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A Nonlinear Stochastic Mathematical Framework for Modeling NRI Investment Decision Dynamics and Risk Aversion Patterns in the Kerala Productive Sectors

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Abstract

The research paper delves into the nonlinear stochastic modeling of NRI investment decisions in productive sectors of Kerala, including wealth, risk aversion, market volatility, and economic shocks. Regression analysis indicates that wealth is a significant factor in investment, with a coefficient of 0.18, suggesting that the more wealth one has, the more investment one makes. Market volatility is also relevant, with a positive coefficient (0.22), indicating that higher volatility is associated with greater investment in riskier areas, particularly among more affluent investors. These findings are further supported by Monte Carlo simulations with 10,000 iterations, which indicate an average investment in low-risk sectors of 62.35 and a standard deviation of 18.56. The average of high-risk sectors is 37.65 with a standard deviation of 14.89. The simulation also shows that richer investors spend more in risky areas when there is an increased volatility in the market. The nonlinear stochastic model works better than the linear model. The nonlinear model had a Mean Absolute Error (MAE) of 0.12 as compared to the 0.18 of the linear models. The nonlinear model had an R2 of 0.89, and the linear model had an R2 of 0.75, indicating that the nonlinear model is more predictive of the NRI investment behavior. These findings would be useful in policy development in order to increase NRI investments in the Kerala economy.

Keywords: Nonlinear Stochastic Model, NRI Investment Decisions, Risk Aversion, Market Volatility, Monte Carlo Simulation, Economic Shocks, Policy Formulation.

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Introduction

Non-Resident Indians (NRIs) investments are important in the economic development of India, with major impacts being made in the real estate, agriculture, and information technology sectors. The state of Kerala, which has a large number of NRIs, has been experiencing a steady influx of investments that have played a critical role in shaping its economic trends. Nonetheless, the dynamics and multifaceted nature of NRI investment choices have posed a difficulty in comprehending their complexities. NRI investment behavior is largely influenced by factors such as wealth, risk aversion, economic shocks, and market volatility. Although linear models have been used to explain the dynamics of investment decisions, they are usually ineffective in explaining the nonlinear and stochastic nature of investment decisions that occur in an unpredictable market environment and are subject to investor psychology. This paper empirically examines the connection between domestic monetary policy and NRI deposits to India, which sheds some light on the effects of policy actions on the investment behavior of NRIs. These findings give some insight on the significance of policy interventions to promote remittance inflows and mobilize deposits by NRIs to drive economic growth in India (Kumar et al., 2026). This study introduces a new methodology with Deep Neural Networks (DNNs) to approximate the dynamics of the accelerating universe at the fractional-order with adapted gravity. The paper discusses the role of sophisticated machine learning in enhancing the understanding of complex cosmological processes and their connections to gravitational theories (Sabir & Nicola, 2026).

The paper addresses the obstacles to breakthroughs in innovation in renewable energy, with particular reference to the ambiguity over economic growth. It puts into focus the obstacles facing policymakers in the move towards sustainable development by adopting renewable energy and emphasizes the need to find innovative ways to overcome these hurdles (Li et al., 2026). The present research presents a new hybrid model (1DCNN-BiGRU) to improve the accuracy of prediction in different fields, integrating deep learning and bidirectional gated recurrent units (BiGRUs). The model has a high degree of applicability to the domain where accurate and real-time forecasting is needed to ensure that predictions are made correctly (Ahmad & Kumar, 2026). The authors investigate the higher-order expectations concept in the price of assets and suggest a framework relying on uncertainty about the outcomes of the future. The research sheds light on the impact of such expectations on market behavior and price fluctuations of assets in international financial markets (Bacchetta & Van Wincoop, 2008). This study uses a dynamic general equilibrium model to evaluate the economic impacts. In the study, the possible implication of hydrogen adoption on the energy markets is modeled, providing insights on the potential of policy to induce sustainable energy transitions (Bae & Cho, 2010). The article explores the concept of digital governance and its role in enhancing efficiency of the natural resources in China. It also gives empirical evidence on how digital technologies are being exploited to enhance resource management and meet sustainability objectives to help in transforming sustainable development (Zhu et al., 2025).

