

Research Article

Navigating Organization Dynamics: The Real-World Example of Condominium Life in Sicily During the COVID-19 Era in Late 2022-2023

Romina Fucà^{1, 2, *} , Serena Cubico¹ 

¹Department of Management, University of Verona, Verona, Italy

²Department of Law and Communication Science, University of Macerata, Macerata, Italy

Abstract

The COVID-19 pandemic brought unprecedented challenges, especially in shared living environments. This study explores the behavior of 39 residents, aged 17 to 91, in a Sicilian condominium, focusing on adherence to socio-juridical mandates and sanitation protocols in communal spaces post-2020 pandemic. The research builds on a previous study that examined the impact of COVID-19 during the first wave, considering factors such as meeting cancellations, social distancing, and mask mandates. The objective is to understand how these factors influenced collective decision-making during and after the pandemic and to assess the alignment of individual actions with collective goals. The present quantitative analysis investigates the trade-offs in collective decision-making, emphasizing the role of shared responsibility in mitigating risks and fostering cooperation. This study underscores the importance of condominium administrators and legal support in promoting cooperative dynamics and socio-juridical precautions for economic resilience. Metrics such as β^{**} (ratio of individual benefit to community benefit) and θ^{**} (ratio of individual self-interest) are introduced to quantify their impact on decision-making processes and societal norms. Finally, this research highlights the significance of coordinated efforts and the need for effective socio-juridical frameworks to enhance communal living and ensure collective well-being during crises.

Keywords

Condominium Governance, Post-Pandemic, Collaborative Dynamics, Social Norms, Community Resilience, Decision-Making Processes, Collective Rationality, Shared Responsibility

1. Introduction

A condominium, a distinctive form of real estate ownership, comprises multi-unit dwellings where individuals own private units, often referred to as ‘owner-apartments,’ while common areas are collectively held [1]. Shared responsibilities for the maintenance and costs associated with common spaces like

rooftops, hallways, lobbies, elevators, and amenities ensure the essential cooperative characteristic of this multi-dwelling living form [2] (p. 205). In contrast to standalone houses, condominiums operate within a collective framework governed by statements of co-ownership and acts of unity, often

*Corresponding author: romina.fuca@univr.it (Romina Fucà)

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vesting decision-making powers in a governing association. There can often be practical joint possession of familiar properties such as land plots and building parts [3]. In addition, clearly defined rights and responsibilities [1] (p. 2), especially in complex condominiums, are crucial for practical management and to mitigate time-consuming and stressful litigations. Reference [3] highlights how “the proportional contribution to the common expenses and the share of common profits, as well as the voting power of each condominium unit owner in the administration of the condominium,” clearly define the space of each condominium’s owner and that “[T]he most common approaches to the determination of the co-ownership shares are based on equality, relative size or relative value of each condominium unit, or a combination of such.”

From a juridical perspective, a condominium is a central organization capable of i. managing routine formalities, ii. navigating complex decision-making processes, and iii. mediating disputes both internally and externally [2]. Taking a sociological perspective, the following exploration will dig into the strategies employed by the condominium administration during the two waves of the COVID-19 emergency. It will examine the significant interplay between leadership styles and preexisting residents’ behaviors and emotional habits in a specific condominium in Sicily, a beautiful island in southern Italy, which was already influential before this considerable emergency.

Jurisprudence, particularly following the 2012 Italian reform of the law governing condominiums, has grappled with the legal identity of the condominium as a distinct entity, separate from individual residents [4]. The prevailing perspective has underscored the significance of condominiums, assigning them greater importance and a more substantial legal standing than individual residents’ legal rights [1]. This shift has prompted the need for a more robust alignment of the powers vested in condominium administrators and associations, which may encompass multiple condominiums, as observed in situations like those in Poland [5]. Consequently, this has led to heightened criteria for individuals undertaking the role of a condominium administrator, necessitating enhanced skills and knowledge encompassing key legislative changes on the rights and responsibilities of private owners. The situation became even more delicate during the COVID-19 first wave when confusion and speculation surrounding the government’s regulations regarding condominium meetings imploded. There was probably a lack of clarity in communication from the authorities [6], leading to confusion among the public. In addition, exaggeration and distortion of information on social media platforms contributed to further confusion among the condominium’s residents [6].

The paper will, therefore, underscore the indispensable role of the condominium association in regulating residents’ safety, particularly amid the challenges posed during and after the post-COVID-19 pandemic. The focus center, after the first round of surveys from November to December 2021, is on the

winter season 2022–2023, revealing how cooperative games, facilitated by the adherence to condominium rules, intertwine with socio-juridical precautionary measures bolstered by the governing association.

1.1. Real-life Scenarios in Collective Rationality

This sub-section explores how groups make rational decisions based on the sensible actions of individual members and how this may evolve rather astonishingly when individuals are clustered in groups’ associations. A group’s act is considered evaluable for rationality if it stems from actions that its members freely and fully control. According to the Classical Rational Theory (CRT), men owe instrumental rationality (also called *means-end rationality*) [7] because they can pursue decisions and choices according to their preferences and “relative to their knowledge and beliefs at the time of acting.” [8] (p. 141) This paper will then briefly discuss systems theory and its connection to business organizational theory to show how the inquired condominium governance is a concrete example of applying collective rationality within real-world organizational dynamics. Notably, the *equilibrium concept* and its relevance to achieving collective goals within organizations and communities show that systems theory provides a convincing framework for analyzing collective behavior and interactions within organizations [9], highlighting the role of *a.* feedback loops, *b.* emergent properties, and *c.* adaptation by residents.

In the context of a condominium, residents can be seen as agents within a Complex Adaptive System (CAS) [10], each with their own set of simple rules and attributes. Residents interact with one another and with the environment of the condominium, leading to emergent behaviors such as cooperation, conflict, or collective decision-making. CAS agents within a condominium possess simple rules and attributes, operate largely autonomously with only local knowledge of their immediate surroundings, and can be easily replaced without disrupting the overall functioning of the system [10]. The paper will also consider whether they entered into contact and/or conflict with Multi-Agent Systems (MASs). CAS agents tend to be simpler, more numerous, and interchangeable. In contrast, MAS agents are often more autonomous, intelligent, and hierarchical.

1.1.1. The ‘Social Choice Theory’

‘Collective rationality’ is then associated with acts that result from rational actions taken by individual group members. It focuses on how groups can reach decisions that align with rationality, efficiency, or fairness. Collective rationality within a condominium context arises from individual residents’ interactions, guided by game theory and CAS principles. Understanding and promoting collective rationality can lead to more effective decision-making processes and ultimately contribute to the well-being and resilience of the condominium community. Within this framework, normative deci-

sion-making principles applied to groups may involve factors such as i. fairness, ii. equity, and the effective distribution of resources. In line with reference [11], it will also be demonstrated that residents within the condominium community may prioritize their self-interests and opportunistic behaviors over collective well-being. They can act in their own self-interest, potentially leading to outcomes where collective well-being is compromised in favor of personal gain.

1.1.2. The Adaptation to Circumstances

Collective anecdotes will illustrate residents adapting to evolving circumstances to benefit themselves at the expense of genuine cooperation and unity. In the following paragraphs, it will be discussed various scenarios and conditions under which residents may choose to cooperate or defect, highlighting the influence of factors such as the ratio of individual benefit to community benefit (β^{**}) and the degree of individual self-interest (ϑ^{**}). Their calculation offers insights into the rationality of collective decisions. By theoretically quantifying individual benefits relative to community benefits, it becomes possible to assess the extent to which decisions align with the overall welfare of the community [12] (pp. 36-37).

Also, if each resident acts according to their own preferences, knowledge, and constraints, the collective outcome may exhibit rational characteristics [13]. Equilibrium concepts from game theory provide a framework for understanding how collective rationality can manifest in decision-making. For instance, in cooperative games, equilibrium solutions represent states where no individual or group of residents has an incentive to deviate from their current strategies.

1.2. Individual Self-Interest vs Collective Welfare

Residents may be averse to inequity yet adjust their behaviors to navigate changing circumstances and maximize the benefits for themselves and their families. This will help highlight the tension between individual self-interest and the collective welfare of the condominium community in the paper.

Conversely, altruistic behaviors emerge when the balance between efficiency and fairness leans towards utilizing collective intelligence (CI) and achieving a higher group consensus [14] considering the proximity of opinions and beliefs, participation in collective decision-making within a condominium is at times perceived as a set of constraints on both group and individual rights and duties. Mainly, Ganzer-Ripoll J. et al. [15] (pp. 128-29) have explored the computational mechanisms for evaluating the output of e-participation systems and what they call “coherent collective rationality,” that is, coherent labeling of inputs in the forum-like discussions can properly lead towards non-contradictory outputs. Croitoru (2014) [16] (pp. 602-607) has elaborated fine sets of “argu-

mentative aggregation of individual opinions” to consider collective opinions “by merging the opinions of non-conflicting coalitions of individuals.” On a similar trend, Ganzer-Ripoll J. et al. [15] (page 483) have proposed a “target-oriented discussion framework” to show that a given set of agents, each with an individual opinion about a given set of arguments related to a topic around a collective decision problem, “can be depicted as a graph whose nodes stand for arguments and whose edges represent either attack or defense relationships between arguments.”

