Rotating Savings and Credit Associations: A Scoping Review

Article *in* World Development Sustainability · June 2023

DOI: 10.1016/j.wds.2023.100081

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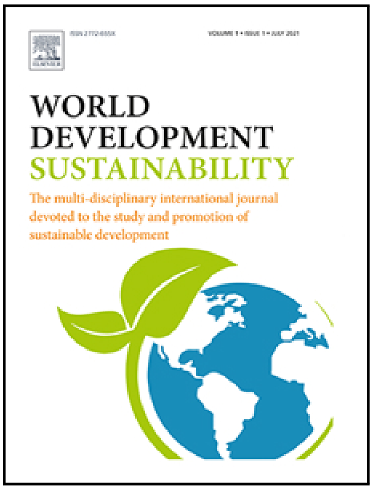
Journal Pre-proof



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PII: S2772-655X(23)00039-3
DOI: https://doi.org/10.1016/j.wds.2023.100081
Reference: WDS 100081

To appear in: *World Development Sustainability*

Received date: 28 September 2022
Revised date: 25 April 2023
Accepted date: 31 May 2023

Please cite this article as: Andres Felipe Zambrano, Luis Felipe Giraldo, Monica Tatiana Perdomo, Iván Darío Hernández, Jesús María Godoy, Rotating Savings and Credit Associations: A Scoping Review, *World Development Sustainability* (2023), doi: https://doi.org/10.1016/j.wds.2023.100081

Rotating Savings and Credit Associations: A Scoping Review

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Highlights

- This formal scoping review analyzed the research in ROSCAs from 2000 to 2022.
- 96 articles met the criteria for inclusion; most of them use statistical and regression analysis from data acquired through surveys and interviews.
- ROSCAs have provided financial benefits to their participants by encouraging them to save money.
- Non-financial benefits of ROSCAs include social capital improvement and empowerment of several communities.
- Promoting altruism, reciprocity, and participation in several ROSCAs at the same time would minimize the effect of defection and default.

Rotating Savings and Credit Associations: A Scoping Review

Abstract

A Rotating Savings and Credit Association (ROSCA) is an informal cooperation strategy that has emerged in several parts of the world as a tool to increase the resilience and social development of individuals in underprivileged communities. This strategy has been widely studied for decades to recognize ROSCAs' benefits, risks, and operation rules in several regions and countries. In this study, we conducted a scoping review using the PRISMA-ScR protocol to determine the most important recent findings about ROSCAs. First, we analyzed the origin, methodological approaches, and most common keywords of the 96 articles included in the review. Second, we discussed the most significant conclusions of each article on topics such as the origin of the community being studied, participants, benefits, risks, operation, penalties, and structure of ROSCAs. Based on this review, we discuss how ROSCAs have provided benefits to their members that are not exclusively financial, how these schemes have evolved from traditional ones to strategies with improved structure, rules, and the use of technology, and some key research opportunities to be addressed.

Keywords:

ROSCA, Informal finance, Resilience, Social capital, Inclusive economy, Microfinance

Contents

1. Introduction

Informal financial cooperation strategies have emerged in several parts of the world to increase the resilience of low-income communities by promoting cooperation between their members (Ryu & Suzuki, 2021; Sedai et al., 2021).

One of the most representative examples of this type of strategy is the Rotating Savings and Credit Associations (ROSCAs) (Geertz, 1962; Coleman, 1994; Leonardi et al., 2001; Collins et al., 2010; Levenson & Besley, 1996). ROSCAs are an agreement between some individuals to cooperatively save a pot of capital by paying a fee each week or month (Besley et al., 1993). ROSCAs vary significantly in terms of the number of members, frequency of contribution, amount of the contribution, and the process for allocating the pot (Baland et al., 2019).

ROSCAs can be classified into three primary types depending on the strategy used to allocate the pot: random, fixed, and bidding. In random ROSCAs, the order of receiving the pot is randomly determined at the beginning of each cycle (the period required for all members to receive the pot once) (Ardener, 1964). In fixed ROSCAs, the order remains fixed across cycles (Baland et al., 2019). Finally, in bidding ROSCAs, the first turns are assigned to members who pay or contribute more to the pot for receiving these initial turns (Ke & Ye, 2019). Regardless of the strategy to define their turns, all types of ROSCAs allow individuals to access some financial services and even social and cultural benefits that formal institutions do not provide, typically to low-income communities without a positive credit score (Levenson & Besley, 1996; Sedai et al., 2021).

ROSCAs have represented an alternative to formal financial institutions. They have inspired banks and credit unions for individuals in poverty situations that require help for credit alleviation or for making affordable a new productive activity to increase their well-being. One of the most successful examples that ROSCAs have inspired is the Grameen Bank (Hossain, 1988). The Grameen Bank was founded in 1976 as a research project with the primary goal of providing financial assistance to rural communities in Bangladesh (Hossain, 1988). This project showed a positive impact on the socioeconomic life of their participants. Therefore, motivated by the positive contributions of the Grameen bank in several aspects that transcend financial life, several researchers and communities have adopted ROSCAs idea to replicate similar projects worldwide to mitigate poverty, mainly in places where formal banking is not an option (Wahid, 1994).

Each ROSCA implementation results from the context of the place where it is replicated. Due to the emergence of ROSCAs in several parts of the world, ROSCAs from each country usually have different structures, rules, and benefits. For example, ROSCAs from Kenya (Oraro & Wyss, 2018), Japan (Onda, 2021), and the United States (Kear, 2016) have significant differences in terms of the number of participants, the pot allocation strategy, the periodicity of the fee payment, and the non-monetary benefits due to their culture, tradition, needs and particular legislation of each country. Although research before 2000 has focused on many of the aspects of ROSCAs mentioned above (Adams & de Sahonero, 1989; Besley et al., 1993; Coleman, 1994; Wahid, 1994; Levenson & Besley, 1996), many researchers have recently explored situated cases of study to identify the particular characteristics, benefits, and challenges of ROSCAs all over the world. Moreover, the new technological developments have allowed researchers to analyze ROSCAs from a theoretical perspective by employing mathematical models and simulations. These differences in the methodological approaches and locations for ROSCAs have increased the number of publications studying them in recent years. However, as far as we know, no literature review has conducted a systematic analysis of the most important findings of these studies. For this reason, we conducted a scoping review to compile the analysis and conclusions of research on this topic during the last 22 years.

We used the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocol extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018) to conduct a systematic map of ROSCAs research since 2000. Based on this map, we identified the country of origin of the data used for this research to recognize which countries have reported most of the studies on ROSCAs and where there are opportunities to conduct such studies. After that, we analyzed the most common keywords of the studies, the co-occurrence of these keywords, and the most common methodological approaches to recognize which topics and how they have been analyzed. Then, we provide the most important findings of the articles included in the review, discussing topics such as origin, participants, benefits, risks, operation, penalties, and structure of ROSCAs. Moreover, we show some technological applications that have emerged in the last years to analyze and support the functioning of ROSCAs. We ended this review with some conclusions and future directions in this research area.

2. Materials and methods

Our protocol was drafted using PRISMA-ScR (Tricco et al., 2018). We searched articles available on the Scopus and Web of Science bibliographic databases to identify potentially relevant documents. The papers included in this review must analyze, study, or model Rotation Savings and Credit Associations (ROSCAs). We only considered peer-reviewed journal or conference papers published between January 2000 to July 2022 and written in English. The final search strategy, defined by team discussion, can be found in Appendix A. To consider different aspects of ROSCAs, we included studies that used qualitative, quantitative, and mixed methods to analyze ROSCAs in real communities and studies that use mathematical, econometric, and computational tools to model these types of associations. We excluded papers that did not fit into the conceptual framework of the review or were not focused on ROSCAs. Finally, we also excluded book chapters, book or conference introductions, and opinion articles without clear and supported contributions.