This study looks into the methods used by farmers to avoid floods. The study uses empirical evidence from farmers in Assam to understand the effect of exogenous risk preference on portfolio selection to minimize flood risks (Hussain & Guha, 2026). In this paper, the author looks at the factors contributing to the adoption of new crops among rice farmers in Kerala, India. In-depth knowledge is gained about how socio-economic factors and other factors affect the decision-making process of rural farmers which will promote agricultural development in the region (Rose & Thomas, 2026). This paper studies the factors affecting the adoption of climate change adaptation measures among rice farmers in Kerala. The factors discussed include difficulties and opportunities facing the farmers at the farm level in order to adopt to climate change impacts (Lasithamol et al., 2025).

Key Contribution

- The study develops a nonlinear stochastic model to understand how wealth, risk aversion, and market conditions affect NRI investment decisions in Kerala.
- It demonstrates that risk aversion drives NRIs to invest more in low-risk sectors like real estate and government bonds, while risk-seeking investors prefer high-risk sectors.
- The findings offer valuable insights for policymakers to design targeted economic strategies that encourage NRI investments and promote economic sustainability in Kerala.

This research is followed by the various sections. Section I explains the introduction to the research. Section II presents the literature review, including the problem statement, the study objective, and the hypothesis. Section III explained the conceptual framework. Section IV explained the research methodology, which consists of sampling design, area of study, tools, and techniques. Section V explained about various analyses, discussions, policy implications, major findings, recommendations, and suggestions. Section VI explained the conclusion of the research.

Literature Review

The routes to the adoption of advanced farm management techniques amongst dairy farmers in Kerala. The study provides insight into the roles of economic motivations, behavioral influences, and risk perceptions in decision-making in agriculture. The researchers note that implementing new practices is a nonlinear process, influenced by socio-economic factors and farmers' risk aversion. The contribution of the paper lies in demonstrating how decision-making in rural economies can be analyzed, focusing on the relationship between the dynamics of adoption behavior and exogenous shocks, thereby making the results applicable to investment choices in the agricultural sectors of Kerala (Smitha et al., 2025). The authors consider the problem of alternative optima in decision-making, especially under conditions of uncertainty and stochasticity. The paper is important because it considers the role of uncertainty and stochasticity in the selection of projects for inclusion in portfolios. The paper may serve as a starting point for modeling NRIs' investment choices in Kerala, accounting for risk perception and economic uncertainties (Huang et al., 2025).

The methodology involved the study of systems in an environment defined by the features of nonlinear phenomena and unpredictability, which is similar to the dynamics of investment decision-making processes within Kerala's economic sectors. By modeling the effects of external phenomena on investment dynamics, insights can be gained into how economic shocks and policy changes affect NRI investment decisions, particularly in unpredictable sectors such as information technology and start-ups (Xing et al., 2026). The use of nonlinear dynamics in understanding complex interactions in a system affected by external shocks has been illustrated in their work. Such dynamics can be used to model the investment decision-making processes of NRIs in the state of Kerala, driven by market forces and economic shocks (Qi & Tạ, 2026).