Integrating social norms, reputation dynamics, and cognitive complexity in cooperation games within the condominium community raises important ethical considerations regarding integrity, fairness, trust, and social responsibility.

Residents, leaders, and the condominium association are responsible for cultivating an ethical environment that promotes cooperation, mutual respect, and the well-being of all community members. This discourse finally poses a mathematical challenge, requiring the delicate equilibrium between options available to free-riders and individual rationality.

1.2.1. A Recalculation of “Bounded Rationality” Among Condominiums’ Residents

A very important conceptual approach involves defining a probability function that articulates an individual’s preferences among various choices, namely the ‘Social Choice Theory’ (SCT) [17] coupled with a concept of “bounded rationality.” It is reasonable to assert that individual residents exhibit limited capacity, especially when the stakes involve the common good. However, leadership styles inclined towards opportunism or marked by inconsistency and contradiction can skew collective paradigms and influence personal computational assessments of how the situation will benefit each member. SCT emphasizes how individuals may have limited cognitive resources and information when making decisions [18] (pp. 143-44). As an example, reference [18] (p. 144) stresses that “noneconomic motives often influence economic behavior.” Starting with Keynes, this idea was further developed by G. Akerlof and R. Shiller in their book *Animal Spirits*, where they provided detailed illustrations of how these non-rational factors affect economic decision-making, particularly in significant investment decisions. Through the lens of CAS and SCT, residents can leverage collective intelligence and decision-making processes to overcome the limitations of bounded rationality.

CAS acknowledges that collective behaviors can emerge from the interactions of simple agents with local knowledge, while SCT provides frameworks for understanding how preferences are aggregated, and decisions are made within groups.

Calculating β^{**} and ϑ^{**} allows residents to quantitatively assess the trade-offs between individual interests and community benefits, providing a structured approach to decision-making that goes beyond mere intuition or heuristic reasoning. By incorporating insights from CAS and SCT,

residents could better navigate complex collective dilemmas, allocate resources more efficiently, and foster cooperation and collaboration within the condominium community.

1.2.2. The Shift Towards Systematic Decision-Making

In this sense, the recalculation of bounded rationality among condominium residents involves a shift towards more informed and systematic decision-making processes enabled by the principles of CAS and SCT. By embracing these frameworks, residents can enhance their collective rationality and contribute to the overall well-being and resilience of the condominium community.

If in the case of SCT, aggregation of individual preferences may permit the arrival of a collective outcome, the concept of “bounded rationality” suggests individuals often ‘cut short their road,’ taking shortcuts, simplified conclusions, and self-made decision rules to navigate complex decision environments. As expressed by [19] (pp. 3-6), this concept delves into intricate mathematical considerations and reformulations influenced by beliefs, trade-offs, reasoning, psychological limitations, and other relevant factors. Pinheiro et al. [20] highlight the impact of different factors, such as the enhancement factor (F), on the strategies chosen by individuals in the dynamics of cooperation and defection in a two-person game. Complexities of decision-making in social contexts imply more than two players, where individuals’ cognitive limitations and imperfect rationality play a significant role, underlining those cognitive abilities, information constraints, and time constraints motivate a personalistic use of payoff structures, social dynamics, and evolutionary pressures.

SAT (Situational Action Theory) will also be useful in emphasizing how individuals’ situational contexts and rational calculations influence their behavior, especially metatraits and higher-order personal values [21]. SAT will help us to consider the interplay between i. individual agency and ii. environmental factors, and iii. situational constraints in shaping behaviors. Reference [22] sees situational settings as masterpieces for humans to look at their surroundings, searching “from social norms to existing power dynamics and to regulatory frameworks” to overcome uncertainty and conflicts. Reference [23] reinforces the relational power of context effects on i. prosocial behavior, ii. social influence, iii. person perception, iv. self-concept, v. self-regulation, and vi. evaluative judgments. From an ethical perspective, cooperation games describe a not always binary reputation world (where reputations are either ‘good’ or ‘bad’) [24] (p. 242), where there can be a multitude of associated social norms influenced by the cooperation strategies but at the same time potentially affecting the top-down and down-top dynamics among individuals.

Through the next simulations, it will be shown how residents categorize their ‘higher order’ norms incorporating information from the condominium in the quality of reputation section of simulations; it will be shown how residents

categorize their ‘higher order’ norms incorporating information from the condominium in the quality of reputation and reputation of actors. Individuals often start with random strategies and evolve through social learning, adopting strategies with higher fitness. Then, i. social norms, ii. reputation, and iii. cognitive complexity interacts to shape cooperative behavior in the condominium. Various normative frameworks enhanced by the condominium’s association involve a change in personal commitment to adopt cooperative strategies.

2. Cooperation vs. Defection

Advanced game theory in the 1960s added the nuance of the maximization of Subjective Expected Utility (SEU) to individual decision-making theory. In the short term, when making rational decisions, individuals try to maximize their own utility because, among alternatives, they trust more what is expected as a rewarding choice. In this context, decision-makers become players with diverse goals and behaviors. Therefore, in the context of collective decision-making or group settings, the assumptions of SEU theory may not always hold. Several factors, such as i. social dynamics, ii. communication, and iii. the presence of multiple decision-makers with diverse preferences can influence decision outcomes. Here are a few reasons why SEU may not directly translate to the collective context:

1. *Aggregation of Preferences*: In a collective setting, aggregating individual preferences into a group decision is often necessary. The assumptions of SEU theory, which are based on individual utility maximization, may not straightforwardly extend to this aggregation process.
2. *Interdependence of Choices*: Individuals’ choices are often interdependent in collective decision-making. One person’s choice may affect the available options or outcomes for others. SEU theory typically assumes independence between individual choices, which may not hold in group decision-making scenarios.
3. *Social Dynamics*: SEU theory does not explicitly consider the social dynamics, negotiations, and communication integral to many collective decision-making processes. These factors play a crucial role in determining outcomes in group settings.
4. *Alternative Models for Collective Decision-Making*: Various alternative models, such as social choice theory or cooperative game theory, have been developed to address collective decision-making. These models often consider issues like fairness, coalition formation, and preference aggregation in ways that differ from the assumptions of SEU theory.

While SEU theory is a robust framework for understanding individual decisions, applying it directly to collective decision-making may require modifications or consideration of additional factors. Researchers often turn to alternative theories and models when analyzing how groups make decisions

and allocate resources. Cooperative game theory, for example, provides a framework for analyzing situations where individuals form coalitions and make joint decisions to achieve common goals.

Returning to individual rationality, Weirich's theory (2010) of collective rationality [25] emphasizes the importance of it as a foundation for evaluating and understanding collective actions and solutions to games. Leveraging on the probability laws as based on Kolmogorov's axioms, reference [25] (p. 85) highlights how potential outcomes of actions are linked to a partition of possible states of the world, and each outcome corresponds to the option's result given a specific element of the partition, or event. The attainable equilibrium standard is a central concept that connects individual and collective rationality in cooperative games. Cooperation in game theory refers to situations where individuals or entities make joint decisions to achieve outcomes that benefit all parties involved. This stands in contrast to purely competitive situations where each participant aims to maximize their own individual outcomes, often at the expense of others. Several classic examples and models explore cooperative behavior, such as the 'Prisoner's Dilemma' and the concept of 'Nash equilibrium.' In the context of interdependent or mutually reinforcing goals, cooperation can be beneficial when players recognize that working together can achieve more favorable outcomes for everyone than purely competitive strategies.

The 'Dynamic Replicator Model' (shown below in Figure 1) extends the traditional Prisoner's Dilemma, incorporating elements of evolution and repeated interactions.



Figure 1. An empty circle labeled "Cooperation" has a direct line with arrows leading to a closed circle labeled "Defection." Source: Figure 6: The dynamic replicator model of the prisoner's dilemma, in [26].

The standard Prisoner's Dilemma is a one-shot game where two individuals must decide whether to cooperate or betray each other. The payoffs are structured incentives to yield the best overall outcome. However, each individual is incentivized to betray the other, leading to a suboptimal outcome. In the Dynamic Replicator Model, the game is played repeatedly, allowing strategies to evolve over time based on the success of previous interactions. Here are the key elements of the Dynamic Replicator Model in the context of the Prisoner's Dilemma:

- Repetition of the Game:** The game is played multiple times, allowing individuals to interact with each other repeatedly.
- Evolution of Strategies:** Strategies evolve over time based on the outcomes of previous interactions. Successful strategies that lead to higher payoffs have a higher chance of being adopted by other individuals in the population.

- Replicator Dynamics:** The model employs replicator dynamics, a concept from evolutionary game theory. Replicator dynamics describes how the frequency of different strategies changes in a population over time based on their relative success.
- Strategy Update Rule:** Individuals may update their strategies based on the success of their current strategy compared to others in the population. Strategies that result in higher payoffs may become more prevalent over time.
- Evolutionary Stability:** The model explores the concept of evolutionary stability, where strategies that are resistant to invasion by alternative strategies become prevalent in the long run.
- Long-Term Outcomes:** Through the repeated play of the game and the evolution of strategies, the Dynamic Replicator Model aims to explore the long-term outcomes and stability of different strategies in the context of the Prisoner's Dilemma. This model is particularly useful for studying how cooperation can emerge and be sustained in repeated interactions, even when the one-shot game might predict defection. Evolutionary dynamics allow for exploring successful strategies in a single interaction and evolutionarily stable over time.

