Pension Security in India
Progress and Prospects

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Editor

Deepak Mohanty

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Foreword

Retirement security stands at a momentous juncture in India, underscored by its evolving demographic landscape, urbanisation, increasing longevity and falling fertility. The demographic dividend has provided a window of opportunity to build a robust pension system in time before cohorts of millions of the population begin to age simultaneously. Ensuring adequate financial well-being for the ageing population in the future presents a critical imperative. This opportunity is further facilitated by the development of public digital infrastructure and the Indian stack of JAM (Jandhan Account, Aadhaar, and Mobile) trinity.

The organised sector, which constitutes less than 20% of the workforce in India, mandatorily has some kind of pension coverage such as Employees' Provident Fund Scheme and National Pension System. It is the informal sector which poses the biggest challenge in providing the coverage due to tenuous employer employee relationship and often their migratory nature. Atal Pension Yojna (APY) scheme, a universal social security scheme for the poor, under-privileged and the workers in the unorganized sector has shown a tremendous and significant growth both in terms of number of cumulative enrolments and assets under management in last decade, since its announcement in the Union Budget 2015-16.

"Pension Security in India: Progress and Prospects" offers a timely and insightful contribution to this vital discourse. This volume is a an outcome of the 1st International Research Conference on Pension (IRCP) 2025, a landmark event organized by the Pension Fund Regulatory and Development Authority (PFRDA) in collaboration with the Indian Institute of Management Ahmedabad (IIMA). The IRCP 2025 is the outcome of the vision of Dr Deepak Mohanty, Chairman, PFRDA to develop PFRDA into a knowledge institution,

a repository of pension statistics and a pioneer in pension research providing inputs into informed policy making in the field. I have had more than four year of association of working with him at PFRDA as Whole Time Member (Finance) and had the privilege of being closely associated with the planning and organisation of the IRCP 2025 under his guidance.

The book compiles the six peer-reviewed papers presented at IRCP 2025. These papers were selected based on a two-stage double blind review process with a focus on rigour and relevance, and reflect the contemporary research and emerging trends in pension reform, pension finance, pension regulation, public policy debate and retirement behaviour. The insights captured here are essential for navigating the complexities of pension reforms in a rapidly changing world.

Finally, this edited volume serves not merely as a record of academic inquiry but also as a valuable resource and roadmap for future research and policy development. It offers evidence-based recommendations for policymakers, provides insights for regulators and financial institutions and opens up new questions for academia. The challenge of creating a robust, equitable and inclusive pension system in India is monumental, demanding collective and sustained effort across sectors and borders. By redefining pensions as instruments of dignity, equity and national development, India can move towards the objective of a fully pensioned society and Viksit Bharat by 2047.

— Professor Manoj Anand
Dean, School of Management of Financial Institutions
Management Development Institute Gurgaon

Preface

In an era marked by profound demographic shifts, evolving labour markets, and increased longevity, the sustainability and adequacy of pension systems have emerged as a critical challenge for policymakers, economists, actuaries, and scholars alike. The complexity of pension systems transcends national boundaries. While every country faces unique institutional, cultural, and economic conditions, the underlying concerns—such as an ageing population, pension coverage gaps, intergenerational equity, and the role of public versus private provision—are shared globally.

The First International Research Conference on Pensions 2025, by bringing together experts from a wide range of disciplines and regions, aimed to create a platform for comparative analysis, cross-country learning, innovative policy thinking, and most importantly, research in the pension space.

This book captures a selection of peer-reviewed papers that reflect the latest research and emerging trends in pension reform, pension finance, and retirement behaviour. It is our hope that this volume will serve not only as a record of the conference proceedings but also as a valuable resource for researchers, practitioners, and policymakers seeking to navigate the complexities of pension reform in a rapidly changing world. As global challenges continue to evolve, so too must our responses—rooted in rigorous research, informed deliberation, and international cooperation.

— Deepak Mohanty

Acknowledgements

The 1st International Research Conference on Pensions (IRCP) 2025 was the result of a vision to transform the Pension Fund Regulatory and Development Authority (PFRDA) into a knowledge institution and to spur research in the area of pensions. We express our deep gratitude to all those whose contributions led to the successful organisation of IRCP 2025 and the publication of this edited volume of selected research papers presented at the conference.

We are thankful to Professor Manoj Anand, Former Whole-Time Member (Finance), PFRDA, for his guidance throughout the planning, execution, and review processes. His stewardship was vital in ensuring the academic integrity and overall success of the research output of the conference in the form of the received and presented research papers. We also thank Ms. Mamta Shankar, Whole-Time Member (Economics), for her encouragement and leadership.

We gratefully acknowledge the valuable contributions of the esteemed faculty members from the Indian Institute of Management Ahmedabad, whose academic support and collaboration have been instrumental in the success of the research conference. We extend our sincere appreciation to Dr Bharat Bhaskar, Director of the Indian Institute of Management Ahmedabad. We also extend our thanks to Prof. Abhiman Das (Economics Area), Prof. Sobhesh Agarwalla (Finance and Accounting Area), Prof. M. P. Ram Mohan (Strategy Area), Prof. Prashant Das (Finance and Accounting Area), Prof. Anindya Chakrabarti (Economics Area), Prof. Tarun Jain (Economics Area), and Prof. Neerav Nagar (Finance and Accounting Area) for their involvement and commitment to academic excellence. We also acknowledge the critical role played by the expert referees from

reputed management institutes across India. Their diligent peer review ensured the high academic standards of this volume.

We gratefully acknowledge the dedicated efforts of the IRCP Organising Committee, whose hard work behind the scenes ensured the seamless execution of the conference. A special mention is due to the core team from the Research Conference Department at PFRDA—Ms. Sumeet Kaur Kapoor, Executive Director; Sh. Rahul Ravindran, Executive Director; Sh. P. Arumugarangarajan, Chief General Manager; Ms. Jaspreet Kaur, General Manager; and Sh. Guneet Singh Anand, Assistant Manager—whose intellectual contributions, operational leadership, and tireless efforts were instrumental in shaping both the conference and this edited volume.

We would also like to acknowledge the valuable contributions of Sh. Sachin Joneja, General Manager; Alpana Vats, General Manager, Sh. Rajesh Mohan, General Manager; Sh. Mohit Yadav, Deputy General Manager; Ms. Puja Upadhyay, Deputy General Manager; Sh. Prodeepto Chatterjee, Dy General Manager, Sh. Manmeet Nagar, Assistant General Manager; Sh. Sudhir Singh, Deputy General Manager; Sh. Nishant Anand, Manager; Sh. Indrajeet S. Bhosale, Assistant Manager; Sh. Abhishek Dhiman, Assistant Manager; and the entire PFRDA staff members who, though not part of the Research Conference Department, extended crucial support in the overall coordination and organisation of the conference.

1

Introduction

Deepak Mohanty

The Pension Fund Regulatory and Development Authority (PFRDA), in partnership with the Indian Institute of Management Ahmedabad (IIMA), convened the 1st International Research Conference on Pension (IRCP) on the 3rd and 4th of April 2025 at the iconic Bharat Mandapam, New Delhi. The conference was a landmark event that brought together a diverse and intellectual group of stakeholders—including policymakers, academicians, industry participants, financial sector professionals, and international regulators.

The primary aim of the conference was to encourage discussion and deliberation of ideas, perspectives, and empirical research focused on pension systems and retirement security. In an era marked by demographic transitions, technological disruption, and fiscal rebalancing, the need for robust and sustainable pension systems has become paramount. India is also navigating the dual pressures of an ageing population and informality in its workforce. With these challenges come opportunities—to build systems that are inclusive, fiscally sustainable, and technologically agile.

Our demographic landscape is undergoing a significant transformation. By 2050, the proportion of the population over 60 is projected to increase from 10.5 percent to 20.8 percent. Our old-age dependency ratio will rise, and the financial strain on the younger generation will increase. Healthcare costs for the older population continue to rise, and the traditional family structure, once a support system for the elderly, is changing. In this context, an accessible and inclusive pension system becomes even more critical to manage not

Deepak Mohanty is Chairman, PFRDA.

only old-age income but also healthcare costs. The need for financial independence through pensions has never been more urgent.

The longevity of present and future generations of Indians would be much higher. Living longer implies that one needs money for a longer period to take care of oneself when no longer able to work and earn. The retirement phase becomes more challenging because of increased medical expenses, the rise of the nuclear family structure, and limited access to formal credit facilities. Thus, with every passing year after superannuation, one becomes more exposed to financial risks unless adequate provision has been made for retirement.

In the economic context of Amrit Kaal, where we are working towards becoming a developed nation by 2047, the financial security of our ageing population ought to be a national commitment—ensuring that every citizen, whether from the formal or informal sector, has the means of a reliable retirement income. Attaining this goal requires continuous innovation, a robust governance framework, and seamless processes leveraging technology.

The Pension Fund Regulatory and Development Authority (PFRDA) has, over the years, embarked on a transformative journey—evolving from a nascent regulator into a dynamic force driving financial security for millions, with the objective of building a "pensioned society in a Viksit Bharat". The pension sector that PFRDA regulates, covering NPS and APY, has made steady progress, with an accumulated corpus of over ₹14.4 trillion and 84 million subscribers. A unique feature of NPS is its availability to all, including children. We have prioritised customer experience, introducing tech-driven initiatives for seamless onboarding, transactions, and exit.

The conference centred on three core themes. First, it aimed to foster experience sharing with global pension regulators, emphasising the need for innovative and portable pension solutions—particularly in light of the growing gig economy and informal workforce. India's strategic use of the JAM trinity—Jan Dhan, Aadhaar, and Mobile—demonstrates how digital infrastructure can be effectively leveraged to deliver social protection to previously excluded populations. The second theme focused on enhancing the sustainability

of pay-as-you-go (PAYG) pension systems. The challenge of rising unfunded liabilities amidst increasing longevity requires urgent policy innovation. India's transition to a Unified Pension Scheme (UPS), blending features of both defined benefit and defined contribution models, offers a possible template for other countries. The third theme revolved around technology and accessibility, especially the use of artificial intelligence, mobile platforms, and blockchain to improve efficiency and inclusiveness.

From over 120 research paper submissions from about 200 authors globally—including from the UK, France, Singapore, the USA, and Bangladesh—eight papers were selected for presentation at the conference after a rigorous double-blind review process and, subsequently, six papers are included in this edited volume, post incorporation of the comments and suggestions from the discussants during the presentation. These papers represent the most impactful, methodologically rigorous, and policy-relevant contributions to the discourse on pension systems. The selection process was overseen by 38 distinguished professors from leading management institutions and involved extensive peer review to ensure scholarly integrity. The conference itself witnessed the presentation of 35 papers (including poster presentations) by authors from diverse backgrounds and over 30 eminent speakers from government, industry, and academia, making it one of the most comprehensive forums for pension research.

The first paper, "Analysis of Pension Funds on Economic Development in India and Brazil", presents a comparative macroeconomic analysis of pension fund investments in India and Brazil over a fifteen-year period. The authors evaluate the relationship between pension assets under management, market volatility, inflation, and GDP. In India, a diversified mix of public and private pension schemes has contributed to capital market development, while Brazil's centralised model has supported infrastructure investment but raised concerns over sustainability. The comparative framework highlights how policy, market structure, and governance practices interact to produce different developmental outcomes, offering valuable lessons for cross-country policy learning.

Retirement adequacy and sustainability are also addressed through two papers that investigate the concept of Safe Withdrawal Rates (SWRs), which provide a measure of how much can be safely withdrawn annually from retirement corpus without risking its permanent depletion. The second paper titled "Balancing Acts: Safe Withdrawal; Rates in the Indian context" assesses the applicability of the widely used 4% rule in the Indian context, arguing that it may not be appropriate given the country's inflation dynamics and investment landscape. Through historical simulations, the study suggests a safer withdrawal range between 3% and 3.5%. It also highlights the diversification value of gold in retirement portfolios and warns against over-reliance on average returns, which can mask the risk of portfolio depletion in adverse market cycles.

The third paper titled "On Safe Withdrawal Rate in the Indian Context under National Pension System" narrows its focus to examine SWRs specifically within the National Pension System (NPS). It models retirement outcomes under various asset allocations and withdrawal strategies over a 30-year horizon. The analysis indicates that while a 4% withdrawal rate may be feasible under specific conditions, a 3% rate is more sustainable and less vulnerable to market volatility. Interestingly, the paper finds that dynamic asset allocation strategies—such as decreasing equity exposure over time—do not significantly improve portfolio success rates. These findings have direct implications for pension advisors and fund managers designing long-term retirement products.

The fourth paper, titled "Retirement Planning: Understanding the Impact of Uncertainty and Behavioural Biases", explores the psychological and behavioural dimensions of retirement planning. Despite India's demographic advantage of a large young population, behavioural biases such as procrastination, overconfidence in financial literacy, and uncertainty about savings adequacy hinder effective retirement preparation. Drawing on the Theory of Planned Behaviour and the Behavioural Life-Cycle Hypothesis, the authors argue that targeted financial education, combined with access to professional financial advice, can help mitigate these biases. The paper also underscores the importance of recognising financial behaviour as socially

and psychologically embedded, rather than purely rational or economic.

The fifth paper, titled "Leveraging Corporate NPS as a Strategy for Expanding NPS in India", evaluates the National Pension System (NPS) with a focus on Corporate-NPS and its potential to expand pension coverage in the private sector. Despite its promise, the study finds that Corporate NPS suffers from low awareness, limited participation, and weak employer engagement. The authors use ten years of data and a mixed-methods approach to identify structural barriers and propose multifaceted solutions. These include strengthening public-private partnerships, enacting favourable tax policies for employers and employees, and leveraging technology for targeted outreach. The paper provides both granular data and broader strategic guidance for improving pension inclusiveness.

The sixth paper, titled "The Great Indian Pension Debate", undertakes a comparative policy analysis of different defined contribution and defined benefit pension schemes offered to Indian government employees. By modelling pension wealth, fiscal implications, and replacement rates under each scheme, the authors find that while DB schemes are more generous, they pose greater fiscal risks. Importantly, the paper suggests that wage revisions—not just investment returns—play a major role in determining pension outcomes. It advocates for reforms that balance sustainability with adequacy and calls for more transparent and participatory decision-making processes.

Several multi-dimensional themes emerge from these studies. One is the critical importance of financial literacy—not merely as a desirable attribute but as a foundational prerequisite for meaningful participation in pension systems. Another is the role of technology, not just in administration but in empowering individuals to take control of their retirement planning. Across the studies, there is a strong call for designing pension products and delivery mechanisms that are inclusive, accessible, and responsive to the needs of India's diverse population.

The IRCP has also shown that India has valuable lessons to offer and much to gain from international collaboration. Comparative

studies such as those involving Brazil, and insights into global best practices, underscore the importance of knowledge exchange. By situating domestic pension reforms within a broader international context, India can adopt solutions that are globally informed but locally adapted. Likewise, India's experience with the JAM trinity, Aadhaar-enabled payment systems, and public digital infrastructure can serve as a model for other countries seeking to improve pension inclusion.

The deliberations at IRCP 2025 underscored the urgency of transforming India's pension landscape in response to evolving demographic and economic shifts. With nearly one in five Indians projected to be elderly by 2050, the conference highlighted the need for inclusive, technology-driven pension solutions tailored to informal, gig, and migrant workers. Discussions emphasised global practices such as auto-enrolment, target date funds, and co-contribution models, while also recognising India's innovations like the JAM trinity and Unified Pension Scheme (UPS). A recurring theme was the importance of flexibility in pension contributions and withdrawals to accommodate low-income earners, along with the need for portability and employment-neutral features in pension products. Policymakers and experts stressed the role of pension funds in infrastructure investment, the integration of ESG principles, and exploring new asset classes to enhance risk-adjusted returns. One of the sessions also deliberated on the budget announcement regarding the establishment of a Pension Forum for regulatory coordination. This session focused on harmonised standards for pension product design, interoperability, and a portable pension account for a seamless and unified customer-centric experience. The conference also emphasised the critical role of financial literacy in enabling effective retirement planning, particularly among women and rural populations. Presentations by academics and global practitioners reinforced the call for a robust ecosystem blending digital innovation, institutional collaboration, and public engagement to secure old-age income. Ultimately, IRCP 2025 reaffirmed that pensions are not merely financial products but instruments of social security, dignity, and economic resilience—demanding collective and sustained effort across sectors and borders.

This edited volume thus offers not only a snapshot of the current research frontier but also a roadmap for future inquiry and policy development in the pension sector. For academics, it opens up new questions related to pension adequacy, behavioural interventions, fiscal modelling, and the implications of technological integration. For policymakers, it offers evidence-based recommendations that can guide reforms. For regulators and financial institutions, it provides insight into improving product design, service delivery, and system resilience.

Considering the demographic transformation in India, the urgency of creating a robust, equitable, and inclusive pension system cannot be overstated. With a large segment of the workforce still in the informal sector and an increasing proportion of elderly dependents, the challenge is monumental. Through forums like the IRCP, a tangible momentum can be built to develop holistic solutions addressing the varied challenges faced by stakeholders in the pension sector. This compilation of research is not just a record of academic rigour—it is a call to action, an invitation to redefine pensions not only as financial instruments but as instruments of dignity, equity, and national development in order to achieve the objective of a fully pensioned society and Viksit Bharat by 2047.

2

Towards a Resilient and Sustainable Pension Society

A Synthesis of Insights from the First International Research Conference on Pension (IRCP) 2025

Sumeet Kaur Kapoor

Abstract

The First International Research Conference on Pension (IRCP) 2025 served as a pivotal forum for addressing the critical imperatives of building a resilient and sustainable pensioned society. This paper synthesises the diverse perspectives and key takeaways from the conference's thematic sessions, identifying common threads and weaving them into a cohesive framework. The deliberations during the thematic sessions addressed some critical areas of India's pension system. The sessions were titled (i) Pension for Future – Building Resilient Old Age Income Security, (ii) Global Lessons on New and Innovative Investment Practices in the Pension Industry, (iii) Pension Forum for Regulatory Coordination and Development of Pension Products, (iv) Fostering Financial Literacy for Sustainable Retirement Planning and (v) Pension Fund Investments with a Focus on Risk and Return. The deliberations underscored the urgent need for inclusive coverage, enhanced flexibility and adequacy, through the optimum leveraging of technology, robust regulation, financial literacy and prudent risk management to secure the financial well-being of India's aging population.

The paper is a synthesis of free-flowing thoughts and ideas during the First International Research Conference on Pension (IRCP) 2025 and does not necessarily represent the views of the author or PFRDA. The author acknowledges the contribution of all the esteemed panellists during the conference for sharing their vast knowledge, which forms the basis of this compilation.

Sumeet Kaur Kapoor is Executive Director, PFRDA.

Introduction

The evolving demographic landscape, marked by a significant increase in its elderly population across the globe, necessitates a fundamental re-evaluation and strengthening of pension systems. The First International Research Conference on Pension (IRCP) 2025 served as a *Maha Kumbha*—a confluence of ideas—bringing together economists, policymakers, regulators, industry specialists, and academicians from across four continents from North America - the United States, from Africa-South Africa & Nigeria, from Europe - the UK and from Asia-Singapore, Nepal and Bhutan. The conference also elicited interest from the audience in fostering collaboration within the SAARC region. Panellists drew extensively from global best practices across jurisdictions and regulatory frameworks.

The First International Research Conference on Pension (IRCP) 2025 provided a crucial platform for global experts to converge and deliberate on the multifaceted challenges and opportunities in this domain. Drawing upon the various view points and essential insights from the conference's thematic sessions, this paper identifies recurring themes and synthesising them into a cohesive framework, thus aiming to establish a robust and enduring society where individuals have adequate provisions for old age income security and pensions.

The Evolving Demographic and Workforce Dynamics

The speakers at IRCP 2025 provided critical insights into the changing demographic dynamics of the Indian population with the following discernible trends[1]:

- *Rapidly Growing Elderly Population:* India's elderly population (60 years and above) is increasing at a significant pace. The decadal growth rate of the elderly population is estimated at 41%.
- *Projected Increase in Share:* The share of the elderly population is projected to double from 10.5% in 2022 to 20.8% by 2050.
- *Growth of the Oldest-Old:* The population of individuals aged 80 years and above is predicted to grow dramatically, by around

1. India ageing report 2023 by UNFPA and Indian Institute for Population studies.

279% between 2022 and 2050. This will lead to a greater proportion of the "oldest-old" within the elderly population.

- *Higher Life Expectancy for Women:* Women in India have a higher life expectancy at ages 60 and 80 compared to men. This trend varies across states and union territories. For example, in Himachal Pradesh and Kerala, women at 60 have a life expectancy about four years greater than men of the same age in those states compared to national average differential of 1.5 years.
- *Rising Sex Ratio Among Elderly:* Consequently, the sex ratio (females per 1,000 males) among the elderly population has been steadily increasing since 1991, while the sex ratio in the general population has remained the same.
- *Ruralisation and Feminisation of Old Age Poverty:* A significant proportion of the elderly, particularly women, reside in rural areas. Older women are also more likely to be widowed, live alone, have no income, and depend on family for support.

Besides the ageing of the population and feminisation of old age poverty, the evolving dynamics of the labour market also drew the attention of the speakers. Over 80% of the total workforce in India is engaged in the informal sector. The informality of the labour force is also an important feature of the workforce in Nigeria (above 90%[2]), Mexico (58%[3]), and other developing countries. A significant percentage of workers in the informal sector lack written job contracts and have tenuous labour market links, which are considered critical for providing pensions. Wages in the informal sector are generally lower compared to the formal sector, leaving meagre disposable income for contribution to pensions. Consequently, many informal workers do not have access to social security benefits like health insurance, pensions, or paid leave.

2. Nigeria Labour Force Survey Q2 2023.
3. National Statistical office, Mexico.

The tenuous market links of the labour force have resulted in an increasing migratory population. The current global estimate[4] is that there were around 281 million international migrants in the world in 2020, which equates to 3.6 percent of the global population. In 2023, migrant workers sent a total of approximately $860 billion[5] in remittances back to their home countries. India, Mexico, China, the Philippines, and Egypt are among the top recipient countries for remittances. Despite their active participation in the work force abroad, the migrants often lack social security in their old age. This is primarily due to the disconnected nature of global pension systems and absence of stable employment during their time overseas.

The burgeoning gig economy presents both opportunities and challenges, including the need for adequate social protections. As per the World Bank estimate, in September 2023, the 'gig economy' accounted for up to 12 percent of the global labour market. In 2020–21, India had an estimated 7.7 million gig workers, comprising 2.6% of the non-agricultural workforce or 1.5% of the total workforce. This number is projected to grow to 23.5 million by 2029–30, constituting 4.1% of the country's total workforce[6]. The nature of work on digital platforms, with its emphasis on flexibility and independent contracts, poses unique challenges for traditional social protection systems.

A central theme throughout the conference was the urgent need to expand pension coverage, particularly to the unorganised sector, migrant workers, and the gig economy. Global experiences in including informal workers and the self-employed in pension systems offer valuable lessons.

Expanding Pension Coverage and Enhancing Inclusivity

The pension coverage in India accounts for a relatively small proportion of the working-age population. Estimates vary, but it leans closer to around 20%. This figure includes those covered by govern-

4. International Organization for Migration.

5. The World Bank.

6. "India's Booming Gig and Platform Economy- A report by NITI Ayog, India.

ment pension schemes, organised sector employment with retirement benefits, and subscribers to schemes like the Employees' Provident Fund Organisation (EPFO), the National Pension System (NPS), and Atal Pension Yojana, besides pension/annuity schemes floated by insurance companies and mutual funds. The Government of India's budget announcement of 2015 emphasised the development of a "pensioned society", primarily through the introduction and promotion of schemes like the Atal Pension Yojana (APY). The aim of a pensioned society for *Viksit Bharat@2047* necessitates a mission-mode expansion of pension coverage. Furthermore, the significant number of Jan Dhan accounts—now above 55 crores[7]—presents a valuable foundation for this expansion. Leveraging this existing infrastructure is a logical and potentially effective strategy to broaden pension inclusion across the country.

Similarly, Nigeria was seen grappling with high informality and low coverage. South Africa has higher coverage but faces lower economic growth, high unemployment, and low savings.

The conference threw up several suggestions for enhancing pension coverage, based on international best practices:

- *Auto-enrolment* – Lessons from countries like the UK and New Zealand highlight the success of auto-enrolment.
- *Pension product design* – The pension product design plays a crucial role in enhancing the coverage of pensions. A well-designed system can overcome many challenges including informality, seasonality, and interruptions in income streams. For example, the National Pension System (NPS) in India is an employment- and status-neutral product allowing account continuity across geography, employment, or even periods of non-employment, thus enabling seamless accumulation over a lifetime. It is also a family-oriented product, providing payout to the spouse and benefits to their children.
- *Flexibility in contribution amount and frequency* – The design of pension products must also consider the unique income pat-

7. PIB, Delhi, dated 18th March, 2025.

terns and potential vulnerabilities of workers in the unorganised sector, necessitating flexible contribution options. Systematic investment in pensions is a highly structured product, which can sometimes create challenges for workers in the unorganised sector with intermittent income streams. Hence, the importance of flexibility in the amount as well as frequency of contributions to address interrupted income streams cannot be over-emphasised. Atal Pension Yojana in India gives flexibility of monthly, quarterly, and half-yearly contributions.

- *Coverage to gig workers and workers on app-based platforms* – The growing gig economy is attracting attention from policymakers globally, with endeavours being made for gig workers to be included in pension systems in the UK, Singapore, India, and Europe. The International Labour Organization (ILO) notes that G20 and other countries are experimenting with both contributory and non-contributory social insurance systems to protect gig workers. The Social Security Code, 2020, in India proposes a legal framework for extending social security benefits to gig workers. The emphasis on their registration through the e-Shram portal and the proposed healthcare coverage under PM-JAY in the recent budget are significant steps in this direction.
- *Regulated withdrawals to strike a balance between adequacy and flexibility* – The conference highlighted the delicate balance between ensuring adequate retirement income and providing individuals with the flexibility to access their savings, especially during financial exigencies for individuals at the bottom of the pyramid with limited financial resources. Models like the two-pot systems observed in South Africa and two-portions in Nigeria offer potential frameworks offering structured mechanisms for withdrawal without significantly compromising long-term accumulation. Similarly, NPS in India offers partial withdrawal for exigencies like medical emergency, building a house or children's higher education and a Tier II option. The Atal Pension

Yojana is a pension account tied to a bank account, and surplus savings are ploughed into the pension account.

- *Borrowings against pension funds* – Returnable borrowings against pension corpus for tiding over exigencies could be explored to soften the very long-term vesting of the retirement pot.
- *Incentives and nudges* – India's low per capita income of around USD 2,500[8] presents a challenge for building an adequate pension system. The effectiveness of tax incentives in this context will remain limited to tax-paying individuals, who may be a minority in a developing economy. Alternatives like co-contribution (Mexico), enhancing government incentives to pension providers, clearly defined benefits (APY – India), and linking contributions to health insurance (Indonesia) can be explored. It was suggested that the collective bargaining power of pension funds could be used to obtain health insurance for subscribers.
- *Target date funds* – Target date funds offer a straightforward investment option for individuals who prefer a less hands-on approach. These funds aim to diversify the portfolio and provide more stable returns over time. Several countries, including Mexico, Colombia, Brazil, and Australia, have already embraced target date funds, with a significant global investment of around USD 4 trillion. India's own NPS's existing four lifecycle funds operate on a similar age-based risk reduction principle (with a balanced option being the latest addition). A suggestion was made to integrate target date funds with automatic enrolment systems and to specifically address the need for effective strategies during the retirement payout phase.
- *Offering more choices to subscribers* – It was opined that subscribers should be allowed to choose asset allocation as per their risk appetite to optimise return, and the allocation should not be skewed in favour of debt funds.

8. The World Bank.

- *Effective designing of the pay-out phase* – Designing how pensions are paid out is crucial. Without annuity options, retirees might outlive their savings or live frugally only to leave behind a significant sum. Stepping up pay-outs only at age 75, could help mitigate the risk of running out of money later in life. Furthermore, pension payouts should also consider the financial needs of the retiree's family.
- *Optimum mix of Defined Contribution (DC) and Defined Benefit (DB) schemes* – While Defined Benefit (DB) and Defined Contribution (DC) systems are typically viewed as alternatives, both may coexist. For example, in India, the Government of India has given the option of the Unified Pension Scheme, which is a contributory scheme wherein GOI is guaranteeing the benefits. DB scheme may not work for individuals with interrupted careers, such as women or migrant labourers, as DB schemes often require a minimum number of service years to qualify for payouts.
- *Adequate funding of schemes with defined benefits* – To guarantee adequate funding for Defined Benefit pension schemes, maximising returns on investments is a primary concern. Additionally, economic variables like interest rate movements have a direct impact on their financial health. Regular contributions and actuarial evaluations are vital for the continued viability of these schemes. To avoid unexpected funding problems, transparency in the operation of these schemes is essential.
- *Cross-border portability* – Addressing the specific challenges faced by migrant workers through cross-border portability solutions and offering greater flexibility to Overseas Citizens of India are also vital steps towards greater inclusivity. For example, it was opined that NPS could be integrated with systems in the UAE and other countries, so returning workers could transfer funds into NPS.
- *Development of annuity market* – Fostering the development of a vibrant annuity market through product innovation and

addressing issues like longevity risk is essential for the decumulation phase. Some of the suggestions made during the conference included:

- Product innovation, such as qualified longevity contracts.
- Designing products with no survival benefit to improve viability. Though previously considered controversial, this idea is gradually gaining acceptance.
- Exploring "Home for Pension", a reverse mortgage concept. While currently being implemented by banks, it hasn't seen wide adoption. Since it involves longevity risk, it may require attention from the insurance sector for greater effectiveness.
- Positioning pension as part of inheritance planning, involving intergenerational wealth transfer.
- Developing collective security mechanisms, such as sector-based pooling funded by employers and employees.

Optimising Investment Strategies and Managing Risks

The conference emphasised the importance of prudent investment strategies that balance risk and return while safeguarding the long-term interests of subscribers, as pension funds have a fiduciary responsibility towards them.

The assets under management in India are currently estimated to be around ₹50 trillion[9], as per some estimates. With a thrust on developing a pensioned society, increasing coverage, and the expected rise in disposable income being channelled towards retirement planning with growth in per capita income, an estimate during the conference pegged the projected AUM under pensions at ₹1,000 trillion by 2047, constituting about 30% of the GDP at that time. This huge inflow would necessitate newer avenues for investments that provide optimal risk-adjusted returns over a very large investment horizon of 50 to 60 years, including the decumulation phase. If one were to

9. Address by Dr. Deepak Mohanty, Chairman, PFRDA at 17th Mint BFSI Summit and Awards, Mumbai on January 17, 2025.

include schemes like NPS Vatsalya for minors, the investment period could stretch by 18 more years.

Diversification across asset classes, exploring alternative investments, employing sophisticated risk management techniques, and leveraging technology for risk prediction are crucial. Recognising the long-term horizon of pension funds necessitates a focus on long-term investment strategies and a nuanced understanding of evolving economic factors. Integrating Environmental, Social and Governance (ESG) considerations into investment decisions to mitigate long-term risks is also gaining prominence.

More specifically, the conference weighed upon the following strategies:

- A very long-term approach with understanding of the nuanced interplay of economic factors, prioritising long-term growth over short-term volatility.
- Diversification and periodic reallocation of assets for duration management for debt securities are key strategies to address the impact of monetary policy.
- The universe of existing instruments under conventional asset classes like equity and corporate bonds may need to be expanded. It was opined that increased mid-/small-cap exposure may be considered.
- Equity typically outperforms inflation in the long run. However, the increased frequency of black swan events and interest rate fluctuations pose significant risks to equity performance. As such, alternative investments are becoming increasingly important.
- Innovation in financial instruments such as climate finance, inflation-indexed bonds, hybrids, and hedging instruments may provide alternative avenues.
- Prioritising safety and inflation protection. Inflation-protected asset classes like gold and real estate may be considered for investments.

- Exploring international market diversification of pension fund investment.
- Pension funds are exposed to long-term ESG risks, which include reputational, regulatory, legal, physical, and transition risks. These risks need to be proactively mitigated. Integrating ESG considerations into investment strategies helps reduce exposure to such risks. High ESG disclosure scores can indicate safer investment opportunities for pension funds. While ESG portfolios in the US are perceived as more volatile, the opposite trend has been observed in India.

Robust Risk Management

- Liquidity monitoring should go beyond benchmarks to provide a more comprehensive risk assessment.
- AI and ML models may be utilised for risk prediction.
- A forward-looking (rather than purely backward-looking) approach to risk management would help create a more resilient system.
- There is a need to shift from a checklist-based approach to risk-based supervision. This will require the development of robust data pools. However, models must be designed to prevent their gaming by the regulated entities.
- While technology is critical, it is not a solution to all challenges. The moral conscience of the board must ultimately guide pension fund management.
- Strong governance helps protect investors, minimise risks, and maximise the overall performance of the pension system. By establishing clear roles and responsibilities, promoting transparency, accountability, and ethical conduct, pension funds can create a more stable and sustainable future for subscribers.

Fostering Infrastructure Investment

- Pension funds, being patient capital, are well-suited for infrastructure investments. The appetite for infrastructure invest-

ment would be substantial, offering opportunities for pension funds. However, pension funds must build the capacity for primary market investments. Lessons can be drawn from global best practices, such as Canadian pension funds which directly invest in infrastructure projects.

- In Mexico, innovative instruments like CKDs have been introduced by Comision Nacional del Sistema de Ahorro para el Retiro (CONSAR).
- Namibia has created SPV trusts for infrastructure funding, managed by independent managers. Currently, only 1.75% of the funds are required to be invested in these SPVs.
- PFRDA has also permitted investment in REITs and InvITs, although the supply of these instruments remains limited.
- Deregulation in the infrastructure sector could foster market development. Excessive regulation delays projects and affects returns. The Hon'ble Finance Minister, during the GoI Budget Speech 2025-26, announced deregulation a specific theme for fostering growth.
- Regulatory stability and swift dispute resolution mechanisms are critical for the development of infrastructure investment instruments.
- Challenges posed in AIF valuation and liquidity need to be addressed for their offtake.

Prioritising Financial Literacy for Informed Decision-Making

The prevailing challenge of limited financial inclusion and literacy—especially within the pension sector—alongside disparities among various demographic segments like females, is quite notable. Hence, the critical imperative of bolstering financial literacy across India, with a particular focus on enhancing preparedness for retirement, cannot be overemphasised. Keeping this in view, several avenues for implementation and outreach of pension literacy can be explored.

There is an impending urgency to embed financial education within the formal education framework at diverse levels, spanning from foundational schooling in both rural and urban centres to specialised professional programmes. Universities have initiated various efforts, including offering value-added financial literacy courses accessible to students from all academic backgrounds, and some colleges have formed dedicated Financial Literacy Committees. Under the New Education Policy, postgraduate certificate programmes and micro-credential courses are now available to non-finance students, with opportunities for multinational corporations and other companies to deliver such programmes. There is potential for the pension regulatory body to integrate pension-specific content into these educational offerings.

The lower participation of women in pension schemes compared to other schemes is a cause for concern. In the case of NPS, women constitute 24% of the participants, though APY has 47% participation from women. A skewed gender participation emphasises the need for targeted interventions by governmental bodies, non-governmental organisations, educational institutions, community leaders and others. It was opined that leveraging corporate social responsibility initiatives to specifically educate women on pension planning could be the way forward.

Integrating financial literacy initiatives with placement programmes in educational institutions to encourage students to prioritise retirement savings from the outset of their careers can be one of the innovative strategies. The crucial role of human resources departments in the corporate sector in improving pension literacy among employees cannot be overemphasised.

The potential of social media for financial education is huge, yet the risk of misleading financial sensationalism needs to be cautioned against.

The behavioural tendency of hyperbolic discounting, where individuals disproportionately value immediate rewards over long term benefits like retirement savings, often leads to procrastination in enrolling in pension schemes. Default enrolment options may coun-

teract their tendency by leveraging inertia. Since individuals are less likely to actively opt out of a default, they end up participating in pension savings, mitigating the negative effects of their present-biased preferences.

