamic relationships over time, making them suitable for economic forecasting (Pesaran & Shin, 1999). ARDL in retirement modelling could strengthen its analysis by explicitly comparing these methods based on key factors such as sample size, data type (cross-sectional vs. longitudinal), and computational complexity. Additionally, logistic regression, as used in Scharn et al. (2017), has been found to be appropriate for categorical outcome variables, making it valuable in retirement planning scenarios where decisions were often binary (e.g., retiring vs. continuing work). In contrast, autoregressive models, such as those employed by Blake et al. (2004), were more suitable for time-series forecasting, particularly when predicting financial market trends affecting retirement savings. A detailed comparative analysis would provide a clearer understanding of the method best suited for different research objectives.

Furthermore, the applicability of predictive models in retirement planning depends significantly on economic conditions and policy frameworks, which vary by country. The current paper has acknowledged the potential for variations in the data sources. However, it did not assess how economic and policy differences influenced model applicability. For example, pension systems in Europe and the United States of America (USA) operate under different regulations, affecting labor market participation and retirement savings behavior (Barr, 2014). The “option value model” used by Belloni and Alessie (2013) considers the impact of social security incentives on retirement decisions. However, this model may yield different predictions in countries with less generous pension schemes. A cross-context evaluation could compare predictive models under various economic and policy conditions, such as varying retirement age policies, taxation on pension income, and healthcare costs. Further, the differences in economic cycles and labor market conditions across countries suggest that certain models may be more effective in stable economies (e.g., Germany) than those experiencing high volatility (e.g., emerging markets). Thus, incorporating a broader discussion on cross-country applicability would improve the robustness of the findings.

Most of the selected papers have acknowledged the predominant reliance on secondary data, but a more in-depth discussion on potential biases and limitations appears to be necessary. Secondary data, while cost-effective and comprehensive, often suffer from issues such as selection bias, outdated information, and lack of control over data collection methodologies (Johnston, 2017). One potential solution is incorporating hybrid data collection approaches, such as supplementing secondary data with targeted primary data collection through surveys or experiments (Groves et al., 2009). For example, while Scharn et al. (2017) utilized primary data collection, other studies have relied on historical datasets (Fang et al., 2022; Belloni & Alessie, 2013; Bonsang & Klein, 2012). A discussion on integrating primary data (e.g., real-time survey responses on retirement intentions) with secondary data (e.g., historical economic trends) would enhance the reliability and depth of the analysis. Hybrid models that blend secondary data with real-time inputs from focus groups or expert panels could further refine predictions in retirement planning.

Incorporating comparative statistical analysis, cross-context economic evaluations, and critical discussions on data limitations strengthens the framework and analytical rigor of retirement planning studies. As a result, it deepens the evaluation of predictive modelling techniques and provides a more holistic understanding of their strengths, limitations, and adaptability across diverse policy and economic environments. In sum, the most relevant and applicable models identified include the ARDL model (Blake, 2004) and logistic regression (Scharn et al., 2017). These are highlighted for future adoption in developing-country contexts due to their flexibility with different data structures and policy environments.

Consumption as a Significant Determinant in Retirement Planning

Table 5 shows the analysis of variables across the 10 selected articles. It reveals a strong emphasis on economic and financial predictors such as wealth, income, pension savings, annuity income, and investment returns, which are commonly linked to dependent variables like retirement timing, consumption behavior, and future retirement income (Blake, 2004; Holden & VanDerhei, 2005; Kutlu-Koc et al., 2017).

Table 5

Variables Used in Articles Reviewed

Author(s)	Year Published	Predictor Variable	Dependent Variable
Blake D.	2004	Wealth Income Financial assets Demographic factors	Consumption Expenditure Retirement timing
Holden S., VanDerhei J.	2005	401(k) accumulation Investment returns Contribution behavior Participation rate	Future retirement income, Financial readiness for retirement
Hopkins C.D., Roster C.A., Wood C.M.	2006	Retirement appraisals Health condition Retirement planning Lifestyle expectations	Post-retirement lifestyle Changes in consumption patterns
Belloni M., Alessie R.	2013	Option value of retirement Pension wealth Policy incentives Health status Age Labor market conditions	Retirement decision (timing), Probability of early retirement
Bonsang E., Klein T.	2012	Retirement status Pre-retirement employment status Marital status Health condition	Subjective well-being Life satisfaction
Alonso J., Alfredo D.	2014	Pension system structure Replacement rate Contribution rates Retirement age policy Fiscal parameters Physical health	Pension system sustainability Adequacy of pension benefits System performance
Scharn M. et al.	2017	Mental health Occupational characteristics Socioeconomic status Motivation to work Annuity income	Probability of working beyond retirement Labor force participation after retirement
Kutlu-Koc V. et al.	2017	Mortality risk Health status Wealth Demographics	Consumption behavior of retirees Spending patterns Financial security
Slipsager S	2018	Pension forecasting assumptions Longevity risk Inflation Investment returns	Accuracy of pension forecast Risk in pension outcomes
Junusbekova G., Zhaumitova M.	2020	Pension provision policies Economic indicators Demographic trends Pension fund structure	Pension system efficacy Retirement income stability

Several studies incorporate behavioral and demographic factor such as age, lifestyle expectations, and motivation to work, alongside health-related variables like physical and mental health or mortality risk, reflecting a growing interdisciplinary approach (Hopkins et al., 2006; Scharn et al., 2017). Policy and systemic elements, including pension system structures and contribution rates, are also notable predictors in evaluating outcomes like system sustainability and adequacy (Alonso et al., 2014; Junusbekova & Zhaumitova, 2020). A trend emerges toward integrating subjective measures such as life satisfaction and well-being (Bonsang & Klein, 2012) and highlighting the importance of assumptions in pension forecasting (Slipsager, 2018). Overall, the variables indicate a shift from purely economic models to more holistic frameworks that consider financial readiness, personal health, and social dynamics in understanding retirement outcomes, though most studies remain rooted in developed country contexts, signaling a need for localized models in diverse socio-economic settings (Belloni & Alessie, 2013).

