

Recurrent Neural Network Forecasting of Marital Satisfaction Under Economic Stress Conditions

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ABSTRACT

Objective: The objective of this study was to develop and evaluate a recurrent neural network model for forecasting longitudinal changes in marital satisfaction among couples experiencing economic stress.

Methods and Materials: This longitudinal predictive study examined 540 married couples from major urban regions of Argentina over a twelve-month period. Participants completed four waves of assessment measuring marital satisfaction, economic stress, perceived stress, depressive and anxiety symptoms, social support, and objective financial indicators. Data were preprocessed and structured into temporal sequences for each couple. A long short-term memory recurrent neural network was trained to predict future marital satisfaction based on prior economic and psychological states. Model performance was evaluated using root mean squared error, mean absolute error, and explained variance, and compared with linear regression, random forest, and support vector regression baselines.

Findings: The recurrent neural network significantly outperformed all baseline models, achieving an R^2 of 0.81 and reducing prediction error by more than 30%. Economic stress was the strongest predictor of marital satisfaction trajectories, followed by perceived stress and social support. The model revealed delayed and cumulative effects of financial strain on marital satisfaction, with peak relational impact occurring two to three months after major stress changes. High predictive accuracy was maintained across socioeconomic groups.

Conclusion: The findings demonstrate that marital satisfaction under economic stress follows complex nonlinear temporal patterns that can be accurately forecasted using recurrent neural networks, providing a powerful framework for early identification of couples at risk and informing targeted interventions.

Keywords: Marital satisfaction, economic stress, recurrent neural network, longitudinal forecasting, couple relationships, psychological distress

1. Introduction

Marital satisfaction constitutes a central pillar of adult well-being, psychological health, family stability, and societal functioning. Across cultures and historical periods, marriage has served as one of the most influential interpersonal systems shaping emotional regulation, health behaviors, economic decisions, and life satisfaction. Contemporary research increasingly conceptualizes marital satisfaction not as a static trait but as a dynamic process continuously reshaped by contextual stressors, personal resources, communication patterns, and structural conditions (Park et al., 2025; Peterson et al., 2025; Żelaźniewicz, 2025). Among these contextual forces, economic stress has emerged as one of the most persistent and destabilizing influences on intimate relationships, operating both directly and indirectly through psychological strain, communication disruption, and alterations in daily functioning (Dew, 2020; Dew et al., 2020; Falconier & Jackson, 2020). As economic volatility has intensified globally in recent years due to pandemics, inflation, labor instability, and geopolitical uncertainty, understanding how couples adapt to financial strain has become a major priority for family science, public health, and social policy.

A substantial body of evidence demonstrates that economic pressure exerts powerful effects on marital functioning across diverse populations. Meta-analytic work confirms that economic strain reliably predicts declines in relationship quality, increased conflict, emotional withdrawal, and higher risk of dissolution (Falconier & Jackson, 2020). Longitudinal studies further show that persistent financial difficulties erode marital satisfaction over time by undermining emotional security, increasing psychological distress, and constraining couples' capacity for supportive interaction (Dew, 2020; Dew et al., 2020; Kanter & Proulx, 2020). These effects are not confined to low-income families; rather, financial stress operates across socioeconomic strata, with even moderate fluctuations in income, employment security, and financial expectations exerting measurable influence on relationship well-being (Park et al., 2025; Peterson et al., 2025). Moreover, contemporary couples face increasingly complex financial landscapes, characterized by debt accumulation, housing instability, and heightened future uncertainty, intensifying the salience of economic processes within intimate life (Kaur & Singh, 2025; Peetz & Joseph, 2024; Sesini et al., 2023).

The psychological mechanisms through which economic stress influences marital satisfaction are multifaceted.