The multi faceted nature of financial literacy requires balanced emphasis on both the acquisition of knowledge and development of confident decision making skills. There is significant role for the government and the public sector in establishing a robust public digital infrastructure for pension literacy.

Simplifying communication and utilising referral-based messaging can be effective strategies to enhance financial literacy adoption.

Strengthening the Regulatory and Institutional Framework

The pension sector in India, today, involves multiple schemes across multiple regulators and administrators, including PFRDA, EPFO, IRDAI, SEBI, etc., leading to a fragmented pension landscape. Keeping in view the low pension penetration in the country, a focused and coordinated approach across all stakeholders is considered a *sine qua non* for achieving pension saturation in India. Accordingly, the Hon'ble Finance Minister, during the GOI Budget 2025–26, announced that a forum for regulatory coordination and development of pension products would be set up. The conference brought forth various possible themes for deliberations at the forum.

The pension forum is a step towards streamlining processes and ensuring a seamless customer experience across pension schemes and products, akin to Unified Lending Interface and Jan Samarth platforms. Harmonising taxation across different pension products and establishing an auto-enrolment mechanism through inter-regulatory collaboration were identified as key priorities. Building robust governance systems that ensure interoperability across different pension schemes is also paramount. Financial instrument providers, such as SEBI-regulated entities, could collaborate with the pension industry to co-develop innovative instruments.

With the enactment of the Code on Social Security, 2020, there is a legislative mandate to cover the informal sector, including gig and

platform workers. It was opined that this could also be taken forward through the pension forum, although the Code is still to be implemented.

Leveraging Innovation and Technology for Efficiency and Reach

Innovation and technology emerged as critical enablers for building a more robust pension system. Studying the user-friendly onboarding processes of successful digital applications, including gaming apps, can inform strategies to improve pension enrolment. The potential of leveraging digital infrastructure, as demonstrated by the mutual fund industry's expansion, can significantly enhance reach and accessibility. Furthermore, exploring the application of emerging technologies like Artificial Intelligence (AI) and Machine Learning (ML) in areas such as risk prediction, customised portfolio construction, and enhancing accessibility and transparency in pension management holds significant promise.

The lack of data availability to academia remains a key challenge, limiting ML development and data training. The establishment of a regulatory sandbox to foster innovation in pension products and service delivery is also crucial.

Conclusion

The First International Research Conference on Pension (IRCP) 2025 provided a comprehensive and insightful platform for addressing the multifaceted challenges and opportunities in building a resilient and sustainable pension society in India. The discussions highlighted the interconnectedness of expanding coverage, enhancing scheme design, leveraging innovation and technology, strengthening the regulatory framework, prioritising financial literacy, and optimising investment strategies.

The path forward requires a concerted and collaborative effort from policymakers, regulators, financial institutions, educators, and individuals to create a pension system that is inclusive, adequate, flexible, and ultimately secures the financial well-being of India's growing elderly population. The insights from IRCP 2025 can offer a valuable roadmap for navigating this critical endeavour.

DETAILS OF SPEAKERS AND PANELLISTS

Plenary Session

Welcome Address by Dr. Deepak Mohanty, Chairperson, PFRDA

Keynote Address by Prof. Bharat Bhaskar, Director, IIM Ahmedabad

Inaugural Address by Mr. Nagaraju Maddirala, Secretary (Financial Services), Government of India

Special Address by Guest of Honour, Mr. Pankaj Chaudhary, Hon'ble Minister of State for Finance, Government of India

Vote of Thanks by Ms. Mamta Rohit, Executive Director, PFRDA

Theme 1 – Pension for Future – Building Resilient Old Age Income Security

- Dr. Soumya Kanti Ghosh, Group Chief Economic Advisor, State Bank of India - Moderator
- Ms. Astrid Ludin, Deputy Commissioner, FSCA, South Africa
- Ms. Omolola Oloworaran, Director General, PENCOM, Nigeria
- Mr. William Price, CEO, D3P Global
- Dr. Deepak Mohanty, Chairperson, PFRDA

Theme 2 - Global Lessons on New and Innovative Investment Practices in the Pension Industry

- Prof. Abhiman Das, Indian Institute of Management, Ahmedabad - Moderator
- Mr. Brian M. Miller, CFA, CFP® – Vanguard, Head of Target Date Fund Product Management
- Dr. Paul Yu, Director, (Policy and Regulation), Mandatory Provident Fund Schemes Authority, Hong Kong SAR, China
- Mr. William Price, CEO, D3P Global
- Prof. Prachi Mishra, Director and Head, Ashoka Isaac Center for Public Policy

- Mr. R. Mark Davis, CFA - Senior Financial Sector Specialist, World Bank Group
- Mr. Tushar Arora, Senior Financial Sector Specialist, World Bank Group

Theme 3 - Pension Forum for Regulatory Coordination and Development of Pension Products

- Dr. M. S. Sahoo, Former Chairperson, Insolvency and Bankruptcy Board of India - Moderator
- Mr. Pankaj Sharma, Joint Secretary, Department of Financial Services, Ministry of Finance, GoI
- Mr. Ramesh Krishnamurthi, CEO, Employees Provident Fund Organisation
- Mr. Amarjeet Singh, Whole Time Member, Securities and Exchange Board of India
- Mr. Rajay Kumar Sinha, Whole Time Member, Insurance Regulatory and Development Authority of India
- Dr. Manoj Anand, Whole Time Member (Finance), PFRDA

Theme 4 – Fostering Financial Literacy for Sustainable Retirement Planning

- Ms. Mamta Shankar, WTM (Economics), PFRDA – Moderator
- Prof. Simrit Kaur, Principal, Shri Ram College of Commerce
- Dr. Arvind Sahay, Director, Management Development Institute, Gurgaon
- Dr. Pawan Kumar Singh, Director, Indian Institutes of Management Tiruchirappalli
- Dr. Ashok Banerjee, Director, Indian Institutes of Management Udaipur
- Dr. Bhimaraya Metri, Director, Indian Institutes of Management Nagpur
- Sh. S Karthikeyan, Director, Department of Financial Services, Ministry of Finance, Government of India

Theme 5 – Pension Fund Investments with a Focus on Risk and Return

- Prof. V Ravi Anshuman, Indian Institutes of Management Bangalore – Moderator
- Prof. S.V.D. Nageswara Rao, Head, SOM, Indian Institute of Technology Bombay
- Prof. Rupamanjari Sinha Ray, Management Development Institute, Gurgaon
- Mr. Vivek Iyer, Partner and Financial Services Risk Leader, Grant Thornton Bharat LLP

3

Analysis of Pension Funds on Economic Development in India and Brazil

Subham Saha | Chayan Ganguly

Abstract

The pension fund industry in India and Brazil responds significantly to economic activity. Thus, the primary objective is to look at pension fund investment strategies and market volatility together, to measure their relationship—even how pension fund size affects major economies—and show how the factors are effective throughout historical periods. The analysis covers the past fifteen years of Brazil and India to study how pension fund investments and market growth affect GDP growth and inflation rates. The analysis shows that returns from Scheme G and Scheme C have a positive connection with India's VIX. The combination of Indian VIX with the return of Scheme G and the VIX of India demonstrates positive links to the return of Scheme C. The Brazil DC Plan returns and Brazil VIX combine as one entity to show they positively affect Brazil VC Plan returns. India's pension fund AUM is influenced by stock market capitalisation and inflation, while GDP does not, whereas these factors negatively affect AUM in Brazilian markets. Factor influence on pension funds shows better performance in India than in Brazil. This study confirms how pension fund management affects economic growth and financial development through the specific approaches that India and Brazil have implemented.

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Introduction

Pension funds demand essential attention because they serve as primary channels to direct savings into productive investment opportunities during economic development. The objective of this study evaluates how pension funds are affected by economic growth in the two developing economies, India and Brazil. The examination of pension fund structures and operations, and resulting outcomes in these two nations, explains their effects on economic development alongside financial markets, together with social and economic stability. The nations of India and Brazil demonstrate several identical economic properties based on their ample citizen numbers, together with their developing financial arrangements, while sustaining major gaps between economic classes. Each nation created pension systems that serve to protect people from social insecurity and act as financial resource accumulators.

NPS operates two main Schemes namely Scheme C and Scheme G, which distribute funds into fixed-income securities, yielding stable yet moderate returns using low-risk investment strategies. Scheme C functions based on how well its assets perform, as well as the current interest rates. Scheme G, on the other hand, offers safe returns and stability with low associated risks. This particular investment plan targets those investors who want their capital protected first before considering high returns. There exists a trade-off between corporate bond and equity returns, while Scheme G provides reliable safeguards and predictable earnings, though at reduced levels. Fund performance under Scheme G is determined by the interest rate movements of government and by fiscal decisions made by government authorities.

India and Brazil developed their pension funds based on various historical, political and economic elements that influenced their development. The Indian pension system has experienced major changes, which led to the transformation from a traditional defined benefit approach to a contemporary defined contribution approach. Indian pension programmes consist of the Employees' Provident Fund (EPF) and the National Pension System (NPS), which collec-

tively serve formal and informal sector employees throughout the country. The Indian pension arrangement strives for inclusiveness and sustainability through its continuous efforts to protect unorganised workers while creating dependable financial conditions in the long term, whereas the Brazilian pension system provides full-scale retirement security to its citizens through its framework. The Brazilian pension system includes two pension schemes which fall under National Social Security Institute (INSS) management and National Superintendence for Supplementary Pensions (PREVIC) regulation. The public system obtains its funding through required worker and employer payroll deductions, while the private part consists of both open and closed pension fund categories. Brazil established reforms that merge social security benefits with economic needs and financial budget limitations.

Rationale of the Study

This study covers how economic development affects the pension funds throughout these two developing countries. The operations of pension funds are evaluated by assessing their functions in savings delegation and investment fostering, while their contributions to financial stability are examined with the aim of assessing economic growth benefits. The study also evaluates the performance of pension fund management approaches in India and Brazil, together with regulatory structures which promote economic development. The research holds special relevance because it addresses the fundamental needs of sustainable pension systems regarding financial security and economic stability within populations that are ageing fast.

India and Brazil are emerging countries belonging to the BRICS group, but they provide rather different views on pension funds and their connection to economic growth and stock exchanges. Both India and Brazil have multipillar pension system. Currently, India's economy is rising at a very fast rate, but challenges include a still developing regulatory system and poverty; while for Brazil, challenges include high inflation, corrupt practices, and high debt levels. India's fast-growing financial market, backed by reforms, draws inter-

national investment interest, while Brazil's is sometimes hampered by political instability and economic misdirection. Both countries offer information on how different aspects contribute to stability and economic growth.

Literature Review

Social Policy and Pension Fund Performance

Costa & Wiggan (2023) discuss how policy discourse in Brazil has induced a paradigm shift of social policy towards the conservative austere-liberal market hegemony. González et al. (2020) show the relevance of active investment strategies and long-term patient investing in pension funds' performance. Similarly, Ren (2022) emphasises the role of various private institutions in developing better pension regulations or making smarter investment decisions, particularly where investments in conservative assets are concerned. Thomas & Spataro (2014) add to this by assessing the broader empirical knowledge on pension fund effects on labour markets, financial market features, and growth influences.

Pension Investments and Economic Growth

Morina & Grima (2022) found that pension asset investments had a linear growth pattern between 2002 and 2018, which significantly enhanced economic growth, boosted financial market productivity, and yielded higher investment returns in non-OECD countries. Kajwang (2022) illustrates that effective risk management by pension fund administrators and custodians, when combined with strategic portfolio decisions, can positively influence GDP based on contributory pension systems. Bodhgire (2021) shows that the HDFC pension fund offered higher returns than other pension funds, demonstrating the critical role of pension fund management in economic growth.

Pension Structures, Planning, and Gender Inequities

Maheshwari & Bhutada (2019) explore the differences in pension structures between India and China, which show distinct variations in the age of pension receipt and tax benefits in India compared to China's multiple taxation systems with no pension relief. Basiglio & Oggero (2020) show how pension information influences retirement planning and affects labour supply and savings decisions, while inadequate knowledge can highlight income disparity, particularly among women. Kumar (2016) evaluates the National Pension System by benchmarking it against traditional pension savings schemes, thus analysing its development through historical data and industry practices, highlighting the significance of pension sector reform for both short-term and long-term public finance and policy objectives.

Research Gap

The economic impact of pension funds demands additional research on several unanswered questions about their role in economic development. Research needs to explore the complete effectiveness of various management strategies and regulatory frameworks while assessing them across India and Brazil, which are considered among the fastest growing economies. Studies focusing on pension fund benefits exist, but analyses about how these funds enhance stability and economic growth in various economic environments remain insufficient. Research still needs to investigate the ways pension funds influence labour markets regarding employee position changes and retirement plans. A lack of comprehensive analysis exists in understanding how emerging economy pension systems will endure long-term in ageing populations with changing financial market dynamics. A thorough examination of these knowledge gaps will generate important insights which stakeholders and policymakers need to perfect pension fund system design and implementation.

Research Objectives

The research objectives are as follows:

1. To understand the role of pension funds in economic development by examining their impact on capital market growth, corporate governance, and financial stability.
2. To analyse the relationship between pension fund investments and the volatility index.
3. To investigate the dynamic interactions and relationship between the increase in AUM of pension funds and key macroeconomic variables in the long run.
4. To analyse the variations in the efficacy of the variables affecting pension funds.

Theoretical Framework

Economic savings receive major mobilisation through pension funds, which operate as fundamental components of economic wealth accumulation. These pooled savings enable investments to succeed in major infrastructure projects and corporate finance activities, along with purchasing government bonds. General economic development occurs when this method enables increased capital investment across various sectors. Pension fund mass creates marketplace stability by providing dependable capital that stabilises short-term investment markets.

Capital market development relies strongly on the expansion of pension fund sectors throughout a region. The purchasing habits of pension fund institutions as institutional investors lead to capital market expansion through their demand for various financial instruments. The market demand leads to enhanced resource distribution along with better price discovery and market liquidity, and both these aspects enable improved price discovery. The evaluation of capital market growth and economic expansion in both India and Brazil becomes possible through assessment of their management practices and regulatory systems.

Organisational governance and employment systems stand directly influenced by pension fund operations during their regular activity. As owners of major stakes, pension funds hold enough power to enhance corporate conduct while demanding transparency alongside sustainable business practices, leading to superior corporate achievement. Pension programmes with rigorous management produce stable retired life funding through investments, so workers can easily change employment. Research between India and Brazil will show various combinations of functional approaches to these factors and how they impact economic growth rates.

Pension systems function within multiple socio-political elements, together with institutional elements and cultural frameworks, which strongly affect their structures and both nationwide outreach and operational capabilities. The ongoing digitalisation in India—such as pension registration through Aadhaar and mobile-phone pension management—works to expand coverage for excluded informal workers and poor household beneficiaries. The achievement of these measures requires public institutions to gain the people's trust, along with financial literacy and widespread cultural understanding of long-term savings schemes among the population. Structural limitations impeding pension coverage include the failure to incorporate informal saving schemes, the practice of receiving old-age support from family, and the existence of regional disparities in awareness levels.

The pension system of Brazil operates with central oversight, with PREVIC and INSS maintaining strong supervisory roles. The effectiveness of centralisation suffers adverse impacts as a result of Brazil's political instability, growing expenditure deficits, and increasing numbers of older people. Serious erosion of public trust in pension institutions has developed because of past pension fund corruption and discretionary benefit changes. Participation levels in retirement welfare programmes are determined by the extent to which citizens believe the government should provide support after retirement.

Together with traditional quantitative measurements, pension institutions need qualitative factors which encompass governance, trust, public awareness, and social norms for sufficient performance

evaluation. Understanding pension fund performance in emerging markets depends on these qualitative factors because they help develop place-specific reforms that boost economic impact and long-term performance.

Research Methodology

The data used in this study is secondary in nature, taken over 15 years for both India and Brazil, covering the financial years 2009–10 to 2023–24. The variables considered for the study are GDP growth rate, pension fund assets (change in AUM of pension funds), financial markets development index (stock market capitalisation as a percentage of GDP), volatility index, inflation rate growth, and pension fund investments (returns from markets in different schemes/plans). These are sourced from websites such as NPS, Economic Times, World Bank, Macrotrends, CEIC Data, ETmoney, Groww, Investing.com, and NSE. For Brazil, data sources include The Global Economy, World Bank, Trading Economics, Banco Central do Brasil, Inflation Tool, St. Louis Fed (FRED), Statista, International Labour Organization (ILO) Reports, SURPC Reports, YCharts, and Yahoo Finance.

The statistical tests used for the study include the VAR Granger Causality Test, normality test, independent sample t-test, Mann–Whitney U test, unit root test, and ARDL model, using statistical software EViews and SPSS.

Analysis and Interpretation

To analyse the first objective, the VAR Granger Causality test is conducted using the variables required, which include the rate of return from pension funds and the VIX of India.

For India, the return of Scheme G, Scheme C and when the returns of two schemes are taken together as a single entity, Granger cause or show a positive relationship with the VIX of India, since the p-value is less than 0.05. The VIX of India, return of Scheme G, and VIX—when taken together as a single entity—Granger cause or show a positive relationship with the return of Scheme C. In all other cases, there is either a negative relationship or no relationship existing between the variables.

Table 3.1

VAR Granger Causality Test for India

Dependent Variable: VIX			
Variable	*Prob.*		
Scheme C Returns	0.8264		
Scheme G Returns	0.0016		
All	0.0009		
Dependent Variable: Scheme C Returns		*Dependent Variable: Scheme G Returns*	
Variable	*Prob.*	*Variable*	*Prob.*
VIX	0.0002	VIX	0.5120
Scheme G Returns	0.0672	Scheme C Returns	0.4143
All	0.0016	All	0.6468

Table 3.2

VAR Granger Causality Test for Brazil

Dependent Variable: VIX		*Dependent Variable: Defined Contribution Plans Returns*	
Variable	*Prob.*	*Variable*	*Prob.*
Defined Contribution Plans Returns	0.8277	VIX	0.7156
Variable Contribution Plans Returns	0.8260	Variable Contribution Plans Returns	0.4314
All	0.8704	All	0.0967
Dependent Variable: Variable Contribution Plans Returns			
Variable	*Prob.*		
VIX	0.6365		
Defined Contribution Plans Returns	0.9458		
All	0.0187		

For Brazil, Defined Contribution Plan returns and the VIX of Brazil, when taken together as a single entity, Granger cause or show a positive relationship with Variable Contribution Plan returns. In all other cases, there is either a negative relationship or no relationship existing between the variables.

To determine the second objective, the ARDL model is applied, for which the required variables are GDP, inflation, market capitalisation, and AUM of pension funds. For this, stationarity of the series is to be checked. After the unit root test, it was found that the series are stationary; thus, ARDL can be applied for India.

Table 3.3

Unit Root Test of India

Variable	*Unit Root Test*	*Test in which the series are stationary*
AUM	0.0425	Level
GDP	0.0000	1st Difference
Inflation	0.0002	Level
Stock Market Capitalization	0.0008	2nd Difference

After the unit root test, it was the found that the series are stationary thus, Autoregressive Distributed Lag (ARDL) Model can be applied.

H_0: There is no long-run relationship and cointegration does not exist.

Table 3.4

F-Bounds Test of India

Test Statistic	*Value*	*Level of Significance*	*I (0)*	*I (1)*
F-statistic	4.079536	5%	2.79	3.67
K	3			

In the long-run form and bounds test, the value of the F-statistic is 4.0795, which is greater than the I(1) value at the 5% level of significance. Therefore, H_0 is rejected, and it can be concluded that a long-run relationship and cointegration exist.

Table 3.5

Levels Equation of India

Variable	*Coefficient*	*Prob.*
Inflation	-26.66918	0.0483
GDP	1.355231	0.1671
Stock Market Capitalization	-7.202051	0.0042
C	318.4630	0.0004

The p-values of inflation and stock market capitalisation are less than 0.05, which is significant, whereas the p-value of GDP is greater than 0.05, which is not significant. So, it can be concluded that inflation and stock market capitalisation have a long-run effect on the AUM of pension funds, whereas GDP does not. Thus, the equation is:

EC = AUM of Pension Funds – (–26.669 × Inflation – 7.2021 × Stock Market Capitalisation + 318.4630)

EC is the error correction term and represents the residual from the long-run equation.

Now we estimate the Error Correction Model.

Table 3.6

Error Correction Model of India

Variable	*Coefficient*	*Prob.*
D (Inflation)	-14.76222	0.0088
D (Inflation (-1))	39.83413	0.0066
GDP	-0.996525	0.1239
D (Stock Market Capitalization)	267.1702	0.0079
D (Stock Market Capitalization (-1))	232.2598	0.0057
CointEq(-1)	-2.907102	0.0062

CointEq(–1) represents the error correction coefficient. Here, CointEq(–1) is negative and the p-value is less than 0.05, which indicates the presence of long-run causality. CointEq(–1) also represents the speed of adjustment of any deviation towards the long-run equi-

librium state. The speed of adjustment is 2.9071 × 100 = 290.71%, which indicates a very high adjustment rate.

The unit root test is conducted first to check the stationarity of the series.

Table 3.7

Unit Root Test of Brazil

Variable	*Unit Root Test*	*Test in which the series are stationary*
AUM	0.0000	1st Difference
GDP	0.0213	Level
Inflation	0.0009	1st Difference
Stock Market Capitalization	0.0005	1st Difference

After the unit root test, it was found that the series are stationary; thus, the Autoregressive Distributed Lag (ARDL) model can be applied.

H_0: There is no long-run relationship and cointegration does not exist.

Table 3.8

F-Bounds Test of Brazil through EVIEWS

Test Statistic	*Value*	*Level of Significance*	*I(0)*	*I(1)*
F-statistic	2.273136	5%	2.79	3.67
K	3			

In the long-run form and bounds test, we observed that the value of the F-statistic is 2.2731, which is less than the I(0) value at the 5% level of significance. Therefore, the null hypothesis is accepted, and it can be inferred that no long-run relationship or cointegration occurs.

Now we estimate the ARDL model.

Table 3.9

ARDL Model of Brazil through EVIEWS

Variable	*Coefficient*	*Prob.*
C	-13.42549	0.7526
AUM (-1)	-1.477539	0.0506
GDP	-0.954939	0.3378
Inflation (-1)	-4.368064	0.0734
Stock Market Capitalization (-1)	1.028071	0.2330
D (Inflation)	-0.636480	0.4418
D (Inflation (-1))	1.951701	0.1341
D (Stock Market Capitalization)	1.351046	0.1494
D (Stock Market Capitalization (-1))	1.124130	0.2789

For AUM of pension funds, its lagged period has a negative influence on itself. In the case of all other macroeconomic variables at level, first difference, and second difference, there is no impact on AUM of pension funds.

To analyse the third objective, a normality test is conducted for the variables of both countries, followed by an independent sample t-test for the series that are normally distributed, and a Mann–Whitney U test for the series that are not normally distributed.

Table 3.10

Test of Normality

Variables	*Shapiro- Wilk Test*	
	India	*Brazil*
AUM	.026	.000
GDP	.000	.422
Inflation	.837	.183
Stock Market Capitalization	.823	.928
Scheme C/ DC Plan Returns	.001	.303
Scheme G/ VC Plan Returns	.139	.151
VIX	.008	.001

For India: inflation, Scheme G, and stock market capitalisation; and for Brazil: GDP, inflation, stock market capitalisation, DC plans, and VC plans—all show that the series follow a normal distribution. Thus, the inflation data for India and Brazil; Scheme G returns of India and VC Plan returns of Brazil; and stock market capitalisation of both countries will undergo the independent sample t-test. The remaining variables will undergo non-parametric (Mann–Whitney U test) analysis.

The independent sample t-test is conducted first:

H_0: There is no significant difference in the distribution between the means of variables affecting funds between Indian and Brazilian pension funds.

H_1: There is a significant difference in the distribution between the means of variables affecting funds between Indian and Brazilian pension funds.

Table 3.11

Independent Samples t-test

		t-test for Equality of Means				
		T	*Df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*
Inflation	Equal variances assumed	-8.484	28	.000	-6.26267	.73817
	Equal variances not assumed	-8.484	27.401	.000	-6.26267	.73817
Scheme G/ VC Plans Returns	Equal variances assumed	-8.038	28	.000	-2.70333	.33633
	Equal variances not assumed	-8.038	26.213	.000	-2.70333	.33633
Stock Market Capitalization	Equal variances assumed	13.437	28	.000	30.20000	2.24751
	Equal variances not assumed	13.437	19.859	.000	30.20000	2.24751

For both inflation and Scheme G / VC Plan returns, the Sig. value is less than $\alpha/2$, which is 0.05 / 2 = 0.025; thus, we reject H_0 and accept H_1. This means they are significantly different. The interpretation is shown in the table below.

Table 3.12

Interpretation of Independent Samples t-test Tabulated Result

Particulars	*P value ($\alpha/2$)*	*Decision ($\alpha/2$= 0.025)*
Inflation	0.000	Reject H_0 as Sig. value <$\alpha/2$, Accept H_1
Scheme G/ VC Plans Returns	0.000	Reject H_0 as Sig. value <$\alpha/2$, Accept H_1
Stock Market Capitalization	0.000	Reject H_0 as Sig. value <$\alpha/2$, Accept H_1

Inflation, Scheme G / VC Plan returns, and stock market capitalisation suggest that the factors of pension funds indicate the means of Indian and Brazilian pension funds are quite different from each other.

The Mann–Whitney U test is a non-parametric test used to determine whether there is a significant difference between the distributions of two independent groups.

H_0: There is no significant difference in the distribution of the variables affecting funds between Indian and Brazilian pension funds.

H_1: There is a significant difference in the distribution of the variables affecting funds between Indian and Brazilian pension funds.

As the Sig. value of the Mann–Whitney U test is 0.000, which is less than the 5% level of significance, we reject the null hypothesis. This means that there are significant differences in AUM, GDP, Scheme C / DC Plan returns, and VIX between the factors of pension funds in India and Brazil. The mean ranks of AUM, GDP, and VIX of India consistently show higher values compared to Brazil, whereas DC Plan returns of Brazil show higher ranks when compared to India.

Table 3.13

Non-Parametric Test (Mann-Whitney U)

Ranks								
Variables	*Country*	*Mean Rank*						
AUM	India	22.93						
	Brazil	8.07						
GDP	India	21.33	*Test Statistics*					
	Brazil	9.67	*Variables*	*AUM*	*GDP*	*Stock Market Capitalization*	*Scheme C/ DC Plans Returns*	*VIX*
Scheme C/ DC Plans Returns	India	8.67	Mann-Whitney U	1.000	25.000	0.000	10.000	51.000
	Brazil	22.33	Z	-4.625	-3.629	-4.669	-4.254	-2.551
VIX	India	19.60	Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.011
	Brazil	11.40						

Table 3.14

Interpretation of Mann Whitney U test Tabulated Result

Particulars	*Sig value (α/2)*	*Decision (α/2= 0.025)*
AUM	0.000	Reject H_0 as Sig. value <α/2, Accept H_1
GDP	0.000	Reject H_0 as Sig. value <α/2, Accept H_1
Scheme C/DC Plans Returns	.000	Reject H_0 as Sig. value <α/2, Accept H_1
VIX	.006	Reject H_0 as Sig. value <α/2, Accept H_1

Through the use of share prices, net profit, and dividend data, the conclusion is that there is a significant difference in the distribution of share price, net profit per share, and dividend per share between the pension funds of the two countries—India and Brazil.

Table 3.15

Analysis of the Variations in the Efficacy of Factors Affecting Pension Funds

Parameters	*India*	*Brazil*	*Comment*
AUM	22.93	8.07	India is more efficient
GDP	21.33	9.67	India is more efficient
Inflation	8.00	23.00	Brazil is more efficient
Stock Market Capitalization	23.00	8.00	India is more efficient
Scheme C/DC Plans Returns	8.67	22.33	Brazil is more efficient
Scheme G/VC Plans Returns	8.07	22.93	Brazil is more efficient
VIX	19.60	11.40	India is more efficient

Thus, the group statistics based on the criteria of comparison taken into consideration show that, on the whole, pension funds of India are more efficient than those of Brazil.

Findings of the Study

It is observed that Scheme G returns, Scheme C and the returns of two schemes combined as one entity, give rise to or establish a favourable relationship with the Indian VIX. When seen together, the VIX of India, return of Scheme G, and Indian VIX separately Granger cause or show a favourable relationship with the return of Scheme C. However, Brazil's Defined Contribution Plan returns and the VIX of Brazil, as one entity, Granger cause or possess a positive relationship with the country's Variable Contribution Plan returns.

For India, the F-Bounds test yields a significant long-run relationship and cointegration. Inflation and stock market capitalisation have a long-run effect on pension fund AUM, while GDP does not. The speed of adjustment towards long-run equilibrium is high, thus indicating long-run causality.

For Brazil, the F-Bounds test results in accepting the null hypothesis, indicating no long-term relationship or cointegration. The lagged period negatively influences the AUM of pension funds, while other macroeconomic variables do not impact it at different levels.

Table 3.16

Efficiency of Factors affecting Pension Funds

Parameters of Risk Management	*Efficiency of Factors of Pension Funds:*	
	India	*Brazil*
AUM	High	Low
GDP	High	Low
Inflation	Low	High
Stock Market Capitalization	High	Low
Scheme C/ DC Plans Returns	Low	High
Scheme G/ VC Plans Returns	Low	High
VIX	High	Low

The above table shows the findings of the independent sample t-test and Mann–Whitney U test. It is also found that the effectiveness of factors affecting pension funds in India is greater than that of Brazil.

Implications of the Study

The pension fund systems of India and Brazil provide essential functions for economic growth, together with social welfare benefits. Social inequality and senior citizen poverty risks emerge because millions of Indian workers remain outside formal pension schemes due to the informal economy. The ability of pension funds to work as inclusive finance channels is diminished because of this. Inflation, coupled with population changes in Brazil, produces pension system instability by reducing retirement benefits for former employees.

In order to overcome these problems, legislation must promote inclusiveness and equitable treatment between distinct age groups. The Indian government needs to establish Aadhaar–NPS digital enrolment systems that provide pension benefits to informal workers, while enforcing mandatory contribution rates from standard employees to support pension funds for casual labourers. The Brazilian government should unite infrastructure development initiatives

with retirement safety systems that perform pension redistributions through inflation adjustments.

Currently, there is a need for policy adaptations that link pension programmes to both economic stability and enduring long-term growth. Agile regulatory principles are essential for the Indian pension system, since its financial assets demonstrate very high sensitivity to market volatility. A unified oversight body should lead the combined supervision of NPS and EPFO operations to enhance efficiency and transparency. Infrastructure bonds, combined with renewable energy projects featuring international assets, will help achieve national development objectives. The Brazilian government needs to create independent institutional bodies that administer pension programmes, in order to stop corrupt practices from rising. The purchase of inflation-indexed bonds acts as a protective measure against currency depreciation for pensioners holding these assets. The two countries need to implement digital methods to sign up informal workers for pensions while also adopting blockchain systems to make pension fund tracking more transparent.

The absence of a strong long-term association between pension fund AUM and GDP growth, particularly in India, is one of the reasons for weak link between retirement security and macroeconomic progress which remains a concern. Even in the presence of positive GDP growth, growth of pension funds remains sluggish and unbalanced, so that rising national income is not trickling down into personal financial planning or institutional saving.

This difference may be due to combination of the following factors: low pension take-up within the informal economy, poor economic and social policy connections, low levels of financial literacy, and lack of behavioural incentives towards long-term saving. A performing economy will not, in itself, generate high pension take-up unless policy connections are instituted.

In the aftermath of this practice–policy disconnect, Indian and Brazilian governments and pension policymakers must follow a multi-dimensional strategy:

- *Coordinate Pension Development with Growth Plans:* Pension system development must accompany country-level economic growth plans. For example, pension-bond-backed, securities-covered infrastructure projects can link public expenditure to asset creation.
- *Support Financial Inclusion Plans:* It is essential to advance projects aimed at establishing pension plans for self-employed personnel and platform workers. The pension system can offer three innovative programmes such as mobile-phone-based micro-contribution plans, streamlined entry plans, and public-matching plans.
- *Tax and Labour Law Reform:* Structure pension contribution charges as a proportion of rising earnings and fixed-wage work agreements. Facilitation of contributions through pay-as-you-go payment channels should be more equitable and inclusive.
- *Build Financial Literacy and Trust:* Public education supported by trust will create the necessary foundation to establish an old-age savings culture. Promotional campaigns should emphasise transparency when displaying fund performance data and detailing elderly poverty risks to attract subscribers.
- *Provide Institutional Autonomy and Effective Supervision:* The Brazilian government must defend its pension regulatory system against recurring political changes. India calls for an integrated supervision system that requires EPFO, NPS, and private schemes under a single authority.

Lastly, narrowing the GDP–AUM gap requires more than economic statistics to meet the social infrastructure goals of pension funds. Sustainable, inclusive, and open models that capitalise on the behavioural needs of different populations must be used in an attempt to convert pension assets into agents of economic and social development.

Conclusion of the Study

This study on the influence of pension funds on economic growth in India and Brazil demonstrates that pension funds are critical contributors to financial development, capital allocation, and economic expansion. Through years of utilisation, pension funds have proven to be effective instruments that produce diverse economic outcomes via different strategies in both nations.

In the Indian context, the study reveals that pension fund assets have grown steadily and have had a small positive impact on the GDP growth rate. The nation's hybrid approach—where the population is covered by a dense blend of government-initiated programmes such as the National Pension System (NPS) and private schemes such as the Employees' Provident Fund Organisation (EPFO)—has spurred massive capital build-up. However, the FMDI has found that market capitalisation as a proportion of GDP remains untapped, prompting calls for better regulation and improved financial market penetration. Inflation growth has been another issue and has affected the effective returns on pension fund investments. Furthermore, the composite figure of the Volatility Index brings into focus the need for efficient mechanisms to address market risks.

Brazil's pension fund system features centralisation and high government interference. Pension funds have been used efficiently to fund infrastructure projects and social security programmes. The enhancement of pension fund AUM has positively impacted GDP growth; however, concerns of sustainability arise due to demographic changes and fiscal pressures. The study finds that the Financial Markets Development Index shows a slightly higher average market capitalisation-to-GDP ratio, indicating a well-developed stock market. However, the Volatility Index reflects extreme market movements, which must be carefully managed. Inflation growth continues to be a concern, particularly because it erodes the real values that can be earned from pension fund investments.

A digest of the comparative analysis indicates that the two countries can learn from each other. India can implement the Brazilian model of centralised supervision to improve effectiveness, while Bra-

zil can benefit from India's liberalised financial sector by extending pension programmes to a larger populace. Thus, efforts should focus on improving regulatory effectiveness and reducing the influence of market fluctuations and inflation, to optimise pension fund contributions in the economic development trajectories of both countries.

Finally, the study stresses the need for forward-looking pension fund policies that are adaptable to evolving conditions. For this reason, the application of these strategies must be continuously evaluated and adjusted, to enhance the economic outlook of both India and Brazil and help create secure financial futures for their citizens.

Further Scope of the Study

The analysis of pension fund investment behaviour to determine their market stability effects, along with their asset management strategies, needs further research. Industry experts can better predict market movements because performance of pension fund are directly linked to market. Predictive modelling allows researchers to study diverse economic structures to recognise essential performance elements that enhance pension fund performance.

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4

Balancing Acts: Safe Withdrawal Rates in the Indian Context

Rajan Raju | Ravi Saraogi

Abstract

The determination of a safe withdrawal rate (SWR) is a cornerstone of retirement planning and addresses the critical question of how much can be safely withdrawn annually from a retirement corpus without risking its premature depletion. This study adds to the empirical evidence on SWR by providing an out-of-sample and comprehensive analysis adapted to the Indian context. The often-cited 4% rule is not appropriate in India's context; rather, a range between 3.0% and 3.5% is more appropriate. Our analysis reveals that while portfolios with higher equity allocations can potentially increase safe withdrawal rates, they also significantly increase the risk of portfolio failure, particularly for withdrawal rates greater than 3.75%. Taxes on fixed deposit interest act as significant drags on the failure rates of 'safe' all-deposit portfolios. In addition, we highlight the importance of gold as a diversifying asset, which can mitigate some market-related risks in traditional two-asset class portfolios.