The main aim of this comprehensive systematic review was to scrutinize diverse approaches to predictive modelling in retirement planning, specifically emphasizing financial considerations rather than behavioural aspects. In our meticulous analysis of the selected articles, a notable observation emerged, a limited number of studies, notably Blake (2004), Hopkins et al (2006) and Kutlu-Koc et al. (2017) integrated consumption in their retirement prediction models. Blake (2004) underscored the unresolved impact of pension wealth on consumption in previous research, emphasizing the imperative for enhanced estimations in this crucial area. Although Black (2004) did not explicitly emphasize that consumption is a direct predictor of retirement, he suggested an indirect effect. Based on Blake (2004), supported by the theoretical foundation of Hurd (1990) and the empirical modeling of French (2005), it is plausible to treat consumption as an indirect predictor of retirement behavior. Although this relationship is not explicitly modeled in Blake (2004), it can be inferred through the presence of overlapping variables in both the consumption and retirement models, the life-cycle logic that links consumption preferences to decisions on labour force participation, and supporting empirical and theoretical literature that demonstrates how consumption needs influence labour supply and, ultimately, the timing of retirement. Consequently, this review was aimed at contributing significantly to the advancement of retirement planning strategies by illuminating this vital but underexplored factor.

A pivotal determinant incorporated into the optimal modelling framework is consumption, and will play a substantial role in testing the underlying hypotheses. While exploring this aspect, certain articles, including those by Hopkins et al. (2006) and Kutlu-Koc et al. (2017), acknowledged the presence of consumption. However, these studies predominantly delved into discussions from a behavioural perspective rather than exploring its financial implications. This distinction underscores the multidimensional nature of consumption, highlighting the diverse perspectives that scholars adopt when examining its role in various contexts.

Accordingly, Blake (2004) asserted that the most appropriate functional form for analysing consumption is the linear function of wealth. This conclusion is reached through the utilization of the ARDL model and Merton's model, encompassing various variables such as income, labour market conditions, demographic status, and spillover effects from other sectors. Empirical evidence gleaned from samples taken in the UK during the late 1980s and early 1990s demonstrates that this consumption equation forecast outperforms other competing models. Notably, Blake (2004) revealed results that deviate from the widely accepted life cycle hypothesis. The marginal impact of pension wealth on consumption, market imperfections, and consumers' acknowledgment of borrowing against the illiquidity of pension assets demonstrate no significant effects on consumption. Additionally, Blake (2004) uncovered a noteworthy surge in consumer expenditure from 1985 to 1988 and predicted a

continued rise in the coming years. This compelling research casts new light on the intricate relationship between pension assets and consumer spending behaviour.

CONCLUSION. LIMITATIONS, AND DIRECTIONS FOR FUTURE STUDIES

This systematic literature review revealed a critical gap in current retirement prediction models, specifically, the underrepresentation of consumption as a core financial determinant. While traditional financial variables such as income, annuities, and savings are frequently incorporated into predictive frameworks, only a limited number of studies (e.g., Blake, 2004; Kutlu-Koc et al., 2017; Hopkins et al., 2006) explicitly considered consumption. Even in those cases, consumption was typically positioned as a behavioural outcome rather than as a proactive driver of retirement adequacy.

By synthesizing findings from ten selected studies, this review contributes to the evolving discourse on retirement planning by emphasizing the need to integrate consumption patterns, particularly pre-retirement consumption behaviour, into financial prediction models. This perspective is reinforced by Solomon (1983), who argued that consumption serves as a vehicle for identity expression and social belonging. Such insights highlight the psychological and social significance of consumption across the life course, reinforcing its relevance in the context of retirement planning. This integration is particularly vital for developing countries such as Malaysia, where ensuring retirement savings adequacy remains an urgent policy and research priority.

Several limitations of this review must be acknowledged. First, the analysis was based on a relatively small sample of ten studies, potentially constraining the generalizability of the findings. Second, the majority of these studies were conducted in developed countries, which may not reflect the socio-economic and cultural contexts of developing nations like Malaysia. Third, the reliance on secondary data within the reviewed literature limits the capacity to draw nuanced, context-specific insights regarding real-time consumption behaviour. Finally, as this study is literature-based, it did not empirically test any predictive models, which constrains the direct applicability of its conclusions.

Future research should aim to design and empirically validate retirement prediction models that explicitly incorporate consumption as a central financial determinant. This includes accounting for factors such as income volatility, inflation, and evolving consumption habits influenced by lifestyle changes and macroeconomic shifts. Given the heavy reliance on secondary data in existing literature, primary data collection—through surveys, interviews, or longitudinal studies—is essential to capture real-time behavioural insights and improve model accuracy in specific contexts.

There is also a compelling need to adapt and validate these models using localized socio-economic variables, particularly in Southeast Asia, where challenges such as informal employment, limited pension coverage, and weak social safety nets significantly impact retirement outcomes. Furthermore, post-COVID-19 behavioural shifts such as increased digital consumption and reduced discretionary spending, should be closely examined to understand their long-term implications on retirement preparedness and financial well-being.

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