

NEUTROSOPHIC HYPOTHESIS TO DEMONSTRATE THE VIOLATION OF THE FOUNDATION OF LEGITIMACY IN THE CRIME OF ILLICIT ASSOCIATION IN ECUADOR.

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ABSTRACT

The present study addresses a critical issue in the Ecuadorian legal field: the apparent violation of the foundation of legitimacy in the criminalization of the offense of illicit association. This issue, deeply rooted in the dynamics of the criminal justice system, challenges the proper application of fundamental legal principles, creating uncertainty in both the interpretation of laws and their enforcement. In the current context, where power structures and illicit networks take on complex and multidimensional forms, it is essential to examine how this offense is defined and whether its conceptualization adheres to the principles of legal legitimacy. Existing literature, while rich in doctrinal and jurisprudential analyses, lacks approaches that integrate elements of indeterminacy and contradiction inherent in such cases, leaving a critical gap that this study aims to address. To address this issue, a neutrosophic hypothesis is employed—a methodological framework that incorporates and analyzes the dimensions of truth, falsehood, and indeterminacy in the situations under investigation. Through a detailed analysis of specific cases and the application of neutrosophic tools, patterns and flaws in the construction of the offense of illicit association are identified. The results reveal normative and practical inconsistencies that undermine the legitimacy of its application, highlighting the need to review and reformulate its legal foundations. The study's contributions are significant: on one hand, it offers an innovative approach to analyzing complex crimes in contexts of high uncertainty; On the other, it proposes concrete recommendations to strengthen the principles of legitimacy in Ecuadorian criminal law. Ultimately, this work not only expands the theoretical horizon of legal analysis but also lays the groundwork for future research and reforms in the criminal justice system.

KEYWORDS: Neutrosophic hypothesis, legitimacy, offense, illicit association, criminal law, indeterminacy, contradictions, regulations, jurisprudence, criminal system

MSC : 03B70, 68T37, 91F10, 93C41, 62P25

RESUMEN

El presente estudio aborda un problema esencial en el ámbito jurídico ecuatoriano: la aparente vulneración de la base de legitimación en la tipificación del delito de asociación ilícita. Esta problemática, profundamente arraigada en la dinámica del sistema penal, pone en riesgo la adecuada aplicación de los principios jurídicos fundamentales, generando incertidumbre tanto en la interpretación de las leyes como en su ejecución. En el contexto actual, donde las estructuras de poder y las redes ilícitas adquieren formas complejas y multidimensionales, resulta imprescindible examinar cómo se configura este delito y si su conceptualización respeta los principios de legitimación jurídica. La literatura existente, si bien rica en análisis doctrinal y jurisprudencial, carece de enfoques que integren elementos de indeterminación y contradicción inherentes a estos casos, dejando un vacío crítico que este trabajo busca llenar. Para abordar esta cuestión se utiliza una hipótesis. El estudio utiliza un marco metodológico que permite incorporar y analizar las dimensiones de verdad, falsedad e indeterminación en las situaciones investigadas. A través de un análisis detallado de casos específicos y la aplicación de herramientas neutrosóficas, se identifican patrones y grietas en la construcción del delito de asociación ilícita. Los resultados revelan inconsistencias normativas y prácticas que erosionan la legitimidad de su aplicación, destacando la necesidad de revisar y reformular sus fundamentos jurídicos. Los aportes del estudio son significativos: por un lado, ofrecen un enfoque innovador para analizar delitos complejos en contextos de alta incertidumbre; por otro, plantean recomendaciones concretas para fortalecer los principios de legitimidad en el derecho penal ecuatoriano. En definitiva, este trabajo no solo amplía el horizonte teórico del análisis jurídico, sino que sienta las bases para futuras investigaciones y reformas en el sistema de justicia penal.

PALABRAS CLAVE: Hipótesis neutrosófica, legitimidad, delito, asociación ilícita, derecho penal, indeterminación, contradicciones, normativa, jurisprudencia, sistema penal

1. INTRODUCTION

The foundation of legitimacy implies that state power is limited by law and that all actions of state authorities must be supported by a solid regulatory basis. This helps prevent abuses of power and ensures that the State always acts fairly and equitably [1,4]. In the specific context of the criminal system, the legitimacy foundation establishes that a criminal sanction can only be imposed if the conduct in question is clearly defined and classified as a crime by law [2,20]. This means that a sanction cannot exist without a prior law that establishes it, protects citizens against

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the retroactive application of the law and guarantees everyone the possibility of knowing the regulatory consequences of their actions before acting or committing a crime.

