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Should gender be a determinant factor for granting crowdfunded microloans?

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Crowdfunded microloans are a suitable tool for financing basic economic activities in developing as well as developed countries, favouring female empowerment. Despite the loans being relatively small, the widespread use of this instrument merits analyzing the factors affecting the microloan. One of these factors is gender because microloans are an important tool to finance projects promoted by women in many developing countries where microfinance is widely diffused. This research aims to determine if the gender of crowdfunded micro-borrowers is related to the main features which define the conditions of a microloan: amount, term, number of lenders, length of time to contact with borrowers and repayment system. The methodology used is the multinomial logit regression. The sample used in this study has been obtained by applying sampling techniques to a extensive public database from Kiva. This provided information on microloans from 56 countries around the world. The results based on amount, term, repayment method and recruitment period indicate that women are the best borrowers. All these variables, except the term, are significant at a 5% level. These findings may be useful to improve financial inclusion and outreach, consistently with the Sustainable Development Goals. Future research is needed to assess how "green and pink" microfinance (with environmental strategies particularly favored by women) can attract more ESG-compliant crowdfunding resources.

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Introduction

This study has been motivated by the increasing empowerment of women in developing countries, mainly in Africa, Asia, and Latin America, as a consequence of establishing the well-known sustainable development goals (SDGs) promoted by the United Nations. This has favored a high increase in the number of microloans granted to women and groups of borrowers in which women are in the majority. It is therefore logical to ask whether there is a different behavior on the part of men and women when repaying these microloans. Obviously, this study will prove to be very useful for MicroFinance Institutions (MFIs), which are interested in knowing the quality of granted microloans regarding the degree of repayment shown by men and women.

The analysis has been based on a sample extracted from a database published by Kiva. The sampling techniques have resulted in the selection of microloans granted to borrowers located in 56 countries. The context of this study is, therefore, of particular relevance since the countries involved in the study represent the main areas of SDGs implementation.

As indicated, the framework of this study is the field of microloans as a consolidated way to obtain small loans for the self-employed and small businesses, among others. This contributes to poverty reduction (Wu et al., 2020), a primary goal for microfinance (Chan, 2005), initiated in Bangladesh some forty years ago as a result of the initiative of Muhammad Yunus and then spread throughout India and to most other Asian countries (see Fig. 1). More specifically, borrowers are low-income individuals (mainly women) and SMEs, mostly located in developing countries. Indeed, jointly with cooperatives, this way of financing represents a high percentage of funding businesses included in the so-called "Social Economy" of a country. This context is consistent with green microfinance where environmental targets

contribute to traditional financial and social goals (Allet, 2014; Moser and Gonzales, 2015; Huybrechs et al., 2019; Archer and Jones-Christensen, 2011).

People are increasingly interested in banking products with a social impact. One way to promote these products is to securitize microloans through crowdfunding. Crowdfunding is is the use of small amounts of capital from a large number of individuals to finance a new business venture, typically operating through online platforms. A currently used definition has been established by Schwienbacher (2019): "crowdfunding involves an open call, essentially through the Internet, for the provision of financial resources either in the form of donation or in exchange for some form of reward and/or voting rights". This product is like a traditional securitized loan and, if banks are replaced by crowdfunding companies targeting small loans, this combined product will be labeled as a "crowdfunded microloan".

Recently, crowdfunding has been used by microfinance institutions (MFIs) to improve the quality of life of the underserved (Sancha-Navarro et al., 2018). This may fill an important gap in sustainable entrepreneurship that responds to Environmental, Social, and Governance (ESG) issues (Tenner and Hörisch, 2021) trying to overcome funding bottlenecks from traditional financial lenders. Crowdfunding helps close such a funding hole (Bento et al., 2019).

Group lending, with its social networking ecosystem, is a traditional microfinance feature, which could be reshaped by crowdfunding patterns. Both group lending and crowdfunding can be reinterpreted in terms of social networks where the interacting stakeholders (from crowd-investors to micro-borrowers) are controlled by digital platforms.

Women's micro-borrowing activities—a central element of green microfinance—can be promoted with crowdfunding, with a positive impact on gender issues. Environmental concerns, albeit less investigated than gender-sensitive socio-economic issues, stand out as a strictly related investigation area, which depends not only on the common participation of ESG acronyms but also on the impact of 'profit and people' on the "planet". Microfinance is typically analyzed using socio-economic patterns (improving women's empowerment through higher income), and it can consequently be linked to environmental sustainability (Warnecke, 2015).

Developed and polluting countries may thus contribute, with crowdfunding resources, to facilitate environmental-friendly growth in poorer areas, through dedicated microfinance projects where women are the core players, and… the West takes care of the Rest. The greener the microfinance strategies, the easier it is to raise dedicated crowdfunds.

In this context, this study responds to the increasing demand for socially responsible banking products to promote environmental-friendly development. People increasingly look for ESG financial investments to reach reasonable profitability, favouring microenterprises as a source of employment and wealth creation for low-income borrowers. This research connects the real and the academic microfinance worlds by suggesting initiatives, which could improve the quality of life of both individual borrowers and local communities, promoting innovative forms of participation and financial inclusion.

The conclusion is supported by the fact that the number of MFIs has increased since the mid-1990s, with more than 10,000 worldwide varying in size and nature (Richardson 2009; Sonfield, 2012; Ghosh, 2013; ResponsAbility, 2019). However, there is a need to improve mechanisms and loan structure, and refine credit-scoring models in the microfinance sector. In this way, this paper examines a combination of academic research and the expertize acquired by practitioners in the field.
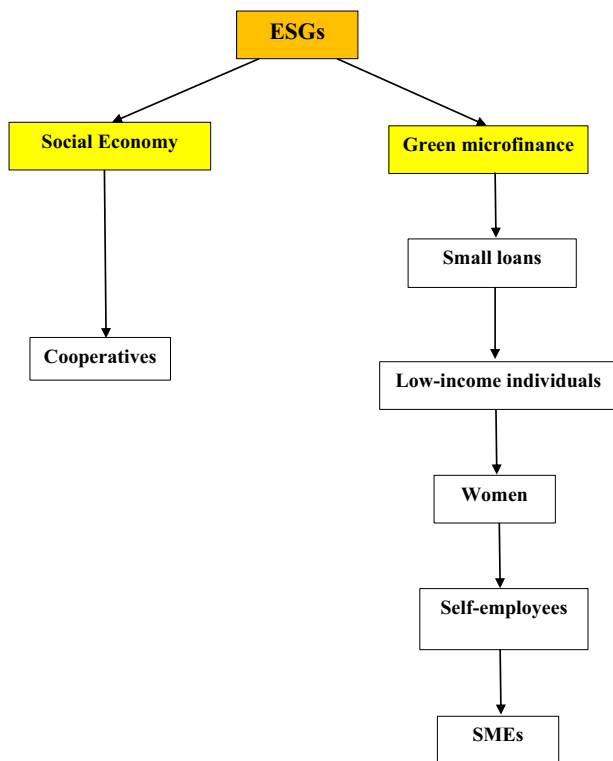

Fig. 1 Schedule of section1. It exhibits two paths where the environmental, social and governance (ESG) criteria can be developed: social economy and green microfinance. The framework of this paper is green microfinance. Source: Own elaboration.

