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Financial Behaviors and Their Predictive Power on Stress: A Neutrosophic QCA Approach

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Abstract. This study examines the relationship between financial behaviors and financial stress levels in a representative sample of Mexican adults (N = 352). Two indices were constructed: the Financial Behavior Index – Psychological Factors (FBIPF) and the Financial Stress Index (FSI). To study the relationship between the two aspects, classical statistical correlation methods were replaced by the Neutrosophic Qualitative Comparative Analysis (NQCA). NQCA is a generalization of Crisp QCA and Fuzzy QCA to the neutrosophic framework, where, in addition to a truth value, an indeterminacy and falsity value are taken into account. In this way, indeterminacy and uncertainty are considered, gaining accuracy. On the other hand, the QCA method is a more flexible alternative to statistical correlation, since it uses set-based measures in situations where there are causal relationships between concepts, rather than equivalence. So, the existence of multicausality is modeled. The method is also an intermediate technique between qualitative and quantitative methods.

Keywords: Financial behavior, Financial stress, Financial well-being, Qualitative Comparative Analysis (QCA), Fuzzy Qualitative Comparative Analysis (FsQCA), Neutrosophic Qualitative Comparative Analysis (NQCA).

1 Introduction

Financial stress is a growing global phenomenon, with direct implications for emotional well-being, physical health, and quality of life. In contexts of high inequality and low financial inclusion, such as Mexico, understanding the behavioral determinants of financial stress is an urgent task both for designing public interventions and for strengthening individual resilience to economic crises.

Financial behaviors, understood as the daily practices of money management, saving, spending, and debt management, are recognized as a key factor in shaping economic well-being, beyond income level. However, questions remain about the true extent of these behaviors as a protective factor against financial stress, as well as about the psychosocial mechanisms that modulate them.

Financial stress has been conceptualized as a specific form of tension derived from the perception of financial inadequacy in meeting basic needs, fulfilling financial obligations, or coping with unforeseen emergencies. It is a subjective phenomenon that can coexist with various income levels and is associated with emotional states such as anxiety, hopelessness, and constant worry about money.

Various studies have documented the negative effects of financial stress on mental health and overall well-being. For example, some studies have found that chronic financial stress significantly predicts higher levels of depression, anxiety, and decreased psychological well-being. Older adults with financial insecurity have a higher incidence of depressive symptoms and perceived stress. In particular, financial instability has been linked to impaired daily functioning and difficulties in interpersonal relationships.

Financial behaviors, defined as habits, practices, and strategies related to money management (saving, budgeting, timely debt repayment, planning), have been identified as key elements that can mitigate or exacerbate financial stress. In general, studies suggest that higher-quality financial behaviors are associated with lower vulnerability to experiencing financial stress, even in conditions of limited income.

According to the theory of planned behavior, financial behaviors can be explained by attitudes, subjective norms, and perceptions of behavioral control. From this perspective, financial habits reflect not only structural conditions but also psychological factors such as financial self-efficacy, anticipatory concern for the future, and locus of financial control.

In recent studies, having savings, tracking income and expenses, and separating money for different purposes have been identified as practices that improve financial resilience in the face of adverse events. However, some

behaviors that might initially be considered positive, such as tracking expenses, could also be associated with high levels of stress if they reflect excessive vigilance or financial anxiety.

The availability of family or community support in the event of financial emergencies has also been suggested as a buffer against financial stress. The perception of having support networks increases the sense of control and reduces uncertainty in the face of financial crises. On the other hand, when people must resort to debt renegotiation, discounts, or extreme measures to cover daily expenses, the likelihood of financial and emotional deterioration increases.

In Mexico, recent data show that more than 60% of the adult population lacks sound financial habits and that this situation is associated with difficulties in dealing with economic emergencies, maintaining household stability, or long-term planning. Despite this, empirical studies directly linking individual financial practices with levels of financial stress remain scarce, especially on a large scale.

A representative study of the Mexican adult population found that only 43% of individuals planned their monthly expenses, and less than 30% had an emergency savings fund. These findings support the importance of strengthening appropriate financial behaviors as a preventative strategy for financial and psychological well-being.

In this context, the present study is based on the hypothesis that financial behaviors are not only a reflection of available economic resources but also of attitudes and cognitive strategies that impact the subjective experience of financial stress. Using a binary logistic regression model has been explored for predicting the presence or absence of protective financial behaviors, associated with the likelihood of experiencing medium or high levels of financial stress. This approach has contributed evidence to the international literature, contributing to the understanding of the psychosocial determinants of financial well-being in complex socioeconomic contexts such as Mexico.