Nash equilibria (NE) in 'coalitional game theory,' a specific branch of game theory, captures stable points in a game where no player is incentivized to unilaterally deviate from their current strategy. This reflects a cooperative or coordinated behavior between players within a given coalition, where individuals or agents pursue their individual goals but also consider the achievement of each other's goals. This kind of cooperative behavior can be beneficial in situations where both players have interdependent or mutually reinforcing goals, and they want to ensure that their interests are protected even in the case of deviations or changes in the game dynamics. In the next section, the model will be furthered, considering that previously were necessary statistical distributions of the variables deemed useful to circumstantiate the resilience of residents in the condominium facing the post-COVID-19 period.

2.1. Condominium Community as a System

Cooperative game theory often involves studying coalitions, where players form alliances to achieve common goals. Various solution concepts, such as the 'Core' and the 'Shapley value,' are used to allocate the gains from cooperation among the participants fairly and stably. The Core represents a set of payoff allocations that are both individually rational (no player can improve their outcome by leaving the coalition) and collectively stable (there is no incentive for a group of players to break away and form their own coalition). Mean-

while, the Shapley value assigns a unique value to each player in a coalition game based on their marginal contribution to all possible coalitions.

Integrating these concepts with Luhmann's systems theory (Section 2.2) will provide a framework for understanding the dynamic interactions within a condominium community. The systemic closure concept will highlight how the condominium association establishes boundaries and differentiates itself from its environment. This differentiation aids in managing cooperation and conflict, creating a stable environment where trust and mutual benefit are promoted.

For instance, the allocation of gains through the Shapley value can be seen as a way to ensure fair participation and satisfaction among residents, reinforcing the trust necessary for systemic stability. Similarly, the stability provided by the Core concept can be linked to maintaining the condominium's systemic boundaries, ensuring that no subgroup has an incentive to disrupt the collective order.

Thus, by applying these game theory concepts, researchers can better understand and enhance condominium communities' resilience and cooperative nature. This approach facilitates efficient resource management and conflict resolution and promotes a cohesive community identity, which is essential for the sustainability of the condominium system.

2.2. Niklas Luhmann's Work on System's Framework

From a normative standpoint, collective rationality encourages residents to align their individual decisions with the overarching goals and values of the condominium community. As highlighted by van Kleef et al. [27], social norms in groups—being normative expectations, conventions, behavioral patterns, and normative beliefs that arise in social systems [28]—may influence affect, perception, and judgment; the cultural context may additionally shape how people respond to norm violations, and how norms are enforced. In the context of condominiums, this should entail prioritizing i. communal well-being, ii. fostering cooperation, and iii. striving for mutually beneficial outcomes. The interplay between top-down (leadership-driven) and down-top (grass-roots-driven) dynamics in shaping social norms and cooperation strategies is also significant. From an ethical standpoint, leadership within the condominium association is responsible for cultivating an ethical culture that promotes cooperation, trust, and mutual respect among residents [29]. This includes enacting and enforcing policies that incentivize ethical behavior, fostering open communication, and addressing conflicts and grievances fairly and transparently. At the same time, individual residents play a crucial role in upholding ethical standards through their everyday actions and interactions with fellow community members.

In practice, the normative framework of collective rationality prompts residents to weigh the potential impacts of their

actions on the broader community and to act in ways that contribute to the collective good. Condominium residents must then recognize their role in contributing to the overall ethical climate of the community and actively engage in cooperative behaviors that uphold shared values and principles. This is sometimes rooted in an “intrinsic desire for equity or fairness,” ensuring compliance with social norms [30].

By adhering to this normative framework, residents contribute to the condominium community's overall cohesion and functionality and uphold the shared norms and values that underpin collective living [31]. Thus, collective rationality is both a theoretical construct and a practical guideline for fostering harmonious relationships and effective decision-making within condominiums. Unfortunately, challenges arise in applying normative principles to collective decision-making, especially when individual preferences or goals conflict. Ensuring a group decision is rational may require trade-offs and compromises among conflicting interests, often possible after several patterns of observable rewarded and unrewarded actions among group members [32] (p. 2), sometimes measured by scholars in terms of “psychological well-being derived from conformity, where behavior is aligned with perceived norms leading to feelings of belonging and acceptance.” [33] (p. 2). Interestingly, reference [34] (p. 2) has configured ethical learning from mechanisms “such as gossip, ostracism, and peer punishment” that can even “motivate individuals to act against their self-interest.”

2.3. Thinking in ‘Reference to A System’

In a condominium, ethical considerations extend to the process of social learning itself, where residents must discern between strategies that prioritize personal gain at the expense of others and those that promote cooperation and collective well-being [35]. Ethical decision-making involves reflecting on the consequences of one's actions, considering the needs and interests of others, and striving for fair and mutually beneficial outcomes.

Niklas Luhmann, a prominent German sociologist from the XX century, views society as comprised of various internally structured systems, which collectively establish common pre-selection that individuals can draw upon in different situations [36]. This helps maintain stability in the face of the multitude of possibilities in the environment. “Reference to the system” or “thinking in reference to a system” (Systemdenken) involves Luhmann framing the object of research within a framework of interconnected actions governed by common structures and mechanisms. Veissière et al. (2019) call “the process of inferring other agents' expectations about the world and how to behave in a social context” “thinking through other minds” (TTOM), a kind of statistical self-collection of behavioral regularities that help predict and organize behavior [37]. However, Luhmann emphasizes that “mere consensus on acceptable behaviors” [38] is insufficient for maintaining social cohesion. As interactions between individuals become more complex,

social structures must also account for the expectations that others hold regarding certain behaviors. This includes anticipating others' expectations and even "expectations of expectations," [38] leading to a cooperative game where individuals strive to meet mutually expected outcomes. In the context of a condominium community, this means that residents develop expectations regarding acceptable behavior, community norms, and the consequences of their actions based on the structure and rules of the community.

Also, the carrot and stick mechanism can play a crucial role in shaping residents' behaviors in the condominium community by providing incentives for cooperation, enforcing compliance with rules and regulations, and reinforcing collective norms and expectations.

Selected events, as mentioned in the previous paragraphs about SAT, are a useful method of self-observing the employment of criteria for choice and decision-making that ensure a degree of predictability of behaviors will be rewarded by the condominium association and/or community. These selected events then become the focus of expectations [38]. In sociology, "structure" refers to the patterned arrangements that shape and constrain social interactions and behaviors within a society or social group. These structures include institutions, norms, roles, and other elements that organize social life. The concept suggests that these structures influence individuals' perceptions, beliefs, and expectations by limiting the range of possible events to those that are most likely or probable within a given social context [38]. In essence, structure shapes expectations by narrowing the range of possible events to those most probable [38]. Failure to fulfill these expectations can result in significant social costs, highlighting the importance of navigating these intricate social dynamics.

2.4. The 'Carrot and Stick' Mechanism

The carrot and stick mechanism, also known as the carrot and the whip, is a metaphorical approach to motivation and behavior management that involves offering rewards (the carrot) for desirable behavior and imposing penalties or punishments (the stick) for undesirable behavior [39]. In the context of a condominium community, this mechanism can significantly shape residents' behaviors, especially in promoting cooperation, compliance with rules and regulations, and overall ethical conduct. It should aim to foster self-regulation and internalization [40] (p. 5) of community norms and values among residents. By consistently rewarding cooperative behavior and sanctioning misconduct, the mechanism helps to reinforce positive social norms and discourage behaviors that deviate from community standards. Over time, "norm recognizers" more than merely "social conformers" [28] (p. 348) can contribute to a culture of mutual respect, trust, and cooperation within the condominium community, reducing the need for external enforcement and reliance on the carrot and stick approach.

The "carrot" aspect of the mechanism involves offering incentives, rewards, or positive reinforcement to encourage residents to engage in cooperative behaviors and adhere to ethical standards. This could include:

- a) recognition or praise for individuals or groups who demonstrate exemplary behavior,
- b) tangible rewards such as discounts on association fees or amenities or
- c) opportunities for community involvement and leadership roles.

By highlighting the benefits of cooperation and ethical conduct, the carrot aspect encourages residents to align their behavior with the values and goals of the community. Conversely, the "stick" aspect of the mechanism involves imposing consequences, penalties, or disciplinary measures to deter residents from engaging in behaviors that violate rules, disrupt community harmony, or undermine collective well-being [41]. This could include fines for rule violations, suspension of privileges or access to community amenities, or even legal action for serious misconduct. The stick aspect serves as a deterrent against unethical or antisocial behavior, sending a clear message that there are consequences for actions that harm the community or its members. The mechanism can also be rather impalpable considering that residents are likely to form "empirical beliefs about others' average cooperation", and this, in turn, becomes a determinant of "cooperation levels" that individuals will be willing to embrace based on how much higher the incentive is to cooperate since the cooperation of others, as clearly highlighted by reference [30] (p. 461).