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Introduction

Determining a safe withdrawal rate (SWR) is a cornerstone of retirement planning, addressing the critical question of how much can be safely withdrawn from a retirement corpus without risking its premature depletion. This concept is especially relevant given the shift from defined benefit to defined contribution retirement plans, coupled with increasing longevity and earlier retirements.

Historically, the 4% rule, emerging from studies such as Bengen (1994) and the Trinity Study (Cooley, Hubbard, and Walz, 1998), has been a benchmark in retirement planning, particularly in the United States. These studies, which focused on historical returns of stocks and bonds, suggested that a withdrawal rate of 4% would likely sustain a retirement portfolio for 30 years. However, while widely accepted and applied, this rule presents challenges when transposed to different geographical and economic contexts. The inherent diversity in global financial markets, coupled with the specificities of local economies, makes the application of a universally accepted SWR, such as the 4% rule, potentially misleading outside its original context (Pfau, 2010; Anarkulova, Cederburg, O'Doherty, and Sias, 2023).

In India, where the dynamics of financial markets and economic conditions differ markedly from those of the US, directly applying the 4% rule raises questions of relevance and accuracy. Despite the critical role of SWR in financial planning, there is a notable gap in the literature on an appropriate SWR for the Indian context. Existing discussions are largely limited to sporadic commentaries criticising the blind adoption of methodologies and conclusions drawn from foreign markets. Saraogi (2022), using debt and equity returns between 1979 and 2022, shows that for an average Indian investor, an SWR of 3% is suitable, while for a risk-conservative investor, it should not be more than 2.6%. This study attempts to add to the empirical evidence on SWR by providing both an in-sample and an out-of-sample comprehensive analysis adapted to the Indian context.

The methodology of this study aligns with the evolving landscape of retirement planning and factors in longer lifespans, earlier retirements, different asset allocations, and taxes. Using data from

2000 to 2023, we follow Raju and Raju (2023) for total return equity and short-term fixed income returns, together with circular block bootstrap and randomised Monte Carlo simulation techniques. Our approach acknowledges the challenges posed by the relatively short span of available data in India, which has historically limited the depth of such studies.

Relying solely on historical averages, as done in many popular retirement-related blogs and marketing materials of providers, can be misleading, especially given the dynamic socio-political and economic environments that influence asset behaviours. We emphasise that while historical data provide a valuable baseline, it is imperative to consider the inherent volatility in asset returns. This analysis aims to offer a more comprehensive perspective, factoring in various market scenarios, enabling investors to plan for retirement with a greater degree of confidence and realism.

Our objective is twofold: first, to establish a robust SWR for India, and second, to contribute to the ongoing discourse on retirement planning. By tailoring our analysis to the unique characteristics of the Indian market, our goal is to provide a more accurate and reliable guide to retirement planning in India, thus helping both financial advisers and individuals make informed decisions for a secure retirement. Our analysis reveals that while higher equity allocations in portfolios can potentially increase safe withdrawal rates (SWR), they also significantly increase the risk of portfolio failure, particularly for withdrawal rates exceeding 3.75%. On the other hand, we find that conservative portfolios, predominantly based on fixed deposits, are vulnerable to the combined impact of high inflation and taxation, which substantially erodes their real returns, hastening depletion. Furthermore, our research highlights the pronounced risk associated with the sequence of returns, especially during the early retirement years, exacerbated by volatility in equity markets. A key insight from our exploration is the potential benefit of incorporating gold as a diversification asset in traditional two-asset class portfolios, which offers a buffer against some market-related risks. This comprehensive study provides a nuanced understanding of the dynamics that shape

retirement planning in India, emphasising the importance of strategic diversification and adaptability in the face of market uncertainties. Our results not only improve the understanding of the dynamics of retirement portfolios in the Indian market, but also offer a comparative viewpoint in relation to existing global benchmarks.

The rest of the paper is structured as follows: Section 2 mentions the data sources and details the methodology; Section 3 illustrates our results; and we conclude in Section 4.

Data and Methodology

Data

Our study uses robust data sources to analyse the Indian equity market, fixed deposit rates, and consumer price indices to adjust for inflation.

The Indian equity market, with its rich history dating back to the establishment of the Bombay Stock Exchange in 1875, provides a fertile ground for our analysis. We use the MSCI India Index (Indian Rupee), which, starting from December 1992, covers approximately 85% of the Indian equity universe. Despite its later start date compared to the S&P BSE Sensex, launched in January 1986, the MSCI India Index is preferred due to its broader market coverage. The correlation between the MSCI India Total Return (INR) and the shorter S&P BSE Sensex TR Index, based on monthly returns from September 1996 to September 2023, stands at 0.98. The regression between these two indices yields an R-squared of 0.95 and a β of 1.02, underscoring their comparability for our analysis.

For fixed deposit rates, we refer to the Weekly Statistical Supplement[1] published by the Reserve Bank of India (RBI), which reports high and low term deposit rates from September 1997. The mean of these rates, supplemented by an additional 1% to reflect the higher rates enjoyed by senior citizens (60 years and older), forms our time series for deposit rates.

1. See https://rbi.org.in/Scripts/WSSViewDetail.aspx?TYPE=Section&PARAM1=4

The Consumer Price Index (CPI), essential for adjusting returns for inflation, is available from two departments: the Ministry of Statistics and Programme Implementation (MOSPI) and the Ministry of Labour and Employment (MLE). Despite MOSPI's indices being more reflective of Indian consumer consumption, their shorter history since 2011 limits their utility for our long-term analysis. Consequently, we use the MLE's CPI data, with a more extended history dating back to March 1960, recalibrated to the 2016 = 100 base year to ensure a comprehensive and pragmatic approach in measuring inflation over the extended period relevant to our study.

Methodology

We calculate annual real returns for equities and fixed deposits adjusted for inflation. To avoid calendar effects, we create 12 time series, one for each calendar month across the observation period (January 2000 to August 2023), giving 284 unique month-year combinations. For example, the first time series spans from January 2000 to August 2023. The next series starts from February 2000 onwards, goes all the way to August 2023, and then wraps back to January 2000 to complete the full circle of 284 months. Constructing 12 such time series from which to sample allows us to simulate calendar effects with the starting point bias of retirement portfolios. Figures 4.1 and 4.2 show the annualised return of the mean rolling calendar months between 2000 and 2023 for equities and fixed deposits.

Table 4.1 presents the summary of the annual returns for equities and fixed deposits, both in real and nominal terms, as well as the inflation rates observed in our data set. In particular, the data reveal a discernible negative correlation (-0.247) between the nominal returns of equities and fixed deposits. On the contrary, in terms of real returns, the correlation between these two asset classes is almost negligible (0.008). This distinction underscores the varying dynamics when considering real versus nominal returns for such an analysis.

Figure 4.1

Mean Annualised Total Real Returns for Equity: December 1999 to August 2023

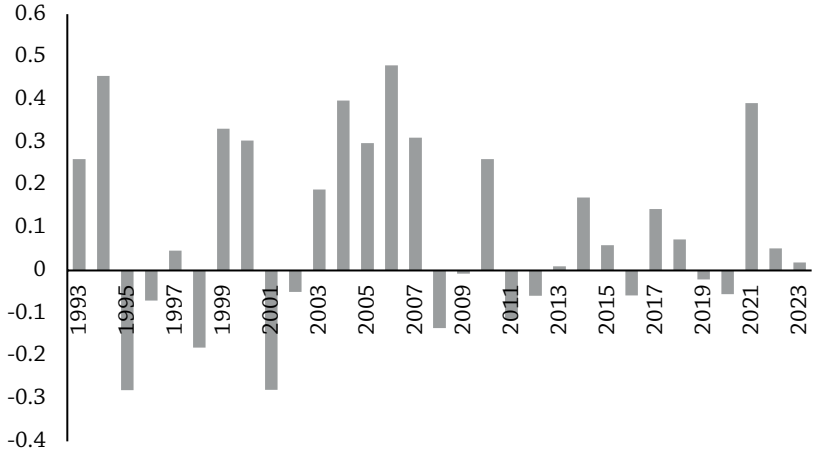

Figure 4.2

Mean Annualised Total Real Returns for Fixed Deposits: December 1999 to August 2023

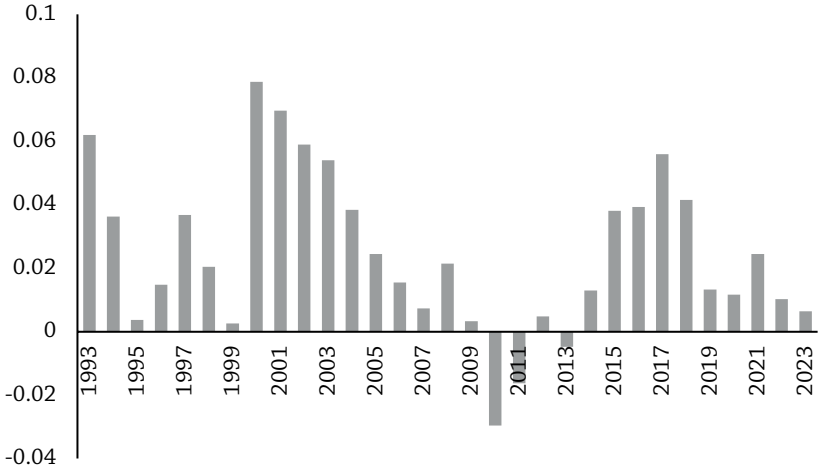

Table 4.1

Summary Statistics of Real and Nominal Equity and Fixed Deposit Returns and Inflation: December 1999 to August 2023

		Arthmetic Mean	*Geometric Mean*	*Standard Deviation*
Real Returns	Equity	9.94	6.54	27.21
	Fixed Deposit	2.44	2.40	2.70
Nominal Returns	Equity	16.79	13.23	28.85
	Fixed Deposit	8.69	8.68	1.44
	CPI	6.31	6.28	2.76

Source: Raju and Raju (2023).

A historical return can be considered as a single observable sample from a distribution of returns. Dimson, Marsh, and Staunton (2004) argue that relying solely on past data for future predictions leads to success bias and sampling error. Although they reference US data, their argument holds more generally across asset classes and geographies. Academic studies (Saraogi, 2022; Anarkulova et al., 2023) adopt Monte Carlo or bootstrapping approaches to simulate long-term portfolios.

Given the relatively short period of our data—from January 2000 to August 2023—our methodology must be particularly rigorous. The short data span presents unique challenges in modelling long-term retirement portfolios, as it may only partially capture longer-term economic cycles or market behaviours. As stated earlier, to address this and enhance the robustness of our analysis, we create 12 distinct time series, one for each month in the observation period. This approach aims to mitigate the starting point bias in retirement portfolio simulations, allowing us to simulate calendar effects more accurately and to understand how the non-stationarity of the data might manifest differently across various timescales.

In our analysis, the first step involves examining the time-series data for stationarity. Stationarity implies that the statistical properties of a time series, such as its mean and variance, remain constant over time. This assumption is critical for reliable forecasting and

model building. Non-stationary data, often encountered in financial time series, means that parameters like mean and variance change over time, affecting predictability and stability, and consequently influencing how the data can be modelled and interpreted. To assess stationarity, we employ the Augmented Dickey-Fuller (ADF) test—a method widely used to detect unit roots in a time series, which would indicate non-stationarity—on the equity and fixed deposit returns data.

The choice to employ both Monte Carlo simulation and bootstrap methods in our analysis is informed by the stationarity of the data, as identified by the ADF test. Monte Carlo simulations, typically applied under the assumption of known and stationary parameters, require careful adaptation to accommodate non-stationary data. The bootstrap method, particularly the circular bootstrap, is more suitable for non-stationary data, as it preserves the temporal structure and is better suited for capturing inherent trends and cyclicality.

Furthermore, our approach to creating 12 monthly time series also provides a nuanced view of the stationarity of the data at different times of the year, enabling a more tailored application of resampling or simulation techniques. This approach is necessary for our long-term projections that span 25, 30, and 35 years, where understanding the underlying properties of the data—including trends and varying volatilities—is essential.

The results of the ADF test are crucial in this context. For both equity and fixed deposit returns, we observe large p-values, indicating insufficient evidence to reject the null hypothesis of a unit root, and thus confirming non-stationarity (the average test statistic and p-value across the 12 time series for equity: test statistic -3.72, p-value 0.25; fixed deposits: test statistic -2.44, p-value 0.58). These findings underscore the need for a careful and tailored approach to modelling and interpreting our time series data for robust long-term retirement portfolio simulations.

Our next analytical step involves the Engle-Granger cointegration test. This test identifies whether two or more time series are cointegrated, implying that they share a long-term equilibrium relationship

despite being non-stationary individually. In simpler terms, if two series are cointegrated, they may sometimes drift apart, but in the long run they will tend to move together, thereby maintaining an equilibrium relationship.

The Engle-Granger test ensures that our simulation methods accurately align with our data's intrinsic properties and relationships. The presence or absence of cointegration between our time series will inform our decision on the sampling approach for our simulations. If cointegration is established, it indicates that equity and fixed deposit returns are linked in a way that their long-term movements are interconnected. In this scenario, we will employ joint sampling of the series, reflecting their interdependent nature. However, if no cointegration is found, it would suggest that the two series do not share a long-term equilibrium relationship, which would lead us to conduct independent sampling for each.

Given the length of the data, we applied the Engle-Granger cointegration test with no trend to provide a more conservative assessment of the potential cointegration between these two financial time series and adjusted the significance level to 10%. The mean results across the series under this revised testing framework indicate a scenario of weak cointegration (test statistic -3.16, p-value 0.09). Specifically, the mean test statistic is more negative than the critical value at the 10% level, suggesting a potential cointegration between the series. However, the corresponding mean p-value is still above the conventional 5% threshold but below 10%, pointing to a marginal, yet notable, indication of a long-term equilibrium relationship between equity and fixed deposit returns in our sample.

Recognising even a weak cointegration is crucial in such contexts, as it implies that the movements of equity and fixed deposit returns are not entirely independent in the long run. Given the weak cointegration in the sample, we adopt a conservative approach in our subsequent analysis. Instead of independent sampling, which would be more suitable in the absence of cointegration, we opt for joint sampling of the series—reflecting a more cautious and thorough modelling strategy, acknowledging the subtle long-term dynamics that

might exist between equity and fixed deposit returns. In doing so, we aim to capture any underlying interconnectedness in these financial series, ensuring that our simulation models are as realistic and robust as possible, especially for long-term forecasting.

After establishing the stationarity and interrelationships of the data through the ADF and Engle-Granger tests, our analysis progresses to the simulation methods. We adopt both Monte Carlo simulations and bootstrap techniques, specifically emphasising the circular bootstrap method to accommodate the non-stationarity observed in our financial data. Monte Carlo simulations excel at exploring various outcomes in complex systems, although their effectiveness depends on the accuracy of the underlying assumptions. In this study, we use Monte Carlo simulations with replacement.

Conversely, the circular bootstrap method—apt for non-stationary data—maintains the dataset's inherent temporal structure and cyclicality. A key aspect of effectively applying this method is determining the optimal block length, which we calculate using the algorithm described in Patton, Politis, and White (2009). This calculation ensures that our block lengths aptly reflect the time series' crucial characteristics, such as volatility persistence and mean reversion. Our simulations use the average of these calculated lengths across the 12 time series of equity and fixed deposits as the block length. For our sample period, the average optimal block length calculated is five.

In contrast to the moving block bootstrap, which risks undersampling data at the series' extremities, the circular block bootstrap employs fixed-length blocks for a more balanced and comprehensive representation of the entire series. This consideration is particularly pertinent due to the limited period of our data, from January 2000 to August 2023.

Our bootstrap generator process begins with a randomised selection among the 12 time series, followed by a second randomisation stage within the chosen month's series. This dual-step randomisation diversifies the starting point and enhances the sequence variability within the chosen time series. Our generator produces bootstrap samples using the optimal block length, concatenating them until the

target number of retirement years is achieved. This approach allows us to generate robust and realistic simulations, preserving both the temporal dynamics and the inter-asset relationships intrinsic to the equity and fixed deposit markets.

In constructing retirement portfolios, we consider annual withdrawal rates ranging from 3.0% to 4.0% in increments of 25 basis points, and portfolio allocations between equities and fixed deposits varying from 0:100 to 50:50 in increments of 10. This range accounts for the prevalent tendency towards fixed deposits in retirement portfolios and the observed home bias in equity investments (Raju, 2023). Our simulations span 25, 30, and 35 years.

In our Monte Carlo simulation and circular bootstrap methodology, ensuring that a sufficient number of iterations is accounted for is critical for robust results. For Monte Carlo simulations, we calculate the required iterations using the formula $n = \left(\frac{z_{\alpha/2}S}{E}\right)^2$,

where n denotes the number of iterations needed, S represents the estimated standard deviation of the output, E is the desired margin of error, and $z_{\alpha/2}$ is the critical value of the normal distribution for a given confidence level (Winston, 2000). Given the higher standard deviation of equity in our data (referenced in Table 4.1), we derived the number of iterations based on this variable. Choosing a high degree of statistical certainty, we set our confidence level at 99% ($z_{\alpha/2}$ = 2.576) with a margin of error (E) of 0.5. This balance between a high confidence level and a reasonable margin of error requires approximately 19,700 iterations. However, to enhance the robustness of our analysis and account for the additional variability not captured in the standard deviation, we execute 50,000 iterations in our Monte Carlo simulations.

For circular bootstrap, we adopted an analogous approach to determine convergence. Here, we assessed the stability of the mean statistic over multiple iterations, using the Standard Error of the Mean (SEM) as our convergence criterion. Using a SEM threshold of 0.05%, at 99% confidence, approximately 2,000 iterations were typically needed to reach the stability of the mean. However, to align

with the robustness of our Monte Carlo simulations, we similarly performed 50,000 iterations for our circular bootstrap analysis.

For each combination of withdrawal rates and portfolio allocations, we therefore generate 50,000 simulation draws. The process for each iteration, m=1,...,50,000, is as follows:

1. *Generation of Asset Returns:* We draw annual total returns on equities and fixed deposits to create a time series of T(m) months of returns. These returns are generated using the Monte Carlo and circular block bootstrap methods, employing the previously described randomisation process. We use the calculated optimal block size for the circular bootstrap, while the Monte Carlo simulation involves randomised single draws. Monte Carlo returns are denoted as $R_{i,t} = \left[R_{i,t}^{\text{equity}}, R_{i,t}^{\text{fixed income}}\right]$ and circular bootstrap returns as

   $$B_{i,t,t+1,t+2,\ldots,t+n} = \left[R_{i,t+1,t+2,\ldots,t+n}^{\text{equity}}, R_{i,t+1,t+2,\ldots,t+n}^{\text{fixed deposit}}\right]$$

2. *Calculation of Retirement Account Balances:* We calculate the monthly balances of the retirement account for the selected durations of 25, 30, and 35 years. Returns depend on portfolio weights w_t, where t indexes the month of the retirement period. These weights range from 100% in fixed deposits to a 40:60 portfolio with 40% in fixed deposits and 60% in equities, effectively implementing an annual rebalancing strategy.
3. *Withdrawal Rates and Portfolio Sustainability:* Starting with an initial wealth W_0 and an adopted annual withdrawal rate (AWR), the withdrawal I is set as a percentage of the accumulated portfolio on the retirement date. As all returns in our analysis are adjusted for inflation, the withdrawal amount remains constant in real terms. The account balance is then adjusted by the year's real asset returns. Should the balance reach zero before the end of the retirement period, the portfolio is deemed unsustainable. We quantify failure probabilities as the ratio of portfolios that exhausted their funds before the retirement period's conclusion to the total number of portfolios.

4. *Taxation:* In our base case analysis, we apply a 30% tax rate on fixed deposit returns and a 10% tax rate on equity returns, computed on nominal returns. If the nominal equity returns are negative, then there is no tax. The tax calculation for each period can be represented by:

$$R_{\text{after-tax},i} = \begin{cases} R_{\text{real},i} - R_{\text{nom},i} \times T_i, & \text{if } R_{\text{nom},i} > 0 \\ R_{\text{real},i} & \text{otherwise} \end{cases} \quad (1)$$

where, $R_{\text{after-tax},i}$ is the after-tax return for the i-th asset, $R_{\text{real},i}$ is the real return for the i-th asset, $R_{\text{nom},i}$ is the nominal return for the i-th asset, and T_i is the applicable tax rate for the i-th asset.

We take the most conservative approach to tax: the annual portfolio return is fully taxed.

All-deposit portfolios are popular "conservative" portfolios. As Raju and Raju (2023) show, taxes on nominal returns depress real returns beyond the effect of inflation. Additional results are also presented for the tax rates of 10% and 20% for an all-deposit portfolio to examine the sensitivity to tax on portfolio failure rates.

5. *Assumptions on Portfolio Management:* Consistent with much of the existing literature, we assume annual investment portfolio rebalancing to maintain the targeted asset allocation. We do not factor in taxes from equity sales or transaction costs associated with rebalancing. In addition, we omit mutual fund or financial adviser fees from our calculations. Although challenging, this decision is made to align with standard practices in the field, highlighting that our findings on lower exhaustion rates are driven by factors other than such fees. It should be noted that index funds and ETFs, with their minimal administrative fees, lend more credibility to this assumption.

Given that all the returns in our sample are real returns, the retirement income is expressed in real terms. We assume that the annual account withdrawal is set as a percentage of the accumulated portfolio on the retirement date. Since these returns are already

adjusted for inflation, the withdrawal amount remains constant in real terms. This approach is equivalent to other studies that use nominal returns and adjust the withdrawal by the inflation rate. Let R_r and R_n represent real and nominal returns respectively, CPI the inflation rate, and W the withdrawal amount. As $R_r \times (1 + CPI) = R_n$, we have:

$$\frac{R_n - W \times (1 + CPI)}{1 + CPI} = \frac{R_n}{1 + CPI} - \frac{W \times (1 + CPI)}{1 + CPI} = R_r - W$$

Equation 2 shows that increasing the withdrawal amount annually by the inflation rate in nominal terms is equivalent to keeping the withdrawal amount constant in real terms. This equivalence ensures consistency in the interpretation of withdrawals and returns, regardless of whether they are presented in real or nominal terms.

Figure 4.3

Illustrative Portfolio Values by Retirement Year for a 30-Year 10:90 Equity–Fixed Deposits Portfolio with 4% AWR Using 500 Circular Bootstrap Simulations

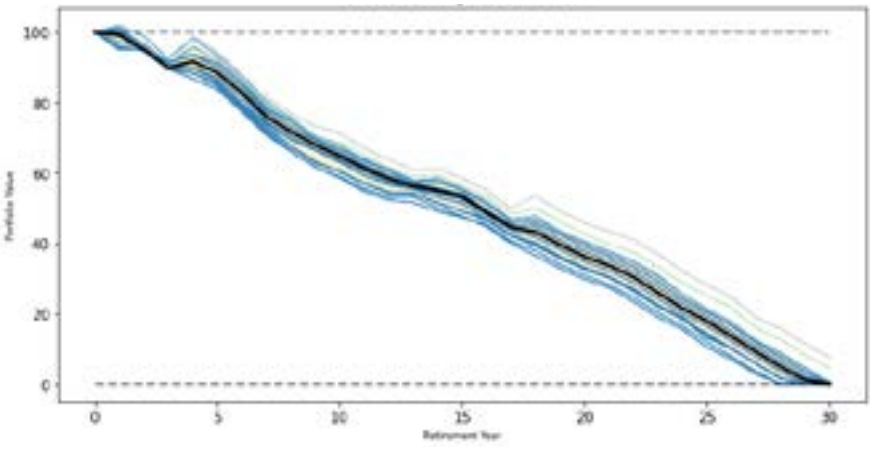

Figure 4.3 illustrates the results of our methodology. For a 30-year, 10:90 equity–fixed deposits portfolio with a 4% AWR using

500 circular bootstrap simulations, the chart shows the portfolio values for each simulation. Failure rates are the proportion of portfolios that fall below zero before the 30th year.

Appropriateness and Limitations of the Methodology

Appropriateness for the Indian Context

The methodology adopted in our study is particularly suited to the Indian financial landscape, marked by its relatively short data history. The use of Monte Carlo simulations and circular block bootstrap methods aligns well with the dynamics of the Indian market. These techniques allow for a comprehensive analysis even with the limited data span available, extending from January 2000 to August 2023. By creating 12 distinct time series for each month throughout the observation period, we effectively address potential starting point biases, a crucial consideration given the rapid evolution and growth of the Indian financial markets in the last two decades. This approach is particularly apt to capture the subtle nuances and trends that characterise the Indian equity and fixed deposit markets, which are critical for realistic long-term retirement planning.

Furthermore, consideration of different withdrawal rates and asset allocation strategies reflects the various investment preferences and retirement planning approaches prevalent in India. The emphasis on fixed deposits in the portfolio mix mirrors the conservative investment inclinations of Indian investors, particularly in the context of retirement planning. This methodological alignment with local market characteristics and investor behaviour ensures that our findings and insights are highly relevant and applicable to Indian retirees.

Limitations and Future Research Directions

Despite its strengths, our methodology is not without limitations, which stem primarily from the constraints of the available data. The relatively short time span of the data, covering just over two decades, may not fully encapsulate longer-term economic cycles or market behaviours that could significantly impact retirement portfolio sustainability. Additionally, the assumption that there are no

transaction costs or taxes arising from rebalancing, and the omission of mutual fund or financial advisor fees, while aligning with standard practices, may not fully reflect the real-world scenario for many investors.

These limitations point towards potential areas for future research. Future studies could explore the impact of longer data sets as they become available, providing a more comprehensive view of market behaviours over different economic cycles. Additionally, incorporating transaction costs, taxes, and investment fees into the analysis could provide insight into their impact on the sustainability of the retirement portfolio. Such extensions would enhance the robustness of the methodology and provide even more nuanced insights for retirement planning in the Indian context.

In summary, our methodology, tailored to the specifics of India, recognises the need for additional research to address its limitations. This continuous evolution in methodology will ensure that our approach remains relevant and effective in guiding retirement planning strategies in India's dynamic financial landscape.

Results and Discussion

As we transition from the methodological framework to the empirical findings of our study, it is essential to contextualise these results within the broader narrative of retirement planning in India. This section presents the outcomes of our Monte Carlo and circular bootstrap simulations, offering a detailed examination of portfolio failure rates across various scenarios. Our analysis not only contributes to a deeper understanding of the dynamics governing retirement portfolios in the Indian market but also provides a comparative perspective against existing global benchmarks. By juxtaposing our results with established studies, such as those of Saraogi (2022) and Bengen (1994), we aim to examine the implications of our findings for retirement planning strategies tailored to the unique characteristics of the Indian financial landscape by critically evaluating the suitability and limitations of different withdrawal rates and asset allocations, underscoring the importance of a methodologically rigorous

and contextually sensitive approach in determining safe withdrawal rates for retirement portfolios.

Portfolio Failure Rates Across Various Scenarios for Portfolios with Varied Equity–Fixed Deposit Allocation

Failure rates, which represent the proportion of portfolios that deplete their funds before the end of the designated retirement period, are presented for various combinations of withdrawal rates and equity-to-fixed deposit allocations in Table 4.2. Our study explores a spectrum of portfolio compositions, considering withdrawal rates from a conservative 3.0% to a more liberal 4.0%, and equity-to-fixed deposit allocations ranging from a conservative 0:100 to a more aggressive 60:40.

The table can be read by first selecting a withdrawal rate and retirement duration and then comparing the failure rates across different equity-to-fixed deposit allocations for both simulation methods.

This comparative view shows how the varying asset allocations and withdrawal rates impact the longevity and sustainability of retirement portfolios under different market simulation approaches. When interpreting this table, it is important to focus on two primary dimensions: the method of simulation (Circular Bootstrap versus Monte Carlo Simulation) and the changing composition of equity and fixed deposit allocations within the portfolios.

The results, derived from both Monte Carlo Simulation and Circular Bootstrap methods, reveal some trends. First, higher withdrawal rates and longer retirement periods have higher failure rates. All-deposit portfolios are particularly vulnerable: annual withdrawal rates (AWR) over 3.50% have 100% failure rates for retirement periods of 35 years under both methods. The fixed deposit, while conservative, suffers from low real returns and a significant drag from tax on the nominal returns. As the equity in portfolios increases, failure rates drop, but asymptotically, indicating that the higher volatility of equity returns does impact the longevity of portfolios with high equity exposure, given the high structural inflation.

Table 4.2

Portfolio Failure Rates Across Various Scenarios

AWR	*Retirement Years*	*0:100*	*10:90*	*20:80*	*30:70*	*40:60*	*50:50*	*60:40*	*0:100*	*10:90*	*20:80*	*30:70*	*40:60*	*50:50*	*60:40*
3.00	25										<1	1	2	3	4
	30								2	1	2	3	5	7	8
	35								58	15	9	9	10	11	12
3.25	25									<1	<1	1	3	4	6
	30								21	5	5	6	7	9	11
	35	83							90	39	20	16	15	15	16
3.50	25								<1	<1	1	3	4	6	8
	30								61	18	12	11	12	13	14
	35	100	58	25	8	8	8	8	99	66	35	25	21	20	20
3.75	25								7	2	4	6	7	9	10
	30	75	17					8	91	43	23	18	17	17	17
	35	100	100	58	33	33	25	25	100	85	52	35	29	25	25
4.00	25								34	10	9	9	10	12	14
	30	100	67	41	25	25	25	25	99	67	38	27	23	23	22
	35	100	100	83	66	58	33	33	100	94	66	46	36	32	30

Source: Calculations by the authors.

Notes: The table presents the failure rates (expressed as percentages) for retirement portfolios in different combinations of withdrawal rates and equity-to-fixed deposit allocations. The failure rate is defined as the proportion of portfolios that deplete their funds before the designated retirement period ends. The results are shown for retirement durations of 25, 30, and 35 years, with withdrawal rates ranging from 3.0% to 4.0% in increments of 25 basis points and equity-to-fixed deposit allocations of 0:100 to 60:40 in increments of 10%. The analysis includes both Monte Carlo Simulation and the Circular Bootstrap methods.

The Circular Bootstrap method, which resamples from historical data, tends to reflect the specific market conditions and correlations inherent in the historical period it covers. In contrast, the Monte Carlo Simulation method, which relies on random sampling, often presents a broader range of potential outcomes, including those that may not have historically occurred. As a result, Monte Carlo simulations might show more conservative (higher) failure rates, especially in more volatile market conditions or higher equity allocations.

The differences between the results obtained from the Bootstrap and Monte Carlo methods are grounded in their underlying mechanics and assumptions. Although both approaches simulate potential future outcomes based on historical data, they differ significantly in handling data and representing uncertainty.

- Bootstrap Method: The Circular Bootstrap relies on resampling of the observed data. This approach maintains the inherent structure and correlation within the original dataset, making it particularly effective for non-stationary data, incorporating the actual historical volatility and correlations, albeit within the constraints of the observed data span. This method may offer more realistic scenarios for markets like India, where historical data spans are shorter, and market dynamics rapidly evolve.
- Monte Carlo Simulation: Our Monte Carlo simulations, on the other hand, generate data based on a random selection of observed data, without regard for any inherent structure or correlation. This method is more flexible in extrapolating beyond the observed data range and can model scenarios that have not occurred historically but are theoretically possible. However, the effectiveness of Monte Carlo simulations hinges on the precision of assumptions about the underlying distributions, which can be challenging in markets with limited data history or significant structural changes.

Employing both methods can offer a holistic view of potential portfolio outcomes for practitioners. Monte Carlo simulations are invaluable for stress testing against diverse market conditions, while Bootstrap methods provide a more historically anchored perspec-

tive. For instance, practitioners might use Monte Carlo simulations to assess portfolio resilience under extreme market downturns and Bootstrap methods to gauge portfolio performance under historical market trends.

Our findings are closely aligned with Saraogi (2022), who suggests a safe withdrawal rate of around 3% for the Indian market for a 40:60 portfolio. Interestingly, our Bootstrap analysis suggests a possible SWR of 3.5%, bridging the gap between Saraogi's conservative estimate and Bengen's widely cited 4% rule. This variation can be attributed to:

- Market Specificity: The Indian market's unique growth trajectory, volatility patterns, and economic factors inherently differ from the US market, influencing the SWR calculation. This specificity necessitates a localised approach to retirement planning, as demonstrated by our study's alignment with Saraogi (2022)'s findings using the Monte Carlo method.
- Historical Data Representation: Bootstrap's reliance on historical data could capture specific market characteristics (e.g., high-growth periods), potentially elevating the SWR compared to Monte Carlo simulations, which may offer more conservative estimates due to their lack of historical structuring.
- Sampling Methodology: The Bootstrap method's preservation of the temporal order of returns could lead to a marginally higher SWR than Monte Carlo simulations, which introduce greater variability by disregarding this order.

Our result extends the work by Saraogi by showing failure rates across different equity-to-fixed deposit allocations and retirement periods. In conclusion, the combination of Bootstrap and Monte Carlo methods can provide practitioners with a nuanced toolkit for retirement planning. Although Bootstrap methods may suggest a slightly higher SWR in the Indian context, it is crucial to consider these findings within the market's historical patterns and current dynamics. A comprehensive approach that integrates the insights of both methods is likely to produce the most adaptable and robust retirement plans.

Our analysis reaffirms the importance of context in determining SWRs. Adherence to a universal withdrawal rate, such as 4%, without considering local market dynamics, could lead to suboptimal retirement strategies. For India, our customised approach indicates a more conservative withdrawal rate, between 3.0% and 3.5%, as a safer benchmark for sustainable retirement planning, blending global best practices with local market realities.

Safe Withdrawal Rates Across Various Scenarios with 95% Target Portfolio Success

Transitioning from the previous section, which focused on failure rates in various portfolio compositions, we now focus on determining safe withdrawal rates (SWRs) that ensure a 95% success rate. This perspective offers a more targeted approach to retirement planning, focusing on withdrawal rates that balance sustainability and income needs.

Table 4.3

Portfolio AWR Across Various Scenarios with 95% Target Portfolio Success Rate

Retirement Years / *Portfolio Allocation*	*Circular Bootstrap*			*Monte Carlo Simulation*		
	25	*30*	*35*	*25*	*30*	*35*
0:100	4.2	3.6	2.9	3.7	3.0	2.6
10:90	4.3	3.7	3.2	3.8	3.2	2.8
20:80	4.4	3.8	3.3	3.8	3.2	2.8
30:70	4.4	3.8	3.4	3.7	3.1	2.7
40:60	4.5	3.8	3.4	3.5	3.0	2.6
50:50	4.4	3.7	3.4	3.3	2.8	2.5
60:40	4.3	3.7	3.3	3.1	2.6	2.3

Source: Calculations by the authors.

Notes: The table presents the annual withdrawal rates (expressed as percentages) for retirement portfolios in different combinations of withdrawal rates and equity-to-fixed deposit allocations. The rate shown is the annual withdrawal rate that allows for a 95% target success rate for portfolios that deplete their funds before the designated retirement period ends. The results are shown for retirement durations of 25, 30, and 35 years and equity-to-fixed deposit allocations from 0:100 to 40:60 in increments of 10%. The analysis includes both Monte Carlo Simulation and circular bootstrap methods. The rate is increased in 10 basis point increments in the calculations.

Table 4.3 can be interpreted by examining the different AWRs required to achieve a 95% success rate across varying retirement periods and portfolio allocations. This approach offers a deeper understanding of the withdrawal rates likely to sustain a portfolio over the long term without significant risk of depletion.

By analysing the table, it becomes apparent that higher equity allocations generally permit higher withdrawal rates for a given success rate. This trend is consistent between both simulation methods, though the actual rates vary slightly between them. For longer retirement periods, the SWR decreases, reflecting the increased risk of portfolio depletion over time.