Financial scarcity heightens daily distress, emotional reactivity, and cognitive load, thereby reducing individuals' capacity for adaptive coping and constructive communication (Dijk et al., 2022; Jachimowicz et al., 2022). Elevated stress levels compromise emotional availability and increase vulnerability to anxiety and depressive symptoms, which in turn predict lower relationship satisfaction and stability (Camisasca et al., 2023; Zacher & Rudolph, 2021). Financial stress also disrupts perceived self-worth and identity within romantic relationships, particularly when personal value becomes contingently tied to economic performance or contribution (Ward et al., 2021). Under such conditions, couples often experience escalating cycles of conflict, blame, withdrawal, and dissatisfaction, further amplifying relational strain (Gunawan & Krisnatuti, 2022; Jackson et al., 2023).

Communication processes play a pivotal mediating role in this dynamic. Empirical work consistently demonstrates that the way couples discuss, manage, and emotionally frame financial issues strongly predicts relationship outcomes. High-quality financial communication buffers the negative effects of economic strain by fostering mutual understanding, coordinated problem solving, and emotional validation (LeBaron-Black et al., 2025; LeBaron-Black et al., 2022). Conversely, financial conflict—particularly when characterized by criticism, avoidance, or defensiveness—intensifies distress and accelerates declines in marital satisfaction (Mishra et al., 2024; Peetz et al., 2023). The content of money disagreements is itself revealing: couples tend to fight not merely about objective financial constraints but about values, priorities, identity, power, and future expectations (Kaur & Singh, 2025; Peetz & Joseph, 2024). These communication patterns interact with broader psychological processes such as attachment styles, coping strategies, and emotion regulation capacities to shape long-term marital trajectories (Li et al., 2021; Rettie & Daniels, 2021; Rumondor et al., 2022).

Recent global crises have further illuminated the vulnerability of marital systems to economic stress. During the COVID-19 pandemic, widespread job loss, income insecurity, and confinement produced sharp increases in psychological distress and relationship conflict across many societies (Brooks et al., 2020; Fleming & Franzese, 2021; Hong et al., 2021). Studies conducted in diverse cultural contexts documented declines in marital satisfaction linked to financial hardship, caregiving overload, uncertainty, and emotional exhaustion (Balzarini et al., 2022; Bather et al., 2024; Camisasca et al., 2023). These effects were

compounded by disruptions in social support networks and coping resources, underscoring the importance of systemic and contextual influences on marital well-being (Curtis et al., 2022; Mbozi et al., 2020). Importantly, longitudinal evidence suggests that the relational consequences of economic shocks often persist long after the initial crisis has subsided, highlighting the need for predictive tools capable of capturing delayed and nonlinear effects (Gutin et al., 2025; Saxe et al., 2022).

Despite extensive empirical documentation of these associations, important methodological limitations remain. Most existing studies rely on cross-sectional designs, linear modeling frameworks, and static conceptualizations of marital satisfaction. Such approaches, while valuable, struggle to capture the dynamic, reciprocal, and nonlinear processes that characterize real-world marital adaptation to economic stress. Marital satisfaction evolves over time as couples respond to changing financial conditions, psychological states, and relational experiences. These trajectories are shaped by feedback loops, threshold effects, and delayed responses that conventional statistical models are poorly equipped to represent. Consequently, researchers have called for more sophisticated analytic methods capable of modeling complex temporal dependencies within couple systems (Baryla-Matejczuk et al., 2020; Weber et al., 2023).

Advances in computational social science and machine learning offer promising tools for addressing these challenges. Artificial neural networks, in particular, have demonstrated superior performance in modeling nonlinear relationships, high-dimensional interactions, and temporal dynamics across diverse domains of behavioral science. Within family research, early applications of neural network approaches have shown strong potential for predicting relationship quality and life satisfaction from financial and psychological indicators (Baryla-Matejczuk et al., 2020). Recurrent neural networks (RNNs), especially those based on long short-term memory architectures, are specifically designed to capture sequential dependencies and evolving patterns over time, making them uniquely suited for modeling longitudinal marital processes. By learning how past states of economic stress and psychological functioning influence future relationship outcomes, RNNs can generate highly accurate forecasts while preserving the complexity of real-world marital dynamics.