The effective use of the carrot and stick mechanism requires striking a balance between rewards and consequences, ensuring that incentives are aligned with desired behaviors and that penalties are proportionate to the severity of infractions [42]. Establishing clear expectations, rules, and behavior guidelines reinforces a sense of collective responsibility and accountability among residents. Consistent enforcement [43] of both positive and negative consequences [44] helps to maintain order, fairness, and trust within the community, reinforcing the "expectations of expectations" by Niklas Luhmann mentioned in the previous paragraph.

Effective communication [45] is essential for implementing the carrot-and-stick mechanism in a condominium community. Clear communication channels, such as newsletters, community meetings, online platforms, and mobile chats, should inform residents about community rules, expectations, and non-compliance consequences. Additionally, opportunities for resident input, feedback, and participation in decision-making processes can enhance transparency, accountability, and buy-in for the mechanism.

2.5. 'Indirect Reciprocity' and Formation of Judgements

Another concept relevant at this research stage is 'indirect

reciprocity,' which operates as a form of social control. In this mechanism, individuals are motivated to cooperate or behave in certain ways to maintain or improve their social standing within the community [46]. This mechanism encourages individuals to consider the potential consequences of their actions on their reputation and relationships with others, like how the carrot and whip mechanism influences behavior within the condominium setting.

Indirect reciprocity operates based on social norms, "where individuals in a population observe and judge each other's behaviors" [46] (p. 1). In the context of indirect reciprocity, individuals evaluate the actions of others and form judgments based on whether those actions align with societal norms or expectations. Those who exhibit cooperative behavior may receive positive reputations or benefits (carrots) from others in the community, while those who act selfishly or against societal norms may face negative reputations or sanctions (whips).

Finally, it will be outlined as per reference [47] that indirect reciprocity occurs when individuals observe and evaluate the behaviors of others in a population, even if they do not directly interact with them. In indirect reciprocity, individuals cooperate based on reputation and social norms. They may have cooperated with those with a positive reputation (generous behavior) and avoided or punished those with a negative reputation (defective behavior). Indirect reciprocity relies on the assessment of others' actions and the formation of reputations within the community. Instead, generous tit-for-tat, a strategy commonly associated with 'direct reciprocity,' requires individuals to interact sufficiently often with the same partners. This is because the strategy relies on repeated interactions and establishing a reputation over time [47]. In general, in direct reciprocity, individuals cooperate with others who have previously cooperated with them (tit-for-tat strategy) or retaliate against those who have defected (tit-for-tat with forgiveness strategy). Direct reciprocity relies on the memory of past interactions and the expectation of future interactions with the same partners. Therefore, direct reciprocity tends to be more effective in environments where individuals have frequent and ongoing interactions with the same set of partners [47].

3. Real-world dynamics in the Condominium

In this context, inspired by real-life social structures, the paper aims to explore equilibrium concepts with varying constraints on coalition formation, mainly focusing on resource selection games (RSGs). The analysis presents a comprehensive perspective on the existence or non-existence of equilibria in general RSGs.

Simultaneously, it draws a parallel to real-world cooperative dynamics, specifically within the realm of condominium living. This study highlights the condominium association as

a crucial element for economic resilience, influencing residents' responses to risks associated with the ongoing pandemic. The strategic interactions within the condominium association mirror the coalition formation dynamics studied in game theory. In this context, equilibrium is defined based on the notion that no viable coalition of residents benefits from jointly altering their strategies, illustrating the delicate balance required for economic resilience and effective responses to pandemic challenges.

Parameters (a) to (c) below highlight the previously discussed role of:

- a) social norms,
- b) collective rationality, and
- c) efficiency considerations on expectations in shaping individual behavior within groups.

Calculating β^{**} (ratio of individual benefit to community benefit) and ϑ^{**} (degree of individual self-interest) allows for a quantitative analysis of how these factors influence decision-making processes and adherence to societal norms.

In the context of game theory and cooperative games, calculating the ratio of individual benefit to community benefit sheds light on equilibrium outcomes. It helps identify whether equilibrium solutions balance individual incentives and collective outcomes, as dictated by the parameters (d) and (e). Understanding the degree of individual self-interest (ϑ^{**}) and its relationship to the ratio of individual benefit to community benefit (β^{**}) is crucial for fostering group cooperation and coordination. By quantifying self-interest and community benefit, strategies can be developed to incentivize cooperative behavior and mitigate potential conflicts of interest.

In the simulated condominium's dynamics, it is considered how the interplay between 'individual autonomy' and 'collective goals' underscores the intricate nature of collective rationality within the condominium context according to the following parameters:

1. Acts of a group are collectively rational when the individual acts of its members are rational,
 - i. This parameter suggests that collective rationality is contingent upon the rationality of individual actions. In other words, for a group to act collectively rationally, each member must make rational decisions based on their own self-interest.
 - ii. In calculating the ratio (β^{**}) of individual benefit to community benefit, this parameter implies that individual actions should be evaluated based on their rationality and contribution to the community's overall benefit.
2. Efficiency is identified as a goal of collective rationality, but it is not an absolute requirement,
 - i. This parameter acknowledges efficiency as a desirable outcome of collective action but recognizes that achieving efficiency may not always be possible or necessary.
3. Efficiency considerations on expectations are considered a goal of collective rationality, but it becomes a

requirement only in certain ideal situations,

- i. This parameter suggests that efficiency considerations on expectations become required under specific conditions, such as when coordination among agents is optimal and when agents have prepared rationally for joint action.
4. In games, a solution represents an equilibrium among the incentives of the agents in the game. In cooperative games, some agents are coalitions of individuals, and not all agents may pursue all incentives.
 - i. This parameter highlights the concept of equilibrium in game theory, where decisions are made based on incentives and payoffs.
 - ii. When calculating the ratio (β^{**}), it is important to consider how incentives influence individual and collective behavior within cooperative games, recognizing that different agents may have varying motivations and objectives.
5. The equilibrium standard for cooperative games considers the pursuit of incentives based on whether they provide sufficient reasons to act.
 - i. This parameter underscores the importance of incentives in determining behavior within cooperative games and suggests that individuals act based on the perceived benefits of their actions.

4. Shared Responsibility in the Condominium

The principles of ‘shared responsibility’ align closely with the goals of measuring individual benefit versus community benefit and understanding the degree of individual self-interest within a condominium or community setting. By promoting shared responsibility, individuals can work together more effectively to address common challenges and achieve shared goals, ultimately benefiting both themselves and the broader community [48].

Shared responsibility not only motivates collective decision-making but also serves to protect individuals from the negative consequences of failure. By understanding the mechanisms through which shared responsibility operates, individuals and groups can harness its benefits to improve cooperation and collaboration in various contexts. For example, there are specific conditions and contexts under which sharing responsibility with others can benefit the individual. This could include situations where the complexity of the task or the level of uncertainty makes it difficult to attribute success or failure to any single person. By sharing responsibility, individuals can mitigate the risks associated with uncertainty and complexity [48].

In both cases, there is a recognition that certain tasks or decisions may involve a high level of complexity or uncertainty. Decisions regarding communal resources, maintenance, or governance in a condominium setting may be multifaceted

and difficult to attribute solely to one individual. Similarly, in broader contexts, such as community projects or initiatives, there may be uncertainty about the outcomes and contributions of each member. Shared responsibility also protects individuals from the negative consequences of failure or suboptimal outcomes [48].

Within a condominium, if a decision has negative consequences, such as increased maintenance costs or decreased property value, distributing responsibility among all residents can prevent any individual from bearing the full blame or repercussions. Similarly, in broader community settings, individuals may feel more comfortable taking risks or participating in initiatives if they know that responsibility is shared among the group. This can encourage greater participation and collaboration, leading to improved outcomes for the community. Marston et al. (2020) have underlined how communities identify solutions to pandemics because “they know what knowledge and rumors are circulating;” in addition, they can operate against “stigma and structural barriers;” in a word, they correspond to a collective response [49] (p. 1676).

By understanding the mechanisms of shared responsibility, individuals and groups can harness its benefits to improve cooperation and collaboration [50]. They will probably “feel less responsible for their choice when playing in a group”, and will be less affected by regret, this last reiterated by reference [51] (p. 7) “as a form of automatic self-punishment.” This may involve implementing structures or processes encouraging shared decision-making and accountability in a condominium, such as resident committees or transparent communication channels [51]. This enhances greater trust, communication, and mutual support among community members, leading to more cohesive and resilient communities.

This way, it is also targeted to inform decisions on resource allocation, incentive structures, and the design of collective action mechanisms to achieve desired social outcomes in condominium settings.

In summary, calculating a ratio of individual benefit to community benefit (β^{**}) and the degree of individual self-interest (ϑ^{**}) is valuable for understanding, evaluating, and promoting collective decision-making processes within various social, economic, and organizational contexts. It facilitates the assessment of i. rationality, ii. efficiency, iii. equilibrium outcomes, and iv. the alignment of individual incentives with broader societal goals.