Table 1 Impact of traditional and crowdfunded group lending on credit quality. Source: Own elaboration.

Credit quality	(Traditional) group-lending impact	Crowdfunded digital group-lending impact
Amount	The amount can grow in the presence of multiple coordinated borrowers.	Crowdfunding can lever resources either as loans or equity.
Term	Terms are generally short, and the repayment schedule is tight to limit risk and build up a positive credit history.	Terms may somewhat be extended due to improved technology-driven monitoring and handling.
Number of lenders	The number of lenders is limited by the effective availability of on-site MFIs, with branches or direct contacts with the group and its representatives.	Platforms ease comparison and competition, increasing the potential number of lenders.
Repayment system	The repayment system is open to the needs and solvency of borrowers: French method, constant repayment, American method, interest-only, or a combination of them.	The repayment system is closed to certain modalities: French method with monthly repayment or bullet repayment. Irregular repayment is marginal in this context.
Period of lenders' recruitment	Usually, syndicated loans are designed to finance big investments. So, the period of lenders' recruitment is the middle term.	In the context of crowdfunded microloans, this period could be labeled as "very short term".

Within this introductory framework, the main research question of this paper is to determine if the gender of micro-borrowers backed by crowdfunding investors affects the main features of a microloan: amount, term, number of lenders, length of time to contact with borrowers and repayment system. Green issues naturally follow as a by-product of developmental win-win strategies.

This study is structured as follows: after this introductory section, paragraph "From traditional microfinance to crowdfunded group lending" examines the digital extension of traditional group-lending practices with crowdfunding platforms. A literature review summarizes in paragraph "Literature review" the main studies on the topic. Paragraph "Methods" illustrates the model and the data set, before the analysis of the results (paragraph "Results") and their discussion (paragraph "Discussion and implications"). Some final remarks, with suggestions for further research, are offered in the conclusion (paragraph "Conclusion and future research").

From traditional microfinance to crowdfunded group lending
Crowdfunded microfinance could supplement traditional group lending, especially in underdeveloped areas with the highest upgrade potential. An analysis of traditional versus digital group lending is required to question the gender-related quality of crowdfunded micro-borrowers. Reliability is influenced by the main loan parameters, as tentatively illustrated in Table 1.

Assortative mating of the group composition is often gender-sensitive (Faridi, 2011), coherent with the framework and the research question of this study.

Group lending is not a microfinance invention, since it was extensively employed in the nineteenth century by insurance companies and mutual banks. It is a popular way of bypassing the lack of collateral, which represents one of the biggest bottlenecks to credit access for the underbanked (Moro Visconti, 2014a). MFIs typically provide a modest loan to a social group of some 5 to 20 people who jointly offer the necessary guarantees and intervene in the case of delinquency of any member. Traditional group-lending schemes assisted by a joint liability represent a typical contract used by MFIs (Altinok, 2018). However, individual loans are the standard contracts in developing countries in Central and South America (as in Colombia, Ecuador, Peru, and El Salvador), where there exist many developed MFIs and microfinance banks.

Transaction costs are naturally shared by those forming the group, and so group lending intrinsically represents a useful tool in reducing the implicit costs of borrowing by transferring its comprehensive burden on to the group (Sharma et al., 2017). If the individual borrower builds up a reliable track record, the MFI could increase lending to other components of the group. The main purpose of group lending is to transfer responsibilities directly to

borrowers, thus relieving bank staff. Group borrowers carry out the selection and control of debtors, enforcing the lending contracts. Joint borrowers can thus obtain otherwise inaccessible loans. Crowdfunding platforms may help MFIs (as will be shown in Fig. 1), with economies of scale and experience (fostered by artificial intelligence), reducing operating costs with technological innovation (e.g., digitalization, which eases big data collection and processing; computerized credit scoring, which builds up the borrowing history; branchless banking using mobile phones; data validation through blockchains, etc.). Lower MFI break-even periods improve economic sustainability and foster potential outreach.

Group lending assisted by joint liability schemes represents an effective instrument to bypass traditional information asymmetries. This happens because joint lending helps group members to make use of their social links to monitor, screen, and enforce joint loan repayment (Moro Visconti, 2014b). Community interrelations incorporate social capital features and facilitate the joint actions of group members who can thus coordinate payback and cooperate to achieve mutually agreed targets (Postelnicu et al., 2014). Technology and digitalization can further reduce operating costs, which threaten microfinance sustainability, limiting its outreach potential. This pattern is fully consistent with a crowdfunded microloan model.

Timely monitoring occurs with weekly meetings between group members and the MFI. During these meetings, the borrower's repayment status is publicly controlled, and screening costs are reduced by meeting debtors jointly and scaling up loan transactions. Digital monitoring is continuous, exploiting network externalities and producing big data, a worthy by-product, which can be stored in the cloud and processed with AI algorithms. Digitalization, embedded in crowdfunding practices, can also improve the credit history of borrowers, difficult recording in paperless environments where transactions are unrecorded.

However, group lending has its drawbacks since it principally works in peasant areas where social control, especially for women, is more restrictive. There may also be a challenge in group dynamics since a classical group loan might be unfit for its smarter members. When the lender finds it difficult to discriminate between risky and safe borrowers, adverse selection may occur, since it imposes the same interest rates on everyone, implicitly subsidizing the worst borrowers and thus discouraging the more reliable (mostly women) from borrowing. A decrease in information asymmetries, where real customers can send a clear signal to the MFI about the creditworthiness of potential borrowers, might contribute to softening unfair surcharges.

Trustworthy individuals have a strong incentive to a careful selection of reliable partners to join the group. Groups are incentivized to adopt a self-selection procedure with assortative matching, even if strong family or clan bonds in peasant areas
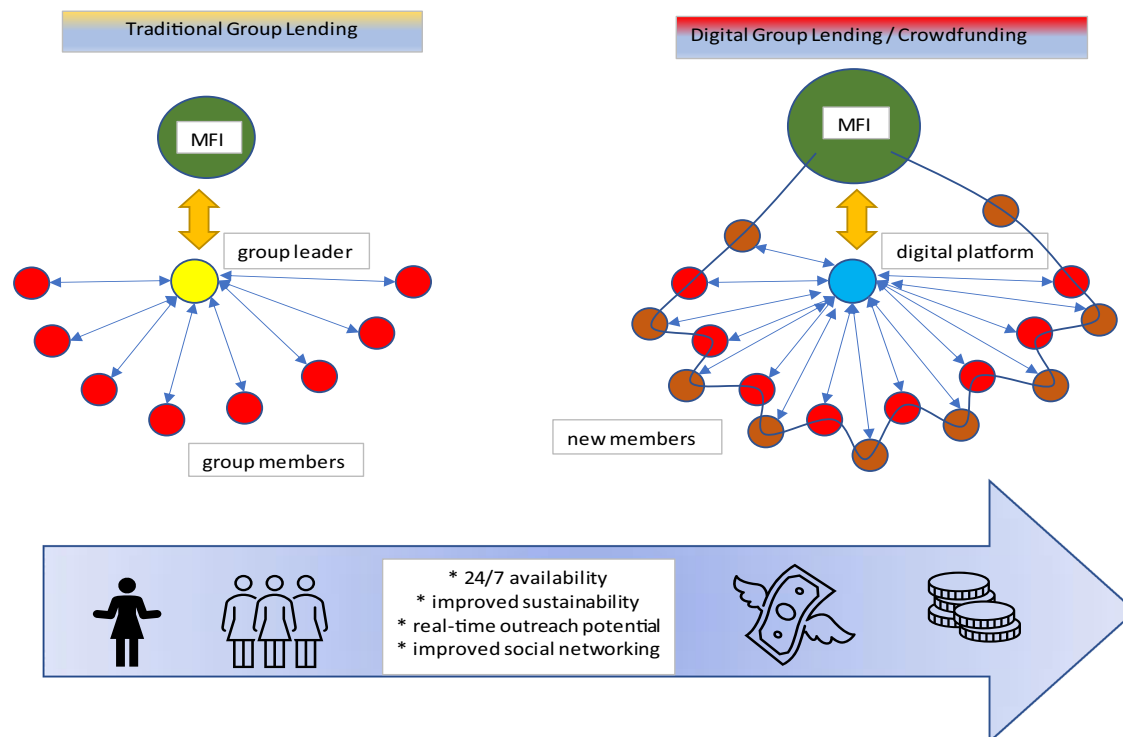
Fig. 2 Traditional versus digital group lending and crowdfunding. It shows the difference between these two social networks. In a digital group lending, the group leader has been replaced by a digital platform which exhibits the advantages listed below. Source: Own elaboration.