This study aims to analyze the impact of financial behaviors on the level of financial stress perceived by adults in Mexico. It is hypothesized that proper financial management (planning, resource allocation, availability of support networks) significantly reduces the likelihood of experiencing financial stress, even in contexts of economic restriction. Through a quantitative and representative approach, the study seeks to provide useful evidence for designing educational, preventive, and public policy strategies aimed at improving the financial health of the population.

In the study, we propose to use the most recent results on the Qualitative Comparative Analysis (QCA) method, specifically Neutrosophic QCA _[1]. The QCA method is a technique used in social sciences to analyze complex causal configurations [2]. It is based on identifying necessary and sufficient conditions to explain the presence or absence of a phenomenon. The method, in its original version, is based on Boolean logic and set analysis, allowing for the modeling of nonlinear causal relationships. It focuses on conjunctural multicausality, meaning that different combinations of factors can lead to the same result [3].

Its advantages include the ability to analyze social phenomena with multiple interrelated causes, its usefulness for comparative studies in political science, sociology, and public administration, and the ability to identify causal patterns in qualitative and quantitative data [3-9]. It has been applied in diverse areas, including public policy, social movements, and citizen security studies. Its ability to handle complex causal configurations makes it suitable for studies in which causal relationships are neither simple nor linear. It has been used in Latin America to study changes in moral policies, such as abortion and same-sex marriage. It has also been applied in citizen security studies and government policy analysis. This has led to its recognition in academia, although its use is still limited in some contexts due to the lack of introductory literature in Spanish. However, its ability to handle complex causality has made it a valuable tool in social research. Furthermore, QCA is a method that combines qualitative and quantitative approaches to analyze causal configurations in social phenomena.

Some of the limitations of QCA include:

1. Sensitivity to case selection: The choice of cases significantly influences the results, which may affect the external validity of the analysis.
2. Difficulty in interpreting causal configurations: It can be complex to determine which combinations of conditions are necessary or sufficient for an outcome.
3. Reliance on binary or fuzzy data: The need to categorize variables in terms of presence/absence or degrees of membership can oversimplify complex phenomena.
4. Although it looks for general patterns, its focus on specific settings can make it difficult to extrapolate results to other contexts.

It has also been generalized to the fuzzy and neutrosophic fields. The QCA method based on fuzzy sets (FsQCA) and neutrosophic sets (NQCA) offers several advantages over the traditional binary set approach (Crisp QCA), these are [1, 10-14]:

1. Greater granularity: Fuzzy sets allow for degrees of membership to be represented instead of strictly binary classifications. This is useful when the phenomena studied are not completely present or absent but rather exist at different levels of intensity.
2. Neutrosophic sets incorporate a third component of uncertainty, allowing for modeling situations in which there is incomplete or ambiguous information.

3. Greater accuracy in case comparison: By allowing for intermediate values, FsQCA and NQCA can capture more nuanced causal relationships and avoid the loss of information that occurs with the crisp approach.
4. More rigorous tests: It has been argued that fuzzy sets produce more conservative consistency measures and constitute more demanding tests for identifying causal patterns.

In this paper, we use NQCA because we need to study the relationship between financial behavior and financial stress in a more flexible way than with traditional statistical correlation. Furthermore, the neutrosophic component allows us to capture indeterminacy in the decision-making process.

The paper is divided into a Materials and Methods section, which summarizes the fundamental concepts of NQCA. The Results section presents the results obtained from the study. The final section is the Conclusion.

2 Materials and Methods

In this section, we present the basic concepts of the NQCA technique that appears in [1].

Among the basic philosophical concepts of QCA is the idea that relationships between variables are not always linear and that nonlinear patterns may exist between them. This changes the classical idea that the causal relationship between concepts A, B, and C is represented by A implies B and B implies C, such that $A \rightarrow B \rightarrow C$. On the contrary, relationships such as $A \rightarrow B \rightarrow C \rightarrow A$ exist. This means that a small (large) difference in the presence of A can lead to large (small) differences in the presence of B, and this makes the consequences difficult to predict.

The key concepts within QCA theory are: (1) conjunction, (2) equifinality, and (3) causal asymmetry.

The conjunction is the joint combination of antecedent conditions to produce an outcome, which contradicts the principle of studying the antecedents separately to understand the result.

Equifinality refers to the achievement of the same outcome through multiple initial conditions and causal pathways. That is, the same outcome can be multicausal and depend on different antecedent variables.