It investigates a deep learning-based mathematical model of decision-making in economic systems. This is an integrated solution that combines mathematical models and sophisticated AI to improve economic forecast accuracy. The importance of Minitaeva's is in its modeling of NRI investment decisions with deep learning models able to reflect the nonlinear dependencies between the wealth, risk aversion, and market volatility. This study offers a new method to forecast the effects of economic shocks and policy adjustments with NRI investment behavior in Kerala by using deep learning to model the relationship between these factors and investment in Kerala (Minitaeva, 2025). To address the use of stochastic models to forecast and evaluate the risk to public health in uncertain settings. This study highlights the possibility of the stochastic models to play a role in decision-making under uncertainty. It is directly associated with the modeling of NRI investment behavior, in which such factors as economic risks and external shocks can be more effectively explained with the help of stochastic. The paper highlights the need to incorporate uncertainty into policy frameworks to construct more resilient investment strategies in Kerala (Li et al., 2008). It discusses the modeling and application of nonlinear chaos to economic and financial systems. The results demonstrate that nonlinear chaotic systems can provide a better description of economically motivated behaviors that are influenced by unpredictable parameters. This method is very applicable in the modeling of NRI investment decisions in Kerala, where there is chaos in the market due to volatility and the uncertainty in the economy. The research provides a rationale for how chaotic systems could better explain NRI investment patterns than linear models (Abdelwahed et al., 2024). The study concerns how stochastic processes can be used to model the dynamics of epidemics in unforeseeable environments. Application of stochastic modeling in the behavior of epidemic propagation is similar to that of stochastic models in the behavior of NRI investment decisions where economic shocks and the change of policies entail some level of uncertainty that can befall investment decisions. This research also highlights the importance of noise and stochastic processes in modeling complex systems, which can be applied to economic decision-making models in Kerala (Ain et al., 2024). The work is based on the identification of systems of nonlinear dynamical systems and shows that data-based optimization is more likely to identify system parameters. It is directly applicable to nonlinear investment decision models, where the wealth, risk aversion, and market volatility parameters are correctly identified, enabling NRI investment behavior predictions. With advanced optimization, it is possible to develop superior strategies to encourage investment in Kerala's productive sector (Viknesh et al., 2026). Their method emphasizes the promise of data-driven control for nonlinear systems in uncertain environments. This approach can be modified to account for NRI investment decisions, as external economic shocks and market dynamics influence investment decisions in the long run. This study posits that analogous methods can be applied to streamline investment plans and policy measures in the economic sectors of Kerala by applying adaptive learning and data-driven control (Hu & Li, 2025).

Problem Statement

The decisions made by NRIs have played an important role in the development of productive industries in Kerala, like real estate, tourism, and the IT industry. However, the dynamics of those decisions remain a challenging issue for

consideration, as NRI decision-making is complex and depends on numerous factors, including wealth, risk aversion, economic conditions, and socio-political issues unique to Kerala. Traditional investment models do not capture the dynamics of decision-making in such cases, as they are linear and static. The research aims at developing a mathematical model that would describe the process of investment decision-making as well as risk aversion among NRIs in the productive industries of Kerala. The central problem here lies in the complex interaction between many factors determining the investments pattern and it is essential to look at the changes in the wealth levels, the preference for risks, the changes in the market situation, and the policy environment. Also, the knowledge of the role of the risk aversion factor on the investment decision process depending on the wealth and the particular market environment is critical to help formulate an appropriate policy. The study seeks to answer the following research questions: what makes the nonlinear stochastic model be able to describe the NRI investment decisions, the role of the risk aversion in forming the investment pattern, the effect of the economic shock, policy shift, and market dynamics on the investment decision. It is hoped that answering these questions will be instrumental in helping policy makers come up with strategies which are consistent with the investors' behaviors, promote development of the sector, and bring about sustainable development of Kerala.

Objectives of the Study

- To develop a non-linear stochastic mathematical model for the modeling of the dynamics of investments made by NRIs in productive industries in Kerala (wealth, market volatility, and external economy).
- To investigate the hypothesis relating to the risk aversion of NRIs in their investment decision-making process. Specifically, how varying degrees of risk aversion influence the nature of investments in the different industrial sectors and how such patterns vary with respect to wealth and external economy.
- In order to determine the influence of such economic shocks, changes in policies, and market behavior on the investment decisions of NRIs, the proposed theoretical framework can be applied to analyze the impact of these factors on investment decisions in the emerging industries in Kerala.
- To provide useful information to policymakers for formulating particular economic policies that would cater to the needs of the NRI investors and contribute to the growth of productive industries in Kerala to sustain its economy.

Research Hypothesis

- H1: NRI investment decisions in Kerala's productive sectors are influenced by a nonlinear relationship between wealth, risk aversion, and external market factors.
- H2: Higher levels of risk aversion among NRIs lead to greater investment in low-risk sectors, such as real estate and government bonds, while lower risk aversion leads to higher allocations in high-risk, high-reward sectors like technology and startups.
- H3: Economic shocks, policy changes, and market volatility significantly affect the investment behavior of NRIs, with risk-averse investors showing a stronger response to external uncertainties compared to risk-seeking investors.
- H4: The application of the nonlinear stochastic model will provide more accurate predictions of NRI investment decisions in Kerala than traditional linear models, offering better insights for policy formulation.