The 100% deposit portfolio has the lowest SWR of all portfolios under the bootstrap method. SWRs are reduced as retirement periods increase. As equity allocation increases, the SWRs initially rise but tend to drop from the 40:60 portfolio onwards, reflecting the increased volatility of equity returns and the high structural inflation, which inexorably erodes portfolio value. As we shall see, taxes also play a significant role in diminishing portfolio sustainability.

Under the Monte Carlo simulation, the SWRs are generally lower than those derived from the bootstrap method. In particular, the SWRs fall more sharply under the Monte Carlo method as equity allocations increase. The 60:40 portfolio has a lower SWR than the 0:100 portfolio. This suggests a possible understatement of the SWR under the randomised Monte Carlo approach, which ignores the inherent structure of returns.

Comparing these findings with those of the previous section, we see a complementary picture emerge. Although higher equity allocations can lead to higher portfolio failure rates, they also allow for higher SWRs when targeting a 95% success rate. This dual perspective suggests that increasing equity exposure raises the risk of portfolio failure but also offers the potential for higher income withdrawals, provided the higher risk is appropriately managed.

The difference between the Monte Carlo and circular bootstrap results in this section also mirrors the previous findings. With its broader range of potential outcomes, the Monte Carlo method tends

to suggest lower SWRs than the bootstrap method. In summary, this section's insights align with the earlier discussion on portfolio failure rates, offering a more nuanced understanding of how portfolio composition affects both the risk of depletion and the potential for income withdrawal.

Impact of Taxes on Failure Rates of All Deposit Portfolios

Next, we examine the critical impact of taxes on the failure rates of all-deposit portfolios. Given that fixed deposit returns are typically taxed on their nominal value, in economies with high structural inflation, this can significantly erode the real value of these returns, leading to faster portfolio depletion. This section examines how varying tax rates on 100% fixed deposit portfolios affect their sustainability.

Table 4.4 provides a comprehensive view of how varying fixed deposit tax rates impact the longevity of all-deposit retirement portfolios. This is achieved by presenting failure rates, defined as the proportion of portfolios that deplete their funds before the end of the designated retirement period, across a range of tax scenarios. The analysis considers withdrawal rates from 3.0% to 4.0% and retirement periods of 25, 30, and 35 years, under four different tax rates: 0%, 10%, 20%, and 30%.

As the tax rate on fixed deposit returns increases, the failure rate of the portfolios also increases, particularly for longer retirement periods and higher withdrawal rates. This outcome underscores the significant impact of taxation on portfolio longevity, especially in scenarios where real returns are already low or negative due to inflation. The compounding effect of low or negative real returns can lead to dire outcomes even for portfolios that are typically considered safe.

For policymakers, these findings highlight the need to carefully consider tax policies on fixed deposit returns, especially in the context of retirement planning. High taxation rates on fixed deposits can severely diminish the efficacy of these traditionally 'safe' investment vehicles for retirees. Inflation, coupled with high taxes on nominal returns, can lead to real returns that are insufficient to sustain a retirement portfolio, thereby increasing the risk of financial insecurity for retirees.

Table 4.4

Failure Rates Across Various Scenarios of an All Fixed Deposit Portfolio with 0%, 10%, 20% and 30% Deposit Tax Rates

AWR	*Retirement Years*	*Circular Bootstrap*				*Monte Carlo Simulation*			
		0%	10%	20%	30%	0%	10%	20%	30%
3.00	25								
	30							<1	2
	35					<1	<1	7	58
3.25	25								
	30							1	21
	35				83	<1	3	33	90
3.50	25								0
	30					<1	<1	10	61
	35				100	1	16	71	99
3.75	25							0	7
	30				75	<1	4	38	91
	35			100	100	7	45	93	100
4.00	25					<1	<1	3	34
	30			9	100	2	20	73	99
	35		33	100	100	24	75	99	100

Source: Calculations by the authors.

Notes: The table presents the failure rates (expressed as percentages) for all fixed deposit retirement portfolios in different combinations of withdrawal rates and retirement durations of 25, 30, and 35 years. The analysis includes both Monte Carlo Simulation and Circular Bootstrap methods.

The data suggest that policy interventions to moderate tax rates on fixed deposits or provide tax incentives for retirement savings could significantly enhance the viability of fixed deposit-based retirement portfolios. Such policy measures would be particularly beneficial in economies with high inflation, where retirees are more vulnerable to the eroding effect of taxation on their savings.

In conclusion, the impact of taxes on all-deposit portfolios is a critical consideration for both individual retirement planning and broader fiscal policy. A nuanced approach to taxation, mindful of the

implications for retirement income security, could play a significant role in bolstering the financial stability of retirees.

30:10:60 Equity:Gold:Fixed Deposit Portfolios

We now explore the impact of introducing gold as a third asset class in retirement portfolios. Gold is a traditional and popular investment choice in Indian households and is often considered a diversifying tool. This subsection examines the failure rates of a 30:10:60 Equity:Gold:Fixed Deposit portfolio, a variation on the previously discussed 40:60 equity-to-fixed deposit allocation.

The gold returns are sourced from Raju and Raju (2023), and we use a tax rate of 10% on nominal gold returns.

Table 4.5

Failure Rates for 30:10:60 Equity:Gold:Fixed Deposit Portfolios

AWR	*Retirement Years*	*Circular Bootstrap*	*Monte Carlo Simulation*
3.00	25		<1
	30		1
	35		5
3.25	25		1
	30		3
	35		9
3.50	25		1
	30		6
	35	8	15
3.75	25		3
	30		11
	35	17	24
4.00	25		5
	30	17	18
	35	33	35

Source: Calculations by the authors.

Notes: The table presents the failure rates (expressed as percentages) for the 30:10:60 Equity:Gold:Fixed Deposit retirement portfolios in different combinations of withdrawal rates and retirement durations of 25, 30, and 35 years. The analysis includes both Monte Carlo Simulation and Circular Bootstrap methods.

Table 4.5 presents the failure rates for portfolios comprising 30% equity, 10% gold, and 60% fixed deposits. This allocation is examined under various withdrawal rates and retirement durations to evaluate the sustainability of these portfolios. Including gold in the portfolio mix introduces a new dimension to the analysis. Gold, often seen as a hedge against inflation and market volatility, can alter the risk profile and sustainability of the retirement portfolio compared to the traditional equity and fixed deposit mix. The table should be read by selecting a withdrawal rate and retirement duration and observing the failure rates for the 30:10:60 allocation under both simulation methods.

Comparing these results with those of the 40:60 equity-to-fixed deposit portfolios, we notice that including gold moderately reduces the failure rates, especially in longer retirement periods. This outcome could be attributed to the role of gold as a diversifier and its potential to stabilise portfolio value during market downturns.

For practitioners, these findings suggest that incorporating gold and other uncorrelated assets into retirement portfolios could be a strategic move, particularly for investors seeking a balance between growth (through equity) and stability (through assets like fixed deposits and gold). The allocation of 10% to gold in a portfolio traditionally dominated by equity and fixed deposits offers a nuanced approach to risk management and asset diversification.

In conclusion, the 30:10:60 Equity:Gold:Fixed Deposit portfolio configuration demonstrates the potential benefit of diversifying traditional retirement portfolios with assets like gold. This approach could provide a more balanced path to achieving long-term financial stability in retirement. However, it requires careful consideration of each asset class's unique characteristics and performance.

Impact of Year 1 Shocks

This subsection examines the impact of a -10% shock to equity returns during the first year on the failure rates of a 40:60 Equity:Fixed Deposit portfolio. Such shocks can significantly influence the sustainability of retirement portfolios, particularly in their

early stages. Using a rolling 12-month series, real equity returns occurred in more than 17% of months—almost a 1 in 5 chance of occurring in any given month of our sample.

Table 4.6 shows the failure rates for portfolios that experience a -10% equity return shock in the first year. The analysis covers AWRs of 3.50%, 3.75%, and 4.00% over retirement durations of 25, 30, and 35 years. This scenario highlights the impact of adverse market conditions in the early stages of retirement, a critical factor often overlooked in long-term planning.

Compared to the 40:60 equity-to-fixed deposit portfolios in Table 4.2, the inclusion of a year 1 shock shows a significant increase in failure rates, especially as the withdrawal rate and retirement period lengthen. This increase underscores the vulnerability of retirement portfolios to early negative returns.

Table 4.6

Impact of -10% Year 1 Shock in Equity Returns on Failure Rates of a 40:60 Portfolio

AWR	*Retirement Years*	*Circular Bootstrap*	*Monte Carlo Simulation*
3.50	25		6
	30	8	9
	35	10	14
3.75	25	25	15
	30	57	22
	35	59	29
4.00	25	58	26
	30	76	35
	35	77	44

Source: Calculations by the authors.

Notes: The table presents the failure rates (expressed as percentages) for the 40:60 Equity:Fixed Deposit retirement portfolios in different combinations of withdrawal rates and retirement durations of 25, 30, and 35 years. Unlike Table 2, year one of the n-period equity returns is set at -10% for all 50,000 simulations, and the rest of the methodology remains the same.

This is a clear illustration of sequence-of-return risk. Furthermore, recovery from such a shock is often not possible even over

30 years, due to the variability of real returns in a high-inflation economy.

This data highlights the importance of considering the volatility of the early retirement phase in portfolio construction. The non-trivial probability of a 10% loss in the first year of retirement requires savers to seriously consider a more conservative approach. They could add a cushion to their portfolio before retirement. Or, if faced with the shock in the first year of retirement, strategies to mitigate this risk might include:

- Lowering the Initial Withdrawal Rate: Given the heightened failure rates at higher AWRs, starting with a lower withdrawal rate in the early years of retirement can provide a buffer against early market downturns.
- Dynamic Withdrawal Strategies: Implementing a flexible withdrawal approach, where spending is adjusted based on market performance, can help protect the portfolio during downturns.
- Portfolio Diversification: Although the 40:60 allocation is already diversified, further diversifying across more asset classes or implementing a more conservative allocation in the initial years can reduce the impact of early shocks.
- Reserve Funds or Alternative Income Sources: Maintaining a cash reserve or having alternative income sources can help reduce withdrawals from the investment portfolio during market downturns.

A word of warning is in order. By arbitrarily setting the rate of equity return at -10% in the first year, we break the inherent structure within the returns, both temporally and across assets, in our simulation. This introduces a statistical error in the results, especially in the circular bootstrap, which maintains that structure. Therefore, the results of the bootstrap method will have a higher statistical error compared to the Monte Carlo results. Despite this additional source of error, the results hold directionally, and our conclusion remains robust: a first-year shock will ripple through and increase portfolio failure rates.

In summary, while a shock of -10% in real equity returns in the first year of a retirement portfolio significantly increases the risk of portfolio failure, careful planning and strategic adjustments can mitigate these risks. Understanding the implications of shocks in the early retirement phase is vital to constructing resilient retirement portfolios under various market conditions. This approach is crucial to ensure long-term sustainability and to achieve retirement financial goals.

Summary of Key Findings

This study has highlighted several crucial aspects of determining a SWR for retirement planning in the Indian context. The analysis, employing both Monte Carlo simulations and circular block bootstrap methods, has revealed nuanced insights into the dynamics of retirement portfolio sustainability in India's unique financial landscape.

Safe Withdrawal Range

Our findings suggest that the widely accepted 4% rule, predominant in Western contexts, is not directly transposable to the Indian market. Instead, a more conservative withdrawal rate, ranging between 3.0% and 3.5%, emerges as more appropriate for Indian retirees. This range reflects the specificities of the Indian market, characterised by its high inflation rates and relative volatility.

Impact of Equity Allocations

The study has shown that portfolios with higher equity allocations, while potentially increasing SWRs, also significantly increase the risk of portfolio failure. The high volatility of equity returns and their inherently high sequence risk make holding high allocations to equity more risky than is evident from the headline average returns. In particular, withdrawal rates exceeding 3.75% markedly increase this risk. This finding underscores the need for a balanced approach in portfolio construction, weighing the benefits of higher equity allocations against the associated risks.

Taxation and Portfolio Sustainability

An important aspect of our analysis has been the impact of taxation on nominal fixed deposit returns. The research highlights that high taxation on fixed deposit returns, a common scenario in India, can considerably impair the longevity of retirement portfolios. This finding is particularly relevant given the traditional reliance on fixed deposits for retirement planning in India.

Diversification with Gold

Our exploration of diversification strategies reveals that the incorporation of gold as an asset class can play a crucial role in mitigating market-related risks in traditional two-asset class portfolios. The inclusion of gold not only contributes to portfolio diversification but also provides a hedge against market volatility, improving the overall stability of the retirement portfolio.

Early Retirement Phase Volatility

The paper has also shed light on the significant impact of volatility in the early retirement phase on portfolio sustainability, specifically the vulnerability of portfolios to early negative returns, especially in high-inflation economies such as India. This insight stresses the importance of devising strategies to mitigate the risk of sequence of return in the initial years of retirement.

In summary, our study contributes to a nuanced understanding of the various factors that influence safe withdrawal rates in the Indian context. By juxtaposing these insights with global benchmarks, the research underscores the significance of contextual and market-specific considerations in retirement planning. Our findings are instrumental for both financial advisors and individuals in tailoring retirement strategies that are attuned to the unique characteristics of the Indian financial market.

Practical Implications

Designing a robust withdrawal strategy from a retirement portfolio is one of the most perplexing tasks that a financial planner faces.

This task is further complicated for a planner in India, given the lack of suitable studies to guide the design of such withdrawal strategies.

An informal survey of available commentary and the authors' conversations with practitioners suggests that higher withdrawal rates are used for retirement planning than presented in this study. The reason for this is straightforward: the absence of India-specific formal studies and the lack of long time series data on historical asset returns in India have led to the adoption of popular international withdrawal rates.

Guidance for Individual Investors

For individual investors, our study underscores the importance of conservative withdrawal rates. In light of the findings, the key takeaway for investors is to consider moderating their withdrawal expectations, with a target AWR that does not exceed 3.5%, which translates to a corpus of about 30 times expected annual expenses at retirement. This approach minimises the risk of portfolio depletion, particularly under the characteristic economic conditions of the Indian market.

Furthermore, while introducing equity into a retirement portfolio can enhance returns, it is crucial to recognise the non-linear relationship between equity allocation and withdrawal rates. Our analysis suggests that beyond a certain point, an increase in equity allocation does not proportionally increase the SWR due to increased sequence-of-return risks. A balanced and diversified portfolio strategy, combining equities with more stable assets such as fixed deposits and gold, is likely to maintain the balance between risk and return.

Wealth advisors advising investors and investment managers managing retirement portfolios should ensure their solutions provide annual tax-efficient portfolios with adequate inflation-adjusted returns to meet the chosen lifestyle expenses for their clients, with assurance of meeting the objectives irrespective of market volatility.

Recognising the diversity of individual financial circumstances is crucial in retirement planning. Each investor's situation, encompassing aspects such as health status, lifestyle aspirations, and alternative

income sources, necessitates a bespoke approach to determining the optimal withdrawal rate and asset allocation. The complexity and unpredictability of personal life events call for a dynamic and personalised financial strategy rather than a generic template. Regular reassessment and adjustments with a trusted financial advisor are the keys to ensuring retirement plans remain congruent with evolving personal needs and external economic changes. Such tailored advice becomes indispensable in navigating the uncertainties of post-retirement years while safeguarding financial security. This advice is a specialised skill and should be recognised as such, making the role of Investment Advisors all the more crucial in the broader wealth management ecosystem.

Suggestions for Policymakers

For policymakers, the study highlights several areas for possible intervention to improve retirement security. A key area is appropriate tax policies related to retirement savings. Considering the significant impact of taxation on fixed deposit returns, policymakers could explore tax schemes that balance individual investors' needs with the government's revenue objectives. Such measures would improve the sustainability of fixed deposit-based retirement portfolios, a common preference among Indian retirees.

In addition, policy interventions could include the review of retirement plan structures to accommodate more diversified investment options, including equities, fixed income, and gold. Encouraging diversification within retirement portfolios can help mitigate market volatility and inflation risks, offering retirees more stable and sustainable income streams.

For policymakers, our study suggests specific areas for intervention to improve retirement security. Implementing or improving tax-deferred retirement savings schemes could significantly encourage long-term savings among the working population. Furthermore, introducing tax exemptions or reductions for certain types of retirement income, such as interest from fixed deposits and returns from equity or gold investments, could greatly benefit retirees. Policy-

makers could also explore more flexible retirement plan structures, accommodating various investment options to suit diverse investor profiles. These policy measures should balance incentivising prudent retirement savings while providing sufficient flexibility for individuals to customise their retirement portfolios. Effective policy intervention in these areas could lead to a more resilient retirement system better aligned with the unique needs and challenges faced by retirees in India.

In conclusion, the practical implications of our study are numerous, addressing both individual investment strategies and broader policy frameworks. By aligning retirement planning practices with the unique dynamics of the Indian financial market, both individual investors and policymakers can work towards creating more robust and sustainable retirement solutions.

A Practical Framework for Determining SWR in the Indian Context

Based on the paper's methodology, we suggest a practical framework for practitioners, including registered investment advisors (RIAs) and investors, to estimate retirement withdrawal rates contextualised to India.

1. *Retirement Horizon and Success Rate Determination:* Investors select their retirement horizon (suggested: 30 years) and a plan success rate with a confidence level (suggested minimum: 90%).
2. *Data Sourcing:* Data quality is of critical importance. Based on the chosen asset classes, obtain high-quality long-term return data, ensuring representativeness for Indian market conditions. RIAs or investment professionals have access to such data series. The source of the data should be made known.
3. *Simulation Process:* Using Monte Carlo and circular block simulations, generate varied portfolio return scenarios across different AWR ranges for the chosen retirement horizon. Use statistical methods to determine the number of iterations. As these could be several tens of thousands, appropriate computational hardware would be required. Unfortunately, we know of no commercial software packages that can run the simulations

straight out of the box as required. However, modern languages like C, Python, or R have well-regarded open-source libraries for running simulations.

4. *Safe Withdrawal Rate Identification:* The highest withdrawal rate that achieves at least the predefined success rate is considered the 'safe withdrawal rate'.
5. *Multi-Asset Handling:* The model supports varied asset allocations, with the computational aspect recommended to be managed by professionals.

As such analysis involves estimations over long periods, they are fraught with significant challenges. Ethical responsibility involves ensuring that any such advice adheres to the highest standards of transparency and integrity. RIAs must remain vigilant against biases and conflicts of interest, ensuring recommendations are solely in the client's best interest, disclose sources of data and methodology, discuss the results in light of the users' specific circumstances, and highlight the need for regular reviews to ensure the plan is aligned with changing market conditions and evolving user requirements and circumstances.

The framework operates within certain limitations, including market volatility and economic changes that require regular reviews and updates. As such, it offers a pragmatic approach to retirement planning in India.

Conclusion

Our comprehensive study reveals crucial insights into retirement planning in India, underscoring the nuanced dynamics of portfolio management in a high-inflation regime. We discovered that while portfolios with higher equity allocations potentially increase safe withdrawal rates (SWR), they also increase the risk of portfolio failure, particularly at withdrawal rates above 3.75%. Furthermore, conservative portfolios, predominantly reliant on fixed deposits, face rapid depletion due to the dual impact of high inflation and taxation. Additionally, we highlighted the significance of gold as a diversifying

asset, which can mitigate some market-related risks in traditional two-asset class portfolios.

Given the long-term horizon of retirement planning, it is imperative to emphasise the importance of ongoing assessment and adjustment. Regular portfolio reviews and strategic rebalancing are crucial in navigating sequence-of-return risks and adapting to life's changing circumstances. Retirement planning is not a static process, but an evolving journey that demands ongoing attention and flexibility.

Recognising that investors have diverse risk profiles and financial situations, personalised investment strategies are more effective than a generalised approach. Tailoring retirement plans to individual needs and goals allows for a more robust and responsive strategy, ensuring that each investor's unique financial landscape is adequately addressed.

From a policy perspective, our findings point to the need for thoughtful fiscal policies, particularly around the taxation of retirement savings. Reducing the tax burden on fixed deposits and fostering an environment that supports a broad spectrum of retirement investment options could significantly enhance financial security for retirees. Furthermore, enhancing financial literacy programmes is essential to equip individuals with the knowledge required for effective retirement planning.

Looking toward the future, retirement planning in India must adapt to the ever-evolving financial landscape. Emerging trends, such as digital investment platforms and changing market dynamics, offer both challenges and opportunities. Further research in these areas will be critical in refining retirement planning strategies, ensuring they remain relevant and effective in a rapidly changing world. Our study lays the groundwork for this ongoing exploration, aspiring to contribute to a future where retirement planning is not only a necessity but a well-informed and attainable goal for all.

A word of caution is warranted when estimating future asset returns. Statistical estimation errors, compounded by evolving socio-political and economic conditions, make forecasting particularly challenging. This paper's analysis, while utilitarian as a baseline, high-

lights the perils of assuming mean-reverting characteristics in asset class returns. It underscores the risk inherent in constructing retirement portfolios based solely on the naïve assumption of long-term market performance.

For example, consider the situation of an individual retiring in November 2007 with a 100% equity portfolio that adheres to a 3% AWR. The dramatic market downturn in 2008 would have led to a portfolio reduction of 61%, signifying a near-certain failure of the portfolio to meet the retiree's obligations. This stark reality coexists with the fact that equity delivered real returns of 7% annually throughout the study period. Sole reliance on these average returns might lead to overly optimistic planning, such as a 5% AWR, which, as evidenced, carries a high risk of failure.

Therefore, our methodology emphasises a more nuanced approach. Allowing investors to model different paths using historical data, select their confidence levels, and determine an appropriate AWR enables a more grounded and adaptable retirement strategy. Regular portfolio reviews, updated with the latest market data and personal circumstances, are essential to maintain relevance and accuracy in retirement planning. This approach echoes the wisdom of adapting to what we cannot control while strategically managing what we can.

These concluding thoughts aim to balance a plan's false sense of comfort with the pragmatism needed for realistic, individualised retirement planning in India's evolving financial context.

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5

On Safe Withdrawal Rate in the Indian Context under National Pension System

Pushpinder Singh

Abstract

The inflation-adjusted rate at which retirement savings can be safely withdrawn over the remaining lifetime is a crucial factor in financial planning. This paper evaluates the applicability of the widely recognised 4% rule in the Indian context. Various asset allocation strategies, including equity, corporate bonds, and government securities, are analysed to determine the probability of success for different withdrawal rates over a 30-year retirement horizon. The findings suggest that a conservative withdrawal rate of 3% is highly reliable for long-term sustainability. Withdrawal rates between 4% and 4.10%, coupled with equity exposure ranging from 40% to 70%, achieve a success rate of 95%, while rates between 3% and 3.3% produce a success rate of 99%. In particular, excessive equity exposure reduces the safe withdrawal rate, whereas corporate bond allocations provide slight improvements. Moreover, dynamic strategies with declining equity exposure over time (gliding paths) improve the failure rate only in the case of initial equity exposure between 40% and 75%.

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Introduction

In recent times, the debate has been evolving around the income drawdown option instead of purchasing an immediate annuity for life in India. While the purchased annuity products guarantee a fixed stream of income till survival, with an option to choose for a bequest, on the other hand, systematic withdrawals from the retirement fund allow retirees to opt for customised asset allocation while being exposed to portfolio risk. The idea of systematic withdrawal raises a question of determining the maximum rate at which withdrawals can be made without outliving the retirement fund. Obviously, the retiree can opt for a lower withdrawal rate, but then it has to be balanced from the aspect of income adequacy.

The safe withdrawal rate (SWR) is the initial proportion of the retirement fund that is safe to withdraw, with inflation adjustment in subsequent withdrawals, in all possible paths of return and inflation. The first reference related to the safe withdrawal rate appeared in the seminal work by William P. Bengen (Bengen, 1994). The paper used historical data of returns and inflation in the US to obtain the inflation-adjusted maximum annual withdrawal rate, which is safe to withdraw without depletion of corpus for at least 30 years. This paper led to the conceptualisation of the 4% rule with a portfolio consisting of 60% equity and 40% bonds with annual rebalancing, although the original paper assumes a constant allocation of equity varying between 50% to 75% for the successful withdrawal of 4%. The 4% rule is widely quoted in retirement planning in the US and is now also being used in Indian retirement planning, especially after the advent of the idea of retiring early. The discussion related to equity allocation was further unfolded in Bengen (1996). Bengen mentions that although in his original paper he considered equity allocation of 50% to 75% for a 4% safe withdrawal rate, in fact even an equity proportion as low as 35% and as high as 85% would also lead to similar results.

This paper is an attempt to evaluate (1) the safe withdrawal rate in the Indian context considering various investment patterns using a simulation framework, (2) the impact of asset allocation among

equity and debt on withdrawal rates in the retirement phase, and (3) a comparison between scenarios of constant and varying allocations[1].

The current paper is organised as follows: Section 2 provides a review of the literature related to the 4% rule. Section 3 discusses the National Pension System (NPS) architecture. Section 4 provides a brief on expenses under NPS and currently applicable tax. Section 5 outlines the data and methodology used in the paper. Section 6 presents an analysis of results, and Section 7 concludes the paper.

Literature Review

The discussion on portfolio longevity during the withdrawal phase began with Bengen's pioneering work in 1994. His initial paper (Bengen, 1994) introduced a portfolio allocation strategy that combined large-cap stocks and bonds. In a follow-up study (Bengen, 1997), he concluded that allocating 30%–40% of the stock exposure to small-cap stocks could significantly enhance the likelihood of sustaining withdrawals exceeding 4% (referred to as the safe rate). In his later work (Bengen, 2001), Bengen explored a dynamic withdrawal strategy, considering retirement as a life stage comprising three distinct phases, each with varying withdrawal rates.

The scope of the study was further extended in Pfau (2010), considering data from 17 developed countries. The results show that only four countries pass the 4% test. One of the main issues with the results was the reliance on historical data for return and inflation. To overcome this, several studies use the Monte Carlo method to estimate the probability of a safe withdrawal rate. The parameters required for simulation have been estimated either from historical returns or prevailing market conditions. Pye (2000) confirmed the 4% rule with a Monte Carlo simulation of an all-equity portfolio using historical returns, and John J. & Singh (2007) used bootstrap sampling to evaluate different scenarios of withdrawal rate and asset allocations. Cooley, Hubbard, and Walz (1994) studied monthly constant and inflation-adjusted withdrawals using monthly returns.

1. The word allocation is widely used in the paper refers to the investment allocation.

More recent papers, such as Finke, Pfau, and Blanchett (2013), using Monte Carlo simulation, suggest that the 4% rule in the US is an anomaly and may not be safe in an environment of low real yields. The original study did not consider the impact of fund management expenses on the SWR. Pye (2001) recently studied this impact using expense ratios and concluded that a 1% expense ratio could reduce the SWR from 4% to 3.5%.

Current Retirement Scenario in India

The subscriber under the National Pension System (NPS) must necessarily purchase an annuity with a minimum of 40% of their retirement wealth, with the option to withdraw the remaining balance. In February 2023, PFRDA introduced an option for phased withdrawal periodically till the age of 75. Retirees can decide their income drawdown from the fund built for retirement for up to 15 years. The architecture is already in place for initiating the process of systematic withdrawal. In this paper, the condition of complete withdrawal up to age 75 is relaxed to age 90 for the sake of computing withdrawals over 30 years.

The available annuity options to NPS contributors are limited compared to developed countries such as the US. Also, there is no inflation-indexed annuity option available[2]. Retirement planning thus requires working out a pay-out plan to supplement the annuity amount in a way that accounts for inflation.

Currently, a subscriber registered under the All Citizen Sector[3] of NPS can either opt for Active allocation, where the proportion of allocation in each asset can be specified, or decide the allocation using Auto Choice[4]. Further, the allocation can be modified four times a year, and the Pension Fund Manager (PFM) once a year. An individual has the option of opting for one of the following under Auto

2. However, LIC has one plan in which annuity increase at the simple rate of 3% each year.
3. The sector represents voluntary enrollments under NPS.
4. The maximum exposure to equity is up to 75% under Tier-I Account and no such restriction on equity allocation under Tier-II account.

investment patterns, with asset allocation varying according to the subscriber's age:

- Conservative Life Cycle Fund with maximum exposure to equity capped at 25%
- Moderate Life Cycle Fund with maximum exposure to equity capped at 50%
- Aggressive Life Cycle Fund with maximum exposure to equity capped at 75%

In the case of a subscriber registered under the NPS Government Sector, the Auto Choice and LC75 investment options are not yet available. Further, government sector subscribers have an additional option of a default scheme in which equity exposure is up to 15%[5]. For the sake of brevity, it is assumed that a subscriber can opt for Active Choice and up to 80% equity in the retirement phase. The gliding path allocations are constructed taking cues from the constructs of life cycle funds.

Expenses and Tax

A major issue highlighted in the literature is the assumption of no expense on investment and related charges while considering the distribution of returns. Expenses and transaction costs can significantly impact the initial withdrawal rate. This paper addresses this issue in the following manner.

Some of the charges under NPS are applicable during the accumulation phase only and can be ignored in the withdrawal phase. Consideration is only given to the additional expenses applicable during the pay-out phase. The declared NAV is net of the Investment Management Fee (IMF) charged by the Pension Fund Manager, custodian charges by the custodian, and reimbursement charges by the NPS Trust. Transaction costs and fund management expenses are

5. Currently, three default schemes namely CG default, SG default, and Corporate CG are catering to the needs of the subscribers of Central Government, State government and Corporate subscribers. Please refer to the circulars available at the official website of the PFRDA for details.

already subsumed in the daily NAV; hence the distribution of returns considered is already adjusted for expenses. The contribution charges are not applicable as it is assumed that there will be no further contribution to the retirement fund. The magnitude of the remaining charges is relatively negligible and hence ignored[6]. The charge structure applicable under NPS during withdrawal is the same for all asset allocations and depends only on the choice of Pension Fund Manager[7]. Further, all withdrawals from the retirement corpus on or after retirement are tax-free, and hence we assume no applicable tax on withdrawals.

Sample Data and Methodology

The data related to investment returns for three asset classes—equity, government securities, and corporate bonds—are calculated using NAV data available in the Handbook of NPS Statistics (2009–2024)[8]. Considering the limited availability of data and the most common frequency of withdrawal being monthly, we use monthly returns for analysis. The return data are available for 185 months (July 2009 to August 2024). Plot 1 exhibits the time series movement of NAV vis-à-vis NIFTY 50. Thus, the NAV series can be assumed to be a reliable proxy for market returns. It can also be seen from the plot that there is a clear difference in PFM-wise performance. To factor in the aspect of PFM-wise performance, the results will later be extended by replacing the PFM with the highest returns.

The analysis of historical returns suggests that the assumption of normality cannot be accepted, as there are too many values around the mean and in the tails, referring to the platykurtic nature of the distribution. These findings align with Fama (1965) and Officer (1972). This rules out the parametric simulation using a Gaussian assumption on returns. The analysis of the frequency distribution of other asset classes also confirms the hypothesis of a non-Gaussian

6. The charge structure is given in Annexure I.

7. In fact it depends on the AUM of the PFM as IMF is applicable as a slab structure.

8. The PFMs are chosen on the basis of date of earliest commencement of business. Interestingly, of 4, two have the highest AUM and two have relatively small AUM.

Figure 5.1

Comparison of the NAV of equity with NIFTY 50

distribution of returns. Hence, this paper relies on a bootstrap sampling procedure to generate the variables of interest.

The CPI (IW) index is used for inflation adjustment of the withdrawal amount. The index is released monthly by the Labour Bureau, Shimla, and represents the price movement in a basket of goods relevant to an industrial worker. This index is widely used to calculate the dearness allowance (DA) applicable to public sector workers. The base year of the index was 2001, which was then revised to 2016. The linking factor provided by the Labour Bureau has been used to produce a single inflation series from 2009 to 2024.

Figure 5.2
Distribution of Continuous Daily Returns

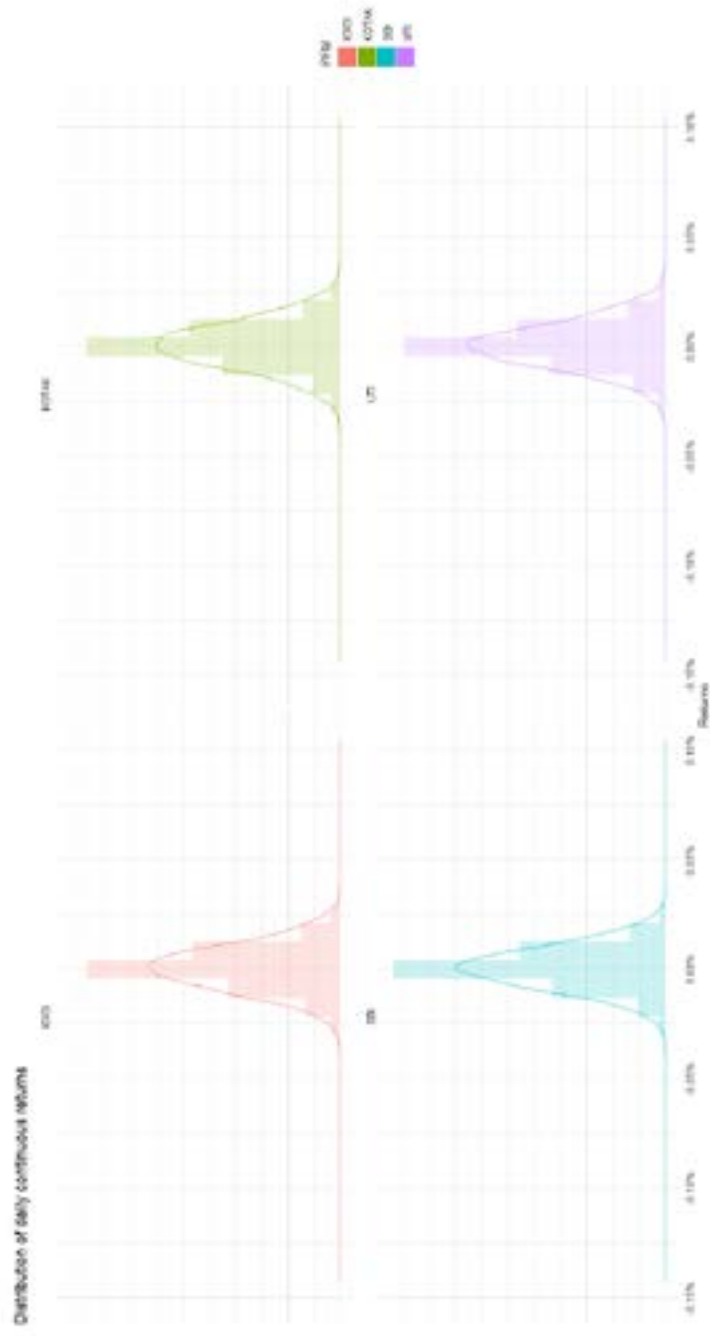

Table 5.1

Comparison of Empirical Frequencies with Gaussian Distribution

Proabilities	*SBI*	*UTI*	*Kotal*	*ICICI*	*Gaussian*
1-P(-5<z<5)	0.31721%	0.37008%	0.31721%	0.26434%	0.00604%
1-P(-4<z<4)	0.44938%	0.55511%	0.58155%	0.39651%	0.00633%
1-P(-3<z<3)	1.16310%	1.16310%	1.37457%	1.16310%	0.27000%
1-P(-2<z<2)	3.85937%	3.91224%	4.41449%	4.46735%	4.55000%
1-P(-1.5<z<1.5)	9.62199%	9.41052%	9.04044%	10.15067%	13.36200%
1-P(-1<z<1)	22.3632%	21.4909%	20.4864%	22.5482%	31.7320%
1-P(0.5<z<0.5)	49.4317%	49.1409%	48.4536%	50.5155%	61.7080%

However, the methodology for inflation indexation applicable to public sector workers differs from what is considered in this paper. These workers receive DA as the inflation component in their salary. There are two important aspects of DA: (i) it is not compounded until wage revision[9], and (ii) it is adjusted on a quarterly/biannual basis based on the average increase over the period. For simplicity, we assume withdrawals to be linked to the actual increase in the index on a monthly basis. In case a retiree wishes to follow a withdrawal pattern aligned with the methodology used during public service, she may opt for an enhanced withdrawal rate over and above the SWR.