To increase consistency among the authors of this review, we all screened the titles of the 227 publications that resulted from our search strategy. During this process, we excluded 104 papers whose title refers to a different area of knowledge or discipline. Then, all of us revised the abstract of each of the remaining 123 articles and decided to exclude 15 papers. We did not find retrieval from one of the remaining 108 papers. Finally, we evaluated the full text of the retrieved 107 articles and decided to include 96 based on the previously described criteria. The flow diagram of this search is shown in Fig A.1. We extracted their keywords, published year, continent, and country of origin of the analyzed ROSCA, methodological approaches, and most important conclusions for each selected paper. We analyzed all keywords to group similar keywords into just one. For example, the words *Save*, *Saving*, and *Savings* were grouped in the concept *Saving*. Similarly, the words *Women empowerment* and *Female empowerment* were grouped in the same concept. We decided this to provide a more accurate analysis of the co-occurrence of keywords and the content of the selected articles. We resolved disagreements on all of these steps by consensus and discussion with other reviewers if needed.

3. Publication trends since 2000

In this section, we first analyze the continent and country of origin of the data used in the studies included in this review. For each year since 2000, we show the number of papers that studied ROSCAs from each continent. Then, we present the methodological approaches used in these studies, including the evolution in the number of articles that have used these approaches since 2000. Finally, we show the most common concepts included in the keywords of the studies and the co-occurrences of these concepts among the articles.

3.1. Continent and country of origin

For each article included in this review, we determined the country and continent of origin of its data. Figs 1 and 2 show the number of papers per continent and country, respectively. Some studies do not use real-world data and employed theoretical approaches based on previous findings. These studies are classified in the category *None* in the figures. Fig 2 also includes a category called *Others* to refer to those countries studied only in one article.

Asia and Africa are the continents where most studies have collected their data. As mentioned in the Discussion section, one of the most important motivations to participate in ROSCAs is the limited access to financial support from formal institutions such as banks. Therefore, ROSCAs are common in

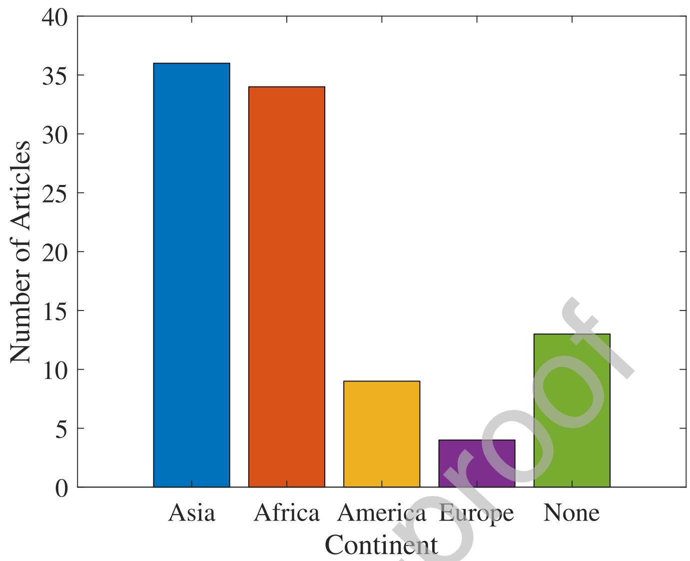

Figure 1: **Continent of origin.** Number of occurrence of continents of origin of the ROSCAs analyzed in the studies.

countries where the poverty index is high (UNDP (United Nations Development Programme), 2021). Research that uses data from developed countries also focuses on underprivileged communities such as migrants, mainly the studies from North America (Ibrahim, 2020; Mianda, 2020; Ibrahim, 2019) and Europe (Bilecen, 2019; Datta & Aznar, 2019). We only found one study that used data from the Caribbean (Stoffle et al., 2009) and two that used data from Mexico (Raccanello et al., 2009; Martin et al., 2009) since 2000. Moreover, we did not find any articles that used data from South America and Oceania. However, ROSCAs from Bolivia have been also studied in some works (Adams & Canavesi, 2019; Adams & de Sahonero, 1989; Donoso et al., 2011), and Colombian researchers have also studied ROSCAs from a theoretical and computational approach (Zambrano et al., 2022, 2020).

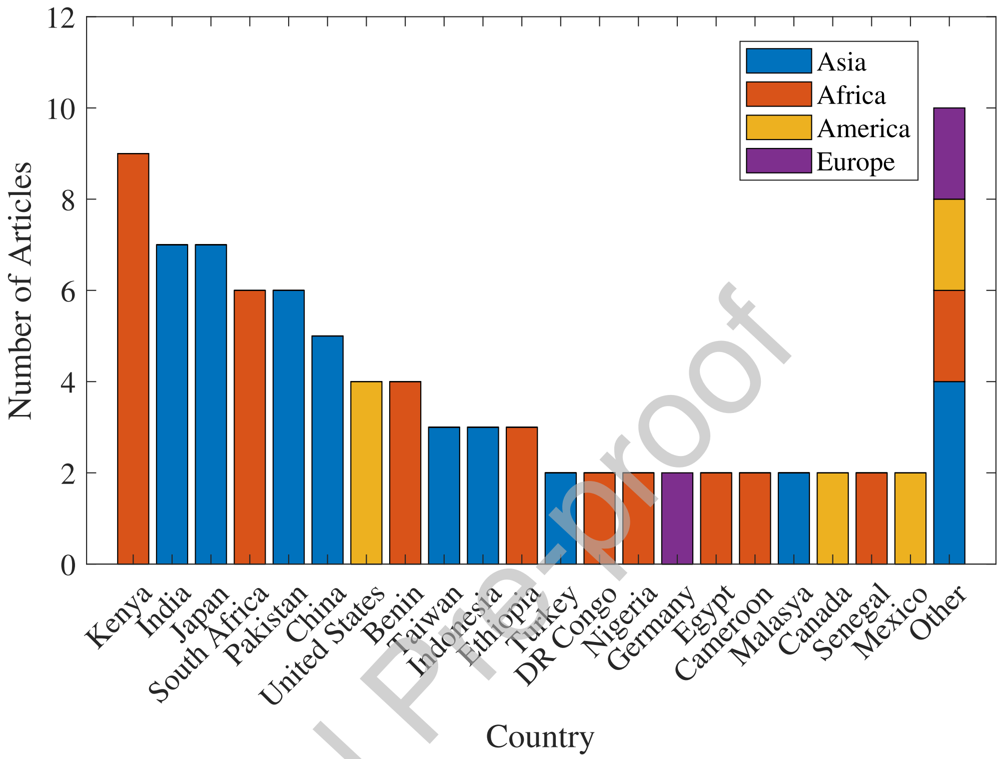

Figure 2: **Country of origin.** Number of occurrence of countries of origin of the ROSCAs analyzed in the studies.

Fig 3 shows the number of publications for each year since 2000. The number of articles that use data from each continent for every year was included. Between 2016 and 2019 seems to be an increasing trend in the published papers. However, this tendency stopped for the last three years, probably due to the effects of pandemics that reduced the possibility of interacting with ROSCAs members and acquiring data from real scenarios. This hypothesis is also analyzed in the Methodological approaches section.