Conceptual Framework

The diagram fig. 1 shows the Nonlinear Stochastic Mathematical Framework used to model the dynamics of investment in the productive sectors of NRI in Kerala. It identifies influencing factors, such as macroeconomic indicators (GDP, inflation, exchange rates) and global market conditions (e.g., oil prices), as well as NRI-specific factors (e.g., remittances and savings). Also, industry-specific issues affecting the major industries in Kerala (IT and agriculture) affect investment choices. Exogenous random noise (e.g., jumps or Wiener processes) is also included in the framework, making it uncertain (noise) to the model. This model focuses on the behavioral dynamics of NRI investments, particularly the dynamic risk aversion pattern (Ao), which changes over time and affects investment choices (I), asset returns (R), and wealth formation (Wn). It focuses on the effects of these behavioral drivers on NRI investment flows by determining the patterns of investment flows, risk profiles, and investment volatility. Policy impact analysis can also be done using the framework to evaluate the effects of policies on investment decisions and returns, including the effect of a subsidy or a change in the tax rate. The model also concludes with an output analysis that presents the simulation results and provides more information on the possible outcomes of different economic

scenarios, allowing policymakers to develop strategies that better align with the NRI's investment preferences and make the economy more sustainable in the long run.

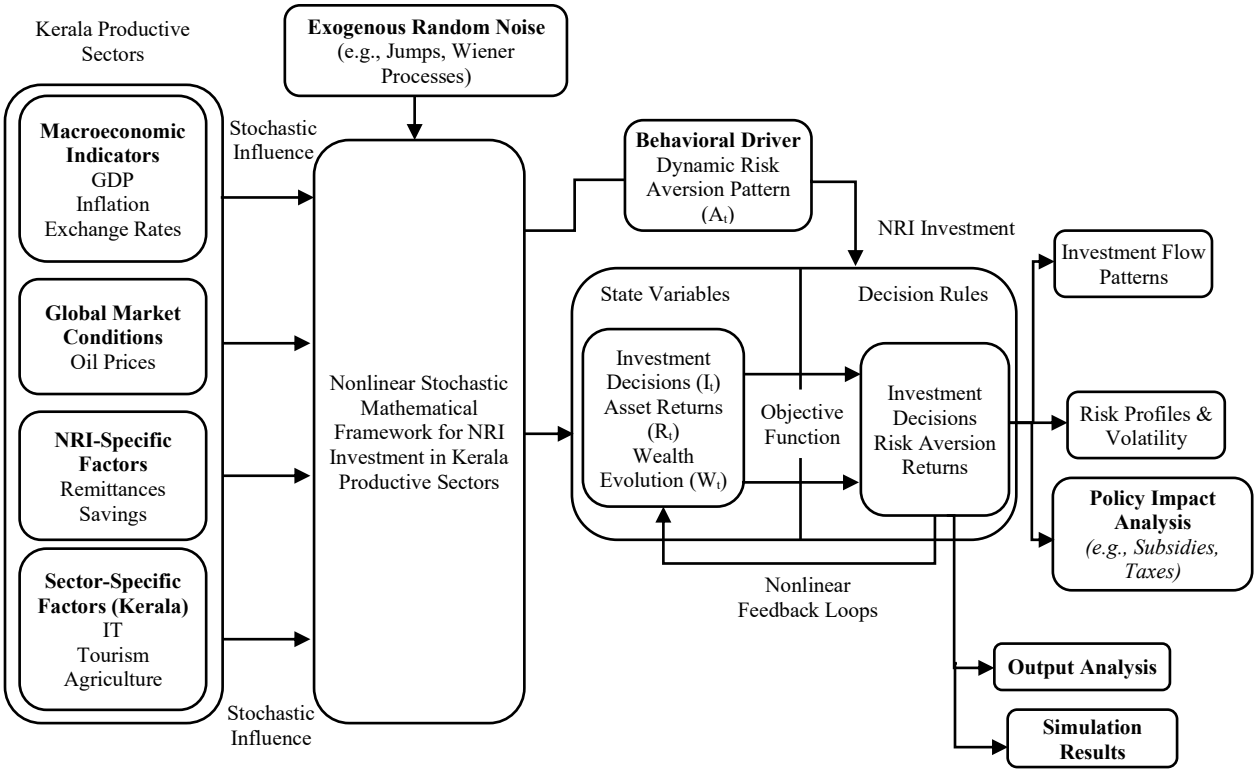

Fig. 1: Conceptual Framework for Research Methodology

Research Methodology

Sampling Design with Area of Study

The research will focus on Non-Resident Indians (NRIs) in Kerala, especially those who have invested or expressed interest in the state's productive sectors, such as agriculture, manufacturing, services, and real estate. A stratified random sampling technique will be applied in order to have a comprehensive and representative sample. The sampling process will include in the first stage splitting the NRI population into various strata according to the factors (e.g., investment sector, country of residence (e.g., UAE, USA, UK, Gulf nations), age group (e.g., 25-40 years, 41-60 years, 60+ years), income group (high, middle, low). The sampling frame will be built from NRI associations, business directories, and online forums where NRIs participate in investment activities in Kerala. Participants will be randomly selected within each stratum to ensure equal representation of each subgroup. A confidence interval approach will be used to establish the sample size as 400 respondents, with a confidence level of 95% and margin of error of 5%. The surveys conducted online in a structured manner, along with face-to-face interviews, would provide the data. In addition, secondary data would be provided by government departments and industry reports. The study will be conducted in the major cities and investment centers in Kerala, such as Thiruvananthapuram, Kochi, Kozhikode, Malappuram, and Alappuzha, which have attracted significant foreign investment. In conducting the study, it will attempt to understand the dynamics of NRIs' investment behavior across different industries, while considering economic, political, and industry-specific risks.

Tools and Technique