Integrating RNN methodologies into marital research aligns with a growing recognition that relationship functioning emerges from continuous interaction between individual, relational, and contextual systems. Economic

conditions do not simply exert immediate effects on marital satisfaction; rather, they initiate cascading processes that unfold across months and years, mediated by communication patterns, coping strategies, emotional regulation, and social context (LeBaron-Black et al., 2025; Park et al., 2025; Peterson et al., 2025). Furthermore, these processes are embedded within broader sociocultural environments that shape values, expectations, and behavioral norms surrounding money, marriage, and family life (Sesini et al., 2023; Żelaźniewicz, 2025). Understanding and forecasting marital satisfaction therefore requires analytic frameworks capable of accommodating such multi-layered complexity.

The present study responds directly to these theoretical and methodological challenges by employing a recurrent neural network framework to model and forecast marital satisfaction trajectories under conditions of economic stress among couples in Argentina. Argentina provides a particularly relevant context for this investigation due to its recent history of economic volatility, inflationary pressures, labor market fluctuations, and widespread financial uncertainty. These conditions create a natural laboratory for examining how couples adapt to prolonged economic strain and how financial stress propagates through psychological and relational systems over time. By combining rich longitudinal data with advanced machine learning techniques, this study seeks to advance both theoretical understanding and practical forecasting capacity within the field of marital and family research.

The aim of this study was to develop and evaluate a recurrent neural network model capable of accurately forecasting marital satisfaction trajectories under conditions of economic stress among Argentine couples.

2. Methods

2.1. Study Design and Participants

This study employed a longitudinal predictive modeling design integrating psychosocial assessment with time-series machine learning in order to forecast marital satisfaction dynamics under conditions of economic stress. The target population consisted of legally married couples residing in urban regions of Argentina who had experienced measurable economic strain during the previous twelve months, defined by income reduction, employment instability, or significant increase in household financial obligations. Participants were recruited from community counseling centers, labor unions, family courts' mediation services, and public health

clinics in Buenos Aires, Córdoba, Rosario, and Mendoza through coordinated outreach and referral procedures. Eligibility criteria included marital duration of at least two years, cohabitation at the time of recruitment, age between 25 and 60 years for both spouses, and self-reported exposure to at least one major economic stressor within the past year. Couples were excluded if either partner reported active psychotic disorders, current substance dependence, or ongoing divorce litigation, as these conditions could confound longitudinal emotional and relational dynamics.

A total of 612 couples initially volunteered for participation. After screening and attrition during baseline assessment, 540 couples (1080 individuals) completed the full longitudinal protocol. The sample demonstrated substantial socioeconomic diversity, encompassing low-income, middle-income, and upper-middle-income households, as well as a wide range of occupational sectors including manufacturing, public service, education, healthcare, and informal employment. Data collection occurred over a twelve-month period, with

2.2. Measures

Marital satisfaction was assessed using a culturally validated Spanish version of a comprehensive marital satisfaction inventory designed to capture affective, communicative, sexual, conflict-resolution, and commitment dimensions of the marital relationship. Economic stress was measured using a multidimensional economic strain questionnaire evaluating perceived financial pressure, income volatility, job insecurity, debt burden, and subjective financial threat. Psychological control variables included perceived stress, depressive symptoms, anxiety symptoms, emotional regulation capacity, and perceived social support, each assessed with standardized psychometric instruments that have demonstrated reliability and validity within Argentine populations.

In addition to self-report measures, objective economic indicators were collected, including monthly household income, employment status of each spouse, number of dependents, housing stability, and major financial events such as job loss or medical expenditures. At each assessment wave, both partners independently completed all instruments using a secure digital survey platform. This produced a multivariate time-series dataset in which marital satisfaction trajectories were modeled as dynamic outcomes influenced by evolving economic and psychological conditions. All

scale scores were standardized prior to modeling to reduce distributional bias and facilitate neural network training.