This section presents a refined approach to understanding the dynamics within a condominium community using theoretical models and simulations. Since obtaining explicit permission from residents to use their data was not feasible, this section focuses on hypothetical scenarios rather than actual survey data.

Effort Contribution (EC): Each resident’s effort contribution (EC) is theoretically quantified based on responses to a series of hypothetical questions covering six key areas:

General Sustainability of Health Status (GSHs)

Residents' Demographic and Socio-Economic Status (DSEs)

Propensity for Charity and Travel (PfCT)

Economic-Educational Resilience (EE-res)

Participatory Nature of Meetings (PNM)

Trust Towards the Leading Condominium Association (TiLCA)

Responses are measured using Likert scales or binary values. For simulation purposes, EC is quantified as the standard deviation from the mean response in the hypothetical community. Cumulative EC levels are calculated by age range.

$$EC_i = \sigma_i \quad (1)$$

Where σ_i is the standard deviation of the responses of the resident i . The cumulative EC by age range is calculated as:

$$EC_{age\ range} = \sum_{i \in age\ range} EC_i \quad (2)$$

Quality of Outputs (QoO): Residents' quality of outputs (QO) is theoretically determined based on their self-assessment of compliance with condominium rules. This assessment is cross-checked with their self-evaluation of the Participatory Nature of Meetings (PNM) so that inconsistent scores are annulled and marked as n.a.

Utility Maximization (UM): Under various outsourcing scenarios, utility maximization (UM) is calculated as the sum of three components:

1. Identifying Meaningful Patterns (Imp)
2. Developing Risk Reduction Strategies (Drrs)
3. Building Trust and Confidence (Btc)

Further, the interplay between various factors must be incorporated and weighted appropriately to refine metrics and create a final formula for the RLS.

First, weighted components for Imp , $Drrs$, and Btc to account for their varying significance within the community are introduced. These weights are w_{Imp} , w_{Drrs} , and w_{Btc} respectively. Additionally, the SCP and QoO are incorporated more dynamically.

Components and Weights:

Imp (Identifying Meaningful Patterns): $w_{Imp} \cdot Imp$

Drrs (Developing Risk Reduction Strategies): $w_{Drrs} \cdot Drrs$

Btc (Building Trust and Confidence): $w_{Btc} \cdot Btc$

Systemic Closure Parameter (SCP): SCP

Quality of Outputs (QoO): QoO .

Then, interaction terms between these components to capture their combined effects more accurately are introduced. For instance, the effectiveness of Imp might be enhanced by the presence of robust $Drrs$.

Interaction Terms:

Interaction between Imp and $Drrs$: $\alpha \cdot Imp \cdot Drrs$

Interaction between Imp and Btc : $\beta \cdot Imp \cdot Btc$

Interaction between $Drrs$ and Btc : $\gamma \cdot Drrs \cdot Btc$.

Where α , β , and γ are coefficients representing the

strength of these interactions.

The formula for UM is then:

$$UM = (w_{Imp} \cdot Imp + w_{Drrs} \cdot Drrs + w_{Btc} \cdot Btc + \alpha \cdot Imp \cdot Drrs + \beta \cdot Imp \cdot Btc + \gamma \cdot Drrs \cdot Btc) \times SCP \times QoO \quad (3)$$

This factor SCP adjusts the overall utility by reflecting the degree of systemic closure within the condominium association. It is a value between 0 and 1, indicating the system is closed or open. Multiplying the sum of Imp , $Drrs$, and Btc by SCP means that the utility is scaled based on the systemic boundaries and integration within the community. A higher SCP indicates a more closed system, which might mean tighter control and higher efficiency of contributions, while a lower SCP indicates a more open system with potentially less control.

In this model, the QoO indirectly influences UM . QoO is determined by the residents' self-assessment of compliance with condominium rules and their meeting participation. It ensures that the contributions measured in Imp , $Drrs$, and Btc are meaningful and accurately reflect the residents' engagement and compliance. This validation step helps filter out inconsistent or unreliable data, ensuring only valid contributions are considered in the UM formula.

Ratio of Individual Benefit to Community Benefit (β^{**}):

$$\beta^{**} = \frac{\text{total individual benefit}}{\text{total community benefit}}$$

Where:

The total individual benefit is the sum of individual ECs across all age ranges.

The total community benefit is the sum of all cumulative ECs across all age ranges.

This ratio indicates how much individual contributions benefit the community compared to collective contributions. A higher β^{**} suggests that particular efforts greatly benefit the community, enhancing overall utility.

Degree of Individual Self-Interest (ϑ^{**}):

$$\vartheta^{**} = \frac{\text{total individual self-interest}}{\text{total community benefit}}$$

Where:

The total individual self-interest is derived from the sum of individual self-interest values across all age ranges.

The total community benefit is the sum of all cumulative ECs across all age ranges.

This ratio measures individuals' self-interest relative to the community's collective benefit. A lower ϑ^{**} implies that individual self-interest is less dominant, potentially leading to higher community utility.

Incorporating the ratios β^{**} and ϑ^{**} , the UM formula in (3) is modified to reflect the broader influence of individual and collective dynamics, providing additional context and scaling factors to understand the RLS within the condomin-

ium. It considers individual components' weighted contributions, interactions, systemic closure, quality of outputs, and the balance between individual and community benefits.

$$RLS = \frac{UM}{\beta^{**} + \vartheta^{**}} \quad (4)$$

These metrics simulate and analyze the impact of different factors on community dynamics within the condominium. By incorporating the *SCP*, the overall utility is adjusted to reflect the influence of systemic boundaries and differentiation within the condominium association. This approach provides a comprehensive framework for understanding the interplay of individual contributions, collective benefits, and the systemic context in fostering a resilient and cooperative community. The paper explores further how individual behaviors do not solely determine residents' safety but are intricately interwoven with the cooperative dynamics facilitated by the condominium's governance structure.

Within this framework, the condominium administrator, in collaboration with a supporting lawyer, assumes a pivotal role in a) documentation, b) processing practices, and c) steering decision-making processes. Their collective efforts encapsulate the essence of socio-juridical precautions, further contributing to the condominium community's economic resilience.

4.1. The Expectations of the Youngest Condominium's Residents

Within the condominium, residents have elected a condominium administrator vested with the responsibility to lead the association and make decisions on their behalf. While all unit owners are association members, this status does not confer legal authority for individual members to act on behalf of the entire condominium. Co-owners collectively pay condominium fees, ensure the maintenance of common elements, and facilitate essential services [52] (pp. 17-18).

The demographic landscape of the condominium has evolved over the years, with apartments changing ownership and new families moving in, while some residents have relocated abroad in pursuit of career opportunities. With an age range spanning 15 to 91 years, the community comprises mostly students, public employees, and free professionals in law and engineering, with a significant portion already retired. Historically, until the early 2000s, limited opportunities for higher education in the local area compelled individuals, including their parents, to pursue studies abroad. This undoubtedly created a unique and often more challenging environment for education and personal growth.

However, with the recent proliferation of educational institutions in the town, the youth now have increased access to diverse educational opportunities without the need to relocate. The emergence of these local educational institutions may have inadvertently contributed to a more accustomed and relaxed environment for the younger generation. The availa-

bility of educational resources and a familiar setting might have altered the traditional dynamics of ambition and drive that were associated with pursuing education abroad.

The youth's perceived 'laziness' could stem from a shift in cultural and educational expectations. With a more accessible and relaxed local education system, there might be a perception that the youth are not facing the same level of challenges and pressures that were experienced by their parent's generation. It is essential to recognize that this perception might not necessarily reflect the youth's true work ethic or potential but rather result from the changing educational landscape and the different opportunities available to them.

From an economic perspective strictly tied to the condominium, the pandemic has induced significant changes, leading to the closure of certain businesses, such as bed and breakfasts, and the restriction of charity activities within the condominium. Health offices that were once housed here have been constrained or closed due to pandemic-related precautionary measures. Notably, the condominium's response to these challenges underscores the importance of economic resilience, socio-juridical precautions, and the emergence of cooperative games as mechanisms for navigating uncertainties and fostering collective well-being.

4.2. The Adherence to Regulations in the Condominium

In the context of the COVID-19 pandemic it is investigated how the condominium residents and management have adapted to and complied with specific regulations issued in response to the World Health Organization (WHO) declaration. This has included health and safety guidelines, quarantine measures, or other directives to control the spread of COVID-19. This includes exploring the formulation of policies, decision-making processes, and communication strategies that the condominium has implemented to address the challenges posed by the pandemic. The adaptive strategies employed by the condominium in response to changing regulations and uncertainties involved i. changes in common area management, ii. sanitation practices, or iii. other alterations were made to align with health and safety guidelines. The organizational structure of the condominium underwent centralization, guided by the doorman under the administration of the condominium administrator and a supporting lawyer. The doorman was crucial in maintaining a safe environment, ensuring proper ventilation, preventing crowding, and regularly checking for potential contamination on surfaces. In alignment with WHO Environment and Engineering Control Expert Advisory Panel (ECAP) recommendations, [53] (pp. 2-4) environmental factors within and around the condominium were meticulously assessed.