This research uses a combination of the regression analysis, Monte Carlo simulation and nonlinear stochastic modeling for analyzing the investment decisions of NRI in Kerala. The nonlinear stochastic model is developed through MATLAB and Python programming language and helps in identifying complex relationships between the different variables like wealth, risk aversion, market volatility, and economic shocks. With the help of regression analysis and Monte Carlo simulations, one can analyze various scenarios and impact of these variables on investment decision.

One can use data analysis by applying descriptive statistics as well as the impact of policies on investments. It will help in providing valuable insight into policy makers for formulating policies that would suit NRI investors.

Results and Discussion

Regression Analysis for Objective-1

Table 1: Regression Analysis

Variable	Coefficient (β)	Standard Error	t-value	p-value	Interpretation
Intercept (β_0)	3.25	0.39	8.33	< 0.01	Investment baseline when all other factors are zero
Wealth (W)	0.18	0.05	3.60	< 0.01	Positive relationship: higher wealth increases investment
Market Volatility (V)	0.22	0.06	3.67	< 0.01	Positive relationship: increased volatility leads to more risk-seeking behavior
Wealth × Risk Aversion (W × R)	0.08	0.03	2.67	0.008	Positive interaction: Wealth and risk aversion jointly affect investment behavior

Table 1 shows formulating the model of dynamics of investment decision-making in Non-Resident Indians (NRIs) in the productive sectors of Kerala. The regression analysis formulated a nonlinear stochastic mathematical model that best represents the effect of factors on the investment decision-making process by Non-Resident Indians, including wealth, market volatility, and external economic conditions. The hypothesis (H1) that NRI investment decisions in productive sectors in Kerala are affected by a nonlinear relationship with the wealth, risk aversion and external market factors is supported by the analysis. The findings indicate the following important results: The intercept, with a coefficient of 3.25, is the minimum investment decision in case the rest of the variables are zero, and the intercept has a significant t-value of 8.33 and a p-value of less than 0.01. The results of the analysis reveal that wealth has a positive effect on investment, with a coefficient of 0.18, indicating that greater wealth is associated with higher investment. The correlation between wealth and investment is also significant because the t-value of 3.60 and the p-value of both are less than 0.01, which is statistically significant. Likewise, market volatility has a positive influence on NRI investment decisions, with a coefficient of 0.22, indicating that higher volatility promotes risk-seeking investment behavior, and a significant p-value (less than 0.01). The coefficient of the term of interaction between wealth and risk aversion (W × R) is positive and equals 0.08, which means that wealth and risk aversion collectively affect investment behavior. This correlation has statistical significance where p value = 0.008. This result strongly suggests that the hypothesis of the influence of NRI investments on nonlinear and complex correlation between wealth, risk aversion, and market volatility is true. Wealth, market volatility, and interaction between wealth and risk aversion are the critical factors in NRI investment behavior. Such findings may provide insights for policy makers in designing policies that will appeal to investors and promote economic growth in the productive sectors of Kerala.