could make meritocratic selection more difficult. Assortative mating and improved group workings can again be catalyzed by crowdfunding-compliant digital platforms, which exploit network externalities, fueling scalable business models.

The advantages of group lending are offset by strategic default options, which emerge when costly social sanctions or cross-reporting mechanisms within the group are difficult to impose (Bhole and Ogden, 2010). Costs also increase according to the scale of lending, because default probabilities increase, and bigger businesses—where more astute borrowers outperform their peers —could suffer from credit rationing criticalities.

Social networks increasingly work using digital platforms, which reshape in real time the group composition and its dynamics. Group members can maintain continual contact through dedicated conversations where they can exchange information on financial services and big data. M-banking can be jointly used providing digitalized borrowers and group lenders with positive spillovers, which range from traceability to immediacy, with consequent transactional savings. Digital platforms inspire transaction virality. As a consequence, the operations become more scalable.

Social networks—represented by stakeholders such as group-lending members or crowdfunding investors—can be mathematically interpreted with network theory patterns. A network is topologically represented by a graph composed of nodes and/or edges with attributes (e.g., names). Owing to their intrinsic features, networks represent a key feature of complex ecosystems. The interpretation of such ecosystems can shed new light on the interactions among connected stakeholders, as shown in Fig. 2.

Group lending can be graphically illustrated, showing how it can be interpreted in network terms. There is a difference between traditional group lending (characterized by few connections between single group members and the group leader, who behaves as a bridging hub directly linked to the lending MFI), and digital group lending, where connections grow and the

disintermediation directly links each member to the MFI. In this case, the rôle of the group leader is less significant.

Figure 1 exemplifies how digital interactions function everywhere and always (7/24), compared to traditional group lending, which faces significant physical barriers and delivery bottlenecks, which hamper socio-economic sustainability, thus limiting outreach potential. Enhanced connectivity among different nodes (consistent with digitized crowdfunding) increases the comprehensive value of the network. In crowdfunding, the small loan size, jointly with a high number of potential investors, facilitates the recruitment of further lenders, diversifying the risks of credit, default, and delinquency of the microloan portfolio, which is digitally managed by the MFI. Gender issues introduce a further pattern for interpretation, consistent with the question considered in this paper.

The representation of a P2P network would be different, with direct relationships between crowd-investors and micro-borrowers, which bypass the intermediation of the MFI. This variant deserves further investigation considering its pros and cons (e.g., Are lower transaction costs offset by higher adverse selection and information asymmetries?).

The comparison between traditional and digital group lending shows the importance of digital (crowdfunding) platforms, which intermediate always (24/7) and ubiquitously (producing geographical scalability) between the group members and the MFI. The value of the platform node, to be appraised considering its mathematical properties (Barabási, 2016), depends on the quantity and quality of "traffic" across the network. "Traffic" is mostly represented by timely information ("small data" digitized and gathered to become "big data") and transactional volumes. This pattern is, once again, fully consistent with the crowdfunding supply and value chain model. Technology and digitalization significantly reduce information asymmetries, coalescing information around bridging nodes represented by the crowdfunding platform and the MFI. This minimizes traditional corporate
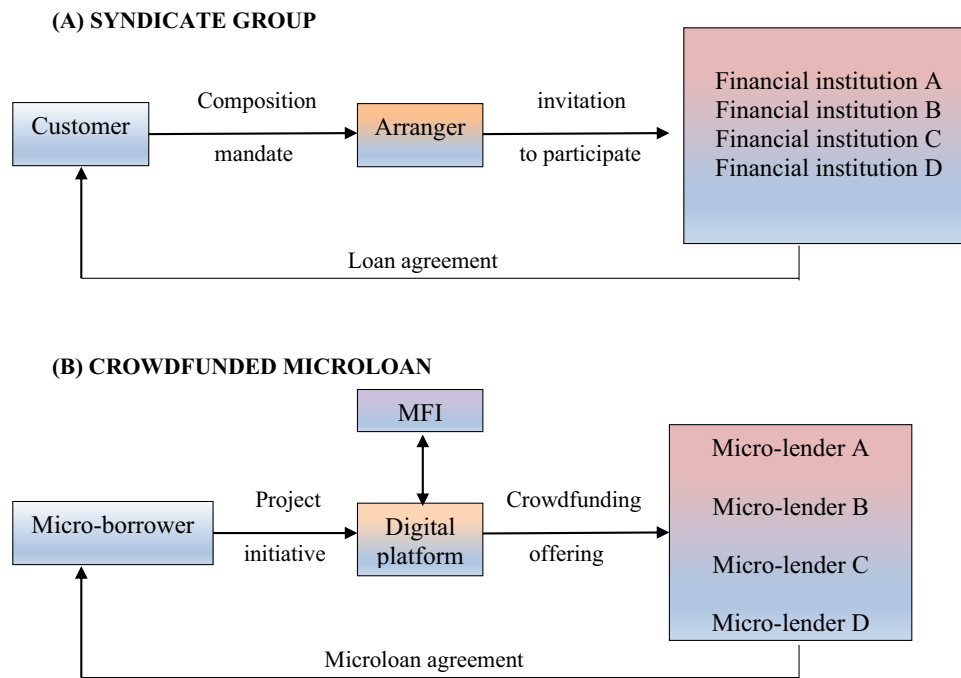
(A) SYNDICATE GROUP

(B) CROWDFUNDED MICROLOAN

Fig. 3 Parallelism between syndicated loans and crowdfunded microloans. The schedule of financing through a syndicate group and by means of crowdfunded microloans, highlighting the parallelism between both operations. **A** A loan agreementwhere the central role of financing customers is played by the arranger and the financial institutions. **B** The role of intermediation, played by a MFI through digital platforms, between micro-borrowers and micro-lenders. Source: Own elaboration.

governance concerns that threaten microfinance sustainability, preventing optimal outreach to those most in need.