Specifically, the doorman ensured that:

- i. Ventilation and hygiene in the concierge and hall were not compromised by excessive crowding,
- ii. Close-contact settings, including external visitors, were

minimized, and

- iii. Condominium HVAC systems underwent regular inspection and cleaning.

In addition, the doorman played a key role in communicating vital health information to residents, particularly during critical periods such as May 2021, when the Sicilian region faced heightened restrictions until the end of April 2021 as designated by the Italian Health Ministry and the Italian Civil Security Corp [54] (pp. 1-5)]. He also checked that the identification of COVID-19 cases in the condominium would have been followed by their isolation through self-quarantine at home and/or management in a medical facility [55] (ivi, p. 4), informing further the other residents on the status of their recovery. This multifaceted approach, anchored in socio-juridical precautions and economic resilience, showcases the condominium's commitment to the safety and well-being of its residents. The challenges posed by the COVID-19 vaccination campaign within the condominium echo global concerns and are deeply entwined with the '3 Cs model' [55] (p. 2)—confidence, complacency, and convenience—raising critical questions about residents' trust in:

- i. The effectiveness and safety of the vaccines,
- ii. The health services and professionals administering them and
- iii. The motivations of policymakers guiding vaccination decisions.

5. Cooperative Games and Legal Resilience

Self-audit mechanisms were rigorously implemented throughout the research process to maintain legal compliance. Regular assessments and adjustments were made to research methods based on legal considerations. Ensuring transparent communication with residents about research objectives and methods while articulating legal parameters became a cornerstone in fostering legal resilience through informed participant consent. Tailored to the specific context of condominium living, the study recognizes and embraces the unique dynamics and governance structures inherent in such communities. This context-specific approach ensures the relevance and applicability of the findings to the target population. However, the reliance on self-reported data introduces subjectivity and potential bias, influenced by *a.* individual perspectives, *b.* social desirability, or *c.* recall bias, impacting the reliability of findings.

While the study focuses on a specific condominium in Sicily, acknowledging the unique socio-cultural characteristics of the region, it cautions about potential limitations in generalizability to other contexts or populations, emphasizing the importance of understanding local or even clique nuances.

The process of transforming data series and creating hypothetical dummies, though enhancing study rigor, may introduce complexity, challenging the interpretation of results

and potentially hindering study replication. Self-observational methods were meticulously designed to address this, with a strong emphasis on legal and ethical standards, ensuring resilience against potential legal challenges.

Prioritizing participant privacy and compliance with data protection laws, the analysis engages in open discussions with condominium residents, informing them about the legal implications of data collection, storage, and sharing. The use of interactive survey techniques fostered resident engagement, adopting a cooperative approach that enhanced the quality of collected data—a collective effort to understand community dynamics.

Drawing inspiration from Luhmann's regulatory approach, the study emphasizes law as a stabilizing force for expectations, enabling them to withstand changes in the factual situation. The concept of systems and autopoiesis, where a structure maintains resiliency through feedback and feed-forward processes, underscores the dynamic nature of systems. Finally, this holistic approach ensures that expectations, legal structures, and cooperative behaviors work together, fostering a resilient framework for cooperative games within the condominium.

5.1. The Condominium's Surveys

Conducting a first round of self-survey for the condominium-based cross-sectional study from November to December 2022, the survey focused on residents living in a middle town of Sicily with a population of approximately 500,000 inhabitants. The town, strategically located near the island's main airports, thrives on tourism, luxury hotels, professional bureaus, and a small expanding university. Employment opportunities, especially for the youth, stem from Small and Medium Enterprises (MSMEs) and professional activities. While economic challenges prevailed in the national context during the 2010s, the town has gradually recovered in the past three years.

The resident interviews encompassed both minors and elderly individuals within the condominium. Exclusions were applied to families' components connected to the condominium but not in town for at least three months. The sampling process began from the first floor and progressed to the last, ensuring a diverse sample. The final total population consisted of 39 individuals living in the condominium, with ages ranging from 15 to 91 (below in Figure 2 the interviewees' percentages on the total by age group and sub-group).

The survey employed a dichotomous endpoint (yes/no) for responses. It was a one-sample study comparing the study group to the population.

Out of the 39 interviewees, the incidence population considered for results was 3 people (the doorman, the principal legal advisor, and the first researcher in this paper actually residing in the condominium), representing 7.7% of the total respondents. Statistical parameters were set as follows:

- a) Alpha (probability of a type-I error): 0.05,

b) Beta (probability of a type-II error): 0.2,

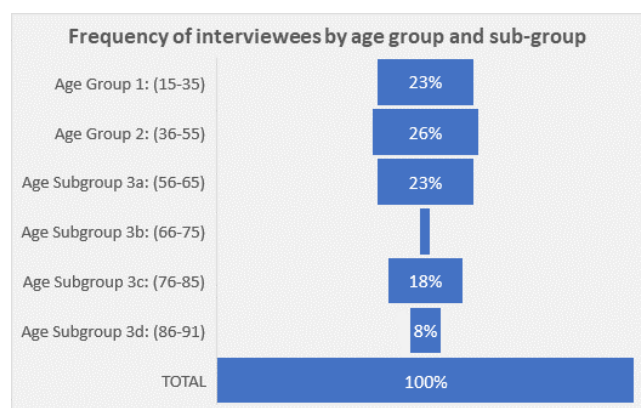


Figure 2. Percentage of interviewees on the total population by age range.

The analysis uses a sample size calculator to determine the appropriate sample size based on the above specified statistical parameter, which is available at: <https://clincalc.com/stats/SampleSize.aspx>. Understandably, a small sample size may limit statistical power (the ability to detect an actual effect). This could impact the reliability of statistical tests and the ability to draw robust conclusions from the data. In statistical terms, a smaller sample size requires a larger effect size to achieve statistical significance. The precision of estimates (confidence intervals, standard errors) may be lower with a small sample. This has been considered when making inferences about population parameters. Given the small sample size, qualitative insights from interviews and open-ended questions have been deemed to be valuable in providing context and depth to quantitative findings.

5.2. Surveys' Findings

This exploration focuses on:

1. **Primary Outcome Variable:** General Sustainability of Health Status (GSHs): The GSHs measure, a cumulative assessment of residents' confidence in sustainability, was derived from open-ended questions. Residents were probed on environmental aspects surrounding the condominium, encompassing responsibilities like garbage disposal, maintenance of common elements, and provision of condo services, including the festive decoration of the Christmas tree.
2. **Residents' Demographic and Socio-Economic Status (DSEs):** Questions regarding age, gender, family size, education level, occupation, and self-perceived salary were included. These factors provide insights into the economic resilience of residents and how demographic shifts may influence their perceptions and responses.
3. **Propensity for Charity and Travel (PfCT):** Residents were questioned about their charitable activities and travel history. This component serves as a proxy for economic engagement, shedding light on residents' economic activities and potentially influencing their exposure and susceptibility to uncertainties.

Hypothetical dummies were created to unravel economic nuances, reflecting a subset of nominal data elements within the four main components. In the first round of the survey, dummies comprehend the following nine key variables are also detailed as a template in Table 1:

- a) **Size of the Family (self-observed):** This variable refers to the self-reported size of the family that an individual belongs to. It provides insight into the household structure and dynamics, which can influence financial decisions, resource distribution, and overall family resilience.
- b) **Level of Education (self-observed):** This variable captures the individual's self-reported educational attainment. Education is a key determinant of socioeconomic status and can influence career opportunities, earning potential, and access to certain resources.
- c) **Professional Status (self-observed):** This variable describes the individual's self-reported professional standing or job title. It provides information about the person's role in the workforce and can indicate the level of job security, responsibility, and career advancement.
- d) **Salary (self-observed):** Self-reported salary reflects the individual's income level. This information is crucial for understanding the economic well-being of the person, including their ability to meet financial obligations, save, and invest.
- e) **Travel History (self-observed):** This variable encompasses the individual's self-reported travel history. In the context of pandemic preparedness, understanding travel history can provide insights into potential exposure to infectious diseases and adherence to public health guidelines.
- f) **Annual Charity (self-observed estimate):** This variable represents the individual's self-estimated annual charitable contributions. It sheds light on the person's social responsibility, generosity, and engagement with philanthropy.
- g) **Confidence in Sustainability (interviews via mobile chat):** This qualitative variable is based on interviews conducted via mobile chat and gauges the individual's confidence in sustainable practices. It provides insights into environmental consciousness, which is relevant in economic and environmental sustainability discussions.

Table 1. The first round of the self-survey questionnaire.

Components	Mode of questions	Self-observations apply
General sustainability of health status (GSHs)	Closed	yes
Demographic and socio-economic status (DSEs)	Open	No
Propensity for charity and travel (PfCT)	Open	yes

*Example of the first-round survey.

Doses of Vaccines Already Taken (interviews via mobile chat): This variable involves self-reported information obtained through mobile chat interviews regarding the individual's vaccination history. It is crucial for understanding the person's engagement with public health measures and preparedness against infectious diseases.