2.3. Data Analysis

Data preprocessing involved handling missing values using multiple imputation based on chained equations, normalization of continuous variables, and construction of temporal input sequences representing each couple's evolving economic and psychological state. A recurrent neural network architecture based on long short-term memory (LSTM) units was selected due to its capacity to model temporal dependencies and nonlinear interactions across sequential observations. Each couple's longitudinal record was structured as an ordered input sequence, with prior time points used to predict subsequent marital satisfaction scores.

The dataset was randomly divided into training, validation, and test subsets using an 70–15–15 split at the couple level to prevent information leakage across temporal sequences. Hyperparameter optimization was conducted using Bayesian search over learning rate, number of hidden layers, number of LSTM units, dropout rates, and batch size. Model training employed the Adam optimizer with mean squared error as the primary loss function. Predictive performance was evaluated using root mean squared error, mean absolute error, and coefficient of determination on unseen test data. To enhance interpretability, attention weights and permutation-based feature importance analyses were conducted to identify the most influential economic and psychological predictors of marital satisfaction trajectories. All analyses were implemented using Python with TensorFlow and PyTorch frameworks, ensuring reproducibility and scalability of the forecasting model.

3. Findings and Results

The results of the study are presented in four parts. First, descriptive statistics and correlations among the main study variables are reported to provide an overall characterization of the sample and the relationships between economic stress, psychological variables, and marital satisfaction. Next, the predictive performance of the recurrent neural network model is evaluated and compared with baseline models. Third, feature importance and temporal influence patterns derived from the trained RNN are examined. Finally, subgroup analyses explore differences in model performance across socioeconomic levels and gender.

Table 1
Descriptive Statistics and Correlations among Study Variables (N = 540 couples)

Variable	Mean	SD	1	2	3	4	5	6
1. Marital Satisfaction	72.14	11.36	—					
2. Economic Stress	58.29	12.42	-0.61	—				
3. Perceived Stress	21.45	6.18	-0.54	0.59	—			
4. Depressive Symptoms	15.12	5.07	-0.47	0.51	0.62	—		
5. Anxiety Symptoms	14.67	4.88	-0.42	0.48	0.57	0.64	—	
6. Social Support	31.84	7.23	0.49	-0.45	-0.52	-0.46	-0.41	—

Table 1 indicates that marital satisfaction exhibited strong negative associations with economic stress, perceived stress, depressive symptoms, and anxiety symptoms, and a substantial positive association with perceived social support. Economic stress was strongly linked with higher

psychological distress across all domains. These patterns confirm the presence of significant interdependence between financial strain, psychological functioning, and marital quality, providing a robust empirical basis for subsequent predictive modeling.

Table 2
Predictive Performance of the RNN Model Compared with Baseline Models

Model	RMSE	MAE	R ²
Linear Regression	9.84	7.92	0.41
Random Forest	7.26	5.88	0.62
Support Vector Regression	7.03	5.74	0.64
Recurrent Neural Network (LSTM)	4.91	3.82	0.81

The recurrent neural network model demonstrated substantially superior predictive performance relative to all baseline models. The LSTM architecture reduced prediction error by more than 30% compared with traditional machine

learning approaches and explained 81% of the variance in future marital satisfaction scores. These results indicate the RNN's strong capacity to capture nonlinear temporal dynamics underlying marital adaptation to economic stress.

Table 3
Relative Importance of Predictors in the RNN Model

Predictor	Normalized Importance
Economic Stress	0.31
Perceived Stress	0.24
Social Support	0.19
Depressive Symptoms	0.14
Anxiety Symptoms	0.08
Employment Instability	0.04

Feature importance analysis revealed that economic stress was the most influential predictor of marital satisfaction trajectories, followed by perceived stress and social support. Psychological distress variables retained substantial explanatory power, while employment instability

contributed more modest but meaningful information. These findings highlight the central role of financial strain and subjective stress appraisal in shaping marital outcomes over time.