Micro-equity stakes can usefully complement microloans, supporting startups and digital entrepreneurship. Microdeposits, micro-consulting, and microinsurance complement microlending practices, providing a wider set of products and services, which are synergistically fitter to accommodate crowdfunding and its practical declinations.

A crowdfunded microloan may be considered the result of "democratizing" syndicated loans, originally conceived to make major investments in projects of large companies. The main objective of these loans is to share and diversify the risks among the participants. This same idea could be applied to more modest microloans. Fig. 3 describes the parallelism between syndicated loans and their "micro" version, which may be useful for the analysis of the existing literature on crowdfunded microloans.

In Fig. 3(B), the upper side corresponds to a microfinance operation, whilst the lower part schematizes lending crowdfunding. This indicates why the literature review of this study is organized in three parts: microfinance, crowdfunding, and the aggregation of these two products: the so-called crowdfunded microloan, especially focused on women.

Literature review

This study is inspired by an increasing volume of literature on crowdfunding and microfinance. However, it goes further in considering some additional implications concerning the sustainability of gender-driven crowdfunded microloans.

Microfinance has been extensively studied in the last forty years in exhaustive literature Chu (2010). Surveys can be found in Armendariz de Aghion and Morduch (2010); García-Pérez et al. (2017); Beck (2015); Moro Visconti (2016). Traditional research focused on MFIs in developing and emerging markets but has been currently extended to developed economies.

The main literature streams are:

a. *Group-lending activities* (which can host crowdfunding innovations, as anticipated in paragraph "From traditional microfinance to crowdfunded group lending"), analyzed by Sangwan and Nayak (2020) and Shah et al. (2019).

b. *Crowdfunding* is summarized in ad hoc surveys (McKenny et al., 2017; Cai et al., 2019; Kim and De Moor, 2017), and interpreted by Beaulieu et al. (2015) and Kietzmann (2017).

c. *Overlaps between microfinance and crowdfunding*, analyzed by Marom (2013), Allison et al. (2015), Anglin et al. (2019), Sherwani et al. (2018), Arshad et al. (2020), Sancha-Navarro et al. (2018), Attuel-Mendes (2016), Berns et al. (2021), Shahriar et al. (2020), Berns, Figueroa-Armijos et al. (2020), Assadi et al. (2018), Blakstad and Allen (2018), Bruton et al. (2015), Dorfleitner et al. (2020), Kim and De Moor (2017), Marakkath and Attuel-Mendes (2015), Martínez-Climent et al. (2019), Motylska-Kuzma (2018), Yum et al. (2012), and Royal and Windsor (2014).

d. *Gender (in)equality issues*, investigated by Barasinska and Schaefer (2014), Koloma and Alia (2014), Salia et al. (2018), Santandreu (2018), Santandreu and López Pascual (2019), Santandreu et al. (2020), Cicchiello and Kazemikhasragh (2022), Cicchiello et al. (2021), and Cicchiello and Leone (2020). Social networks of women are analyzed by Ali et al. (2016).

This literature is coherent with the research question (see Fig. 4).

Entrepreneurial finance is rapidly evolving. In advanced or developing economies (Bruton et al., 2015), entrepreneurs mix start-up finance (backed by angel investors, family, friends, venture capitalists, private equity, and sometimes traditional banks) with microfinance products (Khavul, 2010), crowdfunding investments (Belleflamme et al., 2013), even to peer-to-peer (P2P) lending, and further financial innovation instruments (Moenninghoff and Wieandt, 2013). These are excellent examples of financial innovation, which backs entrepreneurship in both developed and developing countries.
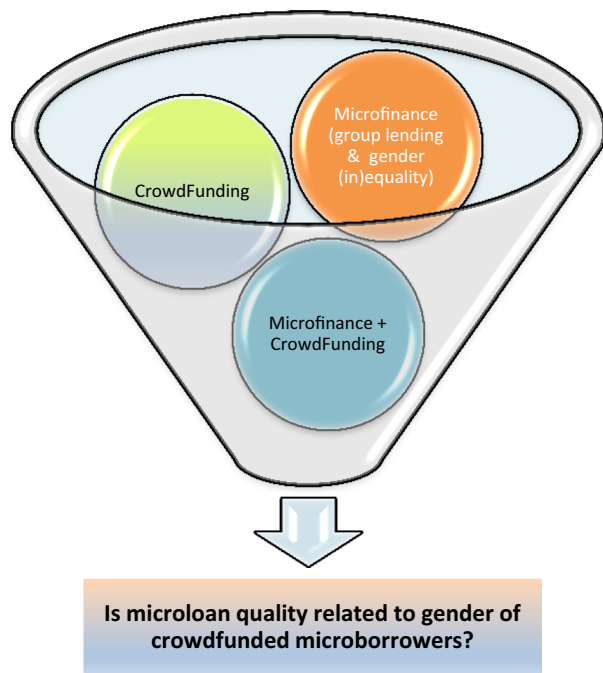
Fig. 4 From the literature strands to the research question. It schematizes that the crowdfunded microloan analyzed in this paper is a hybrid product of a microloan and a crowdfunded loan. Source: Own elaboration.

Microloans collected from crowdfunding sources provide an innovative source of equity for new entrepreneurs (Allison et al., 2015) who face many difficulties in accessing capital in traditional lending institutions (McCarter, 2006). These difficulties increase especially in the case of minorities or gender as highlighted by Kevane and Wydick (2001).

Cicchiello and Leone (2020) encourage investment in SMEs through equity-based crowdfunding by examining the rôle, which may be assumed by national policymakers in developing equity crowdfunding markets through a proper implementation of European Directives in this field.

Microfinance softens gender inequalities, enabling needy women to approach income-generating businesses to help them achieve financial independence. This strengthens their decision-making capacity. In this way, microfinance can potentially reduce gender inequality (Zhang and Posso, 2017).

Many studies within the "gender microfinance" literature show that MFIs better their repayment rates when the target borrowers are women (Kittilaksanawong and Zhao, 2018). In relation with gender inequality issues, some important recent works, such as Cicchiello et al. (2021) have shown that equity crowdfunding campaigns should be aimed at those companies, which have equal numbers of men and women on their boards. This research finds evidence that there is no gender disparity when a project is financed by a greater number of investors.

In addition there is recent research (Cicchiello and Kazemikhasragh, 2022), which hightlights several implications for crowdfunding platform managers in the selection of their target companies and policymakers when defining political actions to promote a greater use of equity crowdfunding among female entrepreneurs. These implications should remove some of the barriers to the granting investment capital to women.

Minorities have been a socio-economic factor analyzed by scholars (Dasgupta and Tabassum, 2017) who have given special sttention to the empowerment of women in less developed areas in India, Bangladesh, and some Latin American countries.

After recognizing the popularity of microfinance, one must also consider the explosion of crowdfunding and its interactional effect (Attuel-Mendes, 2016). The impact of crowdfunding on microfinance ultimately depends on the country in which it is implemented. The growth in the crowdfunding sector and in the number of online platforms focusing on microfinance (as shown, for instance, by Kiva.org) represents a challenge and also an opportunity for MFIs, which for the first time approach potential investors online.