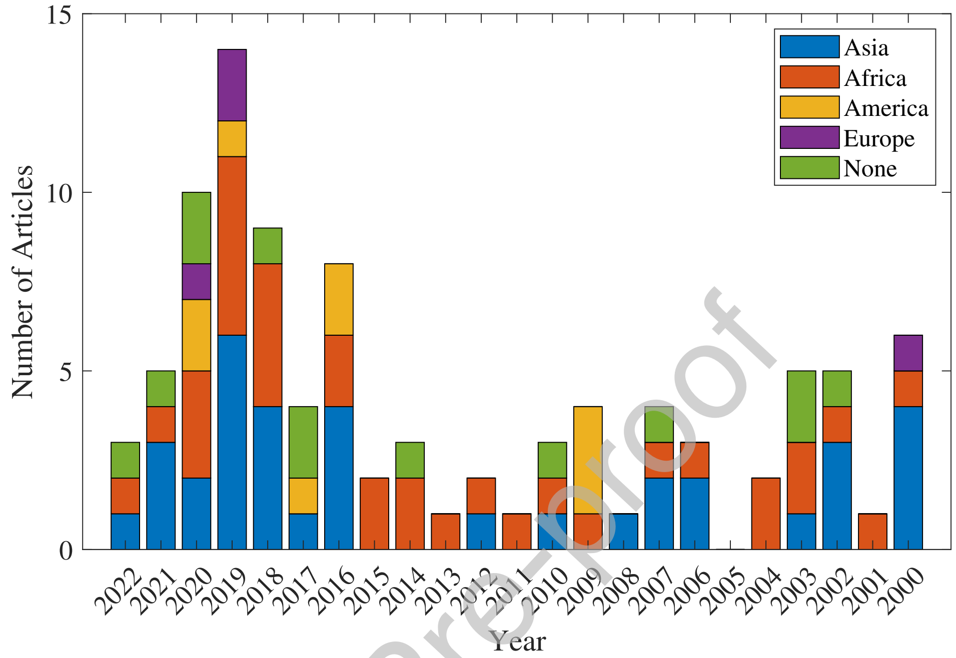

Figure 3: **Published year and continent of origin.** Number of papers published between January 2000 and July 2022 considering the continent of origin of the analyzed ROSCA.

3.2. Methodological approaches

Since 2000, the studies have used different methodological approaches depending on the particular objectives of the authors. Fig 4 shows the number of published articles that have used each of these approaches to analyze ROSCAs. Interviews and surveys are the most common approaches for acquiring data from particular cases of study (Kaur et al., 2021; Han et al., 2020; Lappeman et al., 2020). Using this data, authors tend to provide an analysis using descriptive statistics methods, including central tendency and dispersion measurements, and applying statistical hypothesis testing (Goedecke et al., 2018; Dagnelie & Lemay-Boucher, 2012; Kondo et al., 2007). Other approaches for analyzing cases of study are theoretical and historical reviews. These works use methods employed in systematic or scoping reviews to explore particular research questions about the evolution of ROSCAs in specific regions or countries. In those cases, the authors do not acquire their data and use data or findings from previous studies to provide a similar analysis to those with their own data.

Mathematical models have also been used to analyze ROSCAs. These mathematical models are developed using data from real ROSCAs to provide helpful conclusions about these schemes and their participants. These studies use surveys or previously acquired data to create Probit, Logit, or other regression models and test hypothesis based on the parameters of the models (Egbide et al., 2020; Altuntas et al., 2019; Bonan et al., 2019; Acquah & Dahal, 2018; Bauchet & Larsen, 2018; Sato et al., 2019). Theoretical models from economics, such as utility functions (Dinç et al., 2021; Sedai et al., 2021; Reito, 2020; Ambec & Treich, 2007) and econometric models (Linkow & Rentschler, 2016) have also been used to provide a similar analysis. From this perspective, studies tend to use the rationale formulated by previous findings for their models. Moreover, some of these studies compared their models with data from real scenarios (Sedai et al., 2021).

Technological advances have enabled the use of other approaches that require the use of computing resources. Some hypotheses and scenarios require months or years of data acquisition to be tested and analyzed. Computational models and multi-agent simulations have emerged as an alternative for this type of analysis (Joshi et al., 2020; Sijia & Horita, 2019; Villasanti

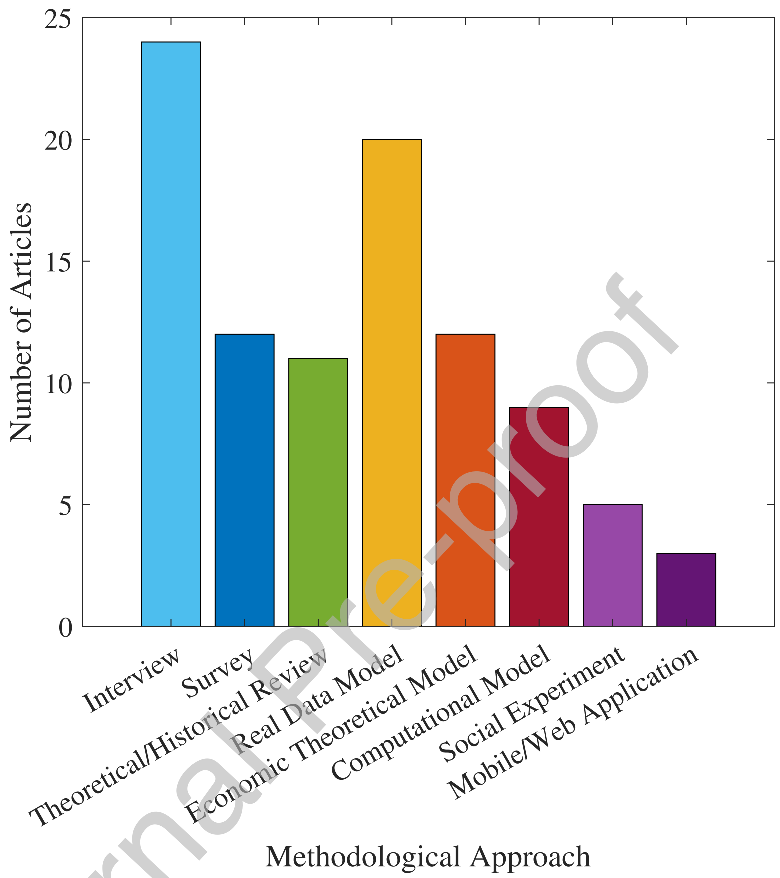

Figure 4: **Methodological approaches.** Number of papers that uses each of the methodological approaches used to study ROSCAs.

et al., 2018; Villasanti & Passino, 2016; Koike et al., 2010). These models employ theoretical concepts of control systems and game theory to propose possible interventions for real ROSCAs (Francois & Squires, 2021; Wambua & Wamuyu, 2020; Mehmood et al., 2019). Also, web applications have been developed to support the operation and maintenance of real ROSCAs. Finally, social experiments have been conducted to analyze the behavior of human beings. These experiments offer useful findings on trust, reputation, altruism, and other concepts of social theory in ROSCAs (Koike et al., 2018; Etang et al., 2011).

Fig 5 shows the evolution of the use of these approaches since 2000. Interviews, surveys, and models based on data from real scenarios have been the most common approaches until 2020. However, during the last three years, the number of studies that use these approaches has decreased. Pandemic restrictions would explain this decrease. During these years, access to communities has been limited. Therefore, other theoretical approaches, such as reviews, and economic and computational models, have prevailed. Moreover, the number of studies that employ computational tools has also been increasing in the last few years.