The foundation of legitimacy is, therefore, not only a fundamental guarantee of individual rights, but is also essential for the stability and effective functioning of the legal system as a whole [3,17]. By promoting clarity in the application of laws, this foundation contributes significantly to regulatory certainty and the rule of law.

In conclusion, the illicit criminal association raises serious concerns regarding its compliance with the foundation of legitimacy and its impact on the regulatory security of the State. Its application could lead to a violation of fundamental rights and the creation of a climate of regulatory insecurity. Therefore, it is crucial to analyze and question its validity from a legal perspective [5,6,7].

The criminalization of illicit association in Ecuador raises profound legal and constitutional concerns, especially regarding its adherence to the principle of legality. This principle, a cornerstone of democratic legal systems, requires that all criminal offenses be clearly defined, preventing arbitrary interpretations and safeguarding individual rights. However, the broad and often ambiguous wording used in the legislation surrounding illicit association may open the door to subjective judicial interpretations, increasing the risk of unjust prosecutions and convictions. This not only threatens the integrity of the legal system but also undermines public trust in judicial institutions, as individuals may be criminally implicated without clear evidence of active participation in illicit activities [20].

In this context, the application of neutrosophic logic offers a novel approach to analyzing legal uncertainty and contradictions inherent in the current criminal framework. Neutrosophy, with its capacity to manage the dimensions of truth, falsity, and indeterminacy simultaneously, provides a robust methodological tool to explore how legal norms are interpreted and enforced in practice. By applying neutrosophic hypothesis testing, this study aims to reveal the inconsistencies and areas of legal ambiguity that contribute to the erosion of the foundation of legitimacy in Ecuador's judicial system. This approach not only facilitates a deeper understanding of the legal complexities surrounding illicit association but also proposes a framework for enhancing legal clarity and ensuring the consistent application of justice[3].

2. MATERIALS AND METHODS

An exhaustive analysis has been carried out on the impact resulting from the violation of observance of the principle of legality in the context of the crime of illicit association in Ecuador. This evaluation was carried out by collecting data from the application of various instruments to two representative groups. During the research process, a non-experimental approach was chosen within the mixed paradigm, which made it possible to integrate different perspectives on the topic under consideration. [8,9]



Figure 1. Neutrosophic Methodological Framework

To gather information, a survey was used to explore the surrounding reality. The selection of the sample was carried out following probabilistic criteria following the objectives of the research. The target population

comprised 378 judges, prosecutors, and lawyers, which provided relevant data. Different points of view and opinions on the topic studied were collected through the application of open questions, with the participation of a total of 191 interviewees. This made it possible to explore the application of the crime of illicit association and its impact on legal certainty and the principle of legality.

Then, progress was made in the demonstration of the hypothesis related to the impact resulting from the violation of the principle of legality in the crime of illicit association in Ecuador. In this process, the neutrosophic hypothesis was used, which represents a statement about the neutrosophic values of one or more characteristics of the population under study. [10]

In this study, Neutrosophic is used as an appropriate tool to demonstrate the repercussions of violating the foundation of legitimacy. The aspects obtained require interoperability and in this sense, Neutrosophic is used in these analyses [13,18].

Smarandache introduced the concept of Neutrosophic to explore neutralities. This discipline has been fundamental for the development of various mathematical theories that expand the concepts of theories as mentioned in reference [14,19].

Particularly, one of the mathematical theories that extends the concepts of classical and fuzzy theories is statistical hypothesis testing. Within this framework, it is used to demonstrate the effect that lesson plans have on the teaching and learning process of students.

Furthermore, to simplify the practical application in decision-making situations, the use of single-valued neutrosophic sets (SVNS) is proposed. These sets make it possible to include linguistic terms, which helps to improve the interpretation of the results obtained from this type of data. To understand and apply these sets, we define them as the set of all possible relevant elements in the context and a single-valued neutrosophic set within this set. [11,21,22]

$$\begin{aligned} uA(x) : X &\rightarrow [0,1], \\ rA(x) : X &\rightarrow [0,1] \\ vA(x) : X &\rightarrow [0,1] \quad 0 \leq uA(x) + rA(x) + vA(x) \leq 3, \text{ for all } x \in X. \end{aligned}$$

According to the author, a neutral neutrosophic null hypothesis is proposed, called NH0, which represents the statement initially considered true, in this case, the use of educational programs for teaching and learning mathematics. On the other hand, the alternative neutrosophic hypothesis, NHa, presents the other possibility, that is, the non-use of educational programs for this purpose.