Crowdfunding is reshaping the nature of entrepreneurship, fostering sustainability (Messeni Petruzzelli et al., 2019), since it allows small (individual) investors to pool limited amounts of money consistent with the funding requirements of new business ventures. As happens in many other financial innovation areas, crowdfunding is rapidly spreading from an initial start-up in many developed economies, to being introduced in developing economies (World Bank, 2013 and 2021).

Crowdfunding has become an important mechanism to acquire financial resources for different areas of investment using digital platforms, which link borrowers and providers of finance. Crowdfunding has recently been used by MFIs to target households in developing countries, improving their quality of life. This especially concerns crowdlending tools and donation crowdfunding (Sancha-Navarro et al., 2018), which reduce the MFI's break-even period, thus fostering sustainability and outreach.

Bapna and Ganco (2020) have revealed that although prior research in traditional equity financing shows that male founders are preferred, emerging evidence in low-stake crowdfunding (e.g., reward-based crowdfunding) indicates that female micro-entrepreneurs may be more advantageous, particularly for gender-consistent crowd-investors. This may establish an innovative link, as shown in Fig. 2, between female crowd-funders and micro-borrowers. Figueroa-Armijos and Berns (2022) show that prosocial crowdfunding may have a positive gender effect, since female small entrepreneurs show better repayment rates, and are consequently more likely to be fully funded. Moreover, Greenberg and Mollick (2017) show that donation-based crowdfunding can be based on choice homophily, which derives from a shared social identity based on assortative mating and group membership.

Peer-to-peer lending (P2P) is a further form of crowdfunding, where borrowers and lenders converge on a crowdfunding digital platform to negotiate their lending terms. The digital platform functions as a mediator between lenders and borrowers. Consequently, P2P lending replaces the bank as a middleman, thus saving transaction costs. The bank (or the MFI, in this case) represents an established institution, which is replaced by innovative P2P lending platforms. Owing to cross-pollination strategies, P2P platforms often cooperate with banks to facilitate the transaction process. This results in an advantage for borrowers (in terms of lower rates) and for lenders, who can earn higher returns thanks to cost-cutting disintermediation. The first platform is represented by Zopa in the UK, which started in 2005. Other comparable platforms are Babyloan in France; Smava in Germany; and Prosper and Lending Club in the US.

To summarize, there is an institutional framework for microfinance, P2P lending and crowdfunding, with a remarkable impact on the origin, adoption and spreading of financial innovation for entrepreneurs in both developed and evolving economies. As a consequence, the institutional framework represents a critical component of any ecosystem to investigate new alternative sources of entrepreneurial finance (Bruton et al., 2015). In both crowdfunding investments and peer-to-peer lending schemes, individual investors coalesce to provide equity. In this ecosystem, internet-based digital platforms act as network orchestrators (intermediaries) connecting potential funders with micro-entrepreneurs. Crowdfunding platforms increasingly rely

Table 2 Number of microloans in several countries. Source: Own elaboration.	
Country	**Number of microloans**
Afghanistan	1
Albania	1
Armenia	1
Azerbaijan	4
Benin	1
Bolivia	7
Burkina Faso	1
Cambodia	15
Chile	1
Colombia	8
Congo	1
Costa Rica	1
Dominican Republic	1
Ecuador	8
El Salvador	13
Fiji	1
Georgia	2
Ghana	2
Guatemala	1
Haiti	4
Honduras	6
India	1
Indonesia	3
Jordan	2
Kenya	40
Kyrgyzstan	3
Lebanon	2
Liberia	4
Madagascar	2
Malawi	1
Mali	1
Mexico	5
Mongolia	1
Mozambique	2
Nepal	1
Nicaragua	6
Nigeria	6
Pakistan	13
Palestine	2
Paraguay	9
Peru	22
Philippines	91
Rwanda	7
Samoa	7
Senegal	4
Sierra Leone	6
Tajikistan	21
Tanzania	4
Togo	6
Tonga	2
Turkey	2
Uganda	14
Ukraine	1
United States	1
Vietnam	12
Zambia	1
TOTAL	385

Many crowdfunding platforms also set up mini-funds to collect and administer their funders' money. There is also an increasing number of mixed models in which crowdfunding patterns are applied to microlending. For instance, not-for-profit entities such as Kiva, the largest microfinancing intermediary in the world, adopt social media through digital platforms (networks) to raise adequate financing from whidespread individuals. Kiva coalesces the funds from many small-scale individual investors and combines them, placing them as one quantity with MFIs. MFIs, for their part, are fully responsible for the disbursement and management of the loans to entrepreneurs (Schwittay, 2014), consistent with Figs. 1 and 2. Peer-to-peer lending where investors directly provide capital to borrowers can also involve microfinance platforms.

Some scholars (Shahriar et al., 2020; Blanco-Oliver et al., 2021) examine the impact of borrowers' gender on delinquency (repayment) rates. According to the classic microcredit literature, for instance, the very fact that such credit targets mostly women contributes, at least partially, to explaining the success of these programs in developing countries. Pitt and Khandker (1998) employ a quasi-experimental approach to illustrate that a credit program in Bangladesh had a larger effect when women were involved.

Many worldwide microfinance studies—not including the USA —show that lending to women has a greater socio-economic impact on households than lending to men. Moreover, women have better repayment records (D'Espallier et al., 2011; Khandker, 2005; Abdullah and Quayes, 2016; Deshpande and Burjorjee, 2017; Kevane and Wydick, 2001).

These literature strands overlap with extended scrutiny on risk-sensitive behavioral gender differences (Karavitis et al., 2021). In particular, much previous research has shown that women tend to be more risk-averse than men (Eckel and Grossman, 2008; Croson and Gneezy, 2009).

Based on these multidisciplinary premises, this study is original and goes beyond the extant literature since, to the best of the authors' knowledge, it innovatively analyses a gender preference for crowdfunded microloans. ESG-compliant environmental strategies may ease the raising of crowdfunding resources, giving rise to "green and pink" microfinance patterns, where women give greater consideration to ecological development.

Methods

As anticipated, the question under consideration in this research paper is to determine if the gender of crowdfunded micro-borrowers is related to the main features, which define the quality of a microloan: amount, term, number of lenders, repayment system, and period of lenders' recruitment. To achieve this end, the methodology is described in paragraph "Methodology", and the empirical sample in paragraph "Sample".

Methodology. The methodology employed in this study is the multinomial logit regression method Statistics Kingdom (2017) to analyze the dependent variable Y, which exhibits three classes in no natural order. The dependent variable is divided into three values: $Y = 0$, if the borrower is male or a group composed of only men; $Y = 2$, if the borrower is female or a group composed of only women; and $Y = 1$, if the borrower is a group composed of both men and women. The analysis follows the methodology developed by Agresti and Franklin (2013), Agresti (2015), and Greene (2018).

Multinomial logistic regression represents a well-known extension of the binary logit. It originates from n independent observations combined with p explanatory variables, where the qualitative response variable has k categories. To build up the

on the "wisdom of the crowd" whenever they select and screen new potential investments while opting individually for the best opportunities. The main principle of many crowdfunding platforms is represented by providing typical investors with easy access to projects in their early stage while giving startuppers alternative access to equity providers.