Depressive Symptoms (interviews via mobile chat): This variable explores self-reported information gathered through mobile chat interviews regarding the presence or absence of

depressive symptoms. It provides insights into mental health, which is a significant component of overall well-being.

Since the condominium was viewed as a microcosm—a community that reflects broader societal dynamics—the need to emphasize the importance of studying this microcosm to gain insights into the factors contributing to resilience and well-being was further felt.

Dummies for the presentation of data are shown below in Table 2 to Table 5:

Table 2. Sample questions related to the General Sustainability of Health Status (GSHs) and response modes on a Likert scale with three points (e.g., Agree, Neutral, Disagree).

Questions	Response Modes
1. How confident are you in the condominium's garbage disposal system?	Agree / Neutral / Disagree
2. Do you feel that maintaining common elements in the condominium is sustainable?	Agree / Neutral / Disagree
3. Are you satisfied with the provision of condo services, including festive decorations like the Christmas tree?	Agree / Neutral / Disagree
4. To what extent do you think the environmental aspects surrounding the condominium contribute to its sustainability?	High Contribution / Moderate Contribution / Low Contribution
5. How confident are you in the efforts made by the condominium management to promote sustainability in daily activities?	Confident / Neutral / Not Confident
6. Do you believe that residents actively participate in activities promoting the sustainability of the condominium?	Agree / Neutral / Disagree
7. Rate your overall confidence in the general sustainability of health status within the condominium.	High Confidence / Moderate Confidence / Low Confidence

*Dummies for the first-round survey.

Table 3. Sample questions related to Residents' Demographic and Socio-Economic Status (DSEs) and response modes.

Questions	Response Modes
1. What is your age range?	18-24 / 25-34 / 35-44 / 45-54 / 55+
2. How do you identify your gender?	Male / Female / Prefer not to say
3. What is the size of your family or household?	Single / Small Family (2-3 members) / Large Family (4+ members)
4. What is your highest level of education?	High School or below / College or Vocational Training / Postgraduate Degree

Questions	Response Modes
5. What is your primary occupation?	Employed / Unemployed / Student or Retired
6. How would you describe your self-perceived salary level?	High Salary / Moderate Salary / Low Salary
7. How satisfied are you with your current socio-economic status?	Satisfied / Neutral / Dissatisfied

*Dummies for the first-round survey.

Table 4. Sample questions related to Propensity for Charity and Travel (PfCT) and response modes on a 3-point Likert scale.

Questions	Response Modes
1. How frequently do you engage in charitable activities or donations?	Regularly / Occasionally / Rarely or Never
2. To what extent do you believe in contributing to charitable causes?	Strong Belief / Moderate Belief / Minimal or No Belief
3. How often do you participate in community service or volunteer work?	Frequently / Occasionally / Rarely or Never
4. How would you describe your travel history over the past year?	Extensive Travel / Moderate Travel / Minimal or No Travel
5. What factors influence your decision to engage in charitable activities?	Personal Values / Community Impact / Other (Specify)
6. How do you perceive the relationship between travel experiences and economic engagement?	Positive Influence / Neutral / Negative Influence
7. To what extent do your charitable activities align with your travel experiences?	Strong Alignment / Moderate Alignment / Weak or No Alignment

*Dummies for the first-round survey.

5.3. The Second Round of Survey

Therefore, after the initial exploration of nine key variables (from the first survey), a second round of investigation was conducted in the winter season of 2022-2023 to explore economic resilience and uncertainties within the condominium, emphasizing components that delve into residents' perceptions and behaviors, particularly considering the economic challenges posed by the pandemic.

The following fourth category has therefore been created to analyze data:

4. *Economical-Educational Resilience (EE-res)*: This category captures various dimensions of an individual's resilience in i. economic stability, ii. adaptability to technology, iii. healthcare access, iv. social connections, v. housing stability, vi. community engagement, vii. remote work adaptability, viii. crisis' preparedness, and

ix. access to education and training. It provides insights into how well individuals are positioned to navigate economic and educational challenges, especially in the context of the post-COVID-19 period.

This second round was driven by recognizing additional factors that play a crucial role in shaping the community's response to uncertainties. These additional variables delve deeper into various aspects contributing to the residents' economic resilience, adaptability, and overall well-being. Because they aimed to capture the intricate dynamics within the community, these new variables interact with the previously studied ones to illustrate that a holistic understanding of these factors is essential for comprehending the community's responses to unexpected events, such as the COVID-19 pandemic.

Dummies for the presentation of data are shown below in Table 5 to Table 7:

Table 5. Sample questions related to Economical-Educational Resilience (EE-res) and response modes on a 3-point Likert scale.

Questions	Response Modes
1. How confident are you in your economic stability?	High Confidence / Moderate Confidence / Minimal Confidence
2. To what extent do you feel adaptable to new technologies in your daily life?	Very Adaptable / Moderately Adaptable / Not Adapt-

Questions	Response Modes
	able
3. How satisfied are you with your access to healthcare services?	Satisfied / Neutral / Dissatisfied
4. Rate the strength of your social connections within the community.	Strong Connections / Moderate Connections / Weak Connections
5. How stable do you consider your housing situation?	Very Stable / Moderately Stable / Not Stable
6. How engaged are you in community activities or events?	Highly Engaged / Moderately Engaged / Not Engaged
7. To what extent can you adapt to remote work if needed?	Highly Adaptable / Moderately Adaptable / Not Adaptable
8. How prepared do you feel for unexpected crises?	Well Prepared / Somewhat Prepared / Not Prepared
9. How satisfied are you with your access to education and training opportunities?	Satisfied / Neutral / Dissatisfied

*Dummies for the second round survey.

Table 6. Sample questions about the Participatory Nature of Meetings (PNM) and response modes.

Questions	Response Modes
1. AGENDA SETTING:	
1.1 How are agendas for condominium meetings typically determined?	Board/Management Decision / Resident Input and Board Decision / Resident Voting
1.2 To what extent do residents have the opportunity to suggest agenda topics?	High Opportunity / Moderate Opportunity / Low Opportunity
1.3 Is there a formal process for residents to vote on meeting topics or agenda items?	Yes / No / Not Applicable
2. DECISION-MAKING PROCESSES:	
2.1 How would you describe the level of resident involvement in decision-making during condominium meetings?	Actively Involved / Moderately Involved / Not Involved
2.2 Are major decisions subject to approval by the majority of residents?	Yes, via Voting / No, Board/Management Decides / Not Applicable
2.3 In what ways can residents express their preferences during decision-making?	Voting-Open Discussion / Written Feedback / Other (Specify)
3. OPEN FORUM OR Q&A SESSIONS:	
3.1 Are there dedicated meeting sessions for residents to ask questions or express concerns?	Yes, Regularly / Occasionally / No
3.2 How satisfied are you with the opportunities provided for resident input during open forums or Q&A sessions?	Satisfied / Neutral / Dissatisfied
4. VOTING MECHANISMS:	
4.1 What voting mechanisms are in place for decision-making during meetings?	Majority Vote / Consensus / Other (Specify)
4.2 Do residents have the ability to vote electronically outside of meetings?	Yes / No / Not Applicable

*Dummies for the second round survey.

Table 7. Sample questions related to measuring the Trust Towards the Leading Condominium Association (TiLCA) and response modes.

Questions	Response Modes
TRUST IN DECISION-MAKING:	
1.1 How much do you trust the condominium association's decision-making processes?	High Trust / Moderate Trust / Low Trust
1.2 To what extent do you feel that residents' opinions are considered in condominium association decisions?	Fully Considered / Partially Considered / Not Considered
1.3 How satisfied are you with the transparency of decision-making within the condominium association?	Satisfied / Neutral / Dissatisfied
COMMUNICATION TRUST:	
2.1 How would you rate the condominium association's communication regarding important matters?	Transparent and Effective / Moderately Transparent and Effective / Not Transparent and Effective
2.2 To what extent do you feel informed about the condominium association's activities and decisions?	Well Informed / Partially Informed / Not Informed
2.3 How satisfied are you with the communication channels used by the condominium association?	Satisfied / Neutral / Dissatisfied
RELIABILITY TRUST:	
3.1 How confident are you in the condominium association's ability to fulfill its responsibilities?	Very Confident / Moderately Confident / Not Confident
3.2 To what extent do you believe the condominium association acts in the best interests of the community?	Acts in the Best Interests / Partially Acts in the Best Interests / Does Not Act in the Best Interests
3.3 How satisfied are you with the overall performance of the condominium association in fulfilling its responsibilities?	Satisfied / Neutral / Dissatisfied
METHODOLOGY:	
4.1 In your opinion, which method is more effective in assessing trust levels: Surveys or Interviews?	Surveys / Interviews / Both are Equally Effective
4.2 How comfortable are you providing honest feedback about your trust levels in the condominium association?	Very Comfortable / Moderately Comfortable / Not Comfortable

*Dummies for the second round survey.

5.4. Patterns of Resilience in the Condominium

This method aligns with the overarching goal of safeguarding residents. Each variable was useful in promoting the well-being and security of individuals within the condominium.

Since its beginning, this study has sought to uncover patterns of resilience and adaptation within the community, which contribute to the condominium's ability to navigate challenges, adapt to uncertainties, and foster a supportive environment.