3.3. Keywords analysis

Keywords occurrence can give an idea of what topics are being analyzed more in articles about ROSCAs since 2000. However, counting the occurrence of keywords without analyzing the concept behind them can bias the analysis. For example, although *immigrants* and *migrants* are different words, both refer to the same concept. Similarly, when comparing keywords such as *Informal savings* and *Mutual-saved money*, three concepts are recognized. The concept *Informal* and *Mutual* are particular for each keyword, but they also have a common concept which is *Savings*. Therefore, we change the focus from keywords to concepts. To do this, we considered the root or the concept behind each word in each keyword and then split all keywords and counted the occurrence and co-occurrence of each concept among all papers. We also considered the country and continent of origin as a concept because

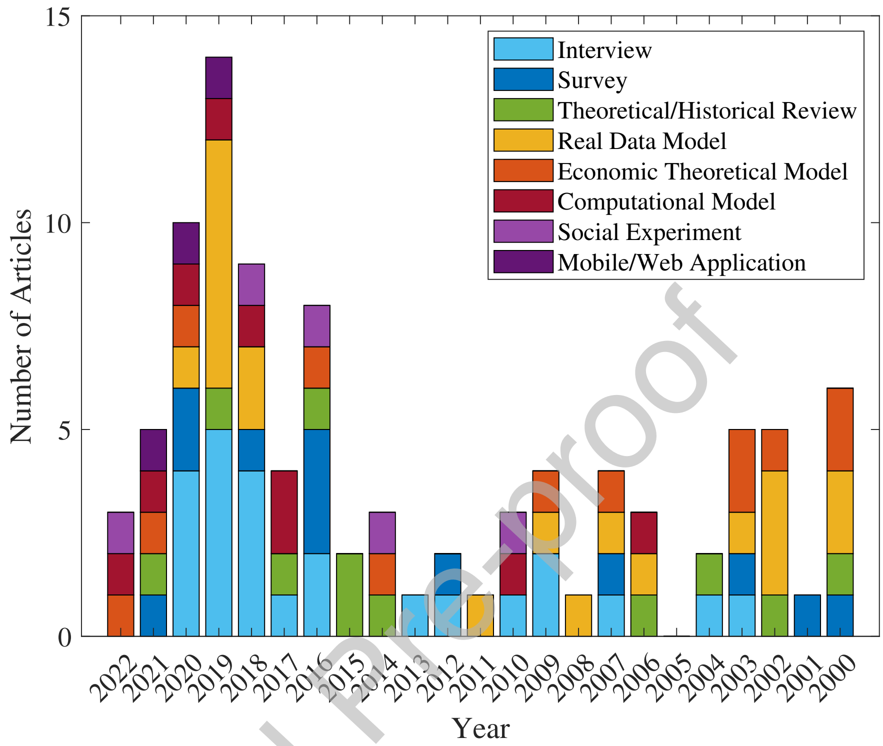

Figure 5: **Published year**. Number of papers published between January 2000 and July 2022 considering the methodological approach of each study.

many articles included them as keywords. This process was made manually without employing any additional software to avoid mistakes in interpreting each keyword's roots or in splitting the keywords with more than one word. To increase consistency, we all screened the keywords of the selected publications and evaluated the concepts described by each keyword. These are the concepts employed for the occurrence and co-occurrence analysis.

Fig 6 shows the number of occurrences of all the concepts that appear in the keywords of at least five studies. As was expected, *ROSCA* is the most repeated concept in keywords. However, only 65 of the 96 articles included it as a keyword. Other common concepts that appear significantly in keywords of articles are related to finance and economy. Concepts such as *Finance*, *Micro*, *Small*, *Enterprise*, *Credit*, *Savings*, *Banking*, *Management*, and *Market* show that authors are researching the usage and performance of ROSCAs as alternatives to formal banking to provide some type of economic benefit to their members, such as credits to start or invest in a micro-small enterprise, or a mechanism to save for uncertain negative events in the future (Sedai et al., 2021; Egbide et al., 2020; Ibrahim, 2019; Ullah et al., 2016c,b,a; Joshi et al., 2020; Satkunasingam & Shanmugam, 2006). The continents and countries of origin also appear commonly in keywords. For this reason, Asia, Africa, Kenya, India, Japan, and other continents and countries that have been widely studied according to Figs 1 and 2 also appear in Fig 6. Finally, some concepts that are not directly related to finance, such as *Social*, *Informal*, *Women*, *Behavior*, and *Rural*, are also common in the studies.

To consider the relation between these concepts, we plotted a network shown in Fig 7 that considers the occurrence and co-occurrence of the concepts. Each node of the graph represents the number of occurrences of the concept in the keywords among all papers. Each arc represents the number of co-occurrences of two concepts in the same article among all studies. We defined a minimum threshold of five occurrences and five co-occurrences to be included in the graph. The strongest connections in the plot occur between ROSCAs, financial concepts, and the two continents with the highest amount of studies. This graph shows a relation between ROSCAs and micro, small, and medium enterprises because of the importance of ROSCAs to finance

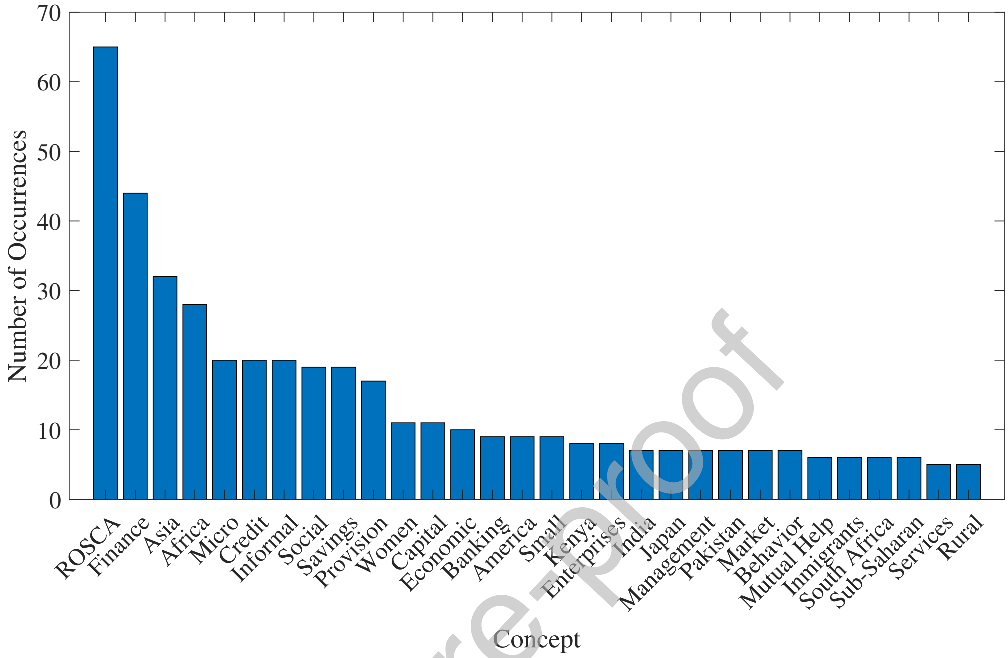

Figure 6: **Number of occurrences of most common keywords.** A threshold of at least 5 occurrences was applied.

entrepreneurs. Lastly, there is also an interesting relation between the concepts of *Social*, *Capital*, *Women*, and *Immigrants*. These relations show that several articles focus on the social groups who participate in ROSCAs, their motivations, behavior in the association, and the non-financial benefit that these individuals would obtain as social, health, or cultural capital (Kaur et al., 2021; Mianda, 2020; Ibrahim, 2020; Lappeman et al., 2020; Kondo et al., 2012). In the discussion section, we deeply analyze the common findings of the studies included in this review.