Table 3 Number of microloans in different sectors. Source: Own elaboration.

Sector of activity	Number of microloans
Agriculture	103
Arts	5
Clothing	30
Construction	3
Education	12
Food	76
Health	3
Housing	24
Manufacturing	1
Personal use	8
Retail	82
Services	28
Transportation	9
Wholesale	1
TOTAL	385

Table 4 Type of variables involved in the analysis. Source: Own elaboration.

Variable	Short description	Type	Values
Y	Gender	Categorical	0, 1, 2
X_1	Loan amount	Quantitative	From 50.00 to 6,700.00
X_2	Loan term	Quantitative	From 5 to 122
X_3	Number of lenders	Quantitative	From 1 to 148
X_4	Repayment system	Categorical	0, 1, 2
X_5	Period of lenders' recruitment	Quantitative	From 0 to 99

logits in the multinomial case, one of the categories has to be considered the base level, and consequently all logits must be built relatively to it. Any category can be considered as the base level. Since there is no obligatory order, category k is here taken as the base level. Let π_j indicate the multinomial probability of an observation belonging to the j-th category. The link between this probability and the p explanatory variables, X_1, X_2, …X_P, the multiple logistic regression model can be defined by:

$$\log \frac{\pi_j(x_i)}{\pi_k(x_i)} = \alpha_{0i} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \cdots + \beta_{pj}x_{pi},$$

where $j = 1, 2, …, k - 1$ and $i = 1, 2, …, n$. Since the sum of all π is 1, one has:

$$\pi_j(x_i) = \frac{\exp\left(\alpha_{0i} + \beta_{1j}x_{1i} + \beta_{2j}x_{2i} + \cdots \beta_{pj}x_{pi}\right)}{1 + \sum_{h=1}^{k-1} \exp\left(\alpha_{0i} + \beta_{1h}x_{1i} + \beta_{2h}x_{2i} + \cdots \beta_{ph}x_{pi}\right)}.$$

For each $j = 1, 2, …, k - 1$, the model parameters are estimated by the method of maximum likelihood. As indicated, in the multinomial logit regression model the estimate for the parameters can be identified in comparison to a baseline category. If x denotes a matrix or a vector, let $\pi_j(x) = P(Y = j|x)$ at a given setting x of explanatory variables, where obviously $\sum_{j=1}^{k-1} \pi_j(x) = 1$. In this context, logit models pair each response category with a baseline category:

$$\log \frac{\pi_j(x)}{\pi_k(x)} = \alpha_j + \beta'_j x,$$

in this case, $j = 1, 2, …, k - 1$, simultaneously illustrates the effects of x on these $k - 1$ logits. As the effects change according to the response paired with the baseline, these $k - 1$ equations show the parameters for logits with other pairs of response categories. Finally, the Pearson chi-square statistic χ^2 and the likelihood ratio chi-square statistic G^2 goodness-of-fit statistics give a model check when data are not scarce (Agresti, 2002).

Sample. In this analysis, a collection of 1,048,575 (N) microloans has been extracted from the website of Kiva[1]. The time period of disbursement of the microloans analyzed in this paper was from July 25, 2007 to June 30, 2020. Considering the huge number of cases thus identified, a smaller quantity composed of 385 microloans has been selected by using the procedure of simple

random sampling, more specifically the following formula:

$$n = \frac{\frac{z^2 p(1-p)}{e^2}}{1 + \frac{z^2 p(1-p)}{e^2 N}}$$

where n is the size of the sample to be determined, z is the standard score corresponding to a 5% significance level (that is, 1.96), p is the population proportion (taken here as 50%), and e is the margin of error (in this case, 5%). To do this, 385 random numbers were generated between 1 and 1,048,575 and consideration given to the corresponding microloans, which have been granted to borrowers located in 56 countries, as shown in Table 2. Some Asian countries, such as the Philippines or Tajikistan, are ranking high in the sample, and many others incorporate a strong growth potential.

These microcredits aimed to cover the financial needs of the financed micro-firms belonging to 14 sectors of activity are shown in Table 3.

Data. Data include information on micro-borrowers and microloans. The variable considered for this analysis and concerning the borrowers is gender (Y). This categorical variable refers to the sex of micro-borrowers and takes the values 0 (for men) and 2 (for women). The sample was composed of 71 individual men and 263 women, and 51 groups of borrowers of which only 2 were composed of men, 32 were composed of women and, finally, 17 were mixed. Groups of only men have been assimilated into men and so they have been assigned the number 0. Analogously, groups of only women have been identified as women and so they have been represented by 2. Finally, mixed groups have been labeled with the number 1. This will be the dependent variable of our empirical analysis.

The variables corresponding to the microloans are:

1. Loan amount (X_1).
2. Loan term (X_2).
3. The number of lenders (X_3).
4. Repayment system (X_4). This categorical variable represents the reliability or confidence in the loan repayment by the borrower and so has been divided into "monthly repayment" (0), bullet repayment (1), and, finally, irregular repayment (2).
5. Period of lenders' recruitment (X_5): This quantitative variable is the difference between the raised time (defined as the time at which the loan amount has been covered by the lenders) and the posted time (defined as the time at which the loan has been publicized in the platform). This categorical variable represents the reliability or confidence of lenders.

The variables involved in the analysis have been summarized in Table 4.

Table 5 Coefficients relating category 2 to category 0 of gender. Source: Own elaboration.

	Coefficient	S.E.	z-stat	Lower $z_{0.025}$	Upper $z_{0.975}$	exp(b_k)	p-value
b_0	1.8339	0.3443	5.3272	1.1592	2.5086	6.2582	9.975e−8 [a]
X_1	0.2004	0.2873	0.6977	−0.3626	0.7635	1.2219	0.4854
X_2	−0.001187	0.01560	−0.07609	−0.03176	0.02938	0.9988	0.9393
X_3	−0.004210	0.01804	−0.2334	−0.03957	0.03115	0.9958	0.8155
X_4	−0.9943	0.2476	−4.0162	−1.4795	−0.5091	0.3700	0.00005914 [a]
X_5	−0.02976	0.008581	−3.4682	−0.04658	−0.01294	0.9707	0.0005239 [a]

[a]Significant at 5% level. *S.E.* standard error.

Table 6 Coefficients relating category 1 to category 0 of gender. Source: Own elaboration.

	Coefficient	S.E.	z-stat	Lower $z_{0.025}$	Upper $z_{0.975}$	exp(b_k)	p-value
b_0	−2.4036	0.6121	−3.9269	−3.6033	−1.2039	0.09039	0.00008606 [a]
X_1	0.7873	0.3289	2.3934	0.1426	1.4320	2.1974	0.01669 [a]
X_2	0.004086	0.02148	0.1902	−0.03802	0.04619	1.0041	0.8491
X_3	−0.02450	0.02216	−1.1056	−0.06793	0.01893	0.9758	0.2689
X_4	−0.1860	0.4718	−0.3942	−1.1107	0.7387	0.8303	0.6934
X_5	−0.02171	0.02121	−1.0237	−0.06328	0.01986	0.9785	0.3060

[a]Significant at 5% level. *S.E.* standard error.