The monthly returns are adjusted for inflation using CPI (IW) monthly changes as per the following approach:

$$(1 + r_t) = (1 + R_t)\frac{CPI(IW)_t}{CPI(IW)_0} \qquad \forall t = 1, 2, 3..., T \tag{1}$$

The initial corpus is assumed to be ₹100,000, with monthly withdrawals taken as a percentage of the corpus. The corpus is rebalanced to the actual proportion after each withdrawal. This paper considers two sets of asset allocation strategies:

(a) fixed allocation and

(b) gliding path allocation strategy.

9. The DA component is merged with Basic Salary at the time of wage revision.

Fifty fixed allocations are considered, with equity allocations ranging between 80% and 35%, in steps of 5%. The allocation to corporate bonds and government securities is considered based on all possible combinations in 5% units. In the tapering allocation strategy, allocations follow a gliding path, with equity composition decreasing with age. The following construction rule is applied:

The algorithm is given as:

- Generate 10,000 paths of monthly returns for 30 years using bootstrap sampling.
- For each path generated, iterate:
  - (a) Starting Wealth W0 = 100, 000 with given percentage of wealth to be withdrawn each month,
  - (b) At the end of a particular month wealth is W_t and r_t is the return given by

$$\mathbf{W_t} = (E_t, C_t, G_t)'$$

and

$$\mathbf{r_t} = (r_t^E, r_t^C, r_t^G)',$$

then after withdrawal the corpus is given by:

$$W_{t+1} = \mathbf{W_t'}(1 + \mathbf{r_t}) - a_{t+1}$$

  - (c) The monthly withdrawals are assumed to be drawn first from Asset Class G, then Asset Class C, and lastly from Equity, in that order.
  - (d) The portfolio is rebalanced annually as per the given allocation.
  - (e) Steps (b) to (d) are iterated for each t = 1, 2, 3..., 360 to find t when the corpus turns non-positive, or reaches 360—whichever is earlier.
- Repeat steps (a) to (e) 10,000 times for each combination of withdrawal rate and asset allocation.

- Calculate the failure rate for a given withdrawal rate and asset allocation as the number of paths (out of 10,000) where the corpus becomes negative before 360 months.

Asset Allocation

Two asset allocation strategies are considered:

(i) Constant Allocation

(ii) Gliding path with equity decreasing at a linear rate.

In the constant allocation strategy, 50 combinations are considered using three asset classes: Equity, Corporate Bonds, and Government Securities (hereafter referred to as Asset Classes E, C and G respectively). The equity allocation (E) ranges from 80% to 35%, decreasing by 5% for each of the 50 combinations. It is assumed that the proportion in Class C and G is at least 10% in all allocations.

To accommodate all possible combinations, we consider allocations that allow for a 5% decrease in equity (Class E) and distribute the difference across Classes C and G. For example:

- A 5% reduction in equity allows two possibilities (either increase C or G by 5%).
- A 10% reduction allows three (increase C or G by 10%, or each by 5%), and so on.

Five additional allocations with 35% in Class E are also included. Details of these allocations are given in Annexure II.

The constructed 9 gliding path allocations are based on the existing three life cycle funds. These have starting equity exposures ranging from 80% in Allocation 1 to 40% in Allocation 9, with a 5% decrease per allocation. In each case, equity exposure decreases by 1% annually for 30 years. Full allocation details are presented in Annexure II.

Analysis and Result

Table 5.2 suggests that the 4% rule, based on US market conditions, is not applicable in the Indian context. Various simulation-

based studies using US data (e.g. Pye, 2000; Blanchett, 2007; Milevsky & Robinson, 1997) have shown that there is virtually no scenario where a 4% annual withdrawal would deplete retirement savings within 30 years. However, these studies often ignored fund management expenses.

Assuming a simple reduction in the SWR of 0.5% due to such expenses (as per Pye, 2001), the safe withdrawal rate falls between 3.5% and 3.75% in the US context. In comparison, findings from this study suggest that in the Indian scenario, the safe rate is even lower—often under 3% in the case of most fixed allocations.

Interestingly, it is observed that a 4% withdrawal rate achieves a 95% success rate in all allocation scenarios where equity exposure lies between 35% and 70%. This result aligns with Bengen (1996), where extreme levels of equity exposure were found to reduce the SWR. The results for the case of 99% success rate show similar analogy.

Table 5.2

Failure Rates(in %) for Fixed Allocations

Allocation	*Withdrawal Rates*												
	4.2%	*4.1%*	*4%*	*3.9%*	*3.8%*	*3.7%*	*3.6%*	*3.5%*	*3.4%*	*3.3%*	*3.2%*	*3.1%*	*3%*
1	7.83	6.81	6.06	5.28	4.57	3.86	3.39	2.95	2.53	2.22	1.95	1.64	1.19
2	7.50	6.46	5.69	4.87	4.15	3.43	3.12	2.66	2.30	1.98	1.67	1.32	1.09
3	7.22	6.31	5.55	4.73	4.04	3.35	3.01	2.57	2.19	1.92	1.62	1.28	1.04
4	7.20	6.17	5.37	4.57	3.89	3.21	2.78	2.45	2.03	1.77	1.39	1.16	0.87
5	6.88	5.99	5.15	4.34	3.74	3.14	2.70	2.37	1.99	1.68	1.35	1.11	0.84
6	6.64	5.80	4.97	4.19	3.61	3.03	2.64	2.23	1.91	1.61	1.30	1.07	0.79
7	6.91	5.95	5.04	4.21	3.67	3.13	2.64	2.13	1.85	1.46	1.17	0.97	0.71
8	6.64	5.66	4.88	4.06	3.48	2.90	2.51	2.07	1.82	1.39	1.16	0.95	0.68
9	6.51	5.41	4.71	3.97	3.40	2.83	2.41	1.99	1.74	1.36	1.07	0.91	0.20
10	6.24	5.25	4.55	3.78	3.24	2.70	2.29	1.94	1.63	1.31	1.04	0.89	0.61
11	6.74	5.83	4.83	4.11	3.48	2.85	2.39	1.92	1.62	1.24	1.03	0.88	0.61
12	6.54	5.50	4.56	3.90	3.34	2.78	2.25	1.88	1.53	1.20	0.98	0.81	0.58
13	6.29	5.23	4.45	3.78	3.16	2.54	2.12	1.79	1.43	1.13	0.94	0.78	0.54
14	6.01	5.00	4.28	3.62	2.98	2.34	2.03	1.74	1.37	1.10	0.89	0.74	0.54
15	5.73	4.82	4.07	3.42	2.90	2.38	1.97	1.65	1.30	1.07	0.86	0.69	0.49
16	6.72	5.75	4.66	3.93	3.27	2.61	2.17	1.71	1.39	1.06	0.92	0.72	0.47
17	6.42	5.45	4.45	3.77	3.09	2.41	1.97	1.64	1.30	1.01	0.87	0.68	0.45
18	6.08	5.08	4.29	3.62	2.97	2.32	1.91	1.59	1.24	0.97	0.82	0.67	0.43

19	5.91	4.80	4.09	3.45	2.80	2.15	1.83	1.45	1.16	0.93	0.79	0.61	0.38
20	5.64	4.59	3.91	3.25	2.69	2.13	1.76	1.39	1.14	0.89	0.74	0.58	0.35
21	5.33	4.46	3.74	3.13	2.57	2.01	1.70	1.33	1.06	0.87	0.70	0.55	0.33
22	6.75	5.80	4.64	3.84	3.08	2.32	1.93	1.61	1.21	0.98	0.75	0.64	0.41
23	6.40	5.41	4.40	3.65	2.95	2.25	1.79	1.54	1.12	0.92	0.71	0.59	0.37
24	6.20	5.11	4.18	3.47	2.80	2.13	1.71	1.42	1.05	0.87	0.67	0.55	0.31
25	5.88	4.78	4.00	3.27	2.53	1.79	1.65	1.07	1.01	0.82	0.65	0.49	0.27
26	5.56	4.57	3.85	3.09	2.44	1.93	1.54	1.23	0.96	0.74	0.56	0.41	0.29
27	5.26	4.32	3.58	2.83	2.28	1.85	1.46	1.16	0.92	0.70	0.48	0.39	0.28
28	5.00	4.15	3.42	2.71	2.13	1.75	1.40	1.07	0.90	0.63	0.65	0.25	0.24
29	7.09	5.74	4.76	3.88	2.99	2.29	1.87	1.44	1.09	0.85	0.57	0.54	0.31
30	6.66	5.44	4.40	3.62	2.76	2.10	1.75	1.30	0.97	0.74	0.57	0.41	0.27
31	6.19	5.15	4.18	3.41	2.58	1.97	1.66	1.24	0.91	0.72	0.53	0.39	0.23
32	5.91	4.78	3.99	3.10	2.42	1.87	1.53	1.14	0.87	0.67	0.48	0.32	0.17
33	5.57	4.56	3.73	2.87	2.26	1.80	1.41	1.04	0.83	0.61	0.46	0.32	0.11
34	5.34	4.27	3.45	2.69	2.13	1.68	1.28	0.96	0.79	0.55	0.43	0.28	0.09
35	5.04	4.02	3.26	2.53	1.99	1.58	1.19	0.94	0.72	0.53	0.39	0.27	0.00
36	4.79	3.85	3.04	2.40	1.88	1.48	1.10	0.93	0.68	0.47	0.37	0.19	0.21
37	7.42	6.15	4.86	3.83	2.98	2.29	1.71	1.30	0.99	0.69	0.53	0.37	0.17
38	6.98	5.68	4.53	3.54	2.78	2.04	1.62	1.18	0.92	0.65	0.48	0.31	0.00
39	6.60	5.25	4.25	3.34	2.52	1.92	1.49	1.12	0.82	0.60	0.43	0.29	0.05
40	6.14	4.90	4.01	3.12	2.35	1.78	1.31	1.04	0.78	0.54	0.39	0.00	0.00

41	5.75	4.63	3.75	2.83	2.19	1.67	1.22	0.91	0.70	0.52	0.36	0.21	0.11
42	5.38	4.33	3.48	2.58	1.98	1.50	1.15	0.84	0.69	0.48	0.35	0.19	0.00
43	5.08	4.12	3.13	2.46	1.87	1.38	1.07	0.79	0.64	0.44	0.30	0.11	0.15
44	6.14	4.90	4.01	2.27	1.75	1.28	1.10	0.78	0.78	0.43	0.25	0.28	0.11
45	4.61	3.49	2.72	2.08	1.63	1.20	1.03	0.72	0.55	0.40	0.23	0.07	0.09
46	8.22	6.76	5.20	3.99	3.07	2.38	1.75	1.27	0.94	0.60	0.48	0.31	0.00
47	7.73	6.25	4.71	3.66	2.79	2.12	1.57	1.17	0.84	0.55	0.45	0.29	0.00
48	7.16	5.74	4.38	3.38	2.57	1.91	1.38	1.07	0.76	0.50	0.38	0.26	0.09
49	6.64	5.31	3.98	3.14	2.36	1.73	1.27	1.00	0.70	0.48	0.32	0.21	0.00
50	6.26	5.11	3.76	2.89	2.13	1.57	1.17	1.00	0.65	0.40	0.30	0.15	0.00

Table 5.3

SWR for various allocations at 100%,99% and 95% success rates

Allocation	*Equity*	*Corporate*	*GSec*	*100%*	*99%*	*95%*
1	80	10	10	<3%	<3%	3.80%
2	75	10	15	<3%	<3%	3.90%
3	75	15	10	<3%	<3%	3.90%
4	70	10	20	<3%	3%	3.90%
5	70	15	15	<3%	3%	3.90%
6	70	20	10	<3%	3%	4%
7	65	10	25	<3%	3.10%	3.90%
8	65	15	20	<3%	3.10%	4.00%
9	65	20	15	3%	3.10%	4.00%
10	65	25	10	<3%	3.10%	4.00%
11	60	10	30	<3%	3.10%	4.00%
12	60	15	25	<3%	3.20%	4.00%
13	60	20	20	<3%	3.20%	4.00%
14	60	25	15	<3%	3.20%	4.00%
15	60	30	10	<3%	3.20%	4.10%
16	55	10	35	<3%	3.20%	4.00%
17	55	15	30	<3%	3.20%	4.00%
18	55	20	25	<3%	3.30%	4.00%
19	55	25	20	<3%	3.30%	4.10%
20	55	30	15	<3%	3.30%	4.10%
21	55	35	10	<3%	3.30%	4.10%
22	50	10	40	<3%	3.30%	4.00%
23	50	15	35	<3%	3.30%	4.00%
24	50	20	30	<3%	3.30%	4.00%
25	50	25	25	<3%	3.30%	4.10%
26	50	30	20	<3%	3.40%	4.10%
27	50	35	15	<3%	3.40%	4.10%
28	50	40	10	<3%	3.40%	4.10%

29	45	10	45	<3%	3.30%	4%
30	45	15	40	<3%	3.40%	4%
31	45	20	35	<3%	3.40%	4%
32	45	25	30	<3%	3.40%	4.10%
33	45	30	25	<3%	3.40%	4.10%
34	45	35	20	3%	3.50%	4.10%
35	45	40	15	<3%	3.50%	4.10%
36	45	45	10	<3%	3.50%	4.20%
37	40	10	50	<3%	3.40%	4%
38	40	15	45	3%	3.40%	4%
39	40	20	40	<3%	3.40%	4%
40	40	25	35	3.10%	3.40%	4.10%
41	40	30	30	<3%	3.50%	4.10%
42	40	35	25	3%	3.50%	4.10%
43	40	40	20	<3%	3.50%	4.10%
44	40	45	15	<3%	3.50%	4.10%
45	40	50	10	<3%	3.50%	4.20%
46	35	10	55	3%	3.40%	3.90%
47	35	15	50	3%	3.40%	4.00%
48	35	20	45	<3%	3.40%	4.00%
49	35	25	40	3%	3.40%	4.00%
50	35	30	35	3%	3.40%	4.00%

The results for gliding allocation (Table 5.4) reveal that reducing equity exposure during the later withdrawal phase lowers the failure rate, albeit not significantly. A 4% withdrawal rate, with an initial equity allocation of 40–70%, achieves a 95% success rate. However, failure rates increase when the initial equity exposure falls below 40% or exceeds 70%.

Table 5.4

Probability of failure (in %) for gliding allocations.

Allocation	*Withdrawal Rates*										
	4%	*3.9%*	*3.8%*	*3.7%*	*3.6%*	*3.5%*	*3.4%*	*3.3%*	*3.2%*	*3.1%*	*3%*
G1	5.85	4.94	4.31	3.52	3.09	2.66	2.28	2.02	1.53	1.38	1.04
G2	5.28	4.94	3.76	3.25	2.77	2.38	2.03	1.73	1.28	1.13	0.77
G3	4.94	4.57	3.41	2.87	2.46	2.12	1.77	1.47	1.00	0.90	0.55
G4	4.69	4.07	3.22	2.70	2.24	1.89	1.60	1.21	0.81	0.78	0.48
G5	4.50	3.89	3.14	2.53	2.04	1.72	1.38	1.04	0.70	0.63	0.39
G6	4.48	3.79	2.96	2.37	1.93	1.56	1.13	0.89	0.60	0.50	0.29
G7	4.51	3.71	2.86	2.20	1.78	1.26	1.03	0.80	0.49	0.41	0.19
G8	4.72	3.67	2.87	2.17	1.62	1.19	0.93	0.77	0.38	0.29	0.12
G9	4.94	3.92	3.04	2.18	1.54	1.23	0.84	0.69	0.28	0.22	0.03

Conclusion

Increasing life expectancy requires innovative retirement planning. The withdrawal rate, in terms of retirement corpus, becomes a crucial factor in determining the corpus required to be built for retirement. If a retiree wishes to receive half of their monthly income with inflation adjustments, the required corpus would be approximately 12–13 times their annual salary at a 4% withdrawal rate and 16–17 times their annual salary at a 3% withdrawal rate.

While the withdrawal rates discussed in the paper are presented on an annual basis, the modelling assumes monthly withdrawals and monthly inflation adjustment to reflect the actual scenario, where retirees require regular monthly income. If a retiree opts for an income pattern similar to that of a public sector retiree, the withdrawal rate would exceed 4%.

The analysis reveals that a 4% withdrawal rate is not sustainable for retirees aiming to avoid corpus depletion over a 30-year retirement period. Several factors contribute to this outcome, including the high-inflation period between 2010 and 2014, higher return volatility compared to the U.S., and the performance of fund management.

It is worth noting that the 4% rule does not explicitly consider fund management expenses, which could further reduce the safe withdrawal rate. However, since these expenses are already reflected in the returns used for the analysis, the withdrawal rates presented offer a realistic perspective for retirees in India.

This paper also demonstrates that extreme equity exposure—whether too high or too low—reduces the success rate of sustaining withdrawals. The results indicate that maintaining an equity exposure between 40% and 70% achieves a 95% success rate for sustaining a 4% withdrawal rate. This finding is consistent with Bengen (1994), which identifies a "comfort zone" for equity allocation between 50% and 70%. Furthermore, the gliding path allocation approach suggests that the probability of failure decreases as equity exposure is gradually reduced over time, though the decline is not significant.

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Anexure-I

Charge Structure

Table 5.5

Charges applicable during retirement phase other than adjusted in NAV

Intermediary	*Charge*	*Amount (in Rs.)*	*Deduction*
CRA	Any transaction	3.75	Cancellation of units
	Annual Maintainance Charge	69	
	Welcome Kit	18	
POP	Annual Maintainance Charge	100	Cancellation of units
	Exit processing Charge	0.125% of the wealth, Min 125 and Max 500	

Table 5.6

Charges Adjusted in NAV

Intermediary	*Charge*	*Amount (in Rs.)*	*Deduction*
PF	Investment Management Fees		Adjusted in NAV
	Upto 10,000 Crore	0.09%[10] of AUM	
	10,000 - 50,000 Crore	0.06 % of AUM	
	50,000 - 1,50,000 Crore	0.05% of AUM	
	Above 1,50,000 Crore	0.03% of AUM	
Custodian	Asset Custody Charges	0.00000000177% of AUC	Adjusted in NAV
NPS Trust	Reimbursement charge	0.003 % of AUM	Adjusted in NAV

10. UTI Retirement Solution PFM charges 0.007% in this slab.

Annexure-II

Fixed Allocation

Sr. No	*Equity*	*Corpo-rate*	*GSec*	*Sr. No*	*Equity*	*Corpo-rate*	*GSec*
1	80	10	10	26	50	30	20
2	75	10	15	27	50	35	15
3	75	15	10	28	50	40	10
4	70	10	20	29	45	10	45
5	70	15	15	30	45	15	40
6	70	20	10	31	45	20	35
7	65	10	25	32	45	25	30
8	65	15	20	33	45	30	25
9	65	20	15	34	45	35	20
10	65	25	10	35	45	40	15
11	60	10	30	36	45	45	10
12	60	15	25	37	40	10	50
13	60	20	20	38	40	15	45
14	60	25	15	39	40	20	40
15	60	30	10	40	40	25	35
16	55	10	35	41	40	30	30
17	55	15	30	42	40	35	25
18	55	20	25	43	40	40	20
19	55	25	20	44	40	45	15
20	55	30	15	45	40	50	10
21	55	35	10	46	35	10	55
22	50	10	40	47	35	15	50
23	50	15	35	48	35	20	45
24	50	20	30	49	35	25	40
25	50	25	25	50	35	30	35

Gliding Path Allocation

Allocation	*Gliding Path 6*			*Gliding Path 7*			*Gliding Path 8*			*Gliding Path 9*		
Year	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*
1	55	20	25	50	20	30	45	20	35	40	20	40
2	54	21	25	49	21	30	44	21	35	39	21	40
3	53	22	25	48	22	30	43	22	35	38	22	40
4	52	23	25	47	23	30	42	23	35	37	23	40
5	51	24	25	46	24	30	41	24	35	36	24	40
6	50	25	25	45	25	30	40	25	35	35	25	40
7	49	26	25	44	26	30	39	26	35	34	26	40
8	48	27	25	43	27	30	38	27	35	33	27	40
9	47	28	25	42	28	30	37	28	35	32	28	40
10	46	29	25	41	29	30	36	29	35	31	29	40
11	45	30	25	40	30	30	35	30	35	30	30	40
12	44	31	25	39	31	30	34	31	35	29	31	40
13	43	32	25	38	32	30	33	32	35	28	32	40
14	42	33	25	37	33	30	32	33	35	27	33	40
15	41	34	25	36	34	30	31	34	35	26	34	40
16	40	35	25	35	35	30	30	35	35	25	35	40
17	39	34	27	34	34	32	29	34	37	24	34	42
18	38	33	29	33	33	34	28	33	39	23	33	44

19	37	32	31	32	32	36	27	32	41	22	32	46
20	36	31	33	31	31	38	26	31	43	21	31	48
21	35	30	35	30	30	40	25	30	45	20	30	50
22	34	29	37	29	29	42	24	29	47	19	29	52
23	33	28	39	28	28	44	23	28	49	18	28	54
24	32	27	41	27	27	46	22	27	51	17	27	56
25	31	26	43	26	26	48	21	26	53	16	26	58
26	30	25	45	25	25	50	20	25	55	15	25	60
27	29	24	47	24	24	52	19	24	57	14	24	62
28	28	23	49	23	23	54	18	23	59	13	23	64
29	27	22	51	22	22	56	17	22	61	12	22	66
30	26	21	53	21	21	58	16	21	63	11	21	68

Allocation Year	*Gliding Path 1*			*Gliding Path 2*			*Gliding Path 3*			*Gliding Path 4*			*Gliding Path 5*		
	Equity	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*	*Equity*	*Bonds*	*G Sec*
1	80	10	10	75	15	10	70	20	10	65	20	15	60	20	20
2	79	11	10	74	16	10	69	21	10	64	21	15	59	21	20
3	78	12	10	73	17	10	68	22	10	63	22	15	58	22	20
4	77	13	10	72	18	10	67	23	10	62	23	15	57	23	20
5	76	14	10	71	19	10	66	24	10	61	24	15	56	24	20
6	75	15	10	70	20	10	65	25	10	60	25	15	55	25	20
7	74	16	10	69	21	10	64	26	10	59	26	15	54	26	20
8	73	17	10	68	22	10	63	27	10	58	27	15	53	27	20
9	72	18	10	67	23	10	62	28	10	57	28	15	52	28	20
10	71	19	10	66	24	10	61	29	10	56	29	15	51	29	20
11	70	20	10	65	25	10	60	30	10	55	30	15	50	30	20
12	69	21	10	64	26	10	59	31	10	54	31	15	49	31	20
13	68	22	10	63	27	10	58	32	10	53	32	15	48	32	20
14	67	23	10	62	28	10	57	33	10	52	33	15	47	33	20
15	66	24	10	61	29	10	56	34	10	51	34	15	46	34	20
16	65	25	10	60	30	10	55	35	10	50	35	15	45	35	20
17	64	24	12	59	29	12	54	34	12	49	34	17	44	34	22
18	63	23	14	58	28	14	53	33	14	48	33	19	43	33	24
19	62	22	16	57	27	16	52	32	16	47	32	21	42	32	26

20	61	21	18	56	26	18	51	31	18	46	31	23	41	31	28
21	60	20	20	55	25	20	50	30	20	45	30	25	40	30	30
22	59	19	22	54	24	22	49	29	22	44	29	27	39	29	32
23	58	18	24	53	23	24	48	28	24	43	28	29	38	28	34
24	57	17	26	52	22	26	47	27	26	42	27	31	37	27	36
25	56	16	28	51	21	28	46	26	28	41	26	33	36	26	38
26	55	15	30	50	20	30	45	25	30	40	25	35	35	25	40
27	54	14	32	49	19	32	44	24	32	39	24	37	34	24	42
28	53	13	34	48	18	34	43	23	34	38	23	39	33	23	44
29	52	12	36	47	17	36	42	22	36	37	22	41	32	22	46
30	51	11	38	46	16	38	41	21	38	36	21	43	31	21	48

6

Retirement Planning: Understanding the Impact of Uncertainty and Behavioural Biases

Pankhuri Sinha | Irala Lokanandha Reddy

Abstract

India's current cohort of young population will eventually age over the next three decades. Despite the fact that the nation is enjoying the benefits of a younger population, this demographic advantage is sure to diminish in the coming years. Population ageing poses a formidable demographic challenge for the world today, with severe economic and financial implications such as higher fiscal costs, particularly in the realm of retirement.

Despite the imperative nature of retirement planning, empirical evidence reveals a casual attitude toward this critical phase of life, marked by inadequate savings and asset accumulation. In this context, the current research addresses this pressing issue and investigates the underlying reasons for the lack of preparation for retirement.

Using the Theory of Planned Behaviour (TPB) and the Behavioural Life-Cycle (BLC) hypothesis, we find that savings adequacy uncertainty, procrastination, and overconfidence (the difference between subjective and objective financial literacy) result in lower retirement preparation. The study also seeks to understand the mediating role of financial advice in facilitating better retirement preparation.

Introduction

Population ageing is an unprecedented demographic phenomenon that exerts significant pressure on the economic and financial structures of economies today (Vieira et al., 2022; Wang et al., 2016). The number of people aged 65 years and older is expected to double over the next three decades, reaching 1.6 billion by 2050 (Richter, 2023). Furthermore, by that time, older people will account for more than 16 percent of the global population (World Social Report, 2023).

Population ageing, combined with a lack of effort by individuals to save for a comfortable retirement (Brüggen et al., 2017; de Villiers & Roux, 2019), increases pressure on existing social security systems (Topa et al., 2018).

Retirement is characterised by permanent withdrawal from the active workforce (Apouey, 2018) and a cessation of work-related income and benefits (Mata, 2021), thus making it a crucial phase in an individual's life. Consequently, the accumulation of wealth and long-term retirement planning becomes imperative. Past literature underscores the importance of retirement preparation. For instance, Magwegwe & Lim (2021) observed the benefits of retirement preparation, and Ameriks et al. (2003) and Lusardi & Mitchell (2007) highlighted the positive effect of retirement planning on wealth accumulation.

Over the years, while retirement researchers (Adami & Gough, 2008; Afthanorhan et al., 2020; Akben-Selcuk & Aydin, 2021; Kimiyagahlam et al., 2019; Vivel-Búa et al., 2019) have emphasised the importance of retirement preparation, empirical evidence shows that people are still casual about retirement planning. Many individuals exit the active workforce (Apouey, 2018) without adequate retirement savings (Magwegwe & Lim, 2021) or assets to sustain retirement. To ensure sustainable well-being and a good quality of life in retirement, voluntary saving is critical in the current landscape (Topa et al., 2018).

In today's world, individuals are surrounded by uncertainties in every sphere of their lives (Mohta & Shunmugasundaram, 2024), which pose hurdles in making effective decisions, including those

related to retirement planning and saving. There is limited understanding and empirical research centred around uncertainty related to savings. This study focuses on the uncertainty with respect to estimating retirement savings. The research intends to examine the effect of this subjective uncertainty on retirement preparation behaviour, along with other behavioural factors such as procrastination and overconfidence that might have an impact.

Although the literature has often explored various aspects of retirement preparation separately—including retirement savings (Adami & Gough, 2008; Alkhawaja & Albaity, 2022; Piotrowska, 2019), retirement planning (Akben-Selcuk & Aydin, 2021; Chua & Chin, 2021; Topa et al., 2018), financial planning (Kock & Yoong, 2011), long-term financial planning (Chua & Chin, 2021), and perceived financial preparedness (Akben-Selcuk & Aydin, 2021)—there is limited research that has integrated these aspects into a comprehensive view of retirement preparation (Sinha & Irala, 2024).

To address these gaps, the following research questions were formulated:

- What are the cognitive and non-cognitive factors that prevent people from getting ready for retirement?
- How do behavioural biases/interventions affect the decision to plan and save for retirement?

In order to answer the above research questions, the following objectives were formulated:

- To study the impact of uncertainty in savings adequacy on individuals' behaviour towards retirement planning.
- To understand the psychological and behavioural factors that affect retirement preparation behaviour.
- To investigate the role of different confidence levels (underconfidence, overconfidence, or confidence) in shaping retirement preparation behaviours.
- To explore the mediating role of financial advice in the relationship between confidence levels and retirement preparation.

The present study makes a three-fold contribution to the ongoing discussion. First, the holistic study of retirement preparation as a combination of retirement planning, financial planning, and retirement savings contribution offers a better understanding of retirement preparation (Sinha & Irala, 2024). Second, we add to the vast body of retirement literature by including the less-studied exogenous variable of savings adequacy uncertainty. Examining its effect on the combined construct of retirement preparation, in the Indian context, offers a demographically different candidate compared to the rest of the world. Third, the study integrates the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and the Behavioural Life-Cycle (BLC) hypothesis (Shefrin & Thaler, 1988) by accommodating the behavioural biases of procrastination and overconfidence. The findings from this study offer new practical insights to banks, public and private insurance companies, and practitioners offering retirement savings plans, as well as to potential savers.

The remaining paper is organised into separate sections. The study begins with an introduction followed by the theoretical background, the development of hypotheses and research models. Next are the research methods and data analysis sections, which present the results, followed by a discussion of the findings. The paper ends with limitations, future research, and the conclusion.

Background

Savings Adequacy Uncertainty (SAU)

In the retirement context, savings adequacy refers to whether an individual's current savings are sufficient for a comfortable retirement (Hershey et al., 2017; Kim & Hanna, 2015). It is determined as the amount exceeding an individual's retirement consumption goals (Wang & Wanberg, 2017). It may also be defined as individuals' subjective confidence in predicting the adequacy of their savings for retirement. This subjective uncertainty was termed Savings Adequacy Uncertainty (SAU) by Van Schie et al. (2012), who examined its impact on retirement savings and retirement savings information. The authors questioned the amount that could be considered sufficient for the post-retirement period.

Retirement Preparation (RETPREP)

Studies on retirement planning behaviour typically encompass financial planning, retirement planning, and retirement savings as the key variables, termed by Niu et al. (2020) as retirement preparation. They have recognised financial planning as a crucial part of retirement preparation (Topa et al., 2012) and long-term financial security (Anderson et al., 2017). Another aspect of retirement preparation, as studied by Henager & Cude (2016), is retirement savings contribution, which indicates investments made outside retirement accounts. Similar concepts were explored by Piotrowska (2019) regarding voluntary contributions for retirement, and by Van Schie et al. (2012) on behavioural intentions to make further contributions to complement retirement income.

To conduct a comprehensive study of retirement, this research integrates the aspects mentioned above—financial planning, retirement planning, and retirement savings contribution—into a single construct of retirement preparation. As indicated by existing literature (Banerjee, 2011; Lusardi, 2010), the level of savings or savings behaviour is contingent upon several factors (e.g., education, income, age, gender, race, financial literacy). One such driving factor is the presence of uncertainty.

The impact of uncertainty on savings behaviour is a contentious topic. According to the expected utility theory on rational choice under uncertainty, a rational human being should save more when his current savings are inadequate. However, research has also recognised the role of subjective uncertainty and its negative impact on savings decisions. Van Schie et al. (2012) noted the conflicting evidence from both psychological and economic theory. Existing psychological research suggests that individuals tend to save less when faced with uncertainty; conversely, economic theory claims that uncertainty leads to an increase in precautionary savings. Empirical evidence supporting economic theory showed that a rise in income uncertainty resulted in increased household savings (Chamon et al., 2013). Given these diverse perspectives and the value of including subjective human behaviour to extend the applicability of a theory

(e.g., behavioural life-cycle hypothesis), this study tests the negative effect of uncertainty in line with psychological literature.

As per the Life-Cycle Hypothesis (LCH) theory by Modigliani & Brumberg (1954), the most important objective in life is saving for retirement. It posits a forward-looking savings behaviour in order to prepare for uncertain future expenditures. The accumulation of resources for retirement needs proper planning, and it is noteworthy that failure to adequately plan for retirement leads to reduced savings (Modigliani, 2005) and, consequently, reduced consumption during retirement (Shefrin & Thaler, 1988).

Savings adequacy, as defined by Wang & Wanberg (2017), involves assessing whether one's savings exceed one's desired retirement consumption, and the issues resulting from failure to plan (Shefrin & Thaler, 1988). Studies conducted around the globe—in the Netherlands, America, and China—have highlighted people's laid-back attitude toward retirement planning and their inability to assess the sufficiency of savings, resulting in insufficient savings for retirement (Bodie & Prast, 2011; Niu et al., 2020). Though Van Schie et al. (2012) studied the impact of SAU, it was only in relation to retirement savings. This study examines its impact on retirement preparation (financial planning, retirement planning, and retirement savings contribution). This leads to the following hypothesis:

H1: Savings Adequacy Uncertainty has a negative impact on Retirement Preparation

Behavioural Biases

Research indicates that the assumptions of the LCH theory are neither fixed nor universally applicable. This allows room for adjustments to these assumptions to better suit different contexts and situations. Shefrin & Thaler (1988) modified the traditional LCH theory, giving rise to the BLC theory. In this revised framework, the authors enriched the basic LCH model by incorporating three key behavioural aspects—self-control, mental accounting, and framing. They believed that these factors play a substantial role in influencing behaviour. This study extends the BLC theory by incorporating procrastination and overconfidence as potential behavioural biases.

Procrastination (PROCRS)

Procrastination is the natural behaviour of people characterised by situation avoidance and voluntary postponement (Wieber & Gollwitzer, 2010), or irrational delay (Steel, 2010) in the face of uncertainty, despite being aware of potential negative consequences. According to Wieber & Gollwitzer (2010), procrastination is not just a postponement of a decision, but it should fulfil four essential criteria: a commitment to the goal in question, having the opportunity to act on the goal, expecting to be worse off later in the case of delay, and voluntarily deciding to put off the intended action.

Further, Lipshitz & Strauss (1997), while stressing the role of uncertainty in effective decision-making, emphasised that uncertainty can lead to hesitation, indecisiveness, or procrastination. Studies in household finance have suggested that procrastination can significantly impact financial planning for retirement. O'Donoghue & Rabin (1999) explained it as an inclination towards immediate gratification, which can result in a trade-off between current and future consumption, ultimately leading to insufficient retirement savings.

The Theory of Planned Behaviour (TPB) (Ajzen, 1991) posits that an individual's attitude towards a behaviour is shaped by the anticipation of positive or negative outcomes associated with it. In retirement planning, a person invests their time and effort, which represents the main cost. As the result of this effort (retirement planning) is not immediately visible, a negative attitude towards retirement planning behaviour tends to develop. When combined with uncertainty, this negative attitude can discourage individuals from taking steps toward the desired course of action, leading to procrastination. Also, including Perceived Moral Obligation (PMO) to perform—or refuse to perform—a specific behaviour (i.e., procrastinate) increases the predictive power of the TPB model.

Brown et al. (2016) found that individuals often choose default auto-enrolment options and lump-sum payments in 401(k) plans rather than making active choices about retirement plans and investment options. Thus, by integrating the BLC and TPB theories, the study proposes the following hypotheses:

H2: Procrastination has a negative impact on Retirement Preparation

H3: Savings Adequacy Uncertainty has a positive impact on Procrastination

Piotrowska (2019) studied procrastination affecting retirement savings and found that, regardless of income, procrastination is the main factor associated with personality that affects retirement savings. Building on this, we propose:

H4: Procrastination mediates the impact of Savings Adequacy Uncertainty on Retirement Preparation

Overconfidence

Overconfidence is considered the most prevalent and the most damaging observed decisional bias (Kahneman, 2011; Stankov & Crawford, 1996), and is defined as the difference between one's actual financial literacy and perceived financial literacy—i.e., objective and subjective financial literacy. Literature has provided various perspectives on overconfidence, mainly centred around financial knowledge and literacy. It is the belief that an individual has in his/her financial knowledge, which is greater than the actual measured financial literacy (Niu et al., 2020).