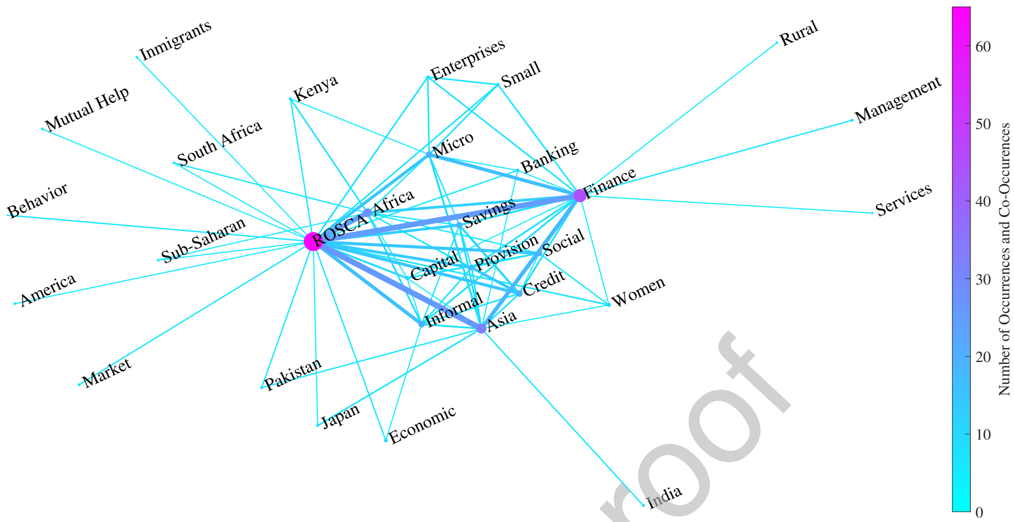

Figure 7: **Keywords Occurrences and Co-occurrences.** A threshold of at least 5 occurrences and co-occurrences was applied.

4. Findings and contributions of publications since 2000

We identified 96 papers addressing studies on ROSCAs between 2000 and 2022 to include in this scoping review. These articles study characteristics such as the origin of ROSCAs, their participants, benefits, motivations, and behavior of their members, and mechanisms of operation and control that have been used by real ROSCAs. Moreover, other articles have also found and proposed alternatives to improve the economic performance and wellness of the ROSCAs and their members through mathematical and computational models and technological applications. In this section, we discussed these findings. To organize the most relevant findings of these articles, we grouped them into five categories. These categories are not exclusive. Therefore, those articles whose contributions go beyond one specific category are discussed in more than one section.

4.1. Origin, participants and benefits of ROSCAs

As it is shown in Figs 1 and 2, ROSCAs have emerged in several parts of the world. Associations in one continent are not necessarily the consequence of another ROSCA from a different place, and the causes of their consolidation can vary from one case to another. The most recognized motivation for creating a ROSCA is the limited access to financial services for several people from different types of social groups (Shoaib & Siddiqui, 2020; Acquah & Dahal, 2018). Although this issue can be common for low-income communities because of a low credit score, migrants and women also have social and cultural barriers to accessing financial services from formal institutions such as banks (Hossein, 2017; Tsai, 2000) or even borrowing money from their neighbors (Johnson, 2004). Therefore, ROSCAs have emerged as a mechanism that can give these communities access to credits, looking for financing for education and health services (Vokes & Mills, 2015; Dube & Edwell, 2018; Oraro & Wyss, 2018), vehicles, housing, lands, livestock, and other means of production (Ibrahim, 2020; Dinç et al., 2021; Benda, 2013; Smets, 2000), or non-capital goods and social and cultural events (Lappeman et al., 2020).

ROSCAs are also used as mechanisms to save money periodically (Geertz, 1962). Women have stated that having the discipline to save money and avoid spending it on non-capital goods would be difficult (Bilecen, 2019). Self-control is not only a problem for women. Men have shown lower discipline saving than women (Tsai, 2000). In several cases, women are mainly motivated to participate in ROSCAs to attenuate the self-control problems of their husbands (Anderson & Baland, 2002). Several studies have shown that individuals from different social groups and demographics recognize their discipline problems to save money (Dagnelie & Lemay-Boucher, 2012; Gugerty, 2007; Satkunasingam & Shanmugam, 2006). Therefore, many individuals participate in ROSCAs looking for a mechanism to force themselves to save and reduce expenses because of the social pressure and the embarrassment that can imply a non-payment or a defection (Imami et al., 2020; Smets, 2019; Eroğlu, 2010; Fessler, 2002). They visualize ROSCAs as an opportunity to effectively save money, increasing their resilience for future uncertain negative events and allowing them to have the capital to invest in the future (Mehmood et al., 2019; Dagnelie & Lemay-Boucher, 2012; Gugerty, 2007; Ambec & Treich, 2007; Aliber, 2001).

This desire to increase and improve their investing opportunities is also an important motivation for consolidating informal associations. Although ROSCAs are common in underprivileged and underrepresented communities, many entrepreneurs from micro, small, and medium enterprises also use ROSCAs as alternatives to formal financing institutions (Egbide et al., 2020; Akoten et al., 2006; Chiteji, 2002; Kan, 2000; Dekle & Hamada, 2000). Some members of ROSCAs also can obtain credits from banks but prefer informal associations because of the lower or null interest rates (Ullah et al., 2016c,b,a; Hansen et al., 2015; Eroğlu, 2010; Shem & Rösner, 2003; Chiteji, 2002; Scholten, 2000; Smets, 2000) and the flexibility of the usage of the credits (Hoque & Khalily, 2002), instead of having excessive restrictions and doubts with banks that they consider difficult to pay because of the high interests (Datta & Aznar, 2019). Although individuals of high income prefer formal institutions to save and invest their money (Carpenter & Jensen, 2002), the participation of medium-income individuals in ROSCAs is higher than individuals with low income (Kedir & Ibrahim, 2011). In some cases, participants of ROSCAs have also recognized that they consider banks corrupted and non-transparent institutions (Kear, 2016). Therefore, no matter the interest rates, they trust informal associations more and prefer this financing option.

Based on this preference of some entrepreneurs for ROSCAs, several works have modeled the possible impact of ROSCAs on entrepreneurs showing positive economic results (Reito & Spagano, 2014; Rogers, 2006). Higher economic growth and lower poverty rates of members of ROSCAs have been observed in real scenarios around the world (Altuntas et al., 2019; Ghazali, 2003; Dekle & Hamada, 2000). This positive economic impact on participants of informal associations, including those who can access formal institutions, shows the viability and the importance of the coexistence of different types of financial institutions to offer the services that people from different demographics require.