The predictors used in the multinomial logit regression were subject to two conditions. First, the predictor has to have an a priori logic relationship with the dependent variable. For example, the loan term and the number of lenders satisfy this condition because a priori one could think that a longer loan term and a greater number of lenders facilitate the amortization of the loan. In effect, a longer loan term implies more flexibility of payments, and a greater number of lenders is a consequence of the favorable position of Kiva on a specific borrower.

Second, if available, other potential predictors could also be used in the analysis. This is the case of the interest rate applied to the analyzed loans but, unfortunately, this information has not been provided by Kiva. In effect, Zhao et al. (2022) point out that Kiva is an interest-free lending platform. In fact, Kiva never collects interest on loans and lenders do not receive interest from the loans, which they fund. Specifically, loans disbursed through Kiva U.S. are offered at 0% interest rate and have no fees. Consequently, this variable has not been taken into account in this study.

Results
By applying the methodology described in subsection "Data", it has proved possible to test the following null and alternative hypotheses:

$$\begin{cases} H_0 : \ln(\text{odds}) = b_0 \\ H_1 : \ln(\text{odds}) = b_0 + b_1 X_1 + \cdots + b_p X_P \end{cases}$$

As indicated, the proposed model aims to maximize the log-likelihood. In this way, the log-likelihood for the model is $LL_1 = -222.8479$, while that for the model with only the constant terms is $LL_0 = -250.1453$. That is to say, the likelihood ratio statistic for the hypothesis that all 5 coefficients of the model are zero is larger than the critical value. The outputs of this model are summarized in Tables 5 and 6.

The information contained in Table 5 can be interpreted as follows:

Table 7 Matrix of correlations between the independent variables. Source: Own elaboration.

	X_1	X_2	X_3	X_4	X_5
X_1	1.0000	0.1702	0.8066	0.07923	0.1221
X_2	0.1702	1.000	0.3178	0.1800	0.1033
X_3	0.8066	0.3178	1.000	0.1330	0.1954
X_4	0.07923	0.1800	0.1330	1.000	0.04810
X_5	0.1221	0.1033	0.1954	0.04810	1.000

- When all the values of predictors (X_j) are zero, the odds of 2 in comparison to 0 is 6.2582.
- A one-unit increase X_1 will augment the odds of 2 in comparison to 0 by 22.2% (i.e., the odds will be multiplied by 1.2219).
- A further one-unit increase X_2 will decrease the odds of 2 in comparison to 0 by 0.1% (i.e., the odds will be multiplied by 0.9988).
- Etc.

Analogously, the information in Table 6 can be interpreted in the following way:

- When all the values of predictors (X_j) are zero, the odds of 1 in comparison to 0 is 0.09039.
- A one-unit increase X_1 will decrease the odds of 1 in comparison to 0 by 119.7% (i.e., the odds will be multiplied by 2.1974).
- A further one-unit increase X_2 will decrease the odds of 1 in comparison to 0 by 0.4% (i.e., the odds will be multiplied by 1.0041).
- Etc.

The following two equations summarize the outputs of the applied model:

$$t_1 = 1.8339 + 0.2004 X_1 - 0.001187 X_2$$
$$- 0.004210 X_3 - 0.9943 X_4 - 0.02976 X_5$$

and

$$t_2 = -2.4036 + 0.7873X_1 + 0.004086X_2$$
$$-0.02450X_3 - 0.1860X_4 - 0.0217X_5$$

where the model equation for modality 1 is $t_1 = \log(P(\text{category} = 1)/P(\text{category} = 0))$ and, analogously, $t_2 = \log(P(\text{category} = 2)/P(\text{category} = 0))$.

The symmetric matrix in Table 7 reflects the correlation between the explanatory variables used in this model:

In the estimated parameters, the following independent variables are not significant as predictors for Y: X_2 and X_3. On the other hand, it appears that only X_1, X_4, and X_5 are consistently significant statistically. Thus, the crowdfunder should promote microloans among women or groups exclusively composed of women when increasing its market share of microcredits. This is because the loan amounts are greater, the repayment system is more reliable, and the period of lenders' recruitment is shorter.

Regarding the goodness of fit of the overall regression, the right tail is given by $\chi^2(10) = 54.5949$ and the p-value $= 3.759e{-}8$. Since p-value $< \alpha$ (0.05), H_0 can be rejected. Therefore, the logistic regression model $\ln(\text{odds}) = b_0 + b_1X_1 + \cdots + b_pX_p$ provides a better fit than the model without the independent variables ($\ln(\text{odds}) = b_0$).

Concerning the factors affecting the most reliable gender for the receipt of microcredits, the results show, after applying the aforementioned methodology, that X_1, X_4, and X_5 are good predictors in the selected sample, while X_2 and X_3, as shown in Tables 3 and 4, are bad predictors.

In this study, a negative coefficient shows that the corresponding variable linked to a probability of being in the gender "male" is higher than the probability of being in the gender "mixed group or female". On the other hand, a positive coefficient indicates that the involved variable associated with a probability of being in the gender "female" is lower than the probability of being in the gender "mixed group or male". The results show that a one-unit increase in X_1 implies a higher probability of being "female" than "male". Contrarily, a one-unit increase in X_2, X_3, X_4, and X_5 implies a lower probability of being "female" than "mixed group or male". However, only three variables are significant in both categories at a 5% significance level: X_1, X_4, and X_5. Finally, observe that the lack of significance of the variable X_3 is not relevant because X_1 and X_3 are highly correlated.

Since scholars have in the past been criticized for advocating excessive burocratic checks on potential borrowers, this study does not to enter this area and concentrates on the perceived outcomes.

However, before selecting the final model, the traditional assumptions were revised as follows: the Box-Tidwell test was applied to check for robustness against the potential violation of the linearity of independent variables and log-odds. The interaction terms are not statistically significant since $p > 0.05$ for all of them. Cook's distance was used to determine possible influential points. An attempt to use the weighted maximum likelihood estimators gave results similar to the classical estimation of maximum likelihood. Finally, the Variance Inflation Factor was used for checking multicollinearity.

Discussion and implications

Microloans are recognized as a valuable tool for women's empowerment in both developed and developing countries. Currently, this prosocial rôle is being assumed by MFIs, which act as a bridge between social and economic needs. However, due to their increasing presence in the social economy, this activity has to be necessarily complemented by an analysis of their financial performance. This justifies measuring the association between gender and the main parameters, which define the quality of microloan repayment.

In this study, the multinomial logistic regression has been employed to reply to this question with the logical limitations of any research involving data availability, specifically the lack of information about delays in payments by micro-borrowers. The findings are relevant for policy implications related to prosocial initiatives in developing areas. In particular, results show that, based on the amount, term, repayment method, and recruitment period, women are the most reliable borrowers. This result is consistent with the microfinance mainstream literature (D'Espallier et al., 2011; Ranabahu and Tanima, 2022).

These findings also justify the inclusion of those most in need, which is consistent with the Sustainable Development Goals. ESG concerns are also closely related, considering in particular the gender-sensitive Social and Governance dimensions.