Anderson et al. (2017) took this definition one step further by bifurcating overconfidence into overestimation, precision, and overplacement. While overestimation refers to overestimating one's actual abilities, precision is excessive certainty regarding the accuracy of one's beliefs. The extant literature discusses not just the various forms of overconfidence but also its causes, such as cognitive ageing (Pak & Chatterjee, 2016). This refers to the age-induced overconfidence in financial skills versus actual financial proficiency. Based on this discussion, the hypotheses on overconfidence are presented below:

H5: Overconfidence has a significant positive association with Retirement Preparation

H6: Underconfidence has a significant negative association with Retirement Preparation

Taking into consideration the effect of financial advice, its mediating effect was investigated through the following hypothesis:

H7: Financial Advice significantly mediates the relationship between Confidence Level and Retirement Preparation

Methods

Data Collection: Procedure and Participants

A cross-sectional design was used to test the proposed conceptual framework. The respondents for our research comprised working professionals drawn from the knowledge industry in India, comprising the software and services sector, financial services sector, healthcare sector, and the education sector. It is worth noting that the first three sectors emerged as the leading employment-generating sectors in 2022 (Burgundy Private Hurun India 500, 2022), and the Indian education sector stood as the beacon of knowledge-intensive employment.

This study is set in the Indian landscape. The stark demographic disparity between India and the rest of the world justifies studying the Indian scenario. Retirement preparation is of critical importance in the Indian context due to the loss of the advantage of a demographic dividend of a young population (Murari et al., 2021). According to the National Commission on Population, India, the share of the elderly (60+ years as per the National Elderly Policy) in India's population was around 9% as per Census 2011 and is expected to grow and reach 18% by 2036. By 2050, every fifth Indian will be a sexagenarian.

Apart from the strong demographic advantage, India is also distinct from other countries in terms of financial literacy. Financial literacy is recognised as one of the three components of financial empowerment of individuals (OECD, 2022). However, there are stark differences in financial literacy rates in advanced and emerging economies. On average, the literacy rates in advanced countries are around 55%, compared to 28% in emerging economies, with India at 24%. Given these disparities in financial literacy and education

between India and the rest of the world, it is appropriate to study the Indian scenario.

Data Measurement

SAU: The scale for savings adequacy uncertainty was adopted from Van Schie et al. (2012). This previous study measured perceived savings adequacy first and, as a follow-on question, measured savings adequacy uncertainty. Likewise, the question "Do you expect to have adequate financial resources to retire comfortably?" was asked, followed by the SAU question: "You indicate that you expect to have (inadequate/adequate) financial resources to live comfortably during retirement. How certain are you that your expectation will turn out to be true?". The last question on SAU was used in the current research.

Procrastination: Procrastination is the natural behaviour of people characterised by situation avoidance and voluntary postponement (Wieber & Gollwitzer, 2010), or irrational delay (Steel, 2010) in the face of uncertainty, despite being aware of potential negative consequences. The latent variable was measured using a 5-item scale from Mann's (1982) Decisional Procrastination Questionnaire (via Steel, 2010).

Retirement Preparation: This is the dependent variable in the study, on which we aim to check the influence of behavioural factors. It is a combination of financial planning, retirement planning, and retirement savings (Niu et al., 2020). Financial planning refers to the long-term financial plan of households (Niu et al., 2020); retirement planning is the self-assessed amount needed for retirement (Henager & Cude, 2016); and retirement savings contribution is the intention to make extra contributions in the coming period (Van Schie et al., 2012). Initially, the combined scale used in this study had two items each for retirement planning, financial planning, and retirement savings contribution. However, one item in retirement savings contribution was dropped because of low factor loading. Thus, the retirement preparation scale included five items that were used for measurement.

Overconfidence: The overconfidence construct was calculated from the responses obtained with respect to objective and subjective financial literacy. The financial literacy scale was adopted from the OECD (2020) International Survey of Adult Financial Literacy. The objective financial literacy scale was a 7-item scale that measured the financial knowledge component of financial literacy. It required basic knowledge of financial concepts like inflation, interest, and risk. The score was calculated by allocating one point for each correct answer and zero otherwise. On the other hand, subjective financial literacy was also measured using the OECD's (2020) 1-item scale on the confidence of individuals in their own financial knowledge. The subjective financial literacy was measured on a 5-point Likert scale.

The final overconfidence construct is a categorical variable calculated using the objective and subjective financial literacy scores as shown below:

Table 6.1

Calculation of Financial Literacy Categories

Financial Literacy (Objective & Subjective)	
Objective Financial Literacy	
High Objective FL (High OFL)	>= Median
Low Objective FL (Low OFL)	< Median
Subjective Financial Literacy	
High Subjective FL (High SFL)	>= Median
Low Subjective FL (Low SFL)	< Median

The scores calculated from the seven questions in the objective financial literacy section were totalled for each respondent, and the median score was obtained for all 380 respondents. Respondents who scored more than or equal to the median score were classified as High OFL, and those with less than the median score were classified as Low OFL. Similarly, respondents with greater than or equal to the median subjective financial literacy score were categorised as High SFL, and those with lower than the median score were categorised as

Low SFL. From these defined categories, overconfidence categories were made based on the criterion shown in Table 6.2 below:

Table 6.2

Calculation of Overconfidence Categories

Objective FL	*Subjective FL*	*Category*	*Meaning*
High OFL	High SFL	1	Appropriate High Confident
High OFL	Low SFL	2	Underconfident
Low OFL	High SFL	3	Overconfident
Low OFL	Low SFL	4	Appropriate Low Confident

Category 1 and Category 4 are the appropriately confident respondents whose objective and subjective financial literacy match. These two categories were clubbed together as the "confident group". Respondents with high objective financial literacy but low subjective financial literacy were categorised as underconfident. Those with low objective financial literacy but high subjective financial literacy were categorised as overconfident.

The data was collected using a survey questionnaire, distributed both online and offline. The first round of data collection was conducted from November 2022 to February 2023, followed by a second round from April 2022 to June 2023. Confidentiality of the responses was ensured throughout the process. The survey link was shared with approximately 900 potential respondents, of which 375 responded (a response rate of 43 percent). Additionally, an offline survey was administered to around 75 participants, resulting in 52 completed surveys (a response rate of 70 percent). The final sample consisted of 380 responses, after accounting for 47 cases of missing data. The demographic characteristics of the sample are represented in Table 6.3.

Table 6.3

Demographic Profile

Demographic characteristics		*Frequency*	*Percentage (%)*
Gender	Male	236	62.1
	Female	144	37.9
Age	22-40	276	72.6
	41-59	87	22.9
	60-79	17	4.5
Industry	Education	133	35.0
	Software & Services	93	24.5
	Healthcare	84	22.1
	Financial Services	70	18.4
Marital Status	Married	231	60.8
	Unmarried	148	38.2
Income	Upto INR 10,00,000	245	64.5
	Upto INR 20,00,000	74	19.5
	More than 20,00,000	61	16.1
Education	University education & higher	362	95.3
	Primary & secondary school	18	4.7
	No formal education	0	0

Statistical Analysis

The measurement model was tested for reliability and validity as shown in Tables 6.4 and 6.5 respectively.

Table 6.4

Reliability Measures

	Composite Reliability (CR)	*Average Variance Extracted (AVE)*	*Cronbach's Alpha*
PROCRS	0.784	0.553	0.771
RETPREP	0.843	0.525	0.840
FA	0.841	0.642	0.830

Table 6.5

Discriminant Validity: Fornell-Larcker Criterion

	PROCRS	*RETPREP*
PROCRS	0.744	
RETPREP	-0.106	0.725

Structural Model Analysis

The relationship between savings adequacy uncertainty, procrastination, and retirement preparation (H1, H2, H3, H4) was tested using AMOS, while the effect of overconfidence and financial advice on retirement preparation (H5, H6, H7) was tested using the Process Hayes Macro. The AMOS results are shown in Tables 6.6 and 6.7, and the Process Macro results are shown in Table 6.8.

Table 6.6

Direct Path Results

AMOS Path	*Estimate (Unstandardized regression weights)*	*Standardized estimate (Standardized regression weights)*	*S.E*	*C.R.*	*Remark*
H1: SAU-> RETPREP***	-0.170	-0.228	0.037	-4.566	Supported
H2: PROCRS->RETPREP***	-0.241	-0.243	0.056	-4.289	Supported
H3: SAU-> PROCRS***	0.174	0.231	0.033	5.288	Supported

Notes: ***p < 0.01, **p < 0.05, *p < 0.1, ^{NS} insignificant.

Hypothesis 1 (H1), which tests the negative direct path between Savings Adequacy Uncertainty (SAU) and Retirement Preparation (RETPREP), is significant (p-value less than 0.05) and negative (β = -0.170). This shows that as uncertainty regarding savings adequacy increases by 1 unit, retirement preparation decreases by 0.170 units.

Hypothesis 2 (H2) tests the negative relationship between procrastination and retirement preparation. Procrastination, as defined earlier, is the tendency of individuals to postpone decisions despite knowing that they would be worse off due to the delay. The hypothesis testing shows that the relationship between procrastination and retirement preparation is negative and significant (β = -0.241, p-value < 0.05), meaning that procrastination decreases retirement preparation; i.e. postponement in taking financial decisions leads to less retirement preparation, including retirement planning, financial planning, and retirement savings contribution.

The association between savings adequacy uncertainty and procrastination was analysed in Hypothesis 3 (H3), which proposes that SAU is positively associated with procrastination. The results show that as uncertainty regarding savings adequacy increases, procrastination also increases; i.e. with the rise in savings adequacy uncertainty, individuals are more inclined to postpone decision-making (β = 0.174).

Table 6.7

Mediation Results

Mediation Path	*Specific Indirect effect*	*Total effect*	*Remarks*
H4: SAU→PROCRS→RETPREP	-0.042**	-0.29**	Supported

Notes: ***p < 0.01, **p < 0.05, *p < 0.1, NS insignificant.

Hypothesis 4 (H4) analyses the effect of procrastination as a mediator in the direct relationship between savings adequacy uncertainty and retirement preparation. The specific indirect path is negative and significant, with a beta coefficient of -0.042 and p-value less than 0.05. This shows that with the increase in savings adequacy uncertainty, retirement preparation decreases due to the effect of increased procrastination. Also, the total effect of -0.29 is negative and significant.

Table 6.8

Process Macros - Mediation Analysis Results

M (Fin_Adv)				*Y (RetPrep)*				*Y (RetPrep)*			
	Coeff.	*SE*	*p*		*Coeff.*	*SE*	*p*		*Coeff.*	*SE*	*p*
a_1	0.0119	0.1172	0.9193	c_1	0.1849	0.0738	0.0127	c'_1	0.1827	0.0706	0.0100
a_2	-0.4078	0.1711	0.0177	c_2	-0.1629	0.1078	0.1317	c'_2	-0.0863	0.1038	0.0245
								b	0.1878	0.0313	0.0000
iM	5.1484	0.7263	0.0000	iY	2.0558	0.4575	0.0000	iY	1.0886	0.4659	0.0200
R2	0.0838			R2	0.0498			R2	0.1343		
F	4.2424	p	0.0001	F	2.4297	p	0.0143	F	6.3768	p	0.0000

As seen from the table above, the direct effect of X on Y is significant (p = 0.017), indicating that confidence has an impact on retirement preparation irrespective of group. The relative direct effect is significant, which shows that the overconfident group is significantly more likely to save for retirement compared to the underconfident group. Results also show that the relative total effect of the overconfident group (as compared to the confident group) on retirement preparation is significant.

Coming to the indirect effects, the relative indirect effect of the underconfident group is significant, meaning that relative to the confident group, the underconfident group's effect on retirement preparation is positively mediated by financial advice. It also implies that the underconfident group tends to take more financial advice, leading to greater retirement preparation. Given that at least one of the relative indirect effects is different from zero, we can conclude that the effect of confidence level on retirement preparation is mediated by financial advice.

Discussion

Savings Adequacy Uncertainty has a negative association with Retirement Preparation (H1). This result finds support in Van Schie et al. (2012), who found that savings adequacy uncertainty increases retirement contributions and the search for savings information. Extending these findings, the current study shows that SAU affects not only retirement contributions but also retirement planning and financial planning.

The second hypothesis, which tests that procrastination is negatively associated with retirement preparation (H2), finds less empirical support. Beshears et al. (2009) suggest procrastination as one of several possible explanations for choosing default options. Brown and Previtero (2016) also show that procrastinators take longer to sign up for 401(k) plans, contribute less, and are more likely to stick with default portfolio allocations. On the other hand, the study by Piotrowska (2019) shows that procrastination has a direct, negative effect on retirement saving.

In line with predictions from the psychological literature, the third hypothesis shows that savings adequacy uncertainty is positively associated with procrastination (H3). It suggests that people tend to postpone decision-making when faced with increased complexity in the decision task (Lipshitz & Strauss, 1997; Tversky & Shafir, 1992). It also addresses the future research directions given by Van Schie et al. (2012) to test whether procrastination is related to uncertainty.

The mediation effect of procrastination on the relationship between savings adequacy uncertainty and retirement preparation (H4) is a new relationship tested in this study. Some evidence exists in the study by Piotrowska (2019), which showed that procrastination successfully mediates the relationship between almost all personality facets and retirement preparation. The same study also shows that people with SAU have a tendency to procrastinate financial decisions, which leads to a negative impact on retirement preparation.

Regarding the overconfidence bias, this study shows that overconfidence has a significant positive association with retirement preparation (H5), which is in line with previous studies that show respondents with greater confidence in their financial knowledge display a higher propensity to plan and take actions for retirement. That is, individuals overconfident in financial literacy are more likely not only to have thought about their retirement plan but also to take actual steps to prepare for retirement (Chen & Chen, 2023). Overconfident individuals also report a higher likelihood of having done some retirement planning. Moreover, on retirement-specific questions, more than 30% of overconfident individuals had already started planning for retirement (Angrisani & Casanova, 2019).

Hypothesis 6 (H6) provides evidence that underconfidence has a significant negative association with retirement preparation, as shown in previous studies where individuals' financial literacy overconfidence (or underconfidence) significantly promotes (or deters) their retirement planning behaviours (Chen & Chen, 2023). Underconfident individuals were the second least likely to start planning for retirement (Angrisani & Casanova, 2019).

The last hypothesis (H7) shows that financial advice significantly mediates the relationship between confidence levels and retirement preparation. Given that at least one of the relative indirect effects is different from zero, this study concludes that the effect of confidence level on retirement preparation is mediated by financial advice. Previous studies have shown that financial advice is the only factor that positively influences individuals' decisions to participate in a retirement plan (Fang et al., 2022). The study by Angrisani & Casanova (2019) shows that underconfident individuals are more willing to learn about retirement compared to overconfident individuals.

Contribution

The findings emphasise the need to address savings uncertainty and procrastination in retirement planning initiatives. Thus, banks and financial institutions offering retirement plans, along with government and regulatory agencies, could focus on reducing this uncertainty. The results also highlight that better and more suitable plan offerings by companies would help bring greater clarity regarding retirement in the minds of potential savers.

The study's insights into behavioural biases and savings uncertainty could lead to the development of new products and services that better address the needs and tendencies of individuals planning for retirement. With regard to financial advice, there is evidence suggesting that financial advice in isolation is not fully effective; other factors such as overconfidence and financial sophistication may also influence its actual outcome. It is advisable that companies conduct a thorough study of their clients and offer customisable financial advice after understanding the nature of their clientele.

Further practical implications for policymakers include the need to incentivise early savings and ensure retirement preparedness among the workforce. They should design educational programmes to assist professionals in determining their retirement needs. The research also highlights the importance of financial literacy and retirement planning education. These findings could inform the development of educational content aimed at improving public

understanding of retirement planning and encouraging more proactive financial behaviours.

Conclusion

The findings of this study underscore the urgent need to address the challenges of retirement preparedness in the context of India's ageing population. While the nation currently benefits from a demographic dividend, the impending shift towards an ageing society over the next three decades necessitates a proactive approach to financial preparedness for retirement.

Using the Theory of Planned Behaviour (TPB) and the Behavioural Life-Cycle (BLC) hypothesis, this research identifies critical behavioural factors—savings adequacy uncertainty, procrastination, and overconfidence in financial literacy—that significantly impede retirement preparation.

The study further highlights the mediating role of financial advice in improving retirement preparedness, suggesting that access to and reliance on expert guidance can help mitigate the adverse effects of behavioural biases. This has crucial implications for policymakers and financial planners, emphasising the need for targeted interventions that promote financial literacy, address behavioural impediments, and encourage long-term saving behaviour.

In conclusion, fostering a culture of early and adequate retirement planning is essential to safeguard the financial security of the ageing population. A coordinated effort involving public policy, financial advisory services, and educational initiatives is required to create an environment conducive to informed decision-making. By addressing the behavioural barriers identified in this study, India can better prepare its population for the economic and financial challenges associated with an ageing society.

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7

Leveraging Corporate NPS as a Strategy for Expanding NPS in India

Pankaj Saggi | Hitesh Bhatia

Abstract

India's evolving demographic landscape, marked by urbanisation and the problem of ageing, necessitates enhanced and adequate pension coverage. The paper modestly attempts to review the National Pension System (NPS), a flagship programme providing structured market-linked pension benefits at retirement by leveraging long-term savings.

By reviewing the barriers in coverage and adequacy, particularly among private sector workers, the paper intends to highlight the pivotal role of "Corporate-NPS (C-NPS)" in achieving sustainable long-term pension inclusion. Given that most of the workforce is employed in the private sector, C-NPS is essential for long-term pension inclusivity. This research paper investigates the challenges and potential solutions for expanding C-NPS coverage, emphasising the role of PFRDA in addressing these challenges. The paper adopts a mixed-method approach of quantitative and qualitative research methodology, using subscriber data spanning ten years from 2014 to 2024, sourced from PFRDA.

Preliminary findings reveal significant gaps and lagged growth in pension coverage in the corporate sector, highlighting an urgent need for a comprehensive and impactful communication strategy. Managerial implications suggest that a public–private partnership approach, technological innovations, targeted awareness campaigns, collaboration with corporate companies, and radical tax reforms (specifically in the corporate sector for both employees and employers) could address these gaps. Drawing on global best practices and case studies showcasing the effectiveness of mindfully created awareness and onboarding campaigns, this study outlines actionable reforms for a more inclusive, equitable, and robust pension framework in India.

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Introduction

India is one of the world's fastest-growing economies, with consumption outgrowing savings (CRISIL, 2024). The country's rapidly urbanising population is coupled with rising life expectancy and ageing, intensifying the strain on existing pension structures, which are found to be inadequate. This highlights a pressing challenge regarding adequate savings for the retirement of the ageing population in times to come. Current retirement planning is dependent upon a variety of unorganised schemes and a few organised ones comprising flagship schemes like the Employees' Provident Fund (EPF), Public Provident Fund (PPF), and NPS. However, these systems often fail to cover a large part of the population. With fewer than 12% of India's working-age population covered by any formal retirement plan, the gaps in pension coverage are ever-increasing (Pension Reform Initiative, 2024).

The National Pension System (NPS) was introduced by the Government of India in 2004 as a defined contribution pension scheme, replacing the traditional defined benefit system for new government employees. Initially mandatory for government employees, it was extended voluntarily in 2009 to all Indian citizens between the ages of 18 and 65. The NPS aims to provide old-age income security by promoting systematic savings during an individual's employment tenure.

Despite the government's tremendous efforts to expand NPS, the growth rate of participation has remained low, and awareness among people—especially in private-sector employment—remains limited. C-NPS plays a critical role in bridging these gaps, as it can incentivise private companies to ensure that their employees are enrolled in a pension plan, thereby expanding the coverage of NPS to a wider population. According to recent reports, while the NPS has attracted a large pool of participants, a considerable segment of the population remains under-covered. As per the PFRDA Report 2023, only about 20% of the employed contribute to the NPS, highlighting the need for strategic interventions.

Given the centrality of the private sector in India's employment landscape, focusing on C-NPS is the key to ensuring that all workers, especially those in the private sector, are included in the pension system—ensuring sustainable financial security for future retirees and lowering the burden on the Government of the ageing population.

This part of the paper explores the evolution of the NPS over the years, from a government-managed pension scheme to a more dynamic, technology-driven platform through the introduction of the Protean app. This transformation highlights broader trends in digitisation, accessibility, and user engagement in financial services, emphasising the implications for stakeholders in India's retirement savings ecosystem (PFRDA report, 2004). Managed by the PFRDA, it serves as a pivotal component of India's social security framework (Ministry of Finance report, 2004).

Structure:

Tier I Account (Mandatory) – The primary, non-withdrawable account meant for retirement savings. This account has tax benefits under section 80C of the old income tax regime.

Tier II Account – *A voluntary savings account, allowing individuals to withdraw their funds at any time, offering greater flexibility just like mutual funds but without the same tax benefits as Tier I.*

Upon retirement or reaching the age of 60, the accumulated corpus is used to provide a monthly pension through the purchase of an annuity, while up to 60% of the corpus can be withdrawn as a lump sum (PFRDA report, 2015). The digital transformation within the NPS has been pivotal in increasing its accessibility and user engagement. In 2021, the NPS transitioned into an advanced platform known as the Protean app (formerly by NSDL e-Governance Infrastructure Limited). This app serves as a comprehensive financial management tool, allowing users to manage their NPS accounts alongside other financial services (Protean, 2021).

Key features of the app include:

- A user-friendly interface that simplifies navigation and account management for users
- Real-time tracking, which enables users to monitor their investments and returns in real time

Literature Review

The NPS is characterised by its defined contribution framework, where employees and employers contribute to the pension corpus. Subscribers have the flexibility to choose their investment options and pension fund managers, allowing for a degree of customisation based on individual risk appetites (Maheshwari & Bhutada, 2019). The scheme is regulated by the Pension Fund Regulatory and Development Authority (PFRDA), ensuring transparency and adherence to established guidelines.

The NPS operates on a defined contribution basis, allowing individuals to invest in pension funds during their working years, which can be accessed upon retirement, typically at the age of 60. Several researchers have focused on the structural design of the NPS. For instance, Singh, S., & Suresh, N. (2018) describe the NPS framework as a hybrid system that combines market-based investment avenues with minimal government involvement, thus promoting financial literacy and individual responsibility among participants. The authors argue that this duality aims to balance safeguarding the financial interests of contributors while also exposing them to market risks.

Another critical area of examination is the performance of various NPS funds. A study by Kumar and Singh (2020) indicated that the NPS has outperformed traditional provident fund systems significantly, offering more robust returns due to its exposure to equities. The research highlights that the equity-oriented NPS fund returned approximately 12–14% annually over a decade, while public provident funds yielded closer to 8–9%, thus affirming the success of hybrid investment options in pension management.

Despite its advantages, various studies indicate multiple challenges faced by the NPS. For example, Gupta and Bansal (2019) high-

light the issues of accessibility and participation, particularly among lower-income and informal sector workers. The study concluded that a significant portion of the workforce still lacks awareness of the scheme, limiting participation rates. Additionally, Teja and Nair (2021) emphasise the complexity of the NPS registration and investment process, which further deters potential contributors, especially those who are less financially literate.

Recent technological advancements have also significantly influenced NPS operations. Chaudhry et al. (2021) explore how fintech innovations are reshaping investment choices and improving user experiences within the NPS. The introduction of mobile applications and online platforms has facilitated the tracking of investments and simplified contributions. Their findings suggest that increased technology adoption within the NPS could further enhance participation and improve fund performance by providing real-time insights.

Looking ahead, the potential for NPS expansion is immense. The Government of India has begun initiatives to further democratise pension access, including measures to extend NPS to the unorganised sector. Sharma (2022) projects that with consistent policy support and financial literacy campaigns, the NPS could potentially cover nearly 300 million additional individuals within the upcoming decade.

Introduced as a contributory retirement savings plan, NPS aims to address inadequacies in existing pension systems. It has expanded inclusivity but struggles with limited adoption in the informal sector. The scheme's flexibility in investment choices and portability is praised. However, challenges include low financial literacy among subscribers and insufficient regulatory oversight. Recommendations include enhancing outreach efforts and integrating long-term care insurance (Manda V. K. et al., 2021).

Comparing post-retirement schemes in India, the UK, and Japan, India's system lags due to limited coverage and benefit adequacy, especially for informal sector workers. In contrast, the UK and Japan offer comprehensive frameworks ensuring near-universal coverage and robust healthcare support. The study advocates for integrating

best practices from these countries, such as improving governance structures and expanding coverage to informal workers (Rajput A., 2024).

Critically evaluating the current state of the Indian pension system, Maheshwari and Bhutada (2019) highlight its fragmented and inequitable structure. While public sector employees receive significant benefits, private sector workers face dissatisfaction due to low returns and limited access. The analysis underscores the urgency of extending pension coverage to the informal sector and reforming existing schemes. Proposals include regulatory adjustments, the development of a private annuity market, and improved financial literacy to boost participation in voluntary pension plans.

Several studies have assessed the performance of NPS in terms of returns and fund management. An analysis by Sane and Price (2018) utilised the penCalc tool to simulate pension income scenarios, providing insights into potential retirement benefits under various economic conditions. Their findings suggest that while NPS offers a structured approach to retirement planning, the actual benefits are highly sensitive to market performance and the choice of investment strategies.

The implementation of NPS in various sectors has encountered both successes and obstacles. A case study focusing on an automobile manufacturing company in India examined the adoption of the Corporate National Pension Scheme. The study revealed that while the scheme was beneficial in promoting retirement savings among employees, challenges such as administrative complexities and initial resistance to change were significant hurdles (Mohapatra, Mamta, 2019).

Another challenge: In response to ongoing debates about pension adequacy, the Indian government approved a new unified pension scheme in August 2024, guaranteeing federal government employees 50% of their base salary as pension. This move signifies a shift from the market-linked payouts of NPS to a more assured benefit model, addressing concerns about income security in retirement (Reuters, 2024). R. Kumari and P. Kumar (2023) examine the NPS as a prag-

matic approach to sustainable investment systems, emphasising its adaptability to changing economic conditions. They advocate for integrating advanced financial instruments to enhance its resilience and appeal to diverse demographics. A. Rajput (2024) compares India's pension frameworks with international systems, highlighting significant gaps in coverage and adequacy. The study suggests adopting features from the UK and Japan, such as universal enrolment and robust healthcare integration, to improve the NPS. D. Panigrahi (2024) evaluates satisfaction levels within the NPS through exploratory factor analysis, finding that customisation and technological advancements can significantly enhance subscriber experiences. B. Kapasi and S. Mahato (2024) analyse the performance of Scheme E (Equity) under the NPS, finding that fintech solutions have improved investment tracking and user engagement. The authors recommend further integration of AI and IoT for personalised pension planning.

Sane and Price (2018) utilised penCalc to analyse the retirement benefits under the NPS, demonstrating how the final retirement income is influenced by:

- The choice of asset allocation (e.g., equity, government securities)
- Contribution periods and amounts
- Market performance of selected funds

penCalc is a simulation tool designed to estimate pension income scenarios for individuals participating in schemes like the NPS in India. The study finds that subscribers who actively manage their portfolio choices tend to achieve better retirement incomes. However, the challenge is related to inadequate financial literacy leading to suboptimal investment decisions.

Research Design, Data Analysis and Results

This study focuses on analysing the subscriber dataset in terms of the Number of Subscribers (according to gender and age) and Assets Under Management (AUM) from 2010 to 2024, providing a quantitative framework for evaluating the NPS. Through rigorous statistical

methods, this research seeks to validate the findings, derive meaningful insights, and showcase the value of C-NPS in India's pension landscape.

When analysing the subscriber data, it is crucial to categorise contributors into distinct groups: Central Government (CG) employees, State Government (SG) employees, corporate entities, all citizens, NPS Lite subscribers, and beneficiaries of the Atal Pension Yojana (APY).

Limitations of the Paper

- Limited Qualitative Analysis: While the content mentions a mixed method of quantitative and qualitative research methodology, the focus is primarily on quantitative analysis. Including more qualitative insights could provide a more holistic understanding of the NPS.
- Limited Discussion on Policy Implications: While the content touches on policy recommendations, a more in-depth discussion of the potential policy implications of the findings could enhance the practical relevance of the analysis.
- Data Source and Time Limitations.

Data Source

Data provided by the Pension Fund Regulatory and Development Authority (PFRDA).

Key Metrics

- Number of Subscribers: Evaluated growth across categories.
- Assets Under Management (AUM): Assessed financial growth and sustainability.
- Annual Growth Rates: Calculated percentage increases in subscribers and AUM.

Analysis Techniques

- Software: SPSS Statistics 30.0

- Time-Series Analysis: Visualised trends with plots and trendlines.
- Statistical Testing: One-way ANOVA and Kruskal–Wallis tests were used to assess sectoral differences.
- Correlation and Regression Analyses: Identified relationships between variables.
- Forecasting Models: Used historical data to predict future subscriber and AUM trends.

Overview of the Datasets

Including Gender Statistics (Table 7.1)

Corporate subscribers surged from just 1 in 2010 to over 1.9 million in 2024, reflecting strong corporate adoption. APY saw exponential growth, reaching 55.5 million subscribers in 2024, highlighting its wide appeal. In contrast, NPS Lite fluctuated, peaking at 4.48 million in 2016 before declining.

Table 7.1

Subscriber Gender Statistics (2015–2024)

Summary of Male vs. Female Participation (2015-2024)					
Year	*Male*	*Female*	*Total*	*Male Percentage*	*Female Percentage*
2015-16	76,966	24,590	101,556	75.8%	24.2%
2016-17	80,744	27,938	108,682	74.3%	25.7%
2017-18	73,937	20,985	94,922	77.9%	22.1%
2018-19	69,946	17,327	87,273	80.2%	19.8%
2019-20	108,573	30,080	138,653	78.2%	21.8%
2020-21	81005	21,220	102,225	79.4%	20.6%
2021-22	96,967	28,054	125,021	77.5%	22.5%
2022-23	119,362	35,852	155,214	76.8%	23.2%
2023-24	106,370	34,239	140,609	75.7%	24.3%
Grand Total	1,022,074	310,576	1,332,650	76.7%	23.3%

AUM Growth

The total AUM rose sharply from ₹4,679.2 crores in 2010 to ₹1,167,220.52 crores in 2024, with the corporate sector experiencing a steep increase.

Percentage Changes

The corporate sector's growth showed notable peaks, including a 770.69% surge, underlining its dynamic contributions.

The data indicates a significant gender disparity in participation. The proportion of male participants increased by 1%, while female participation remained nearly the same—around 24.2% in 2015–16 and 24.3% in 2023–24. However, there has been a remarkable 40.5% increase in overall participation.

The persistent disparity highlights a potential area for targeted outreach and engagement strategies to encourage higher female participation. Initiatives such as mentorship programmes or marketing campaigns—including surveys or focus groups—could help identify barriers and improve inclusion.

Overview of Age Distribution by Gender

The 20–25 age group exhibits the highest participation, with males (82,569) and females (41,857), making it the most engaged demographic, followed closely by the 26–30 age group. Across all age brackets, males consistently outnumber females. The 20–25 segment shows 66.4% male dominance compared to 33.6% female participation. This gender gap is even more pronounced in the 18–20 group, where males account for 74.6%.

Participation declines significantly beyond the 36–40 age group, reinforcing the trend that younger demographics are more active. To sustain engagement, targeted campaigns should focus on the 20–25 and 26–30 age groups while working to boost female participation. Additionally, strategies to appeal to individuals aged 41 and above could help overcome participation barriers and enhance inclusivity.

Table 7.2

Age Distribution by Gender (2015–2020)

Age -wise and Gender-wise Subscribers of NPS Corporate Sector

Age	*2015-16*			*2016-17*			*2017-18*			*2018-19*			*2019-20*		
	Male	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*
18-20	102	15	0	134	55	0	99	34	0	28	10	0	33	9	0
20-25	12859	7238	0	11905	6899	0	8687	4680	0	7380	3930	0	7379	4600	0
26-30	28576	11564	0	30318	13051	1	23380	8914	1	18575	7074	0	28276	11690	0
31-35	12441	3106	0	12447	3555	0	12610	3070	0	13287	2552	0	26438	7171	19
36-40	9643	1206	0	9735	1454	0	11502	1831	0	11358	1614	0	17815	3335	6
41-45	7366	759	1	7866	1078	0	8738	1124	1	8037	967	0	11129	1352	3
46-50	3642	398	0	4526	913	0	4803	758	0	4918	631	0	7499	852	1
51-55	1664	208	0	2573	616	0	2769	400	1	3439	381	0	5323	582	0
56-60	656	90	0	1224	513	0	1210	162	0	2596	160	2	3973	434	1
61-65	17	6	0	16	4	0	135	12	0	320	7	0	696	54	0
66-70	0	0	0	0	0	0	4	0	0	7	1	0	12	1	0
70-75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
more than 75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7.3

Age Distribution by Gender (2021 -2024)

Age-wise and Gender-wise Subscribers of NPS Corporate Sector												
Age	*2020-21*	*2020-21*	*2020-21*	*2021-22*	*2021-22*	*2021-22*	*2022-23*	*2022-23*	*2022-23*	*2023-24*	*2023-24*	*2023-24*
	Male	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*	*Male*	*Female*	*Trans-gender*
18–20	20	11	0	136	115	0	216	194	0	237	97	0
20–25	5249	3213	1	7977	5400	1	11348	6112	1	15080	9272	1
26–30	21701	9314	5	24771	11234	3	28592	12417	1	25287	10636	0
31–35	18136	4289	8	18578	4867	0	25837	7660	1	21769	6178	0
36–40	13188	2071	3	16432	2916	6	22382	4724	0	18189	3916	0
41–45	8561	955	2	11824	1688	0	14696	2370	0	12172	2304	2
46–50	5133	508	2	6477	899	0	8078	1229	0	6837	1092	0
51–55	3978	434	0	5004	502	1	5076	711	0	4388	537	0
56–60	4052	338	0	4949	378	0	2720	388	0	2288	187	0
61–65	977	85	0	795	51	0	398	45	0	62	7	0
66–70	10	2	0	24	4	0	18	2	0	13	4	0
70–75	0	0	0	0	0	0	1	0	0	0	0	0
More than 75	0	0	0	0	0	0	0	0	0	0	0	0

Overview of Partial Withdrawal Cases

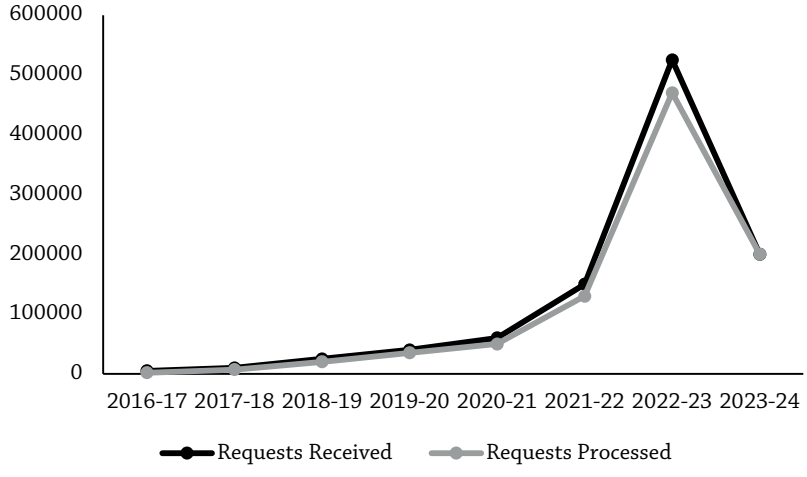
Table 7.4

Partial Withdrawal Cases Reported and Settled

Year	*No of partial withdrawal requests received*	*No of partial withdrawal requests processed*
2016-17	1,213	640
2017-18	6,421	3,537
2018-19	22,313	15,573
2019-20	35,500	28,106
2020-21	62,497	45,990
2021-22	1,46,292	1,31,556
2022-23	5,32,234	4,86,555
2023-24	2,06,643	1,99,630

Figure 7.1

Partial Withdrawal Cases



The number of requests received surged significantly over the years, with a sharp rise from 2018–19 onwards and an exceptional

spike in 2022–23. The year-to-year growth is remarkable, particularly the jump from 1,46,292 in 2021–22 to 5,32,234 in 2022–23, marking a more than threefold increase.