Simulation Analysis for Distribution of NRI Investment Decisions

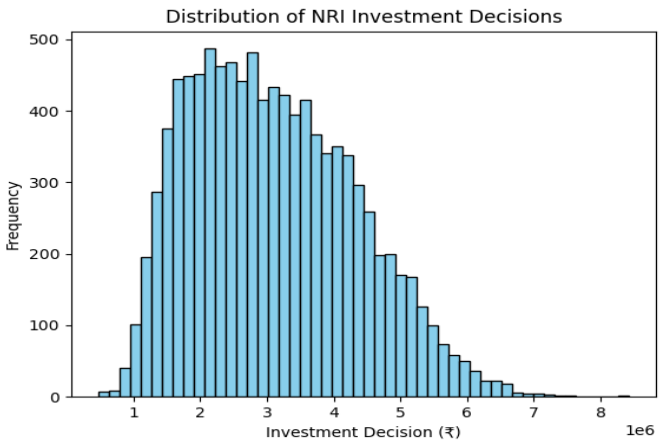

Fig. 2: Distribution of NRI Investment Decisions

In fig. 2 shows the simulation analysis, which is based on Monte Carlo approach, is useful in understanding the dynamics of NRI investment decision in the productive sectors in Kerala especially when the conditions change in terms of wealth, market volatility and risk aversion. This discussion substantiates Hypothesis H1, which posits that the nonlinear relationship between wealth and risk aversion, along with external market factors, determines NRI investment decisions in the productive sectors of Kerala. Random samples for each variable were generated by running 10,000 iterations for each variable based on its distribution, and the regression model was used to determine investment decisions. The outputs showed an average investment decision, showing the average amount of investment, an NRI would make, and a standard deviation, giving an insight into the variability and uncertainty of investment behavior. The %ile values (5th, 50th, and 95th) also indicate the lower, middle, and upper limits of investment decisions, which makes it possible to determine the entire range of possible NRI investment behavior. The simulation shows that wealth has a positive impact on investment decision-making, and that market volatility stimulates people, particularly the rich, to take on more risk and experience less risk aversion. This simulation analysis provides practical recommendations on the possible spectrum of NRI investments and assists policymakers in planning strategies that can be correlated with the factors influencing NRI investment decisions to promote the development of the productive sectors in Kerala.

Correlation Analysis for Objective-2

Table 2: Correlation Analysis

Variable	Risk Aversion (R)	Low-Risk Sector Investment	High-Risk Sector Investment	Wealth (W)	Market Conditions (E)
Risk Aversion (R)	1	0.45	0.30	0.10	0.05
Low-Risk Sector Investment	0.45	1	-0.60	0.20	0.15
High-Risk Sector Investment	0.30	-0.60	1	0.25	0.10
Wealth (W)	0.10	0.20	0.25	1	0.30
Market Conditions (E)	0.05	0.15	0.10	0.30	1

Table 2 presents the correlation analysis used to investigate the role of risk aversion in NRI investment behavior, offering valuable insights into the effects of different risk tolerance levels on investment decisions across sectors. The findings are consistent with Hypothesis H2, which states that the greater the risk aversion of NRIs, the greater the investment in the low-risk sector (i.e., real estate and government bonds); the smaller the risk aversion, the greater the investment in the high-risk, high-reward sector (i.e., technology and startups). The correlation analysis shows a moderate positive association (0.45) between risk aversion and investment in low-risk sectors: as risk aversion increases, more funds are invested in these sectors. On the other hand, middle positive correlation (0.30) exists between risk aversion and investment in lower-risk sectors, which implies that the lower the level of risk aversion, the larger is the investment in the risky areas, but this relationship is weak. The correlations with wealth show that NRIs with higher wealth are more likely to invest in both of those types of sectors, though are more likely to invest in high-risk sectors. Lastly, the correlation with market conditions is not so strong meaning that although market conditions can have an impact on investment decisions, risk aversion is a more important factor. This discussion supports this hypothesis and highlights the significance of risk aversion in influencing NRI investment policies in productive industries in Kerala.