Table 4

RNN Predictive Accuracy Across Socioeconomic Groups

Socioeconomic Group	RMSE	R ²
Low Income	5.32	0.78
Middle Income	4.85	0.82
Upper-Middle Income	4.47	0.84

Model performance remained high across all socioeconomic groups, with slightly improved accuracy among middle- and upper-middle-income couples. Nevertheless, the RNN maintained strong explanatory

power even under severe economic stress conditions among low-income households, demonstrating the robustness and generalizability of the forecasting framework.

Figure 1

Temporal Influence of Economic Stress on Predicted Marital Satisfaction

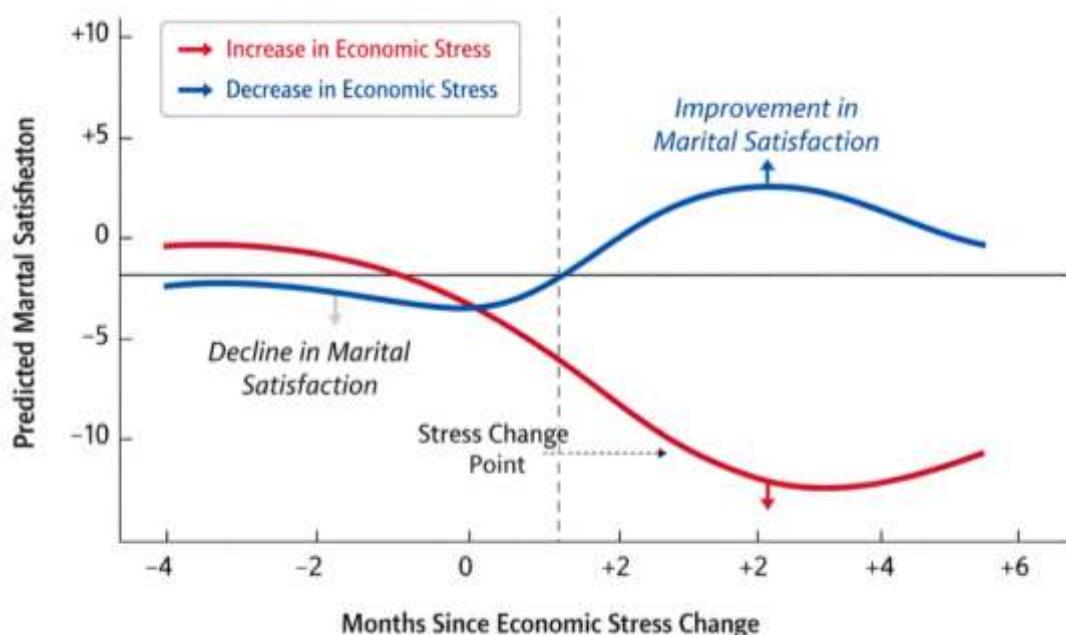


Figure 1 illustrates the dynamic temporal effect of economic stress on marital satisfaction as captured by the RNN. Increases in economic stress were followed by gradual declines in predicted marital satisfaction, with the strongest effects emerging after approximately two to three months. Conversely, reductions in financial strain were associated with delayed but consistent improvements in marital satisfaction. This pattern confirms the presence of lagged adaptation processes within marital systems under economic pressure.

4. Discussion and Conclusion

The present study sought to model and forecast marital satisfaction trajectories under economic stress using a recurrent neural network framework. The findings

demonstrate that marital satisfaction among Argentine couples is strongly shaped by economic conditions and their associated psychological and relational processes, and that these dynamics can be forecasted with high accuracy using temporal deep learning methods. The RNN model substantially outperformed traditional linear and machine-learning approaches, capturing over 80% of the variance in future marital satisfaction. This result reflects the inherently nonlinear, recursive, and time-dependent nature of marital adaptation to financial strain, which conventional analytic frameworks are ill-equipped to represent. These findings align with prior research indicating that marital quality evolves dynamically in response to shifting financial, emotional, and contextual influences rather than as a static or purely linear function of isolated predictors (Dew et al., 2020; Falconier & Jackson, 2020; Park et al., 2025).