Lastly, financial services are not the unique motivation for ROSCAs members. In some cases, the creation of social capital is more important than the economic benefit that members would receive (Onda, 2021; Vokes & Mills, 2015; Benda, 2013; Stodder & Schroth, 2003). Some of them believe that informal associations are an opportunity to meet new people who can be helpful for career development or future business or to increase their social status (Shoaib & Siddiqui, 2020; Acquah & Dahal, 2018). In other cases, mainly for women, migrants, and other underrepresented groups, ROSCAs are an empowerment tool that helps them meet people with similar ideas, habits, and cultures, consolidating links and friendships that transcend the professional and economic field (Sedai et al., 2021; Kaur et al., 2021; Kshetrimayum, 2016; Bilecen, 2019). Women and migrants have recognized that ROSCAs help them to feel welcomed and respected by others who are similar to them (Mianda, 2020) and, in the case of immigrants, who preserve the same ancestral traditions (Stoffle et al., 2009). This social capital has also shown a beneficial impact on the physical and psychological health of ROSCAs members. For example, *Mujin* participation in Japan is correlated to a reduction in the decrease of the functional capacity of elderly people (Sato et al., 2019; Kondo et al., 2012, 2007). These studies have shown a negative impact of ROSCAs on the health of those participants who are only interested in the economic benefit. Therefore, social capital and its positive implications are also substantial benefits of ROSCAs that the formal banking system cannot offer.

4.2. Operation and control

Although all ROSCAs share similar characteristics, such as the periodical fee and the allocation of a percentage of the pot to each member, each ROSCA has its peculiarities that directly impact the performance of the association. Some characteristics such as the order of the pot allocation, structure, number of participants, roles, connectivity and interactions between members, amount of the fee, and control strategies are fundamental for the success of the scheme (McNabb et al., 2019; Sadr, 2017).

Usually, ROSCAs have a horizontal structure where all members can participate in most decisions. However, the leader and other members with relevant roles tend to be more influential on the most important decisions of the association. Therefore, the ethics of these members are crucial for the correct functioning of the association (Han et al., 2020). One of these decisions is the order of the pot allocation, which would be decisive for the particular actions of each member of the scheme. The traditional method to assign this order is by a random selection at the beginning of the process (Mehmood et al., 2019). During the first meeting, individuals usually know when they will receive the pot. In several cases, the leader, the members with important roles, and their closest friends or guests received the first turns because of their influence, while the random selection is applied only for the remaining turns (Bauchet & Larsen, 2018). In other cases, the first turns are assigned to those members who decide to pay more for these turns (Ke & Ye, 2019). This type of association, called Auction or Bidding ROSCA, helps those members who need the money for an investment, such as starting a micro-small enterprise, or for any particular reason to be the first to receive the pot. In this way, members who would benefit more from receiving the pot earlier are prioritized if they can pay for it. However, some individuals would need the pot early to pay doubts and cannot pay for receiving it before others. To help them, in some cases, members of the ROSCA agree to assign the order based on the needs of each participant, giving priority to those with higher needs (Bilecen, 2019).

ROSCAs participants do not necessarily prefer the first turns (Baland et al., 2019). Individuals with higher incomes and women tend to be more patient and accept later turns (Bonan et al., 2019). Some ROSCAs agree to wait until the end of the process to divide the total pot among all contributing members without assigning an order for the pot allocation (Stoesz et al., 2016). Although this would not be optimal considering the value of money over time, some members prefer it to avoid a defection of a member after receiving the benefit, the temptation of spending the pot if they receive it early, or just the negative perception of owing money to the others (Aliber, 2001). In summary, the order of the pot allocation is always based on the particular interests and sense of justice of the members who desire to maximize their income, diversify the risks and help those with more needs (Le Polain et al., 2018).

Another important decision in ROSCAs is the admission of new members. This decision is mainly influenced by the social circle of the person who desires to participate (Smets, 2000). In several cases, ROSCAs only admit new members if they have been suggested by older members, looking for higher trustworthiness of the scheme (Aredo, 2004). With this admission methodology, recommenders will pay for the credit defaults of their guests. Another common selection criterion is the income of the candidates. If they cannot demonstrate regular incomes or a minimum level of income, ROSCAs exclude them because of the risk of defaults in the fees (Carpenter & Jensen, 2002; Mohieldin & Wright, 2000; Smets, 2000). This rule justifies that, in some cases, individuals of middle income participate more in these schemes than individuals from low-income communities. This evidence reframes the initial motivation for using ROSCAs only as an alternative for low-income communities who cannot access formal financial institutions because, in several cases, they cannot access informal schemes either.

ROSCAs do not have a standard number of members. Participants tend to trust other members, mainly in small associations. However, in schemes with more members, participants prefer to use signed contracts, registering of contributions, identification cards, and other strategies that do not depend on the social relations of the members (Yimer et al., 2018). To punish the defaults, ROSCAs use heavy economic penalties, disqualification to receive the pot, social sanctions, and exclusion of social and cultural events (Yimer et al., 2018; Anderson et al., 2009; Koike et al., 2018, 2010). The economic penalties, added to the small interest rates, sometimes provide a surplus in the pot after all the turns. This surplus is employed for the common benefit of the community. On some occasions, this money is divided among all the members. In other cases, the members who actively participate by asking for credits and paying higher fees also demand to receive a higher percentage of the pot surplus (Le Polain et al., 2018). Finally, from a theoretical and mathematical perspective, it has been argued that in the absence of an external (social) sanctioning mechanism, ROSCAs are never sustainable, even if the defecting member is excluded from all future ROSCAs. (Anderson et al., 2009). However, other theoretical models have shown that some associations can be immune to defection without social sanctions if the number of resources lost because of the default is small enough to avoid a reduction in the motivation of their members (Reito, 2020). This result shows the importance of trust and motivation. In real scenarios, many participants trust their ROSCAs because of the requirements to become a member and the strategies to minimize defections (Yimer et al., 2018). However, informal associations have some risks and disadvantages that would diminish motivation and cause a negative impact on their members.

4.3. Risks and disadvantages

Although ROSCAs are resilient to the loss of money, the loss of motivation of the members would be the immediate cause of ROSCAs' failures. This loss of motivation can result from the default of any of the members or discontent with the rules, roles, or transparency of the association (Koike et al., 2018; Ahn et al., 2017; Stodder & Schroth, 2003; Zeitlyn, 2003; Tsai, 2000). For this reason, the ethics and behavior of the members, mainly the leader, is vital for the scheme's success. However, there are also other risk factors in ROSCAs, even in scenarios where all individuals desire to cooperate. In some cases, mainly in bidding ROSCAs, individuals would be tempted to pay an excessive fee or accept high-interest rates to obtain an early turn (Ke & Ye, 2019; Bauchet & Larsen, 2018). This situation would be aggravated due to the impatience of several members who are reluctant to wait several months (Bonan et al., 2022). If fees or rates are excessive, some participants will fall into difficulty paying doubts, forcing them to default and reducing the motivation of the other members.

The reduced financial knowledge of several members and the low intervention of the government due to the informal nature of the associations would worsen this negative situation (Bophela & Khumalo, 2019). These reduced financial skills can also motivate the transition to Ponzi schemes because of the desire of the members to obtain immediate and higher rewards (Zelenova & Kruchinsky, 2019). These schemes are unsustainable because, at some point, new members will not receive back the money they contributed. After all, this money is employed to pay the profit of older participants, and later contributions would not be enough. Therefore, this transition and the lack of financial skills exacerbate the risk for ROSCAs members.

In some cases, participants will be trustworthy and have a minimum financial education to avoid unsustainable decisions. However, some intrinsic characteristics of ROSCAs can also be a disadvantage compared to formal institutions. Many ROSCAs are conformed by members that do not have regular incomes (Johnson, 2004). Therefore, even if individuals want to contribute to the association, they would not be able to pay their fees for some months. Moreover, the maximum pot is the sum of the particular contributions of each member. This amount of money is considerably less than the amount of money that a bank would have. For this reason, if some individual needs a credit higher than the total pot, the benefit received from the ROSCA would not be enough (Mohieldin & Wright, 2000). Finally, if the associations do not charge an interest fee or invest the pot to get an extra return, the members would be losing money over time because of the inflation of countries and the evolution of the value of money (Scholten, 2000).