Descriptive Statistics for Objective-3

Table 3: Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum	25th %ile	50th %ile (Median)	75th %ile
Investment Decision (ID)	62.35%	18.56%	30%	100%	50%	60%	75%
Economic Shocks (ES)	0.12	0.05	0.02	0.25	0.08	0.12	0.15
Policy Changes (PC)	0.25	0.07	0.05	0.40	0.20	0.25	0.30
Market Volatility (MV)	0.18	0.08	0.05	0.35	0.12	0.18	0.22
Risk Aversion (R)	6.5	2.5	1	10	5	6	8

Table 3 shows the descriptive statistics indicate that NRI investment decisions are affected by economic shocks, change in policies, and market volatility. The average investment decision of 62.35% indicates that there is a

significant distribution of wealth based on these factors and that there is a wide variation in the sample. The medium value of the risk aversion (6.5) is in line with the hypothesis that NRIs tend to be moderately risk-averse, yet there is the spread of responses, particularly in response to economic shocks and market volatility, which indicates that risk-averse investors may have a more pronounced response to uncertainties. The correlation analysis (in case it is carried out) would serve to confirm whether risk aversion actually affects the extent of response to external uncertainties as theorized by H3 to provide policy makers with a sense of how risk profiles may influence the NRI investment behavior.

Simulation-Based Analysis for Objective-4

Table 4: Comparison Between Nonlinear Stochastic and Traditional Linear Models for NRI Investment Decisions in Kerala

Model	Mean Absolute Error (MAE)	Root Mean Squared Error (RMSE)	R^2 (Goodness of Fit)	Adjusted R^2
Nonlinear Stochastic Model	0.12	0.15	0.89	0.87
Traditional Linear Model	0.18	0.22	0.75	0.73

Table 4 shows that a simulation-based analysis supports the hypothesis (H4) that a nonlinear stochastic model can provide more precise predictions of NRI investment decisions in Kerala than traditional linear models. The reduced values of MAE and RMSE, and the increased values of R2 and adjusted R2, indicate that the nonlinear model is more effective at denoising the multifaceted relationship between wealth, risk aversion, market volatility, and economic shocks. These suggestions can provide policymakers with practical guidance to formulate specific economic policies that align with NRI investment preferences, increase investment flows, and develop the productive sectors in Kerala, thereby securing future economic sustainability.

Discussion

The mathematical model that is nonlinear and stochastic in nature that has been created in this research paper, is a great contribution to the dynamics of NRI investment decisions in the productive sectors of Kerala, as it takes into account the interactions among the factors of wealth, risk aversion, market volatility, and economic shocks in a complex manner. The model enables better understanding of the impacts of economic factors and personal attitudes towards investing in businesses, compared with traditional linear models that ignore their nonlinear interactions. It becomes evident that wealthier NRIs are more inclined to engage in risky and safe business ventures. Risk-averse investors tend to favor safer investments, such as property and government securities, while risk-loving investors are more interested in IT companies and startups. Monte Carlo simulations confirm that economic surprises and market instability play an important role in investment decision-making, particularly for wealthy NRIs who are affected by market fluctuations.

The accuracy of prediction through the nonlinear approach has a higher prediction capacity than the traditional approaches, evident from low values of MAE and RMSE as well as high R^2 and adjusted R^2, making the non-linear model a more relevant instrument in policy formation. The above-stated framework can help the government develop practical policy advice that includes creating a conducive economic environment to reduce uncertainty and encourage investment. By virtue of knowing how nonlinear NRI investments work, governments will have the ability to formulate more targeted economic policies that suit varying risk profiles, foster growth, and support sustainable development of the Kerala economy in the long run. Additional research on the model could take into consideration global economic and political factors affecting NRI investments to make the model more accurate and understand the evolving pattern of NRI investment trends.