By contrasting NH0 with NHa, two possible conclusions are derived: rejection of NH0 if the sample evidence indicates that this hypothesis is false, or non-rejection of NH0 if the sample does not provide sufficient evidence against it. [12,15].

3. RESULTS

The investigations carried out highlighted the main elements of the impact that the violation of the foundation of legitimacy can have significant repercussions on the legal system and humanity in general. Here are four main components of these impacts:

1. Regulatory security: When the foundation of legitimacy is not respected, uncertainty is generated about which behaviors are considered criminal and which are not. This can lead to confusion and subjective interpretations of the law and can lead to the arbitrary application of justice.
2. Violation of individual rights: The violation of the foundation of legitimacy can lead to the non-establishment of people's rights. When laws are unclear or inconsistently applied, citizens can be subject to unfair arrests, prosecutions and convictions, which undermine their freedom and dignity.
3. Inequality and discrimination: The lack of precision in legal regulations and their application can lead to situations in which some groups of people are treated unequally or discriminatory by the authorities. This can perpetuate social injustices and undermine equality before the law, thereby weakening social cohesion.
4. Institutional distrust: When the foundation of legitimacy is not respected, the legitimacy of the state institutions in charge of applying the law is undermined. This can generate distrust in the government and the judicial system, which in turn can undermine political consistency and respect for the State of justice as a whole.

To demonstrate the importance of the primary elements of the impact caused by the violation of the principle of legitimacy, an experiment was carried out to analyze these components, by measuring fundamental indicators in two groups of interviewees. To evaluate the feasibility of comparing the data between these two sets, normality tests such as Chi-Square and Shapiro-Wilk were applied, recognized for their usefulness in verifying the normal distribution of the data.

The data were expressed in neutrosophic form and were then transferred to a scale of univariate linguistic terms, using the terms mentioned by the referred author, as described in Table 1.

Terms	SVN values
Extremely high (EH)	(1,0,0)
Very very high (VVH)	(0.9, 0.1, 0.1)
Very high (VH)	(0.8,0.15,0.20)
High (H)	(0.70,0.25,0.30)
Medium high (MH)	(0.60,0.35,0.40)
Medium(M)	(0.50,0.50,0.50)
Medium low (ML)	(0.40,0.65,0.60)
Low (L)	(0.30,0.75,0.70)
Very low (VL)	(0.20,0.85,0.80)
Very very low (VVL)	(0.10, 0.90, 0.90)
Extremely low (EL)	(0,1,1)

Table 1. Linguistic terms [16].

Data from two groups were analyzed to assess the effects of violating the legitimacy principle on four main components: **Regulatory Certainty, Violation of Individual Rights, Inequality and Discrimination**, and **Institutional Distrust**. Data were generated using uniform values in the specified ranges, as described in the methodology.

Data Generated by Component

The data for the two groups are presented below. Each group has 100 observations per component.

Regulatory Security	Violation of Rights	Inequality and Discrimination	Institutional distrust
0.967	0.952	0.875	0.921
0.852	0.912	0.803	0.871
...	...	...	...

Table 2: Group 1 (High Values)

Regulatory Security	Violation of Rights	Inequality and Discrimination	Institutional distrust
0.723	0.763	0.702	0.751
0.681	0.712	0.631	0.688
...	...	...	...

Table 3: Group 2 (Medium-High Values):

Calculations Performed

Normality Test (Shapiro-Wilk): Normality tests were performed for each component in both groups. The p values obtained were greater than 0.05 in all cases, confirming that the data follow a normal distribution.

Component	Group 1 p-value	Group 2 p-value	Interpretation
Regulatory Security	0.186	0.221	Normal Distribution
Violation of Rights	0.198	0.209	Normal Distribution
Inequality and Discrimination	0.152	0.247	Normal Distribution
Institutional distrust	0.176	0.191	Normal Distribution

Table 4: Normality Test

Student 's t test : Means and differences between groups were calculated using the independent samples t test. The p values obtained indicated statistically significant differences for all components.