Lastly, exogenous factors such as natural disasters, thefts, health issues, and even the death of a member, and economic issues of the region or country of associations would also be a risk to their success (Linkow & Rentschler, 2016; Ahn et al., 2017). However, when a loss of money happens due to an exogenous cause, ROSCAs tend to evolve and be more resilient compared to those scenarios where the cause of the loss was a defection of a member (Linkow & Rentschler, 2016; Eroğlu, 2010). As we mentioned before, the motivation to cooperate is the most relevant factor for the scheme's success. When the cause of the loss is a defection, the decrease in motivation is higher, and the probability of failure of the ROSCAs increases (Kedir & Ibrahim, 2011). For this reason, it is crucial to maintain the members motivated and committed to the success of all the participants.

4.4. Improvement of economic performance and wellness

Many studies have modeled ROSCAs to identify alternatives to improve their economic performance and the wellness of all their members (Besley et al., 1993). These works have included concepts such as altruism, reciprocity, and reputation to find helpful insights to improve real ROSCAs. One of the most relevant findings of these works is the importance of reciprocity and altruism for the correct operation of traditional ROSCAs (Koike et al., 2018). When individuals are more willing to contribute to others and are also motivated by the contributions of others, ROSCAs tend to be successful and provide economic development to their members (Koike et al., 2010; Villasanti et al., 2018; Sijia & Horita, 2019; Klonner, 2008). Several social experiments have also demonstrated that members of ROSCAs usually have high levels of reciprocity and altruism (Koike et al., 2018; Etang et al., 2011). Therefore, a strategy to potentially improve the performance of ROSCAs is to maintain and enforce these behaviors between members. For example, ROSCAs have been employed to finance the electrification of vulnerable communities that historically had no access to electricity services (Diouf, 2016). This type of project promotes reciprocity by benefiting the community over individual interests.

Maintaining members highly motivated is vital to deal with the defection issue. One possible solution is to improve the selection process of new members. Although the use of a minimum threshold of income has become a method to select the participants of ROSCAs, this would deny access to people who really need that financial service and would not necessarily defect the association in the future. Therefore, through computational modeling analysis, it has been proposed to use reputation to select new participants (Koike et al., 2010; Zambrano et al., 2020). This selection method has been used by ROSCAs when requiring old members to recommend new ones (Tsujimoto et al., 2007; Aredo, 2004). On the other hand, other authors proposed to increase the economic and social penalties (Koike et al., 2010; El-Gamal et al., 2014). With this strategy, individuals will be more reluctant to defect to avoid these penalties and lose their reputation with others (Imami et al., 2020; Eroğlu, 2010). Finally, to reduce the economic impact of defection, it has also been proposed to increase the interest rates, mainly for ROSCAs with a high number of members (Ahn et al., 2017), and to use a cash reserve ratio that will support the losses caused by defaults (Zambrano et al., 2022).

Defections and defaults are inevitable, even in cases where all the individuals desire to cooperate. If individuals have to decide between using their capital to acquire some vital goods or continue contributing to the association, survival would be the decision for everyone. For this reason, some variations in the order of turns to reduce this situation would increase the resilience of the association. One possible strategy is giving first turns to individuals who have higher needs. In these cases, if those individuals invest that benefit appropriately, they would have more options to continue contributing in the future instead of losing the capacity to pay the fee of the ROSCA (Bilecen, 2019). Another option is giving priority to individuals with higher incomes and capital because they would have a higher capacity to continue contributing to others, and the risk of default after receiving the pot will be reduced (Ke & Ye, 2019; Ahn et al., 2017).

The structure can also be modified to increase the resilience of associations and individuals. If each member participates simultaneously in more than one association, it would have a higher probability of receiving a pot earlier and a lower probability of losing all the money due to a ROSCA's failure. This strategy, inspired by the diversification of investments to reduce the risk, is studied in (Zambrano et al., 2022), showing promising results. Moreover, several ROSCAs members in real scenarios have been participating in more than one association showing economic growth (Acquah & Dahal, 2018; Ullah et al., 2016c). Another proposal of the work in (Zambrano et al., 2022) is to reduce the number of members on each ROSCA. Small ROSCAs can force their members to save while reducing the probability of defection by decreasing the number of members. Following these proposals, participants diversify their contribution while reducing the number of people they depend on, significantly decreasing the risk. Furthermore, although the pot will be lower, the waiting time until receiving it will also be lower due to the small number of members. This idea has also shown promising results in real scenarios (Ambec & Treich, 2007).

Lastly, a final proposal to increase the performance of ROSCAs is the transition from informality to formality (Dube & Edwell, 2018; Kear, 2016). This transition would provide this type of association with rules such as a cash reserve ratio requirement, a maximum fee, a maximum or a minimum number of members, or interest rates, added to government support to reduce the risks of defaults and defections. However, before transitioning to formality, it must be analyzed if the new formal ROSCAs would have the same issues as banks, discouraging the participation of several social groups that the current informal ROSCAs contribute. Therefore, another alternative is to provide both options to participants and allow them to decide between formality, informality, or both. This option has also shown promising results (Chiteji, 2002). In summary, some proposals such as diversification, the coexistence of formal and informal financial services, and the formalization or regulation of current ROSCAs should be analyzed to improve the benefits and reduce the risks of their participants (Onoyere, 2014; Reito & Spagano, 2014; Klonner, 2003).

4.5. Technological applications

Technological development has allowed new methodological approaches to analyze and support ROSCAs. Since observing and evaluating the performance of improvement strategies in real ROSCAs takes significant time and effort, computer tools have been proposed in research work to model human dynamics (Sijia & Horita, 2019; Ahn et al., 2017). These computational models have been used to predict the results of applying realistic variations to ROSCAs (Zambrano et al., 2022, 2020). Based on dynamic systems and multi-agent systems theory, the works in (Koike et al., 2010; Zambrano et al., 2022, 2020) have demonstrated the importance of motivating reputation and altruism and the need for decentralized structures, diversification of investments in ROSCAs, and a cash reserve ratio to increase resilience in scenarios with low trust and trustworthiness. Furthermore, the authors of (Joshi et al., 2020) have also used agent-based models to explore the resilience of informal associations to disasters, showing the importance of carefully tailoring to local contexts. Finally, computational models have also been used to analyze the particular actions of each participant of informal associations to increase their individual resilience (Villasanti et al., 2018; Villasanti & Passino, 2016). These works have used feedback control theory to show that the best actions for individuals are the investment in health and education capital, which can represent a high return on investment in the future, and being altruistic with their neighbors to increase the probability that one of them would help them in the future if they need it.

Technological tools have also been used to provide ROSCAs participants with better control tools and allow them to participate in these schemes even if all the members are not geographically in the same place (Francois & Squires, 2021). These tools help participants organize their finance, have an individual and collective register of contributions and expenses, schedule reminders for future fees, and identify defaults (Wambua & Wamuyu, 2020; Mehmood et al., 2019). In summary, these technological tools help ROSCAs, mainly those with a higher number of members, to increase the security and transparency in the transactions, pot allocation, and economic decisions of members (Yimer et al., 2018).