Despite the concerns expressed by some scholars (e.g., Moodie, 2013) about microfinance concerning women ("because it translates risk into peril"), the interest in a gender approach to microfinance has been shown by García-Pérez et al. (2017) to underline recurring terms such as "development", "gender", "social capital", "(rural) women", and "women's empowerment".

The results of the present research confirm the findings in other literature, which also connect gender to crowdfunding success. The variable "gender", founded on the logit regression model, is significant at a 5% level when estimating the probability of success of a crowdfunding initiative, even with other explanatory variables. This means that crowdfunding activities reduce the barriers confronted by female entrepreneurs when trying to raise capital. Moreover, the "gender" variable is positive at a 10% significance level when considering that women co-founders improve the success of the ventures initiated by women (Bento et al., 2019). These findings reinforce the links between crowdfunding and microfinance and the gender-sensitive usefulness of group or individual micro-borrowing backed by crowdfunding platforms (Zhao et al., 2021).

Moss et al. (2018) show that crowd-funders prefer to fund specialized microenterprises where the social aspect is emphasized over the economic. This focus on specialization is consistent with the pivoting rôle of the two main nodes of the network—the crowdfunding platform and the MFI—which exchange information and loans, thus justifying their function (as shown in this study in Figs. 1 and 2).

The impact of gender on microfinance is, however, still debated. D'Espallier et al. (2011), focusing on repayment and MFI performance, show that higher repayment rates do not necessarily imply improved welfare for women. Amine and Staub (2009) evidence that women entrepreneurs in sub-Saharan African countries (the poorest in the world) face a daunting array of challenges arising from their economic, legal, sociocultural, political, and technological environments.

From another perspective, Mascia and Rossi (2017) detect gender discrimination in bank lending across eleven European countries. According to the authors, the costs of bank financing (e.g., fees, commissions, interest rates, etc.) are typically more favorable for male-led enterprises compared to female-run companies. In addition, any change in direction from male to female leads to an improvement in lending conditions. Figueroa-Armijos and Berns (2022) show that considering the entrepreneur as being female or rural, a key feature of individual vulnerability, increases the probability that the project is fully funded. Kgoroeadira et al. (2019) indicate that in the small-business loan crowdfunding market, lenders ignore business features, preferring to focus on personal characteristics. This is consistent with the gender attributes examined in this study.

Other studies on this topic have focused on similar factors. In this sense, previous research (Beck et al., 2013) has shown that there is a lower probability of arrears for loans screened by female borrowers than for those screened by male borrowers even when an explicit control is in place. This result reveals the relevance of this factor (among others), which demands further study to focus on gender in a wide range of financial activities.

The present study answers some of these challenges, showing the conditions under which women are the best borrowers.

Gender sensitivity also affects crowdfunding activities. For instance, according to Barasinska and Schaefer (2014), female borrowers are often discriminated against by bank lenders. However, studies of Peer-to-Peer lending in developed countries such as the United States and Germany find that female borrowers have better probabilities of obtaining funds than males.

There is a possible trend of gender as a determining factor for the granting of crowdfunding microcredits. As shown in this research, access to crowdfunding, incentivized by gender features, may ease further entry to the main financial market.

The results of this study have both theoretical and practical implications. On the one hand, this paper helps in revisiting the literature on crowdfunded microloans, especially in relation to gender preference. Another contribution of this study lies in the results obtained by using a multinomial logit approach.

The practical contribution is especially relevant from a gender perspective. This article demonstrates that the results based on amount, term, repayment method and recruitment period indicate that women are the best borrowers. This research has a solid implication for reconsidering some misconceptions about gender and crowdfunding microcredits. It can also make a practical contribution to a better prior preparation promoting and supporting women-driven grass-rooted development.

Moreover, it must be emphasized that the results may encourage a possible new tendency of fostering sustainable financial inclusion, overcoming female discrimination relating crowdfunding platforms and microfinance. Finally, the empirical evidence that crowdfunded microloans are a suitable tool for financing basic economic activities in developing as well as developed countries confirms favouring female empowerment.

Conclusion and future research
Several studies (D'Espallier et al., 2011) argue that in microfinance women tend to outperform men in terms of repayment and that microloans are gender-sensitive, as women traditionally show better achievements than men (Wilde, 2017) related to the main microloan parameters. This women-friendly outlook contributes to making microfinance consistent with Sustainable Development Goal no. 5, promoting gender equality (OECD, 2018).

However, as illustrated by Salia et al. (2018), there are some drawbacks to women's microfinance empowerment, such as girl child labor, polygyny, conflicts with spouses, and the neglect of perceived female-domestic duties due to women's devotion to their business activities.

This research tries to help build bridges between the real microfinance world and the academic sphere by providing initiatives, which could improve the quality of life of individuals and local communities, promoting innovative forms of participation, and financial inclusion.

More research is needed for further exploration, specifically concerning the quality of microloans, which represents a key element for fostering sustainability and outreach. Further scrutiny may conveniently address the credit-scoring models in the microfinance sector when granting microloans to projects led by women. The results herewith presented could provide more

insights into these issues. Another area of investigation could concentrate on gender homophily between crowd-investors and micro-borrowers, looking for elective affinities, which strengthen "pink" social links.

Whereas in group lending each joint borrower faces the pressure (the moral liability) of the co-borrowers of the group, in individual loans the only pressure is the loss of the collateral. Thus, the ratio (relative importance) of "total men or total women to the size of the group" could make a difference in the behavior of a lending group in this sample. In conclusion therefore, it is recommended that the findings presented in this paper be borne in mind by future researchers when considering how to optimize the lending group's assortative mating according to different proportions of men and women. These insights may prove useful even for practitioners and regulators looking for innovative ways to foster sustainable financial inclusion, overcome female discrimination, and promote ESG-compliant equitable development.

Environmental issues represent a fashionable concern with a paradoxical link between the West and the Rest: whereas developed countries are the most polluting, much damage is concentrated in poorer areas. "Green and pink" microfinance can help to confront this problem, promoting women-driven grass-rooted development. Environmental-friendly microfinance, if properly monitored with ESG metrics, can attract crowdfunding resources from Western countries, fostering win-win strategies along value co-creating chains.

The main contribution of this paper is the study of microloans in the context of the SDGs promoted by the United Nations, in particular, the analysis of women empowerment as a way to favor development in African, Asian, and Latin American countries. The data have been obtained from Kiva, the fifth microfinance company operating in USA after Pacific Community Ventures, CDC Small Business Finance Corp., BRAC USA and Grameen America Inc. Starting from the available information on these microloans, it has been possible to consider all variables, which have a significant effect on the degree of repayment of these loans. As the frequency of repayment exhibits more than two categorical options, the multinomial logit regression has been used as the most reliable methodology for this study.

The value added by the present paper is the significant quality of microloans granted to women according to the frequency in repayment. In contrast to the existing works that analyze specific geographic areas and sectors of activity, these findings refer to countries in all parts of the world as the information has been extracted from a microloan institution operating in all developing areas and industries.

Data availability
The datasets analyzed during the current study are available from the corresponding author on reasonable request. These datasets were derived from the following public domain resource: https://www.kiva.org/build/data-snapshots.

Note
1 https://www.kiva.org/build/data-snapshots.

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Additional information

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