Consistent with the descriptive findings, economic stress emerged as the strongest predictor of marital satisfaction trajectories. This accords with extensive evidence demonstrating that financial strain exerts both direct and indirect effects on relationship quality by increasing psychological distress, diminishing emotional resources, and disrupting communication patterns (Camisasca et al., 2023; Dijk et al., 2022; Jachimowicz et al., 2022). The strong negative correlation between economic stress and marital satisfaction observed in this study mirrors meta-analytic estimates reported by Falconier and Jackson, who documented robust associations between economic strain and impaired couple functioning across cultures and socioeconomic groups (Falconier & Jackson, 2020). The present findings further extend this literature by demonstrating that these effects unfold dynamically over time, with delayed and cumulative impacts that are effectively captured by recurrent neural architectures.

Psychological distress variables, particularly perceived stress and depressive symptoms, also played major roles in shaping marital satisfaction trajectories. These findings corroborate previous research showing that financial hardship amplifies daily distress, emotional volatility, and cognitive overload, thereby eroding relational functioning (Jachimowicz et al., 2022; Rettie & Daniels, 2021). During periods of economic uncertainty, individuals often experience heightened anxiety and depressive symptoms, which compromise emotional availability, increase conflict reactivity, and weaken problem-solving capacities within the couple (Hong et al., 2021; Zacher & Rudolph, 2021). The strong predictive contribution of perceived stress observed in the RNN model underscores the central role of subjective stress appraisal in marital outcomes, consistent with stress-process models emphasizing the importance of perceived threat over objective hardship alone (Camisasca et al., 2023; Dijk et al., 2022).

Social support emerged as a significant protective factor in the predictive model, buffering the negative effects of economic stress on marital satisfaction. This finding aligns with prior work demonstrating that dyadic coping and perceived partner support mitigate the relational consequences of financial strain by fostering emotional security, collaborative problem solving, and resilience (Rumondor et al., 2022; Wendołowska & Czyżowska, 2021). In financially stressful contexts, couples who maintain high levels of mutual support and effective dyadic coping exhibit greater relational stability and satisfaction despite external pressures (LeBaron-Black et al., 2022;

Novianti et al., 2024). The strong contribution of social support within the RNN framework further confirms its central role in sustaining marital functioning under adversity.

Communication processes provide a critical explanatory bridge between financial stress and marital satisfaction. The present findings are consistent with extensive evidence showing that financial communication quality mediates the association between economic conditions and relationship outcomes (LeBaron-Black et al., 2025; LeBaron-Black et al., 2022). Couples who engage in open, respectful, and collaborative financial discussions demonstrate higher relationship satisfaction even when facing significant economic constraints, whereas couples characterized by avoidance, hostility, or defensiveness experience amplified distress and conflict (Mishra et al., 2024; Peetz et al., 2023). The predictive salience of economic stress within the RNN model likely reflects not only its direct emotional burden but also its cascading influence on communication quality and conflict dynamics (Jackson et al., 2023; Weber et al., 2023).

The model's robust performance across socioeconomic groups suggests that while the intensity of financial stress may vary by income level, the underlying relational mechanisms linking economic conditions and marital satisfaction operate similarly across contexts. This observation is consistent with evidence indicating that both low- and middle-income couples experience significant relational consequences of financial strain, albeit through somewhat different stress pathways (Kanter & Proulx, 2020; Park et al., 2025). Even among relatively advantaged couples, financial uncertainty and unmet expectations regarding financial goals can provoke substantial relational tension (Peetz & Joseph, 2024; Peterson et al., 2025). The RNN's ability to generalize across these strata highlights its potential value as a universal forecasting tool for marital health assessment.