4.6. New Research Directions

Although research about ROSCAs has been mainly focused on specific communities around the world employing several methodological approaches, the interest of researchers is still highly concentrated in Asia and Africa. Before 2000, Wahid (1994) and Adams & de Sahonero (1989) had shown the presence of ROSCAs in North and South America, respectively. However, the number of publications that used data from America during this century has been lower than ten. Therefore, there is a need to continue investigating the particularities of ROSCAs in America, mainly in South America, to understand how the context of a country would impact the benefits, management, and limitations of these cooperative schemes. This research would have a significant impact in countries such as Colombia, Venezuela, and Argentina, where several cooperative efforts have emerged in different social groups (Pardo-Martínez & Huertas de Mora, 2014; Larrabure et al., 2011), including Japanese migrant communities that have employed these cooperative strategies in Argentina after World War II (Tsujimoto, 2000, 2006; Kimura, 2011).

Another research direction for future years is to investigate interventions in ROSCAs looking for an improvement in the socioeconomic conditions of the communities that would be benefited from them. As shown in this review, most studies have conducted a descriptive analysis using surveys and interviews or proposed interventions based on mathematical and computational models. However, few studies have intervened in the associations to test the real impact of the proposed alternatives to improve ROSCAs. These interventions should be designed in agreement with the administrators and members of associations to understand the possible implications of these interventions that are not necessarily considered in mathematical models and simulations, and to avoid a negative impact on the community. It is critical to establish close communication with these organizations to implement affordable interventions that would offer the desired impact on these communities and report the complete design and implementation experience to replicate this type of intervention in several parts of the world.

One of the interventions explored is using technological devices as control and advisory tools for administrators and members of ROSCAs. Further developments in control theory and artificial intelligence can potentially be used to recognize those patterns that would maximize members' profit and design ideal advisors for ROSCAs, considering privacy and ethical issues.

5. Conclusion

This article presented a scoping review of Rotating Savings and Credit Associations (ROSCAs) research over the last 22 years. Asia and Africa were the continents with the highest amount of ROSCAs studied since 2000. There have been different methodological approaches to studying these informal associations. These approaches mainly include cases of study that collected data through surveys and interviews and used descriptive statistics or developed regression models based on these data to analyze them. Some of the most important findings are the ability of ROSCAs to help their members increase their financial wellness by forcing individuals to save money and enabling them to have better investments. Furthermore, ROSCAs also enforce the social relations of their members, improving their social capital, and, in some particular groups such as migrants, women, and the elderly, maintain ancestral traditions, improve physical and psychological health, and empower them. Moreover, some strategies, such as increasing the number of ROSCAs where each individual participates, reducing the fee and the number of participants of each ROSCA, and promoting altruism and reciprocity, would potentially minimize the effect of defection and default.

With the recent development of technological and computational tools, new methodological approaches have become available. Multi-agent systems, feedback control theory, and machine learning models have been employed to analyze ROSCAs. Furthermore, these models also offer the opportunity to test several promising strategies before applying them in real scenarios to recognize if they can be affordable and helpful for communities. Finally, web and mobile applications also become available to improve the transparency and security of ROSCAs, helping their members register transactions and providing investment and contributions advice. We consider that future research directions should be the observation of these associations in continents where they have not been widely studied and the application of these mathematical and technological tools to improve ROSCAs' performance and wellness of their members. For these interventions, researchers should remember the limitations that mathematical models and technological tools have, the ancestral and social importance of ROSCAs to several communities, and the need for close communication with the communities.

Acknowledgments

This work was partially supported by Google through the Google Research Award for Latin America, and by the Universidad de los Andes and Universidad de Ibagué through Convocatoria Conjunta Unibagué-Uniandes.

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Appendix A. Final Search Strategy

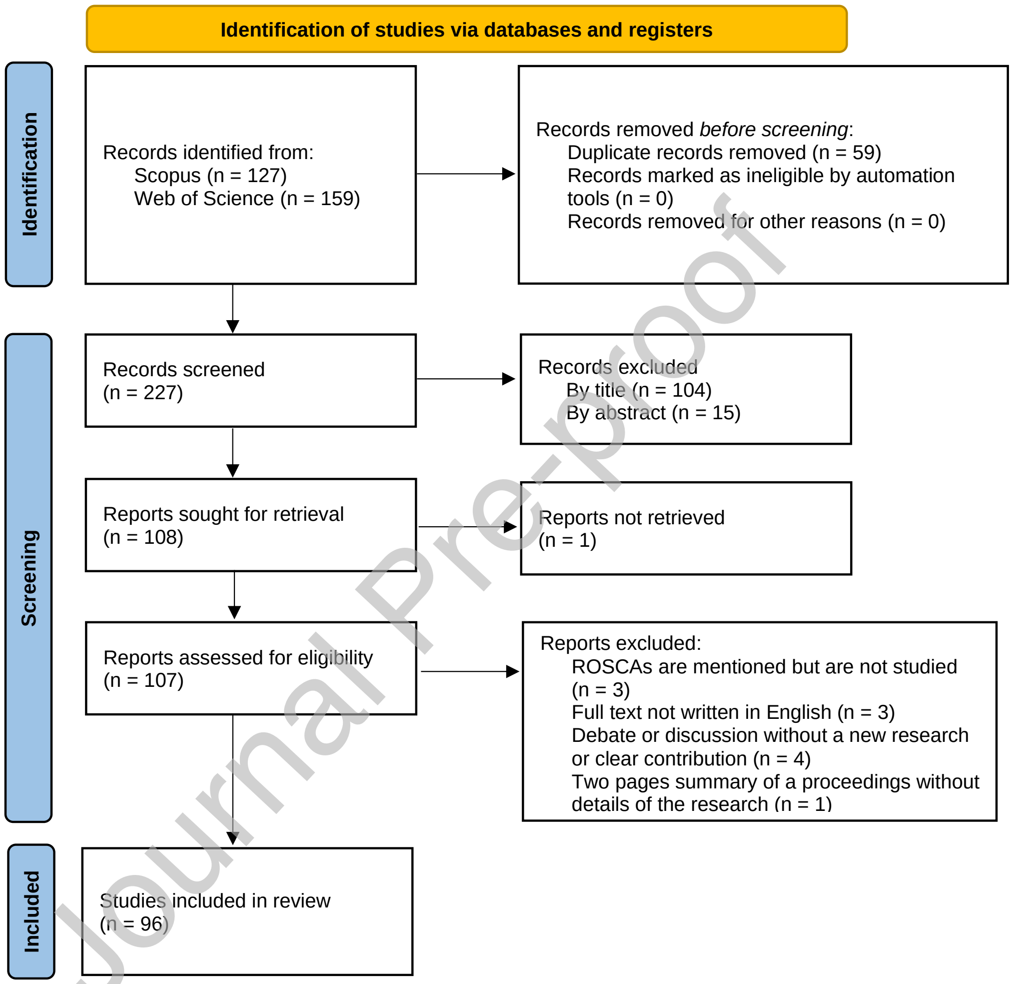

Figure A.1: Identification and screening processes followed to determine the included studies in this review.

S1 File. **Final search strategy.** Search strategy employed to identify articles that would be included in this review.

Conflict of Interest Statement

Manuscript Title: Rotating Savings and Credit Associations: A Scoping Review

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Ethical Statement

Hereby, Andres Felipe Zambrano, Luis Felipe Giraldo, Monica Tatiana Perdomo, Iván Darío Hernández and Jesús María Godoy consciously assure that for the manuscript Rotating Savings and Credit Associations: A Scoping Review the following is fulfilled:

1) This material is the authors' own original work, which has not been previously published elsewhere.

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3) The paper reflects the authors' own research and analysis in a truthful and complete manner.

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