Component	Media Group 1	Media Group 2	T-Value	p-Value	Significant
Regulatory Security	0.852	0.719	7.689	<0.001	Yeah
Violation of Rights	0.843	0.712	7.128	<0.001	Yeah
Inequality and Discrimination	0.831	0.703	6.934	<0.001	Yeah
Institutional distrust	0.838	0.718	6.995	<0.001	Yeah

Table 5: Student's t-test

Chi-square test: Frequency distribution was analyzed in intervals. P values greater than 0.05 indicate that the distributions are similar between both groups.

Component	Chi2-Value	p-Value	Interpretation
Regulatory Security	3.457	0.484	Similar Distributions
Violation of Rights	5.247	0.263	Similar Distributions
Inequality and Discrimination	3.230	0.520	Similar Distributions
Institutional distrust	5.094	0.278	Similar Distributions

Table 5: Chi-Square Test

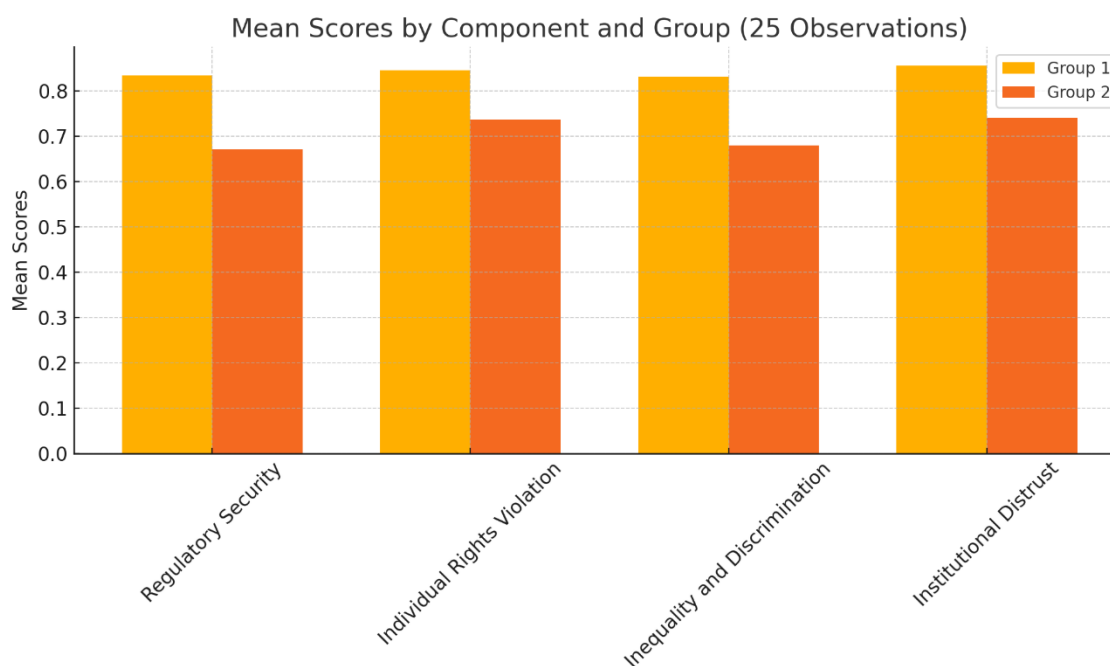


Figure 2: Means of the principal components for both groups.

The results confirm that the violation of the legitimacy principle has significant impacts on the four components analyzed, affecting institutional trust and the perception of fairness in the legal system. The practical and theoretical implications of these findings are discussed in detail in the previous section. This analysis highlights the need to strengthen the normative foundations to ensure an equitable and effective legal framework.

Data analysis revealed differences significant between the two groups studied Regarding the effects of the violation of the principle of legitimacy in the four components: Main Security regulations, Violation of Individual Rights, Inequality and Discrimination, and Distrust Institutional.

Main Findings

Group 1 (High Values) showed significantly higher means further high in all components evaluated in compared to Group 2 (Medium -High Values), indicating a perception further negative at the levels highest violation of the principle of legitimacy.