Statistical Analysis

Compound Annual Growth Rate (CAGR) for the number of partial withdrawal requests received was calculated using the formula:

Where:

– Beginning Value (2016–17): 1,213 requests

– Ending Value (2023–24): 2,06,643 requests

– n = 7 years

$$CAGR = \left(\frac{206{,}643}{1{,}213}\right)^{\frac{1}{7}} - 1$$

Calculating the quotient

$$\frac{206{,}643}{1{,}213} \approx 170.70$$

Now, we take the 7th root:

$$CAGR = (170.70)^{\frac{1}{7}} - 1 \approx 3.1018 - 1 \approx 2.1018 \text{ or } 210.18\%$$

This CAGR represents an average annual growth rate of approximately 210.18% over the 7 years from 2016–17 to 2023–24.

Forecasting Requests for the Next 3 Years

Using this CAGR, we can forecast the number of partial withdrawal requests for the next 3 years (2024–25, 2025–26, and 2026–27) with the formula:

Future Value = Current Value × $(1 + CAGR)^n$

Where:

- Current Value = 206,643 (for 2023–24)
- n = 1 for the first forecast year, 2 for the second, and 3 for the third.

Year 1: 2024–25

Future Value = 206,643 × (1 + 2.1018)1

Future Value ≈ 206,643 × 3.1018 ≈ 641,438

Year 2: 2025–26

Future Value = 206,643 × $(1 + 2.1018)^2$

Future Value ≈ 206,643 × $(3.1018)^2$ ≈ 206,643 × 9.6219 ≈ 1,989,736

Year 3: 2026–27

Future Value = 206,643 × $(1 + 2.1018)^3$

Future Value ≈ 206,643 × $(3.1018)^3$ ≈ 206,643 × 29.098 ≈ 6,006,839

Forecasted Requests for the Next 3 Years

Table 7.5

Forecasted Requests

Year	*Forecasted Requests*
2024–25	641,438
2025–26	1,989,736
2026–27	6,006,839

The forecast, based on a historical CAGR of 210.18%, predicts a sharp rise in partial withdrawal requests, continuing the strong upward trend of recent years. However, this projection assumes uninterrupted growth, without accounting for market shifts, demand saturation, or economic fluctuations that may influence future withdrawals.

The surge in partial withdrawal requests, especially the spike from 2021–22 to 2022–23, may be attributed to multiple factors. Economic pressures such as inflation, rising living costs, and financial instability likely prompted individuals to access savings. Post-COVID-19 financial adjustments and uncertain job markets also played a pivotal role. Market volatility further influenced withdrawal behaviour, encouraging liquidity management and portfolio rebal-

ancing. These factors underline the importance of strategic financial planning and policy innovation.

Overview of Normal Exit Data, Partial Withdrawal and Grievance Cases

The table presents projections for various categories of subscribers under the National Pension System (NPS) and Atal Pension Yojana (APY) from FY 2023–24 to FY 2027–28.

Table 7.6

Normal Exit in the Next Five Years

Sr. No	*FY*	*CG*	*SG*	*Corporate*	*All Citizen*	*NPS Lite*	*APY*
1	2023–2024	754	4,279	2,698	7,835	3,742	-
2	2024–2025	9,119	35,134	15,303	46,234	98,126	-
3	2025–2026	10,126	40,750	16,034	49,857	91,560	-
4	2026–2027	10,224	48,153	16,889	51,018	109,935	-
5	2027–2028	10,690	56,177	18,837	52,529	101,956	-

Note: a) Government Sector: on the basis of "Date of Retirement of Subscriber" in CRA System.

b) All Citizen - On the basis of Date of Birth + 60 yrs.

c) For Corporate - On the basis of "Date of retirement" and where Date of Retirement is not available DOB + 60 years.

d) NPS Lite - GDS Subscribers - DOB + 65 yrs and for NON-GDS - DOB + 60 yrs.

e) The data corresponding to 2023-24 is the number of subscribers who have already attained age 60.

The total exits for All Citizens rise from 7,835 in 2023–24 to 52,529 in 2027–28, indicating a substantial increase in mature subscribers reaching retirement age.

- For *CG (Central Government)*: Minor growth is observed—from 754 in 2023–24 to 10,690 in 2027–28.
- For *SG (State Government)*: A significant increase is seen—from 4,279 to 56,177, highlighting a growing wave of retirements within state government services.
- For *Corporate*: Numbers increase from 2,698 to 18,837, reflecting a steady retirement trend.
- Under *NPS Lite*: Exits grow from 3,742 to 1,01,956, showing significant variability.

This rising number of exits underscores the growing need for effective pension planning and management. As more individuals rely on NPS and APY systems for post-retirement income, policymakers must adapt frameworks to ensure sustainability and adequacy of benefits. Monitoring demographic trends will be critical to tailoring these programmes to the evolving needs of India's retirees.

Statistical Testing

The ANOVA test was conducted on the AUM dataset across different sectors. The results are summarised below, including a graphical representation.

Sectoral Differences

The ANOVA and Kruskal–Wallis tests both indicated statistically significant differences in AUM growth across sectors ($p < 0.05$). Further, an effect size analysis revealed that approximately 10.4% of the variance in AUM could be attributed to sectoral differences.

Correlation and Regression

A very strong positive correlation ($r \approx 0.994$) was observed between corporate subscribers and AUM, suggesting that growth in subscriber numbers significantly influences financial outcomes. Regression analysis further highlighted that corporate contributions were a key driver of the "Total without SG/CG" values ($p = 0.018$), underlining the impact of the corporate segment on AUM performance.

The distribution of AUM across sectors is illustrated using a box plot (Figure 7.2), providing a visual overview of how assets are spread among different contributors.

ANOVA Test Results yielded an F-statistic of 5.97 and a p-value of 3.043. Since the p-value is well below the 0.05 threshold, the test confirms that the differences in AUM between sectors are statistically significant and unlikely to be due to random variation.

Kruskal–Wallis H-Test Results returned an H-statistic of 16.75 and a p-value of 0.0049. As a non-parametric test, the Kruskal–Wal-

lis test is especially useful when the assumptions of ANOVA may not hold. It, too, confirmed the presence of significant inter-sector differences in AUM.

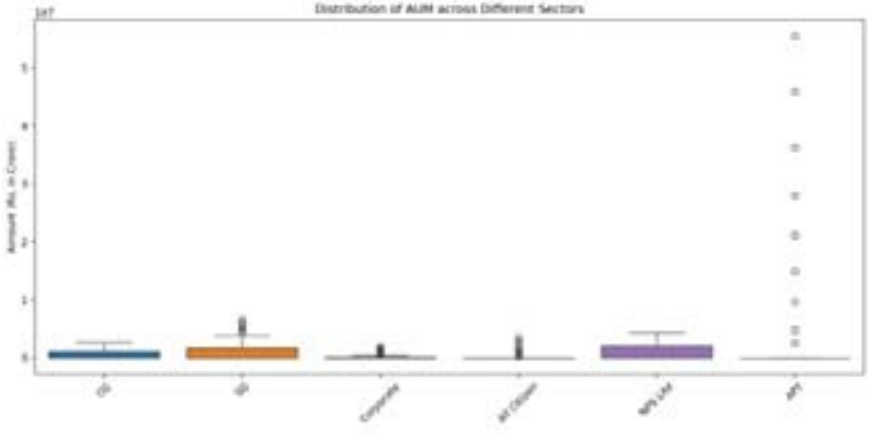
The effect size, measured using eta-squared (η^2), was 0.104. This indicates that 10.4% of the variability in AUM is explained by sectoral categorisation. While not a large effect, it represents a moderate impact—implying that the sector to which a subscriber belongs meaningfully influences their contribution to the overall asset pool.

Interpretation and Implications:

These statistical findings reinforce that the differences observed across sectors are not only statistically significant but also practically meaningful. Since each sector behaves differently in terms of AUM trends, forecasting models and predictive strategies must be tailored accordingly. The moderate effect size suggests that policy emphasis on sectors with higher stability or growth potential could yield better outcomes. This interpretation retains every analytical detail while presenting the insights in a more accessible and cohesive manner.

Figure 7.2

Distribution of AUM across Different Sectors



Forecasting Analysis

Another methodology adopted in this paper is forecasting AUM under three distinct tax-related scenarios:

1. The current tax rebate remains unchanged
2. The tax rebate is withdrawn
3. Tax reforms are introduced, increasing the rebate

The scenario analysis reveals that the corporate sector continues to exhibit robust growth potential, with forecasted AUM increasing significantly under optimistic assumptions—reaching as high as ₹79.16 crore by 2029. By contrast, the Central Government (CG) and State Government (SG) sectors display declining trends under most projections, signalling potential structural issues that may warrant policy intervention.

The scenario models, based on historical Compound Annual Growth Rate (CAGR), present a wide spectrum of outcomes. In the SG sector, for instance, pessimistic scenarios show aggressive declines in AUM, while the corporate sector continues to expand steadily across most scenarios.

In the CG segment, the base scenario—where tax incentives remain unchanged—shows a downward trend in AUM, falling to ₹1.51 crore by 2029. Under the decreased rebate rate scenario, the figures show a modest improvement, reaching ₹2.48 crore by the same year.

Figure 7.3

Forecasting under Three Tax Rebate Scenarios

Forecasted AUM for CG, SG and Corporate Sectors (2025-2029)

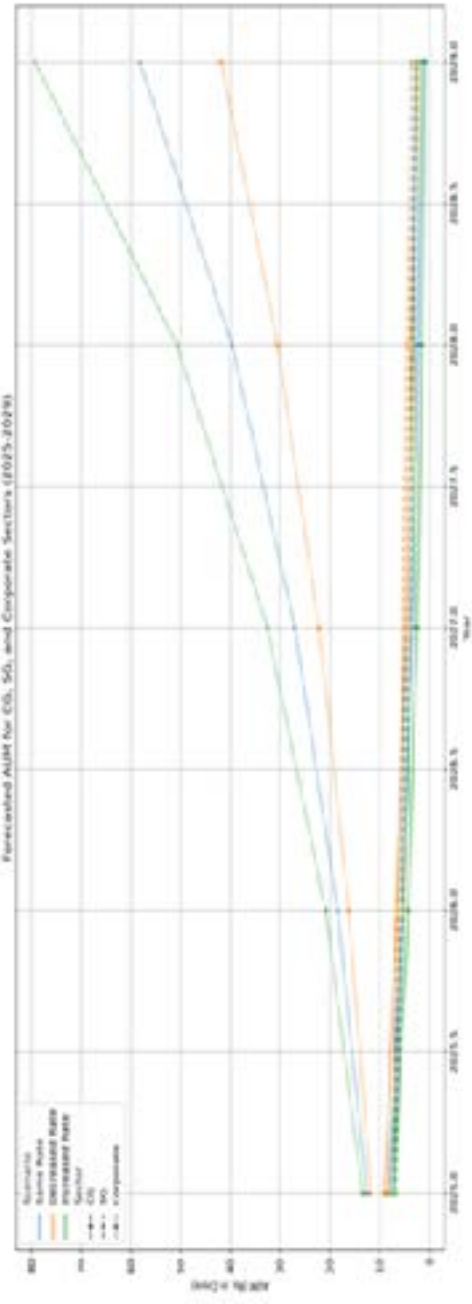


Table 7.7

Forecasted Data for All Three Sectors Scenarios. (In Rs. Lakh Crore)

Sector	*Scenario*	*Year*	*Forecasted AUM*
CG	Same Rate	2025	8.11
CG	Same Rate	2026	5.32
CG	Same Rate	2027	3.49
CG	Same Rate	2028	2.29
CG	Same Rate	2029	1.50
CG	Decreased Rate	2025	8.96
CG	Decreased Rate	2026	6.49
CG	Decreased Rate	2027	4.71
CG	Decreased Rate	2028	3.41
CG	Decreased Rate	2029	2.47
CG	Increased Rate	2025	7.26
CG	Increased Rate	2026	4.26
CG	Increased Rate	2027	2.50
CG	Increased Rate	2028	1.47
CG	Increased Rate	2029	0.86
SG	Same Rate	2025	7.10
SG	Same Rate	2026	5.71
SG	Same Rate	2027	4.59
SG	Same Rate	2028	3.70
SG	Same Rate	2029	2.97
SG	Decreased Rate	2025	7.45
SG	Decreased Rate	2026	6.28
SG	Decreased Rate	2027	5.30
SG	Decreased Rate	2028	4.47
SG	Decreased Rate	2029	3.77
SG	Increased Rate	2025	6.76
SG	Increased Rate	2026	5.17
SG	Increased Rate	2027	3.96

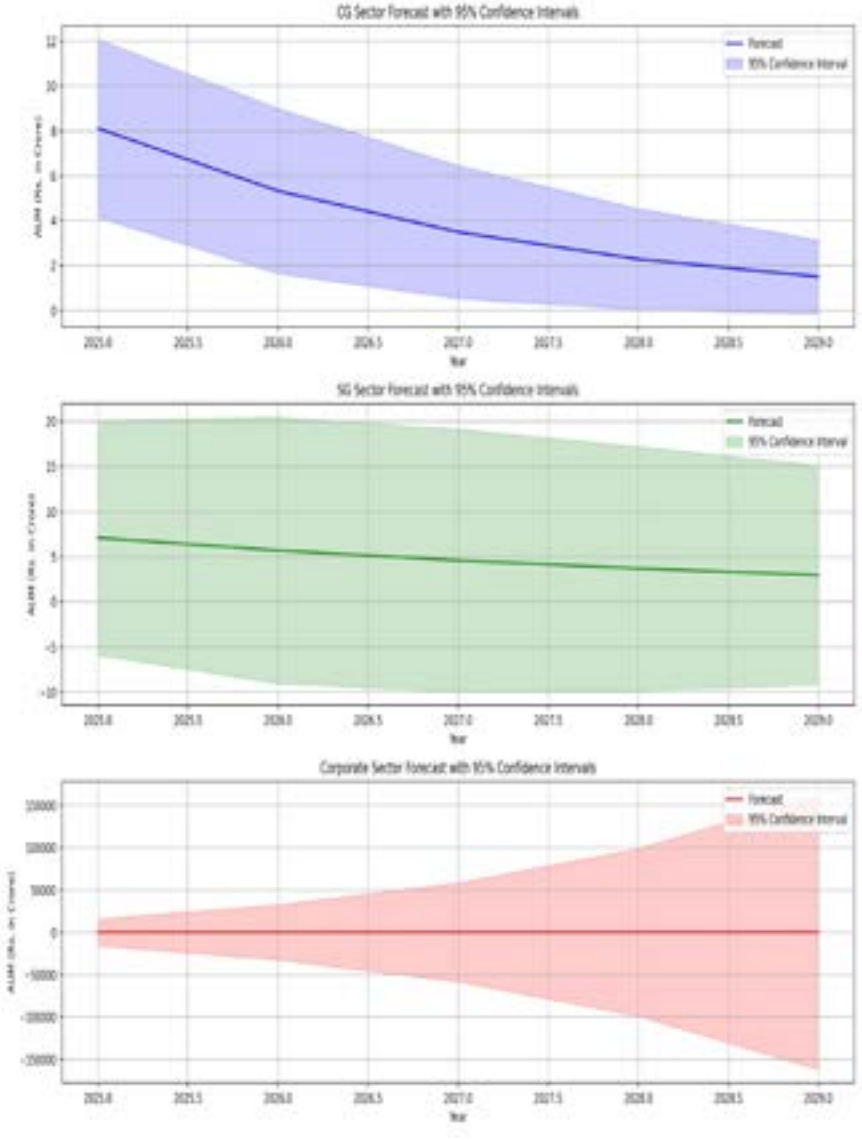
SG	Increased Rate	2028	3.03
SG	Increased Rate	2029	2.32
Corporate	Same Rate	2025	12.55
Corporate	Same Rate	2026	18.41
Corporate	Same Rate	2027	27.01
Corporate	Same Rate	2028	39.63
Corporate	Same Rate	2029	58.14
Corporate	Decreased Rate	2025	11.75
Corporate	Decreased Rate	2026	16.14
Corporate	Decreased Rate	2027	22.17
Corporate	Decreased Rate	2028	30.46
Corporate	Decreased Rate	2029	41.84
Corporate	Increased Rate	2025	13.35
Corporate	Increased Rate	2026	20.83
Corporate	Increased Rate	2027	32.51
Corporate	Increased Rate	2028	50.73
Corporate	Increased Rate	2029	79.16

Key Implications: These forecasts carry several implications. First, all three scenarios point to continued difficulties in the CG and SG sectors. The improved performance in the "Decreased Rate" scenario hints that current assumptions may be overly pessimistic and deserve recalibration. Second, the results underscore the urgent need for structural reforms to prevent further erosion of AUM in government-affiliated sectors.

To reinforce the reliability of these projections, the analysis incorporates 95% confidence intervals for CG, SG, and Corporate sectors. Forecasting was performed using a model that accounts for key influencing factors—including the increase in subscribers, exits from the system (due to retirement or premature withdrawal), and policy shifts represented in each scenario. The outputs, along with their confidence intervals, are depicted in the visual forecasts.

Figure 7.4

Confidence Level Mapping

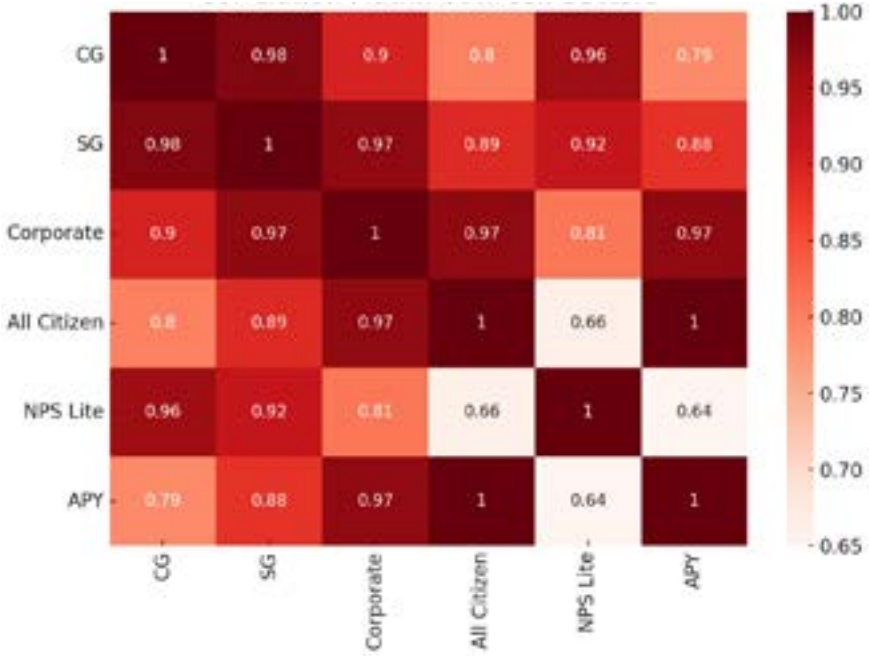


The confidence intervals highlight the uncertainty in the forecasts, especially for the Corporate sector, which shows extreme volatility. This image shows three distinct plots for forecasts in the CG, SG, and Corporate sectors, each accompanied by 95% confidence intervals.

Another method used in this paper is the Correlation Matrix. The heatmap (Figure 7.5) created in this research paper depicts the correlation matrix for different subscriber sectors under the National Pension System (NPS), including Central Government (CG), State Government (SG), Corporate, All Citizens, NPS Lite, and Atal Pension Yojana (APY). Correlation coefficients range from –1 to 1, where 1 indicates a perfect positive correlation, 0 represents no correlation, and –1 indicates a perfect negative correlation.

Figure 7.5

Correlation Matrix between Sectors (Heat Map)



Observations

Strong Positive Correlations across Sectors: Most sectors exhibit high correlation values (greater than 0.8), suggesting that subscriber growth in one sector is strongly associated with growth in others. The strongest correlations are observed between CG and SG (0.98), and between Corporate and All Citizens (0.97), reflecting similar growth trends likely influenced by common macroeconomic or policy factors.

Corporate Sector's Diverse Correlations

An important result is the strong correlation of the Corporate sector with both All Citizens (0.97) and SG (0.97), indicating that corporate growth is aligned with general subscriber trends and State Government performance.

Moderate Correlations for NPS Lite and APY

While NPS Lite shows high correlations with CG (0.96) and SG (0.92), its correlation with All Citizens (0.66) and APY (0.64) is relatively moderate. This divergence could suggest that NPS Lite caters to a distinct subscriber demographic, potentially in rural or low-income areas. APY exhibits strong correlations with Corporate (0.97) and SG (0.88), reflecting its expanding reach and potential ties to policy-driven adoption among organised sectors.

The correlation matrix visual also depicts sectoral interdependencies within the National Pension System (NPS). The heatmap uses a colour gradient, where darker shades represent stronger correlations and lighter shades indicate weaker relationships. This visually highlights how the growth trends of different NPS subscriber categories are interlinked.

For instance

Strong Dependencies: Dark red cells between CG and SG (0.98), and Corporate and All Citizens (0.97), visually stand out, showing their tight-knit growth relationships. This signifies that policies targeting these sectors have spillover effects on others. The Corporate sector's connection with All Citizens and APY, indicated by high cor-

relation coefficients (0.97 and 1.00, respectively), reflects the pivotal role of private-sector engagement in driving overall growth.

Moderate Dependencies: The lighter hues for NPS Lite and APY correlations with other sectors (e.g., 0.64 between NPS Lite and APY) represent weaker relationships. These observations highlight a divergence in growth patterns, likely due to demographic, regional, or operational differences.

Unique Outliers: NPS Lite shows lower correlations with All Citizens (0.66) and APY (0.64), indicating that this sector operates independently to some extent, catering to specific population segments such as low-income or rural workers.

These observations emphasise the complexity of inter-sector dynamics within the NPS, guiding both immediate policy adjustments and future research opportunities. The correlation matrix reveals crucial insights into sectoral interactions within NPS. Strong positive correlations indicate significant interdependence, while weaker correlations suggest areas for independent optimisation. These patterns can guide policy design, resource allocation, and subscriber engagement strategies to enhance NPS performance across all sectors.

Analysis of average contribution per subscriber was also attempted in this study:

Table 7.8

Average Contribution

Month End	*Avg Contribution in CG per subscriber*	*Avg Contribution in SG per subscriber*	*Avg Contribution in Corp per subscriber*	*Avg Contribution in All Citizen per subscriber*	*Avg Contribution in NPS Lite per subscriber*	*Avg Contribution in APY per subscriber*	*Avg Contribution in Total per subscriber*
Mar 10	0.75	0.10	4.00	0.23	-	-	0.60
Mar 11	0.97	0.21	1.34	0.16	0.00	-	0.46
Mar 12	1.2	0.30	0.75	0.19	0.01	-	0.48
Mar 13	1.54	0.66	0.78	0.27	0.02	-	0.63
Mar 14	1.80	1.00	1.00	0.37	0.03	-	0.74
Mar 15	2.43	1.38	1.52	0.55	0.04	-	0.92
Mar 16	2.90	1.97	1.96	0.51	0.05	0.02	0.97
Mar 17	3.75	2.55	2.55	0.63	0.06	0.04	1.13
Mar 18	4.42	2.99	3.07	0.76	0.07	0.04	1.11
Mar 19	5.49	3.67	3.84	0.94	0.08	0.05	1.16
Mar 20	6.57	4.44	4.24	0.95	0.09	0.05	1.21
Mar 21	8.35	5.67	5.56	1.22	0.10	0.06	1.36
Mar 22	9.57	6.62	6.45	1.27	0.11	0.06	1.41
Mar 23	10.75	7.37	6.97	1.32	0.12	0.06	1.41
Mar 24	12.36	8.83	8.56	1.53	0.17	0.06	1.59

Figure 7.6

Trend of Avg Contribution in Total per subscriber Over Time

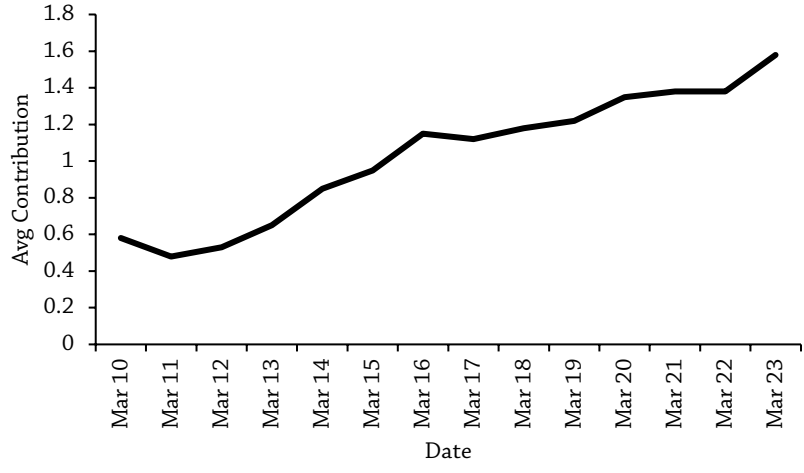


Figure 7.7

Trend of Avg Contribution in Corp per subscriber Over Time

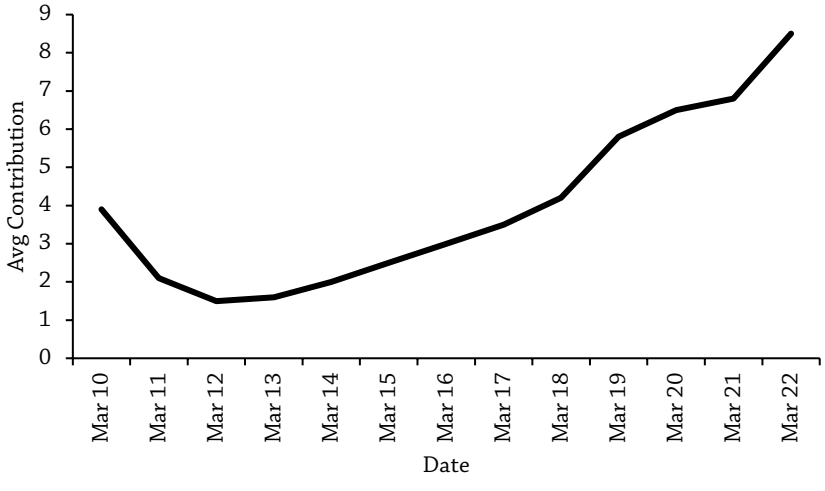


Figure 7.8

Trend of Avg Contribution in CG per subscriber Over Time

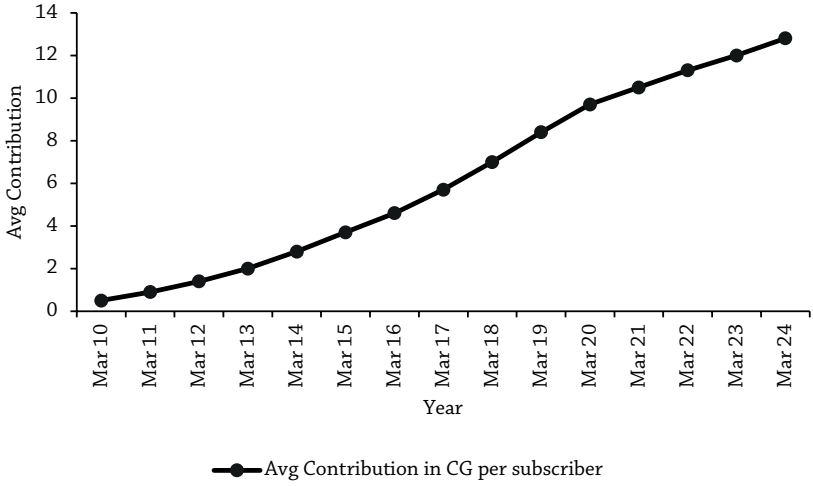


Figure 7.9

Trend of Avg Contribution in SG per subscriber Over Time

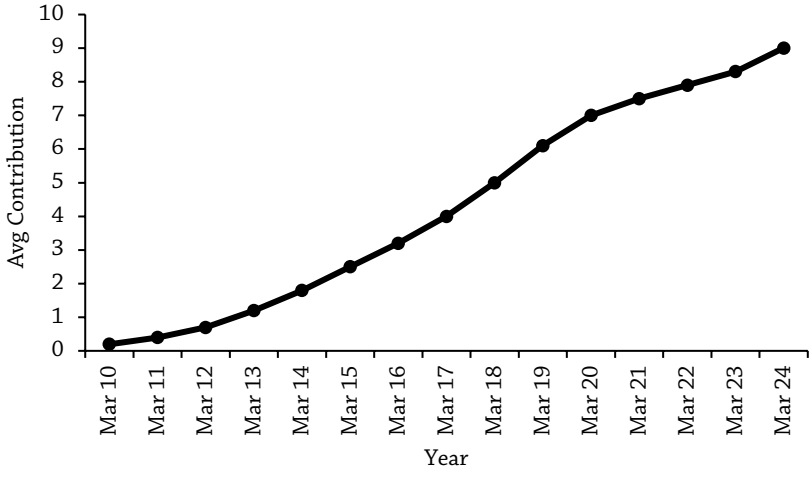


Figure 7.10

Trend of Avg Contribution in APY per subscriber Over Time

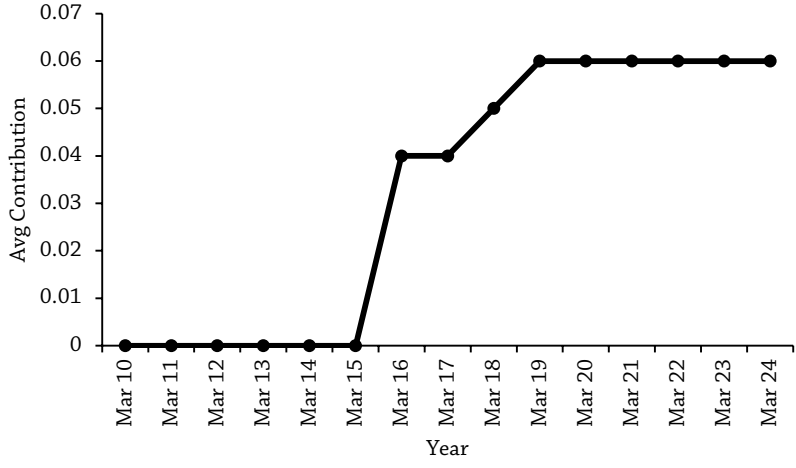


Figure 7.11

Trend of Avg Contribution in All Citizen per Subscriber Over Time

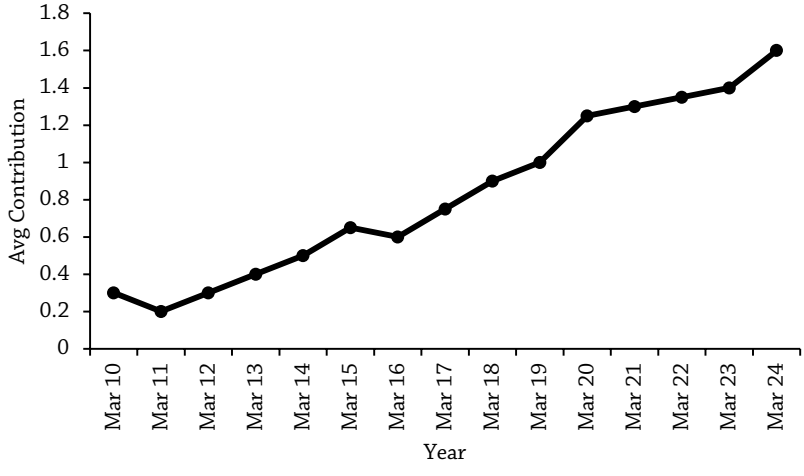
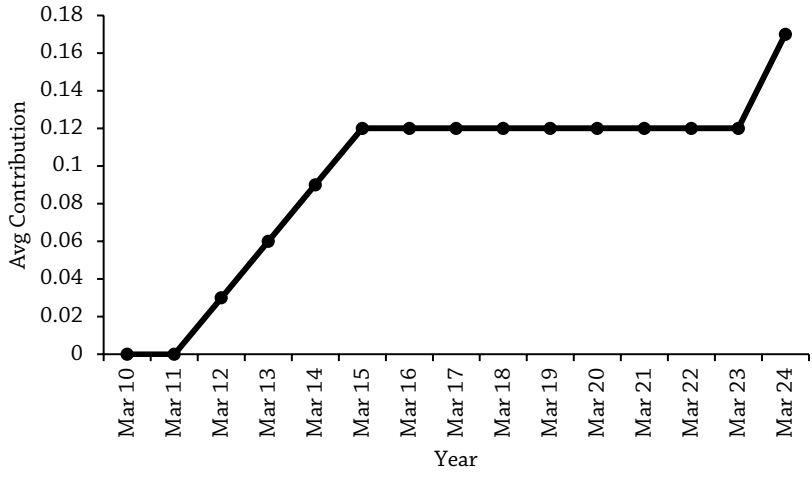


Figure 7.12

Trend of Avg Contribution in NPS Lite per Subscriber Over Time



Overall Trend in Average Contribution

The average contribution per subscriber increased from ₹0.60 lakh in March 2010 to ₹1.59 lakh in March 2024—almost tripling over this period, which signals strong growth in subscriber investments. There has been a notable annual increase. For example, from March 2023 to March 2024, the average contribution rose from ₹1.41 lakh to ₹1.59 lakh—a 12.20% increase. This jump is significantly higher than the more modest annual increases of 3–6% seen in earlier years (such as 2022–2023).

Sector-Specific Performance

There was a steep decline of –66.50% in March 2011.

Recovery and Growth

From March 2014 onwards, contributions steadily increased from ₹1.00 lakh to ₹8.56 lakh by March 2024.

Recent Growth

The latest figures show a 22.71% increase, indicating growing corporate engagement.

NPS Lite and APY Contributions

Both started with very low contributions, but over the years, they have grown steadily. Notably, NPS Lite reached ₹0.17 lakh in March 2024, reflecting rising interest in these pension schemes.

Growth Rate Analysis

The corporate sector saw a significant drop in its early years, but it began to gain momentum after 2014. The highest growth rate was observed between March 2015 and March 2016, with a 51.78% increase in corporate contributions. Overall, the total contributions have been consistently positive since March 2013.

Comparative Analysis

Corporate contributions consistently remain higher than those from other sectors, indicating that corporate subscribers heavily influence the overall averages. Meanwhile, the growing contributions in the All Citizen scheme and NPS Lite suggest increased inclusivity and a broadening of subscriber engagement in retirement savings. The average contributions in the All Citizen category were relatively stagnant in the early years and did not grow as much as the corporate contributions. This may indicate a need for targeted strategies to boost growth in this segment.

External Influences:

The fluctuations in percentage change during the early years (such as in March 2011) hint at external economic impacts or shifts in investment trends affecting subscriber behaviour.

Overall Implication:

The data show a strong upward trend in average contributions among subscribers, especially within corporate-oriented schemes.

This trend may reflect broader market dynamics, effective outreach strategies, and improved financial literacy. Monitoring these trends is essential for strategic planning in future investments and enhancing subscriber engagement.

Conclusion, Recommendation, Research Gap, and Future Implications

In many countries, tax incentives can effectively attract new investments and drive economic growth. However, for developing economies, it is crucial to carefully evaluate and scrutinise such proposals (Sebele, Favourate et al., 2022). Focused communication strategies should be developed to convey the benefits of the increased tax rebate. Campaigns should target informal workers using straightforward language and relatable scenarios.

- *Incentive-Based Workshops:* Offer small incentives (e.g., free health check-ups or gift vouchers) for attending NPS information sessions. Real-life examples and testimonials from individuals who benefited from NPS can effectively personalise the narrative.
- Establish peer learning groups where potential NPS participants can share experiences and insights. These groups can enhance understanding and motivation to participate by fostering community discussions.
- Implement surveys to assess the barriers faced by informal workers regarding NPS enrolment. This approach could help identify the specific areas that need addressing, such as concerns over fund management or fears of complex procedures.
- Organise events where informal sector workers can enrol in NPS, interact with financial advisers, and win prizes.