Causal asymmetry refers to the fact that, on the one hand, a set of antecedents can lead to a specific outcome; however, the absence of these conditions does not necessarily mean that the outcome will not occur. In other words, the principle of causal asymmetry in QCA refers to the idea that the presence and absence of an outcome can be explained by different combinations of causal conditions. That is, the causes that lead to a phenomenon may not be the same as those that explain its absence.

For example, let us imagine we are trying to understand why some people manage to get a job quickly while others take much longer. According to the causal asymmetry principle for rapid employment, we might find that a combination of factors such as having a strong network of contacts, relevant experience, and effective communication skills is sufficient. On the other hand, for not getting a job quickly, the absence of these factors does not necessarily explain the outcome. There may be other reasons, such as an economic crisis, workplace discrimination, or a poor job search strategy. This principle helps us understand that we cannot always simply reverse causal logic. What causes an event is not necessarily the opposite of what causes its absence.

For the NQCA, we use neutrosophic sets. These allow us to deal with indeterminacy, as well as uncertainty. The theory introduced in [1] proposes using a Neutrosophic Likert Scale, which includes indeterminacy, neutrality, ambiguity, and inconsistency, thereby better capturing the personal opinions of respondents.

The fundamental concepts of neutrosophic sets and single-valued neutrosophic sets are shown below:

Definition 1 ([15]). Given U is a universe of discourse, it is said that $N = \{(x, T(x), I(x), F(x)): x \in U\}$ is a neutrosophic set, if for a set $A \subset U$, it is formed by a truth-membership function, $T_A: U \rightarrow]-0, 1+[$; an indeterminacy-membership function, $I_A: U \rightarrow]-0, 1+[$; and a false-membership function, $F_A: U \rightarrow]-0, 1+[$.

In the definition $]-0, 1+[$ means a non-standard interval of values that has only philosophical significance. The practical definition derived from Definition 1 is the single-valued neutrosophic set.

Definition 2 ([16, 17]). Given U is a universe of discourse. A single-valued neutrosophic set is said to be $N = \{(x, T(x), I(x), F(x)): x \in U\}$, such that exists for a set $A \subset U$ a truth-membership function, $T_A : U \rightarrow [0, 1]$; indeterminacy-membership function, $I_A : U \rightarrow [0, 1]$; and falsity-membership function, $F_A : U \rightarrow [0, 1]$, with $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Although Definition 2 infers that there is not necessarily a restriction on defining the three membership functions, they can be classified according to the information they contain as follows:

T+I+F<1: Incomplete,

T+I+F=1: Complete,

T+I+F>1: Contradictory.

The method proposed in [1] is as follows:

1. Define the outcome: Identify the phenomenon, event, or condition that we need to investigate as a result or causal consequence within the study.
2. Identify the variables that are the premises or causal conditions or inputs that are considered relevant to the study conducted.

3. Define a Likert Scale to perform the measurements. In this article we recommend a triple (T, I, F), where T is the degree of truthfulness, I is the degree of indeterminacy, and F is the degree of falsity ([1]). It thus follows logically that in the evaluations there may be inconsistencies, incompleteness, or contradictions in the opinions of the respondents.
4. Collect data on all the variables identified for the study. This can be achieved through surveys, interviews, tests, and other evaluative techniques to gather the opinions of the people involved in the study.
   The neutrosophic Likert scale should be used to express the opinions of the people involved.
5. Fuzzification: In this step the triples (T, I, F) are converted into a single fuzzy numerical value using Equation 1.

$$\mu_A(x) = 1 - \frac{1}{2}[(1 - T_A(x)) + \max\{I_A(x), F_A(x)\}] \quad (1)$$

6. With all evaluations converted from neutrosophic to fuzzy, the Fuzzy QCA or fsQCA method is applied. This method uses two indices: consistency and coverage values, which are calculated using Equations 2 and 3, respectively.

$$consistency(X_i \leq Y_i) = \frac{\sum min(X_i, Y_i)}{\sum X_i} \quad (2)$$

$$coverage(X_i \leq Y_i) = \frac{\sum min(X_i, Y_i)}{\sum Y_i} \quad (3)$$

Where:
X_i is the membership value of case i in the set of causal conditions.
Y_i is the membership value of case i in the outcome set.

In QCA, coverage and consistency are two key metrics used to evaluate the strength and relevance of causal relationships. Consistency measures the degree to which a condition or combination of conditions is sufficient or necessary for an outcome. When testing for necessity, consistency indicates how often cases exhibiting the outcome also exhibit the proposed necessary condition. When testing for sufficiency, consistency shows how often the presence of a condition leads to the expected outcome. A consistency score means that the condition is always present when the outcome occurs.