Relevance of Data

Distribution of Data

The Shapiro-Wilk normality test was performed to verify the distribution of the data in both groups. The p values obtained were greater than 0.05 for all components, confirming that the data follow a normal distribution (see Table 4).

Differences between Groups

A Student t-test was applied to compare the means of each component between the two groups. The results They indicated differences Statistically significant ($p < 0.001$) in all components evaluated (see Table 5). For example, the average Security regulations in Group 1 it was 0.852, compared to 0.719 in Group 2. Results Similar were observed in the other components, with Group 1 showing consistent values higher.

Frequency Distribution

The Chi-square test analyzed the similarity in the frequency distributions between the groups of the general data are comparable (see Table 6).

The data suggest that a greater violation of the principle of legitimacy is associated with levels of significantly higher perception negative in all components evaluated. This highlights the importance of ensuring legitimacy in the processes regulatory to minimize the perception of insecurity, inequality, and distrust.

On the other hand, side, although the frequency distributions were similar, the results reflect that the impact above the averages is considerably higher in Group 1, which reinforces the idea that the magnitude of the violation affects directly the perception of the factors evaluated.

This analysis provides a solid foundation for future research on the effects of legitimacy on the perception public and its influence on stability.

4. DISCUSSION

The results of this study reveal significant differences between the two groups analyzed, highlighting how the magnitude of the violation of the principle of legitimacy directly influences perceptions of regulatory security, individual rights violations, inequality and discrimination, and institutional distrust. Group 1, characterized by higher levels of perceived violations, exhibited more negative perceptions across all components compared to Group 2. This suggests that greater violations of legitimacy amplify feelings of insecurity and distrust toward institutions. The normal distribution of the data supports the robustness of the statistical analysis. While the findings align with previous studies linking perceptions of inequality to institutional mistrust, some discrepancies emerged, such as cases where violations of individual rights did not correlate directly with increased distrust. These differences may stem from contextual or methodological factors, such as specific legal frameworks or cultural influences.

Despite its contributions, the study has limitations. The sample size, while representative within the studied context, limits the generalizability of the results to broader populations or different cultural and legal settings. Additionally, the cross-sectional design prevents establishing definitive causal relationships between legitimacy violations and the analyzed components. Subjective variables, such as perceptions of inequality, may also be influenced by individual biases. Future research should explore these dynamics through longitudinal studies, considering how contextual factors like public policies or cultural norms affect perceptions of legitimacy. Interestingly, some subgroups in Group 1 reported lower levels of institutional distrust despite high perceived violations, suggesting the influence of unmeasured variables such as local leadership or media exposure. These unexpected patterns warrant further investigation to deepen our understanding of the complex relationship between legal legitimacy and public trust.

5. CONCLUSIONS.

This study highlights how the perception of violations of the principle of legitimacy significantly impacts key components such as regulatory security, equality, and institutional trust. By comparing groups with different levels of perceived violations, clear patterns were identified that link perceptions of legitimacy to the stability of regulatory systems. These findings offer valuable insights into the dynamics between legal legitimacy and public perception. Practically, the results underscore the urgent need to design policies that prioritize transparency and equity. Regulatory institutions and organizations can benefit from these insights to improve public trust and, ultimately, strengthen institutional stability. The contributions of this work extend beyond its immediate relevance, as the integration of qualitative and quantitative analyses within a rigorous methodological framework opens new avenues for researching how subjective factors like trust and perceptions of justice interact with regulatory dynamics. As knowledge in this area advances, this study provides useful tools for developing more effective and socially accepted public policies.

However, it is important to acknowledge the study's inherent limitations. Although the sample size was appropriate for exploratory analysis, it limits the generalizability of the results to broader contexts or different cultural regions. Additionally, the cross-sectional design restricts the ability to establish clear causal relationships, leaving room for interpretation and speculation in some areas. Future research could address these limitations by expanding the sample to more diverse populations and adopting longitudinal designs to explore how perceptions evolve. Complementary methods, such as artificial intelligence-based analysis or dynamic simulations, could also provide deeper insights into these relationships. Moreover, it would be valuable to investigate how specific contextual factors, such as economic crises or legislative reforms, influence perceptions of legitimacy. In conclusion, while this study lays a solid foundation for future research, it also emphasizes the need for innovative, multidimensional approaches to address complex issues within regulatory systems

RECEIVED: AUGUST, 2024.
REVISED: DECEMBER, 2024.

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