C-NPS must be seen as a Growth Catalyst

C-NPS provides a structured and regulated retirement savings option for India's extensive private sector workforce. It facilitates long-term financial security and alleviates future fiscal pressure on the government.

Opportunities in Product Diversity

Introduce tiered, risk-based plans like ultra-conservative, balanced, and high-growth (equity-heavy) options. Design sector-specific products (e.g., for IT, manufacturing, and the gig economy). Add flexible contribution options to attract start-ups and SMEs.

Boosting C-NPS via Aggressive Marketing Campaigns

Digital-First Campaigns: Leverage LinkedIn, YouTube, and Instagram to reach and engage younger professionals (especially the 20–30 age group). Use influencers and finance educators to demystify NPS, exhibit success stories, and explain the importance of social-security planning.

Employer-Driven Awareness: Partner with HR departments for C-NPS onboarding sessions during employee induction. Introduce incentive-based enrolments (gift cards, paid sessions, tax planning consults).

Trust-Building Through Success Stories: Share real-life case studies of C-NPS beneficiaries from the corporate sector. Highlight the return performance of C-NPS funds versus traditional savings.

Gamified Engagement: Create mobile app features with retirement goal tracking, badges for milestones, and peer comparison.

Regional and Gender-Sensitive Campaigns: Focus on female participation and inclusion through women-centric messaging. Deploy multilingual campaigns across Tier 2 and Tier 3 cities.

Recommendations for Policy and Innovation

Provide corporate tax incentives for mass enrolment, especially to new start-ups, to boost early adoption of C-NPS. Encourage integration with payroll systems for automated contributions.

C-NPS is not merely a subset of the National Pension System—it is its growth engine. By channelling efforts into enhancing awareness, refining product designs, and aligning fiscal policies, India can harness the full potential of C-NPS to construct a pension architecture that is inclusive, adaptive, and future-ready.

Future research and policy formulation must now focus on sustaining this momentum by embedding behavioural insights, expanding product innovation, and deepening corporate collaboration in the national retirement planning landscape.

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8

The Great Indian Pension Debate

Shweta Kalla Baxi | Sarthak Gaurav | Usha Ananthakumar

Abstract

The current study examines the three pension schemes for central government employees in India – the Old Pension Scheme (OPS), the National Pension System (NPS), and the Unified Pension Scheme (UPS). We conduct a comparative analysis of these schemes to evaluate the impact on government expenditure from each and assess whether UPS contributions are adequate in meeting future pension obligations. Our results reveal that the relative cost of each scheme is sensitive to how long the employee lives after retirement and the benefits given in each scheme. For a shorter lifespan post-retirement, the OPS cost can be less than UPS and NPS. However, the cost of OPS can be significantly higher for retirees living around or beyond the national average life expectancy. The viability of UPS may be affected by low investment returns, high inflation, or the inclusion of decadal pension revisions, as given in OPS. Policy implications to manage the fiscal impact are discussed.

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Introduction

On 24 August 2024, the Government of India announced a new pension plan, the Unified Pension Scheme (UPS), for the government employees of the country (GOI, 2024). The new scheme complements the current National Pension System (NPS), launched over two decades ago in 2004 (GoI, 2003). With UPS becoming operational from 1 April 2025, the employees working in the government sector will now belong to one of the three schemes – Old Pension Scheme (OPS), NPS, or UPS. In this study, we provide a comprehensive analysis of the impact of these schemes on government expenditure at the micro level.

The Indian pension system has undergone significant changes over the last few decades (Mohanty, 2022). These changes have been most pertinent for government sector employees because, until a few decades ago, accessibility to social security was limited to employees in the government sector in the form of OPS. OPS is a defined-benefit, pay-as-you-go (PAYG) scheme. The benefits in this scheme are a fixed proportion of the final pre-retirement income, indexed to inflation and market wages. The PAYG scheme meant that the pension benefits for a retiree were drawn from the current budget revenues, and the retiree did not contribute towards it during their working life. OPS was replaced by a defined contribution pension scheme, termed NPS. Unlike OPS, the benefits in NPS are not fixed, and the pension is a function of the contributions made by the employees and the government and the returns attained on them. The latest scheme, UPS, is a contributory scheme with defined benefits. The employee and the government will contribute during the employee's working life, and the government will use the corpus accumulated to guarantee a pension in old age, which will be indexed to inflation.

The three co-existent schemes – OPS, NPS and UPS – differ significantly in their benefit structures and funding needs. These differences make it difficult to compare the schemes directly from a fiscal standpoint. Furthermore, the comparison hinges on multiple assumptions with respect to future returns on investment, income profiles, and inflation rates, among others. Hence, the appropri-

ateness of the schemes for the stakeholders has become a subject of intense debate. We contribute to this debate by conducting an analysis of the potential impact of each scheme on the government in multiple scenarios. We also discuss the key policy implications, particularly with respect to the funded schemes of NPS and UPS against the backdrop of macroeconomic, social, and demographic changes. This study focuses exclusively on the pension schemes applicable to central government employees, as the schemes for state government employees may differ. Furthermore, this paper restricts its analysis to government expenditure and does not delve into the employee-level impacts.

Pension reforms have been a subject of intense research. Many studies have evaluated the impact of such reforms on the financial and employment behaviour of the beneficiaries (Blau, 2016; Clark & Quinn, 2005; El Mekkaoui & Legendre, 2022; García-Miralles & Leganza, 2024). However, fewer studies have conducted a comparative evaluation of pension schemes globally (Zvi et al., 1988). In India, there have been some qualitative attempts at understanding these schemes (Bali, 2014; Sadhak, 2009). However, there has not been a structured attempt at analysing the financial implication of each of these schemes for the employer, a gap our paper aims to fill.

To generate comparable counterfactual scenarios, we consider the case of a representative employee joining grade C in the Seventh CPC and estimate his income profile. The discounted cost incurred by the government is estimated at the time the employee joins the government for each of the three schemes – OPS, NPS, and UPS. The source of the expenditure for the government is from contributions in NPS, pensions in OPS, or both in UPS. We make several assumptions on salary increments, inflation, rate of return on investments, and rate of discounting, among others. Sensitivity checks are carried out to observe the impact of these assumptions on our outcomes.

Our results reveal that the expenditure incurred by the government is a function of the life expectancy of the employee post-retirement. If the employee lives up to the average life expectancy of 72 years (with the spouse living an additional five years), the

government expenditure is the highest in the case of OPS, followed by UPS and then NPS. However, if the employee happens to have an early demise, the cost is higher in the case of UPS, followed by NPS and then OPS. With respect to the viability of UPS, the investment returns achieved on the contributions are an important factor that will determine the funding status of UPS. Furthermore, giving pension parity to all retirees at the same designation, separated by time, may be challenging under the current scenario in UPS. The sensitivity of our results to assumptions has been examined to check the directional consistency of the results.

The study makes an important contribution to the economics of pensions in India (Asher, 2008). To our knowledge, this is the only study performing a counterfactual analysis of government expenditure at the micro level in a multi-pension scenario. We also contribute to the literature studying pension systems' success and viability against the backdrop of changes in the macroeconomic scenario (Chybalski, 2016; Outlioua & Fazouane, 2023). The study also contributes to the literature analysing the differences between defined benefit, defined contribution and hybrid schemes (Zvi et al., 1988). The study, hence, makes a modest attempt at suggesting the right scheme under specific macroeconomic environments. Finally, the study also shows the impact of longevity risk on the cost of pension schemes, a subject that has found relevance globally (OECD, 2007).

In the next section, we describe the evolution of the current pension system in India. In the following section, we share the methods used for making all computations, including the assumptions made. The results are then discussed, and we share our conclusions in the final section.

Evolution of the Pension System in India

India's pension landscape has experienced a structural transformation over the last two decades, moving from fragmented occupational arrangements to a more integrated, multi-tiered system (Mohanty, 2022). In the post-independence period, pension provision was confined to the government sector through an occupational pen-

sion known today as the Old Pension Scheme (OPS). This unfunded, defined benefit (DB) scheme promised pension benefits amounting to 50% of the final salary, adjusted periodically for inflation and wage revisions (GoI, 2025a).

A major reform occurred in 1995 with the establishment of the Employees' Pension Scheme (EPS), aimed at expanding retirement income security to the organised private sector (GoI, 1995a). EPS is a defined benefit scheme with mandatory contributions, financed by employers and the central government and administered by the Employees' Provident Fund Organisation (EPFO). The pension benefits in the scheme are capped, however, and hence adequacy challenges prevail.[1]

Concurrently, the National Social Assistance Programme (NSAP) was introduced in 1995 to provide basic social security for economically vulnerable elderly populations (GoI, 1995b). The National Old Age Pension Scheme (NOAPS), a component of NSAP, delivers non-contributory, means-tested pensions to individuals below the poverty line. These transfers are modest and often insufficient for sustained income security, but they marked the first formal recognition of old-age vulnerability outside formal employment.

Despite these developments, the challenges of low pension coverage and inadequate benefit levels persisted. The fiscal pressure of the PAYG scheme of OPS was also a looming concern. The transition from PAYG was reinforced by recommended pension models from international financial institutions like the World Bank. Citing the long-term fiscal unsustainability of PAYG systems, the World Bank supported a shift toward multi-pillar pension frameworks with funded occupational pensions (Holzmann, 1999). All of these led to the introduction of the NPS in 2004, initially as a mandatory, defined contribution (DC) scheme for new central government employees (GoI, 2003). By 2009, NPS was extended to all citizens as a voluntary DC scheme. The NPS contributions are accumulated in an individual retirement account and invested to generate returns. The pension benefits are

1. In addition to EPS, employees also have access to a defined contribution Provident fund, the Employees' Provident Fund (EPF), also administered by the EPFO.

determined by the final corpus that gets accumulated. This design differs from the fiscal guarantees of DB schemes. Nevertheless, demand for guaranteed benefits as in OPS led to the launch of the Unified Pension Scheme (UPS), a hybrid scheme incorporating the elements of both DB and DC schemes for government employees (GOI, 2024). UPS seeks to balance fiscal prudence with certainty of benefit by incorporating a funded structure to service the guaranteed benefits.

Additionally, the government has launched schemes to cater to the social security needs of the workforce in the informal sector (ILO, 2019). Two schemes deserve mention. The Atal Pension Yojana (APY) is a voluntary, contributory defined benefit scheme for informal workers, featuring government co-contributions for low-income subscribers. APY's uptake is approximately 7.47 crore as of 2025, a modest fraction of the informal workforce (GoI, 2025b). The government also introduced other schemes like the Pradhan Mantri Shram Yogi Maan-Dhan Yojana for the informal workforce, which is also a contributory defined benefit scheme. Despite these efforts, social security coverage for the informal sector remains a significant challenge. However, with steady growth in voluntary pension enrolments and increased policy focus on social security, pension coverage is likely to deepen in the years to come.

Method

We evaluate the government cost from two sources to analyse how each pension scheme impacts government finances. First, the government incurs expenditure towards contributions into the pension account during the employee's working life. Second, they also incur costs in providing benefits post-retirement through pensions, lump-sum payments, and gratuities. We consider the case of a hypothetical male employee working in the government and estimate his earning profile. The expenditure incurred by the government is computed for this employee, assuming he is in OPS, NPS, and UPS. The approach follows the hypothetical worker profile method used by the OECD to assess pensions (GoI, 1995a; OECD, 2023).

Government employees are classified into one of three grades for pay determination – A, B, and C. Since most central government employees are in grade C (MoL, 2003), we consider the example of a hypothetical grade C employee[2]. The employee is assumed to begin working at pay level 1 at the age of 22, earning ₹18,000 per month as basic income.

For each scheme, we compute the present value of all the government contributions and government-guaranteed pension benefits, discounted to when the employee joins the workforce. As OPS and NPS contributions are made from the sum of the basic salary and annual inflation allowances in the form of dearness allowance (DA), only these two components are considered for our calculations. We acknowledge the presence of other perks like a housing rental allowance, transport allowance, etc., from which the employee benefits. We assume that the employee joined in 2016, which is the first year of implementation of the most recent Seventh Central Pay Commission (CPC) at the time of writing. The basic salary is assumed to increase by 3% annually, and DA increases by 7% annually, starting from 0 in the first year of implementation of recommendations of each new CPC. This assumption accounts for the decennial revision in basic salary and inflation resetting when each new CPC makes its recommendations. Based on the new CPC recommendations, the basic salary is assumed to increase by a fitment factor of 2, and as mentioned earlier, the inflation allowance is reset to 0%. Gratuity is also applicable for all schemes, calculated as half of the emoluments at the time of retirement times the number of completed six months of service, up to a maximum of ₹25 lakhs. All figures are in nominal terms. The expenditure across the lifetime is discounted back to 2016 to get a fair estimate. We assume a discounting rate of 8%. The retirement age is assumed to be 60 years. For simplicity, we ignore the impact of taxes and promotions.

For OPS, the cost incurred by the government is only towards the benefits provided, which are fixed at half of the basic salary before

2. A micro-simulation analysis can be used to compute the cumulative impact for all employees combined.

retirement, and the DA and pension revisions with each CPC. We also consider the provision of family pension in OPS, available at the rate of half of the pension of the deceased retiree for seven years after death and 30% thereafter. We also include the age-dependent increase in pension available in OPS after the retiree attains the age of 80 years. As per the current policy, the pension increases by a factor of 1.2 at the age of 80, 1.3 at the age of 85, 1.4 at the age of 90, 1.5 at the age of 95, and 2 after attaining 100 years. The pension in OPS is also assumed to increase as the pay benefits are revised in each CPC by the same factor on a decennial basis.

For NPS, the contribution rates towards the employee's retirement account are 10% by the employee and 14% by the government. The pension is dependent on the accumulated corpus. Hence, from the government's perspective, the cost incurred in NPS is only towards the contributions. Note, however, that NPS offers tax benefits on contributions and corpus withdrawals at retirement. To that extent, the cost incurred in NPS might appear understated.

For UPS, the scenario is slightly complicated, considering it is a funded scheme with defined benefits. The government incurs costs for contributions during the employee's working life at 10%, while the employee makes a 10% contribution. Additionally, the government also contributes 8.5% of the basic salary plus DA to a pooled corpus, which acts as a contingency fund to make up for any gaps in the available funds to service the commitments of pension during an employee's retirement period. The contributions are invested into a diversified fund, generating returns, and the corpus accumulated is used to fund the pension obligations. However, in case of a shortfall over and above the individual and pooled corpus fund availability, we assume that the government will make good on the promise of the benefits. Hence, we estimate the cost incurred by the government as the sum of discounted contributions made during the working life and the discounted shortfall in funding, if any. The shortfall is assumed to be zero if the accumulated corpus is sufficient to fund the pension obligations. In this case, the additional corpus left after

pension benefits have been completed is assumed to go into a pooled corpus inaccessible to the government for other requirements. The provision of a family pension at the rate of 60% of the pension of the deceased retiree is also included. We assume the pension will not be revised upwards in UPS with each CPC. However, we also show the impact on costs if these pension revisions are made in UPS.

The mortality rates have declined over the past decades in India (GOI, 2022). Changing mortality can alter the demands from pension outlays for the government. Hence, we evaluate how the life expectancy of the employee can impact the expenditure, starting from 60 years to 100 years. The life expectancy of females is typically higher than that of males (ibid.). We account for this difference by assuming our synthetic employee's female spouse outlives the employee by five years.

The specification of the present value of expected government expenditure for each age up to survival, $E(G^D)$ is as follows. For OPS:

$$E(G^D_{OPS}) = \sum_{k=T}^{D} \frac{P_k}{(1+r)^{k-t_0}} + \sum_{k=D+1}^{D+5} \frac{P_k . s}{(1+r)^{k-t_0}} + \frac{G}{(1+r)^{T-t_0}} \quad (1)$$

where P_k denotes the pension at age, k, the age at which the employee starts working is t_0, D is the age of the employee at death, T is the age at retirement and r is the rate at which pensions are discounted. The second term denotes the family pension given to the spouse after the employee's death. We assume that the spouse outlives the employee by 5 years only and hence the summation of pension benefits is done over this period. *s* refers to the factor of reduction applied to the employee's pension to obtain the family pension; it is a function of the years since the employee's death and the scheme (OPS/UPS). Gratuity, denoted by G is a function of the number of years of service and the pre-retirement income, I_{T-1}, expressed as below:

$$G = \max (0.5\, I_{T-1}.(T - t_0), 2500000) \quad (2)$$

The expected expenditure for NPS is expressed as:

$$E(G^D_{NPS}) = \sum_{k=t_0}^{T} \frac{C^G_k}{(1+r)^{k-t_0}} + \frac{G}{(1+r)^{T-t_0}} \quad (3)$$

where C^G_k denotes the contributions made by the government towards the retirement account of NPS when the employee is k years of age. The contributions are made throughout the working life and hence, the government expenditure for NPS is independent of the number of years that the employee survives after retirement.

Expected government expenditure for UPS is denoted as:

$$E(G^D_{UPS}) = \sum_{k=t_0}^{T} \frac{C^G_k}{(1+r)^{k-t_0}} + \frac{G}{(1+r)^{T-t_0}} + \max(S, 0) \quad (4)$$

The C^G_k in case of UPS includes contributions made by the government towards the individual account and the pooled account. The third term indicates that any shortfall, S, in the pension obligations is to be made good by government finances. Suppose in any year during retirement, the accumulated corpus is insufficient to service the year's pension demand. In that case, the shortfall will equal that year's funding gap plus the discounted value of future pension obligations until the employee and their spouse survive. The shortfall is also discounted to the start of employment like other metrics. The accumulated corpus used to compute the shortfall also includes the pooled contributions. Note that the UPS government expenditure is independent of the employee's lifespan except for the third contingency term in equation (4). This implies that the UPS expenditure will typically be constant unless the funds become insufficient to service the obligations.

We analyse our results for multiple scenarios pertaining to inflation rates, investment returns, fitment factors, replacement rates, and changes in mortality rates; the results show how much the government expenditure will likely be impacted under various contingent scenarios.

Results and Discussion

The comparison of the fiscal impact of the pension schemes is not straightforward. While the fiscal burden under OPS is clear, since there is no employee contribution, the other schemes place demands on the government budget in the form of co-contributions. Therefore, to provide a fair assessment of the impact on government finances from each type of pension, we analyse the present value (at the time the employee joins the workforce) of the government expenditure per employee under each pension scheme.

For the baseline estimation, we show the expenditure incurred by the government due to pension benefit outlays under the stated assumptions in Figure 8.1. The estimations assume that the employee lives for 72 years, which is the average life expectancy for an urban male, and that the spouse lives for an additional five years (GOI, 2022). Our results show that the discounted expenditure incurred by the government in this scenario is comparable for OPS and UPS, with the former being marginally higher. The expenditure under NPS is lower than that of the other schemes. While these results indicate that the government is likely to incur lower expenditure under NPS, this might not be true in all cases.

In Figure 8.2, we plot the discounted expenditure incurred by the government for the three schemes against the maximum age until which the employee lives. We assume that the spouse lives for five additional years after the employee's death. The NPS expenditure remains constant irrespective of the maximum age of survival, as the contributions are already paid during the employee's working life. The tapering of the cost in OPS at older ages occurs because we cap the maximum age at 100 years, and the slight kink at higher ages reflects the age-dependent increase in pension. For UPS, the expenditure remains nearly constant regardless of lifespan, which indicates the sufficiency of the contributions (including the pooled corpus) in servicing the pension benefits under standard assumptions.

If the retired employee lives up to 65 years, the government incurs the lowest expenditure under OPS. However, if the employee

Figure 8.1

Scheme-wise Discounted Government Expenditure in Lakh INR

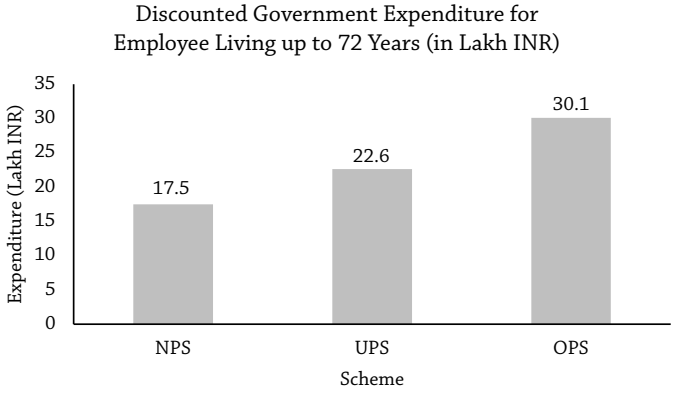
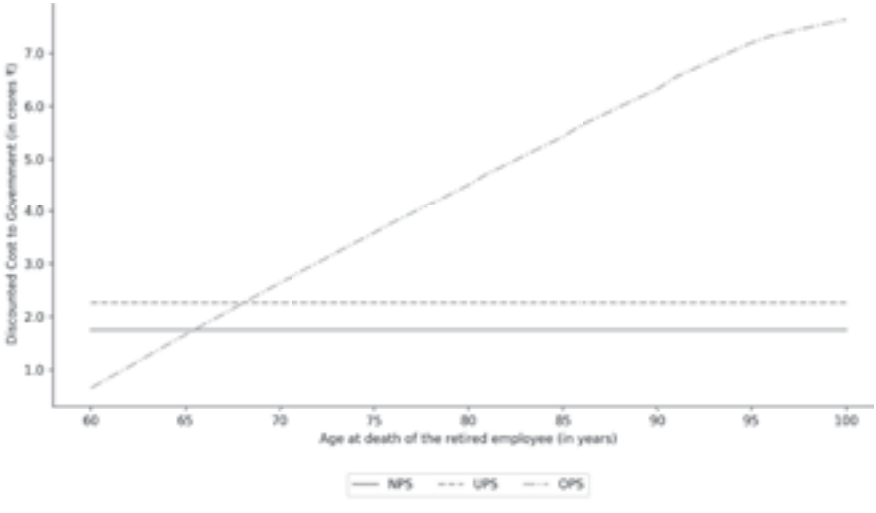


Figure 8.2

Discounted Government Expenditure at Each Age at Death of the Retired Employee in Crore INR



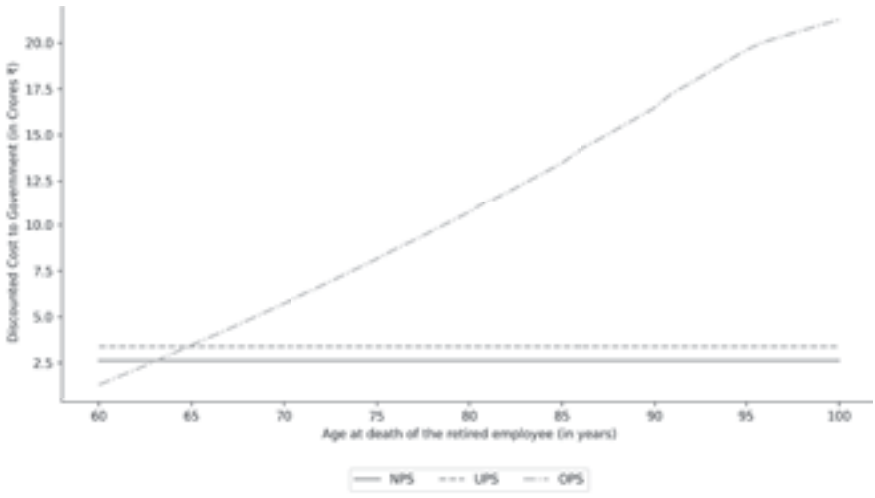
lives beyond 68 years of age, the cost incurred under OPS exceeds that under UPS. Hence, the relative cost of each scheme compared to the others is a function of the age until which the employee and their spouse survive post-retirement.

The figure also indicates that expenditure under OPS increases almost linearly as the maximum age of survival rises. The average life expectancy increased from nearly 63 years in 1970–75 to 70 years in 2000–04. From Figure 8.2, we can observe that for an employee who lives until 70 years, the cost incurred by the government is nearly twice what it would have been had the employee lived only up to 63 years. Therefore, the contributory schemes of NPS and UPS, with capped expenses, help avoid unanticipated expense shocks in later years.

Note that the fiscal impact we measure intends to put a value on the money needed to pay the promised benefits. For such computation, it is often suggested that a default-free discount rate be used (Brown & Pennacchi, 2016). Based on data available from the Reserve Bank of India on open government securities expiring around this time, the lowest rate comes to 6.8% (RBI, 2025). Adjusting for a small default risk premium and a liquidity premium—both of which tend to inflate returns, as argued by Brown & Pennacchi (2016)—the effective rate may decline to around 6.1%. The government expenditure for all schemes measured at this risk-free rate is shown in Figure 8.3. At this lower discount rate, future benefits are discounted less, and the expected discounted expenditures rise accordingly. In this scenario, OPS expenditure surpasses NPS expenditure within three years and UPS expenditure within five years of retirement. While UPS expenditures appear higher, our results also show that a portion of the collected corpus will remain even if the retiree lives until 100 years, as per the given assumptions. In the next section, we conduct a sensitivity analysis for UPS to assess its viability under various scenarios.

Figure 8.3

Government Expenditure Discounted at Risk-Free Rate for All Schemes in Crore INR



Sensitivity Analysis of UPS Expenditure

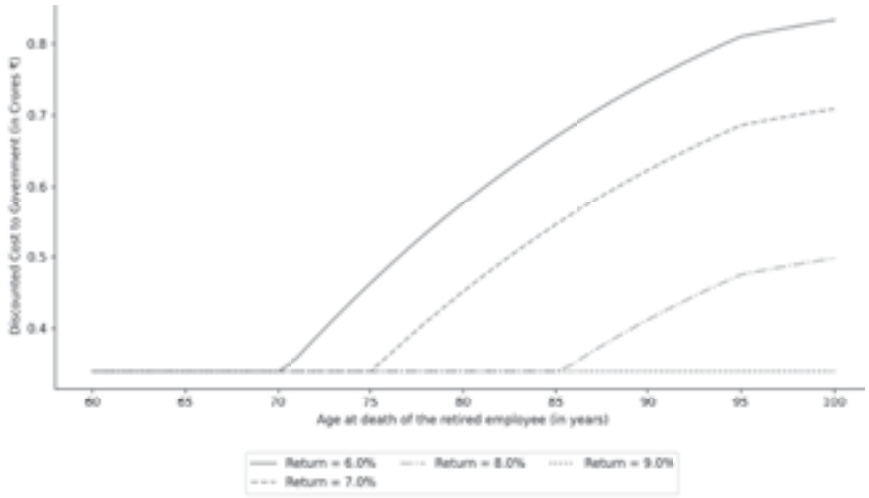
UPS is a hybrid pension scheme that combines elements of OPS and NPS. The guaranteed benefits in UPS are intended to be funded by contributions made during employees' working lives. In this section, we explore multiple contingent scenarios by relaxing our assumptions to assess the viability of the contributed funds in servicing the guaranteed pension obligations of UPS post-retirement.

In the previous section, we assumed returns of 9% per annum throughout the employee's life, including the post-retirement period. Here, we examine what happens if returns are lower or higher than this assumed rate. The discount rate is held constant at 8% for these simulations. The investment returns are varied between 6% and 9% in 1% increments. Results are presented in Figure 8.4. At 6% investment returns, if the employee lives beyond 70 years, the UPS corpus accumulated for the individual (including pooled corpus) may be insufficient to meet guaranteed pension commitments. This thresh-

old rises to 75 years if the returns increase to 7%. The default investments of the CG scheme have generated an average return of 9.5% since inception, and hence, the likelihood of the corpus falling short seems low (NPS, 2024). Nevertheless, the government must closely monitor prevailing returns in relation to inflation to ensure fund buoyancy. Reallocation of portfolios toward higher-yielding instruments could help bridge any funding gaps.

Figure 8.4

Discounted Government Expenditure in UPS at Different Investment Returns in Crore INR

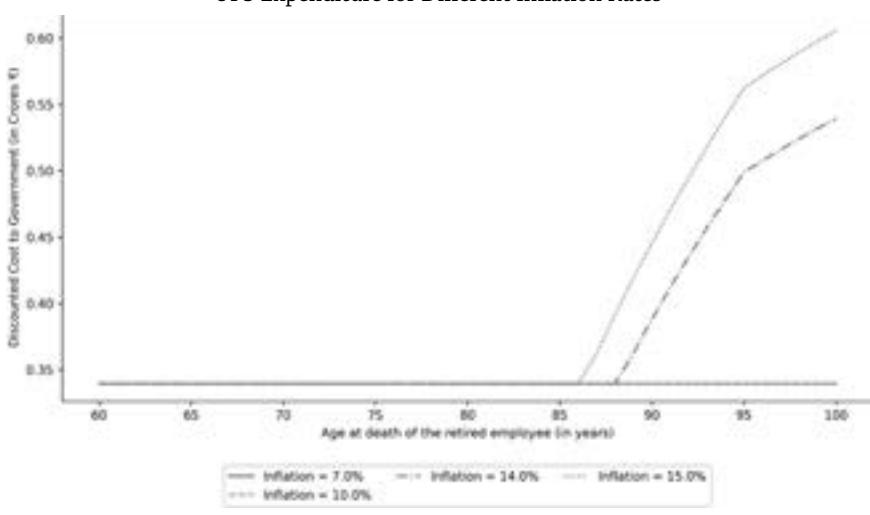


We also vary the inflation rates to examine whether the contributions are sufficient to meet pension obligations if inflation remains elevated throughout the working and retirement phases. For this analysis, investment returns are fixed at 9%, and the discount rate is kept at 6.1%. Inflation is incremented annually from the current 7% up to 15%. The results, shown in Figure 8.5, indicate that if inflation approaches 14%, the contributions fail to meet pension requirements if the employee lives beyond 88 years. The age threshold at which contributions become insufficient declines as the inflation rate increases.

Interestingly, lower investment returns appear to have a more pronounced effect than higher inflation. This outcome is expected, as elevated inflation during working years leads to higher contributions (in nominal terms), resulting in greater corpus accumulation. Hence, the inflation impact is relatively milder compared to the impact of reduced investment returns in terms of government expenditure.

Figure 8.5

Discounted Government Expenditure in UPS at Different Inflation Rates in Crore INR

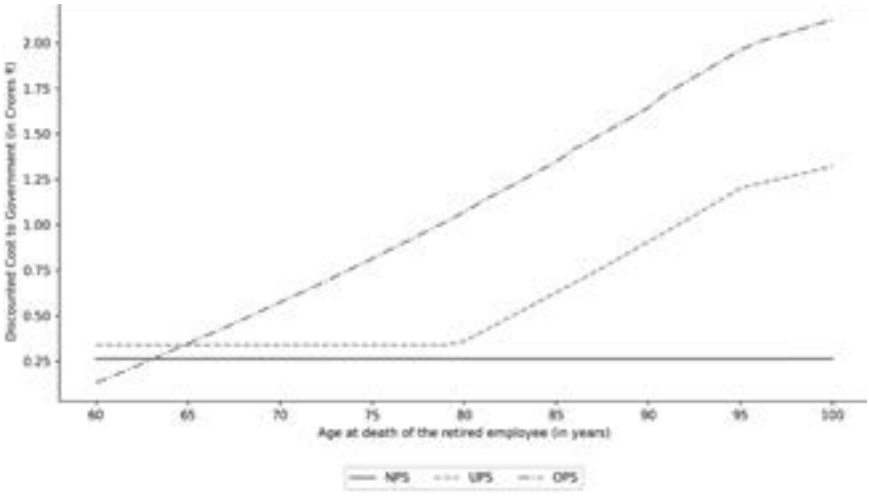


Current UPS documentation does not clarify whether pension benefits will be revised in line with each decennial wage revision recommended by the CPC (Unified Pension Scheme Notification, 2025). In our baseline scenario, we assumed UPS does not provide for such decadal increases. However, the government may revisit this position in the future. We simulate the additional cost implications if such revisions were included in UPS pension payouts, keeping the discount rate at 6.1%. A fitment factor of 2, as used in OPS, is assumed. Results are shown in Figure 8.6. Under this scenario, if UPS allows pension revisions every ten years, contributions will exceed the pen-

sion requirements only if the employee lives beyond 79 years. Given rising life expectancies, such a provision could jeopardise the funding status of UPS.

Figure 8.6

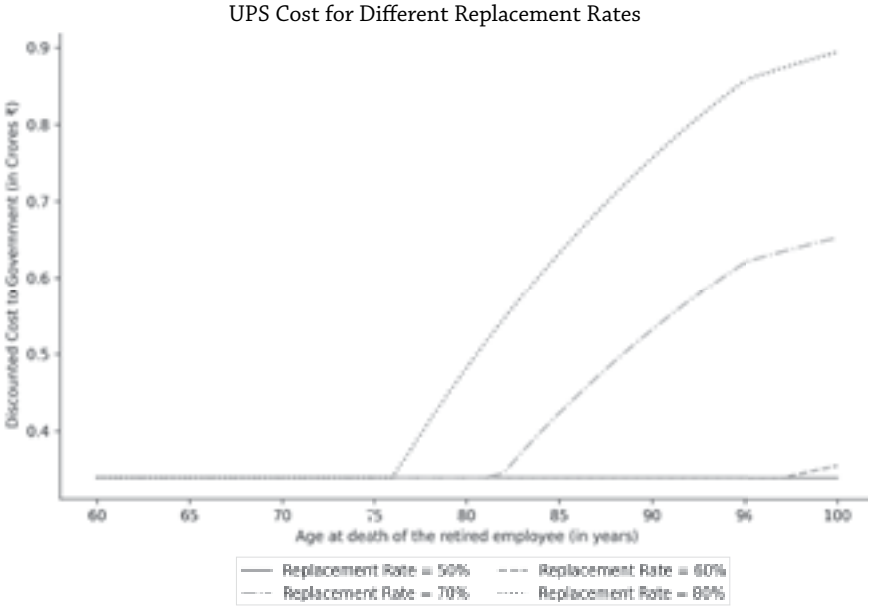
Discounted Government Expenditure for All Schemes with Decennial Pension Revision in UPS



In our baseline scenario, the pension corpus in UPS was sufficient to meet pension obligations under current benefit structures. The guaranteed benefits in UPS comprise a fixed pension replacing half of the pre-retirement income. In this section, we analyse the maximum pre-retirement income replacement rate that can be sustained while keeping UPS fully funded. We vary the replacement rate from 50% to 80% and examine changes in government expenditure. Figure 8.7 shows that while the combined individual and pooled corpus can support a 50% replacement rate under the given assumptions, increasing the replacement rate beyond this threshold leads to expenditure surpassing the available corpus at lower life expectancies.

Figure 8.7

Discounted Government Expenditure for UPS at Different Replacement Rates in Crore INR



Conclusion

There are multiple pension schemes co-existing for a relatively small cohort of working professionals employed with the government in the country. The existing pension schemes differ with respect to their funding status and benefits, making direct comparison of the schemes very complex. In this paper, we attempt to analyse the cost to the government of each scheme under different scenarios.

Our analysis reveals that the relative cost to the government of each scheme is a function of the age up to which an employee survives and the benefits included. For lower life expectancies, OPS costs the government the least, while at life expectancies closer to or more than the national average, OPS expenditure is the highest. The stated benefits of UPS are likely to be serviceable from the funds contributed during the employee's working life. However, UPS contributions

may struggle to accommodate benefits such as decadal pension revisions with each CPC, unless investment returns improve. Furthermore, under scenarios of low investment returns and high inflation, the funds available in UPS may become insufficient to meet pension obligations.

Against the backdrop of recent pension reforms, the current study provides a fiscal lens through which the schemes may be compared. The study emphasises the importance of investment strategy and inflation management in maintaining fiscal balance. Policymakers may gradually shift towards higher-yielding investments to preempt budgetary challenges in the later years. The study is limited by its assumptions and does not account for all future contingencies. It should not be considered a ready reckoner for pension-related decisions. However, under the simplifying assumptions, it highlights the key variables that will require close monitoring.

The imperative for pension reforms rests on concerns over long-term fiscal sustainability. However, as a welfare state, India must also ensure that retirement income streams adequately meet the consumption needs of retirees. Policy changes should follow broad deliberation with all relevant stakeholders to enhance stability.

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