Then, the following second round of variables was integral to the overarching goal of safeguarding residents and fostering a resilient community within the condominium microcosm. Here are the new ten variables in their respective details:

- Employment Stability*: Assessing employment stability, including factors such as job security, tenure, and the nature of the employment contract.
- Financial Reserves*: Understanding the financial preparedness of individuals, including savings, investments, and access to emergency funds.
- Technological Adaptability*: Exploring the individual's adaptability to technological advancements, especially in professions prone to automation or significant technological changes.
- Access to Healthcare*: Evaluating the availability and accessibility of healthcare services, including health insurance coverage and the ease of accessing medical facilities.
- Social Network Strength*: Assessing the strength of an individual's social network, which can provide support during economic challenges or uncertainties.

- f) *Housing Stability*: Examining the stability of housing situations, including factors such as homeownership, rental stability, and the risk of eviction.
- g) *Community Engagement*: Understanding the level of engagement and involvement in community activities, as strong community ties can contribute to resilience.
- h) *Adaptability to Remote Work*: For professions that allow remote work, assessing the individual's adaptability and access to necessary resources for remote work.
- i) *Crisis Preparedness*: Exploring the extent to which individuals have prepared for various crises, including economic downturns, through contingency planning.
- j) *Access to Education and Training*: Evaluating the availability and accessibility of continuous education and training opportunities to enhance professional skills.

The datasets were merged based on a unique identifier that is common to both surveys. This identifier was a participant ID assigned to everyone with the future aim of granting privacy to interviewees. The merged dataset can be treated as panel data, where everyone is observed over two time periods (surveys). The systemic perspective suggests analyzing changes over time and observing the relationship between the variables measured in both surveys. Using panel data analysis techniques, such as fixed effects models or random effects models, can be useful to control individual-specific characteristics and better understand the impact of changes in variables over time.

6. Discussion

This section focuses on the measurement and perception of the risk of COVID-19, presenting hypotheses, results, and statistical analyses. This study formulates the following hypotheses:

1. H1: System/Environment Difference: This hypothesis suggests that condominiums have a distinct boundary separating them from their surroundings, emphasizing their status as distinct social systems. Investigating this hypothesis can help determine how condominium residents perceive boundaries between their community and the external environment, influencing their sense of identity and belonging.
2. H2: Allopoiesis/Autopoiesis and Operational Closure: This hypothesis explores whether condominiums exhibit characteristics of allopoietic or autopoietic systems, focusing on operational closure. Examining this hypothesis can show how condominium governance operates autonomously and self-regulates its operations, impacting decision-making processes and community dynamics.
3. H3: Symbolically Generalized Media and Codes: This hypothesis examines the role of symbolically generalized media and codes in facilitating communication and establishing norms within condominium communities.

Investigating this hypothesis can help identify the key communication channels and codes governing interactions among condominium residents, influencing their behavior and decision-making processes.

4. H4: Influence on Decision-Making and Communication: This hypothesis posits that factors such as system/environment difference, operational closure, and symbolically generalized media influence decision-making processes and communication within condominium communities. Exploring this hypothesis can provide insights into how the principles of Systems Theory manifest in the organizational behavior and community dynamics of condominium governance.

By systematically testing these hypotheses, the paper can gain valuable insights into the complexities of decision-making processes and communication dynamics within condominium communities.

7. Conclusions

This analysis has provided insights into the cooperative dynamics within the condominium by evaluating the participatory nature of meetings and trust levels. These factors are crucial for fostering a harmonious living environment where residents collaborate effectively.

The study examined how behaviors supportive of the condominium, encapsulated in the General Sustainability of Health Status (GSs) construct, foster compliance with broader societal benefits. The focus on place attachment underscores the importance of residents' connection to their community. In addition, the research focuses on a systemic hypothetical researcher's condominium to avoid unnecessary entanglements, aiming to understand post-COVID-19 resilience, especially attitudes and beliefs supported by the condominium administration.

The second survey round focused on Economic-Educational Resilience (EE-res), capturing various dimensions of an individual's resilience in economic stability, adaptability to technology, healthcare access, social connections, housing stability, community engagement, remote work adaptability, crisis preparedness, and access to education and training. This comprehensive approach delves deeper into factors contributing to economic resilience, adaptability, and overall well-being, especially in the post-COVID-19 context. These new variables interact with the previously studied ones to provide a holistic understanding of the community's responses to unexpected events.

Integrating narratives and stories obtained through self-observational tools and interviews via mobile chats represents a shift from traditional cause-and-effect explanations, emphasizing a more dynamic and contextual understanding of social phenomena.

The study outlines functions to discriminate learning and memory within a modality, providing a detailed framework for analyzing memory and learning processes in response to

condominium regulations.

The conclusions are consistent with the data and analyses, reflecting a thorough evaluation of the participatory nature, trust levels, and various behavioral and demographic factors.

Including multiple methods and encoding systems supports the multifaceted analysis presented in the data.

Acknowledging limitations such as potential bias from the researcher being a resident, future research should delve deeper into the dynamics of condominium communities. This can be achieved by embedding findings from relevant strands of sociological research, including CRT, CAS, SAT, and SCT. Exploring these theoretical frameworks can enhance our understanding of how diverse factors influence community resilience and cooperative behaviors, ultimately contributing to developing strategies that foster stronger, more adaptive, and resilient condominium communities.

Abbreviations

Btc	Building Trust and Confidence
CRT	Classical Rational Theory
CAS	Complex Adaptive System
Drrs	Developing Risk Reduction Strategies
DSEs	Demographic and Socio-Economic Status
ECs	Effort Contributions
EE-res	Economic-Educational Resilience
GShs	General Sustainability of Health Status
Imp	Identifying Meaningful Patterns
PfCT	Propensity for Charity and Travel
PNM	Participatory Nature of Meetings
QoO	Quality of Outputs
RLS	Role of the Legal System
RSGs	Resource Selection Games
SAT	Situational Action Theory
SCP	Systemic Closure Parameter
SCT	Social Choice Theory
SEU	Subjective Expected Utility
UM	Utility Maximization

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Author Contributions

Romina Fucà: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Serena Cubico: Project administration, Resources, Software, Supervision, Writing – review & editing.

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Data Availability Statement

Data is available from the corresponding author upon reasonable request.

The data supporting the outcome of this research work have been explained through simulated dummies in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest and agree with the final version.

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Biography



Romina Fucà holds a Ph.D. in Systems Theory from the University of Macerata, Italy. With over twenty years of research experience, her expertise lies in economic behavior, organizational behavior, probabilities, choice under uncertainty, payoffs calculations, and AI in semantics and translational tasks. Between 2016 and 2018, Dr. Fucà published three significant sociological works with Aracne Editrice in Rome: “Curbanismo,” “Modeling e Decision-making,” and “L’evoluzione dell’Urbanesimo nelle Emergenze.” Her latest book, “Schengen and the Cross-border Operations in Europe: Security Systems and the EU Borders,” was published online in December 2019. Dr. Fucà volunteers for the “Business Management” course at the Department of Management, University of Verona, Italy. She is a peer reviewer for the Journal of Information Analysis (JIA) and the International Journal of Economic Behavior and Organization (IJEBO). Since April 2022, she has been a featured reviewer at Computing Reviews by ThinkLoud, Inc. Her dedication to scholarly excellence is evident in her extensive review work for numerous MDPI academic journals, including ‘Behavioral Sciences,’ ‘Sustainability,’ ‘Journal of Clinical Medicine,’ and ‘International Journal of Environmental Research and Public Health,’ among others. From 2019 to 2024, she has reviewed over 200 papers across various journals, showcasing her broad expertise and commitment to advancing research. Dr. Fucà holds a Web of Science Researcher ID (O-5395-2019), an ORCID (<https://orcid.org/0000-0001-9546-1253>), a Semantic Scholar ID (167802695425), and a Scopus Author ID (57205454690).



Serena Cubico is an Associate Professor of Business Organization at the University of Verona, Dept. of Management. She holds a Ph.D. in Organizational Psychology from the same institution. Her research fields include business management, organizational behavior, human resources management, and entrepreneurship education. Professor Cubico is an active member of several university committees, including the Third Mission-Territory Enlarged Commission (since 2021) within the Department of Business Economics, the Quality Assurance Team for the Business Economics degree course (since 2017), and the Joint Commission for the Communication Sciences degree course (since 2016). Her primary research interests focus on the organizational behavior of local business systems and the management of small and medium-sized enterprises (SMEs). She specializes in methods and tools for detecting and analyzing entrepreneurial skills and mindsets, particularly in relation to business design and creation. Additionally, she explores management styles and tools for evaluating and developing staff performance and behavior, with a strong emphasis on organizational well-being. Professor Cubico’s publications predominantly cover topics related to entrepreneurship, SME development, human resources, and organizational behavior.

Research Field

Romina Fucà: Economic behavior, Organizational behavior, Basics on probabilities, Choice under uncertainty, Payoffs’ calculations, AI in semantics and translational tasks

Serena Cubico: Business Management, Organizational Behaviour, Human Resources Management, Entrepreneurship Education.