Coverage assesses the empirical relevance of a condition in explaining an outcome. It measures how much of the outcome is explained by a given condition or combination of conditions. When testing for necessity, coverage indicates the proportion of cases with the condition that also exhibits the outcome. When testing for sufficiency, coverage shows how much of the outcome is explained by the sufficient condition. A low coverage score suggests that the condition has a limited role in explaining the outcome. These metrics help researchers determine whether a condition is a strong explanatory factor in a QCA model.

3 Results

A study was conducted to analyze the relationship between financial behaviors and levels of financial stress in the adult population. The population consisted of 352 adults residing in Mexico. Only cases with complete data on key analysis variables were included. Participants ranged in age from 18 to 98 years ($\mu = 45.0, s = 17.26$). The demographic composition included diversity in terms of gender, education, and employment status.

We used two main variables, which are the following:

Financial Behavior Index – Psychological Factors (FBIPF): This index integrates indicators related to financial management, financial habits, ability to cope with emergencies, and financial planning. It was assessed based on a scale of values, the details of which are explained below using single-valued neutrosophic numbers.

Financial Stress Index (FSI): This index assesses the degree of subjective financial stress, worry, or difficulty. There is also a single-valued neutrosophic numbers-based scale.

The variables to be considered in addition to the above are summarized in Table 1:

ariable	Description (Question)
P_1	You keep money for payments separate from daily expenses
P_2	You can cover financial emergencies with a loan from family/friends.
P_3	Are you concerned about debts with banks or financial institutions?
P_4	Are you concerned about unexpected health expenses or emergencies?
P_5	You hope to cover your elderly future with your employment income.
P_6	You keep track of income and expenses
P_7	You can cover economic emergencies with savings
P_8	Have you had eating problems due to your financial situation?
P_9	Have you suffered isolation or family problems due to your financial situation?
P_{10}	Have you had work problems due to your financial situation?

P_{11}	You have requested renegotiation or discount to pay debt
P_{12}	Due to your age, you are considered a young person
P_{13}	You consider that your educational level is high
P_{14}	Say your marital status (married, single, or in a common-law relationship)
P_{15}	Few people depend on you financially
P_{16}	You have a permanent job
P_{17}	The cost of living in your area of residence is acceptable
P_{18}	There is enough social pressure to spend money
P_{19}	In difficult financial times, you can count on family or community support
P_{20}	You believe that effort is part of financial success and therefore do not believe in money acquired "easily."
P_{21}	You usually use apps to manage your money
C	FSI

Table 1: Summary of the variables used in the study.

Respondents were asked to use a Neutrosophic Likert scale consisting of three components listed below:

1. On a scale of 0 to 10, rate how you think the variable behaves. 0 means no manifestation at all, and 10 means maximum manifestation.
2. On a scale of 0 to 10, rate how you consider the variable behaves. 0 means maximum manifestation and 10 means no manifestation at all.
3. On a scale of 0 to 10, rate how confusing, contradictory, or indeterminate you consider the variable behaves. 0 means complete clarity in the assessment, while 10 indicates complete confusion.

For the study we conducted, 352 citizens were interviewed, resulting in a response $x_{ij} = (T_{ij}, I_{ij}, F_{ij})$ that represents the self-assessment of the ith interviewee (i = 1, 2,…, 352) based on the jth criterion (j = 1, 2, …, 22). Such criteria are the P_j in Table 1, with (j = 1, 2,…, 21) and j = 22 as criterion C in Table 1.

Note that the criterion is evaluated as a triple of values $(T_{ij}, I_{ij}, F_{ij}) \in [0, 10]^3$, where T_{ij} is truthfulness, I_{ij} is indeterminacy, and F_{ij} is falseness. These values correspond to the scale indicated as 1, 3, and 2 respectively, shown above.

The values are transformed, first converting them from the scale $[0, 10]^3$ to $[0, 1]^3$, for this, we use Equation 4.

$$\tilde{x}_{ij} = (\tilde{T}_{ij}, \tilde{I}_{ij}, \tilde{F}_{ij}) \quad (4)$$

Where,

$\tilde{T}_{ij} = \frac{T_{ij}}{10}$,

$\tilde{I}_{ij} = \frac{I_{ij}}{10}$,

$\tilde{F}_{ij} = \frac{F_{ij}}{10}$.

We then convert these into a single numerical value using Equation 1. So, we have:

$X_{ij} = \mu_A(\tilde{x}_{ij})$ for all i and j = 1, 2, …, 21.