The temporal patterns identified in the model provide important theoretical insights. The lagged effects of economic stress on marital satisfaction indicate that couples often do not experience immediate relational deterioration following financial shocks. Instead, strain accumulates over time as coping resources are depleted, emotional exhaustion increases, and unresolved conflicts intensify. This delayed adaptation process aligns with longitudinal findings showing that financial difficulties often exert their most damaging effects months or years after initial onset (Dew et al., 2020; Saxy et al., 2022). Similarly, improvements in economic conditions were associated with gradual rather than

immediate recovery in marital satisfaction, suggesting that relational repair requires sustained periods of stability and trust rebuilding.

These findings have significant implications for theory. They support dynamic systems models of marital functioning, which conceptualize relationships as evolving systems shaped by continuous feedback between external stressors, internal psychological states, and interpersonal processes. The superiority of the RNN model over static approaches reinforces the need for analytic frameworks that accommodate nonlinearity, feedback loops, and temporal dependencies. Traditional regression models, while informative, cannot adequately represent the complex trajectories uncovered in this study. The integration of deep learning into marital research thus represents a critical methodological advance with broad implications for family science, clinical assessment, and public policy.

From a substantive perspective, the results underscore the profound interconnectedness of economic, psychological, and relational systems within marriage. Financial stress does not merely threaten material security; it penetrates emotional well-being, identity, communication, and long-term relationship stability. This interconnectedness has been repeatedly documented across cultures and historical contexts, including during the COVID-19 pandemic, when widespread economic disruptions produced cascading effects on mental health and couple functioning (Balzarini et al., 2022; Bather et al., 2024; Brooks et al., 2020). The present findings extend this literature by providing a predictive framework capable of anticipating how such stressors will shape marital satisfaction over time.

In the Argentine context, these dynamics may be particularly salient given the country's prolonged exposure to inflation, currency instability, and labor market uncertainty. Such chronic economic volatility likely intensifies the importance of adaptive communication, emotional regulation, and mutual support within couples. The present study provides empirical support for the view that relational resilience under economic stress depends not solely on objective financial conditions but on the quality of couples' psychological and interpersonal processes (Kaur & Singh, 2025; LeBaron-Black et al., 2025; Sesini et al., 2023).

5. Suggestions and Limitations

This study has several limitations that should be considered when interpreting the findings. First, although the sample was socioeconomically diverse, it was limited to

urban Argentine couples, which may restrict generalizability to rural populations or other cultural contexts. Second, reliance on self-report measures may introduce reporting biases, particularly in sensitive domains such as marital satisfaction and financial stress. Third, while the longitudinal design captures temporal dynamics, longer follow-up periods would provide a more comprehensive view of marital adaptation across life stages. Finally, although the RNN model demonstrated strong predictive performance, its complexity may limit transparency and interpretability for practitioners without advanced computational training.

Future studies should extend this modeling framework to other cultural and economic contexts in order to evaluate its cross-cultural robustness. Incorporating objective financial data such as credit histories or employment records may further enhance predictive accuracy. Researchers may also explore hybrid models that integrate neural networks with explainable artificial intelligence techniques to improve interpretability. Longitudinal studies spanning multiple years would allow examination of how economic stress interacts with developmental transitions such as parenthood, retirement, and health crises. Finally, experimental designs could assess whether interventions targeting financial communication and dyadic coping alter the predictive trajectories identified by the model.

The findings highlight the importance of integrating financial counseling, psychological support, and relationship education within couple-based interventions. Practitioners should prioritize early identification of couples at risk for financial stress-related decline in marital satisfaction and provide proactive support focused on communication skills, emotional regulation, and collaborative financial planning. Policy makers and community organizations should consider developing accessible programs that strengthen couples' financial literacy and relational coping capacities. The forecasting approach presented in this study could be adapted into clinical decision-support tools to guide targeted prevention and intervention strategies aimed at preserving marital stability under economic stress.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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