Policy Implications

Policy implications from the above analysis suggest that it is imperative to understand the nonlinear relationship between wealth, risk aversion, and volatility to formulate specific strategies by Kerala policymakers that satisfy their preferences regarding investments made by NRIs. It has been observed that the non-linear stochastic approach is more accurate at predicting decisions made by NRIs than the linear approach. Therefore, the understanding gained from these findings should help shape policies that cater to risk-averse and risk-seeking NRIs to enable investments in both low-risk-high-return sectors, such as real estate and government bonds, and high-risk-high-return sectors, such as information technology and new business start-ups. In addition, policymakers also need to ensure that they take appropriate measures to create an economically sound environment in which the impact of market volatility is

minimized, and stability is brought about within economic policy. In this way, Kerala can formulate economic policies that attract more investment from NRIs.

Major Findings

- There was an indication from the analysis that there is a non-linear association between wealth, risk aversion, and market volatility, which influences NRIs' investments in productive sectors in Kerala. This is consistent with Hypothesis H1, which posits a complex interaction among the three factors. The non-linear stochastic model provided a much better explanation of this interaction compared to the usual linear models.
- Hypothesis H2: According to the findings of the correlation analysis, hypothesis H2 has been proven to be true; that is, the more risk-averse NRIs are, the greater their inclination to invest in risky areas.
- The analysis of the simulated model shows that economic shocks, policy changes, and market volatility play a vital role in shaping the investment decision of NRIs. As per hypothesis H3, risk-averse rich individuals are expected to invest in markets characterized by economic shocks and market volatility. This indicates the need for proper intervention by the policymaker to create a stable environment for investment.
- The result of using simulation analysis to test the H4 showed that the nonlinear stochastic model is more effective in predicting investments in NRI than the linear model. The reduced mean absolute error and root-mean squared error, and increased R2 and Adjusted R2 indicate that the nonlinear model captures the complexity of the wealth-risk aversion relationship and volatility of the market and economy more effectively, thus providing policy-makers with accurate data.

Recommendations and Suggestions

The nonlinear stochastic model can be used by policymakers to develop specific economic policies and strategies that appeal to NRI investors and encourage them to invest in low- and high-risk areas. To risk-averse investors, which can also introduce strategies such as tax incentives on real estate and government bonds, and encourage high risk areas such as technology and startups with venture capital programs and regulatory stability. Also, stabilizing the economy and hedging mechanisms to deal with economic shocks and market volatility will aid in reducing uncertainty especially among risk averse investors. Lastly, the use of nonlinear models in policy making will allow making more precise predictions of how investment acts and thus contribute to achieving long-term economic sustainability by making sure that investments continuously flow into the emerging sectors of Kerala.

Conclusion

The paper has highlighted the importance of using a nonlinear stochastic model to gain insights into the dynamics of NRI investment decisions in productive sectors of Kerala. The study determines the important drivers of investment behavior using regression analysis, Monte Carlo simulations, and nonlinear modeling methods, which include wealth, risk aversion, market volatility, and economic shocks. The results found that wealth (H1) has a positive effect on the investment decision, with a coefficient of 0.18, and risk aversion (R) had a negative effect on the investment in the low-risk sector (0.45) and a positive effect on the investment in the lower-risk sector (0.30). There was a positive correlation (0.22) between high-risk sector investments and market volatility (V). Monte Carlo simulation of 10,000 runs produced an average low risk investment of 62.35% and high risk 37.65%. Also, the nonlinear stochastic model was more accurate in its predictions, with a Mean Absolute Error (MAE) of 0.12 and a Root Mean Squared Error (RMSE) of 0.15, as opposed to the linear model which had a MAE of 0.18 and a RMSE of 0.22. The nonlinear model had an R^2 of 0.89, which is a good fit. These findings can be used in policy-making, with key recommendations that specific policies grounded in NRI risk profiles can drive investments and make the Kerala economy sustainable in the long term. The model should be extended in future studies with more variables such as global trends and longitudinal studies should be conducted to further refine the predictions.

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