$Y_{ij} = \mu_A(\tilde{x}_{ij})$ for all i and j = 22.

For marital status (P_{14}), nominal values are replaced directly by a numerical value, “married” is replaced by 1, “in a common-law relationship” is replaced by 0.5, and “single” is replaced by 0.

In this way, NQCA becomes FsQCA, and then the well-known method is applied.

The combination of P_1*P_2*¬P_3*¬P_4*P_5*P_6*P_7*¬P_8*¬P_9*¬P_{10}*¬P_{11} is considered to constitute the FSI, where ¬ is the negation of the premise. For example, if P_3 is: “Concern about debts with banks or financial institutions”, ¬P_3 is the opposite, that is, “No concern about debts with banks or financial institutions”.

For negation, we use the classic fuzzy formula:

$$n(x) = 1 - x \quad (5)$$

The results of the calculations are summarized in Table 2.

Conditions	Consistency	Coverage	Coincidence
P_1	0.45524252	0.53957554	0.32787531
P_2	0.44510565	0.5422249	0.32352923
P_3	0.94334447	0.92804788	0.87905228
P_4	0.97090089	0.96056411	0.933684
P_5	0.47652535	0.55848918	0.34613224
P_6	0.45591818	0.55318248	0.3332114
P_7	0.45363368	0.55387284	0.33223801

P_8	0.93890685	0.92389924	0.87150716
P_9	0.95377395	0.94901932	0.90728806
P_{10}	0.93538056	0.95949421	0.89984755
P_{11}	0.93164523	0.94519833	0.88390056
P_{12}	0	0	0
P_{13}	0.47674284	0.58196743	0.35512926
P_{14}	0.57653896	0.63272404	0.43197365
P_{15}	0.59781416	0.67831077	0.46576376
P_{16}	0.58736965	0.64102872	0.44198936
P_{17}	0.57468877	0.61650963	0.42335085
P_{18}	0.439867	0.51192081	0.30990055
P_{19}	0.45905727	0.55037268	0.33385325
P_{20}	0.44039248	0.51732294	0.31213614
P_{21}	0.47224484	0.54406941	0.33834691
P_{22}	0.45797898	0.52976868	0.32561383
P_1*P_2*¬P_3*¬P_4*P_5*P_6*P_7*¬P_8*¬P_9*¬P_{10}*¬P_{11}	0.44534632	0.45197656	0.262506

Table 2: Result of the consistency, coverage, and coincidence of the variables P_i for all i= 1, 2, …, 22 individually and for the combination of all up to 11 with some negations.

We used the coincidence index shown in Equation 6:

$$coincidence(X_i \leq Y_i) = \frac{\sum min(X_i, Y_i)}{\sum max(X_i, Y_i)} \qquad (6)$$

Coincidence is an index that reflects the degree of agreement between the studied sets. The more similar the data results are to each other, the higher this index.

From the results in Table 2, it can be seen that variables P_3, P_4, P_8, P_9, P_{10}, and P_{11} have all three indices (consistency, coverage, and coincidence) greater than 0.8. This indicates that the bad financial habits represented by these indices (see Table 1) are related to high financial stress (FSI).

On the other hand, P_{12} gives a null result, which means that there is no relationship between age and financial stress. The rest of the variables give results less than 0.8, although generally greater than 0.4. As for P_1*P_2*¬P_3*¬P_4*P_5*P_6*P_7*¬P_8*¬P_9*¬P_{10}*¬P_{11} which represents the FSI, it does not present a sufficiently significant relationship with financial stress as well, since the consistency and coverage values are greater than 0.4, but less than 0.45, while the coincidence is approximately 0.26, which is low.

Conclusion

This paper studied the relationship between financial stress and factors that could influence financial practices in Mexico. To do this, 352 people were surveyed on 22 aspects to be measured, including their level of financial stress. Traditionally, a statistical correlation study method or a predictive method with linear regression could have been used. However, we applied a lesser-known and more flexible technique, which studies the relationship between variables using a method called Qualitative Comparative Analysis (QCA), which is based on the principle of causal relationship rather than equivalence between different factors and outcomes. For greater accuracy, we used a neutrosophic Likert scale with three evaluative values: one for truthfulness, one for indeterminacy, and one for falsity. We used the NQCA method, which appears in [1]. As a result, we found that worry about debt and unexpected expenses; having previous eating disorders, isolation, family problems, work problems, and financial deductions, among others, is highly correlated with financial stress.

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