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Green finance instruments: Exploring minibonds issuance in Italy

Roy Cerqueti[1,2] | Catherine Deffains-Crapsky[2] | Saverio Storani[2,3]

[1]Department of Social and Economic Sciences, Sapienza University of Rome, Rome, Italy
[2]Université d'Angers, GRANEM. SFR CONFLUENCES, Angers, France
[3]Department of Economics and Law, University of Macerata, Macerata, Italy

Correspondence
Roy Cerqueti, Department of Social and Economic Sciences, Sapienza University of Rome, P.le Aldo Moro 5, I-00185 Rome, RM, Italy.
Email: roy.cerqueti@uniroma1.it

Abstract

In the context of green finance, minibonds play a crucial role. This financial instrument was introduced in 2012 as a valid alternative to bank credit for corporate financing, aimed mainly at small and medium-sized enterprises. Minibonds also represent useful support for implementing the ecological transaction agreed upon in COP 21, held in 2015 in Paris. Indeed, as of 2017, this instrument has been expanded from an environmental perspective by allowing the issuance of green minibonds. This article contributes to the debate on minibonds and the companies issuing them. Specifically, it proposes a cluster analysis approach for comparing the issuance level of minibonds in 2016 and the subsequent performances of the issuing companies in the triennium 2017–2019. Performance is divided into three macrocategories: profitability, productivity, and growth opportunities. The results suggest a nonlinear connection between the variables of interest, showing heterogeneous effects of minibonds on performance. However, the statistical data analysis seems to establish a positive relationship between minibonds' issuance level and companies' performance.

KEYWORDS
cluster analysis, Companies' performance, green finance, minibonds

1 | INTRODUCTION

Following the 2008 financial crisis and the increasing regulation introduced by the Basel Accords, companies sought alternative sources of financing. Suppose this task is more accessible for large companies and small and medium-sized enterprises (SMEs)[1] have found themselves in a difficult position. Italy, in particular, was one of the countries worst hit by both the financial crisis and the sovereign debt crisis that erupted in 2011 (European Commission, 2017).

Italy has a structural weakness due to an atavistic dependence of enterprises on bank credit. Sraffa (1922) observed that the banking system was an absolute necessity for the Italian industry. There is a lack of alternatives and a general reluctance to invest in movable goods. This scenario is confirmed by Visco—the President of the Bank of Italy—who, speaking at the Baffi Carefin Research Center (2019), reports much data regarding the dependence of Italian companies on the banking system.

Moreover, as explained in the reputation theory (Diamond, 1991), large enterprises have had time to increase their credit quality information and have easier access to public debt markets. On the

[1]In defining what SMEs are, the European Commission has implemented some criteria. A microenterprise refers to those companies with less than 10 employees and an annual turnover or annual balance sheet equal to or less than 2 million euros. Small enterprises have fewer than 50 employees and an annual turnover or annual balance sheet not exceeding 10 million euros. Medium-sized companies have a maximum of 250 employees and a turnover of less than or equal to 50 million euros or an annual balance sheet total of no more than 43 million euros.

contrary, many SMEs are characterized by an opacity of information that usually justifies the high dependence on banks (Fama, 1985).

To contrast this phenomenon and relaunch the economy, the Italian legislator in 2012 introduced the "Decreto Sviluppo",[2] allowing unlisted companies and SMEs to issue financial securities. Before entering the "Decreto Sviluppo" into force in the civil code, there were a series of restrictions that set stringent limits for issuing bonds. The civil code says, through art. 2412, a limit on the issue of bonds, providing that companies could issue bonds for a total sum not exceedingly twice the equity, resulting from the latest approved financial statements. This limit may be exceeded if professional investors subscribe to the excess bonds. This legal rule is applied not only to unlisted companies but also to listed ones. The "Decreto Sviluppo" removes those restrictions that prevented unlisted companies from issuing bonds.

Furthermore, the "Decreto Sviluppo" specifies how unlisted companies, other than banks and micro enterprises, must use regulated markets or multilateral trading systems. In the following years, the lawmaker introduced a series of facilities to encourage companies to use this alternative form of financing. Among such instruments, a relevant role is played by minibonds.

Minibonds play a crucial role as a green finance instrument. In this respect, in 2017, firms were allowed to issue securities aimed at environmental sustainability. This decision affected all Italian bond platforms according to the Paris agreements' guidelines in 2015.[3] Noteworthy is the Italian position, with 237 billion euros available for green investments thanks to the Green New Deal.[4] The minibonds market can certainly help achieve the targets set internationally regarding emissions. Indeed, they provide a vast win-win opportunity for energy modernization and evolution, especially for SMEs.

Minibonds, in this regard, have high development potential for Italian SMEs, as this market is in its early stages. In fact, up to 2021, only 23 issues have been registered for a counter value of 200 million euros. According to the Politecnico di Milano (2022), in 2022 could be reached a counter value issued of more than 7 billion euros with over 794 potential new issuers belonging to the eight sector most exposed to the energy transition: manufacturing, electricity and gas supply, water supply, construction, transport and storage, information and communication services, real estate, and agriculture.

However, much needs to be explored to understand the effects of such financing on the issuing companies' performance. A positive relationship between minibond issuance and performance would drive companies towards this instrument, favoring the country's economic and environmental efficiency. To investigate minibond phenomena, we carried out a cluster analysis based on the Voronoi tessellation (Voronoi, 1908b).

This proposal aims to compare those firms that belong to the same cluster in terms of performance and issuance level of minibonds. In this respect, cluster analysis seems to be particularly effective in providing a global study of the relationship between such financial quantities (in this respect, see the literature review in the next section). We also present a disaggregated analysis of the individual performance components.

Some significant results emerge from the analysis. On the one hand, there is a high degree of heterogeneity among the companies that make up the sample; if we consider the individual variables of interest, we find high levels of skewness and kurtosis. On the other hand, we note that some variables grow over time, especially in the macrocategory growth opportunity. The macrocategory profitability seems to be affected by outliers within it. The last macrocategory records interesting values in terms of absolute values. Looking at the results of the cluster is possible to notice a positioning of the companies within the clusters of reference that is somewhat fragmented, especially in the second approach analyzed.

The paper is organized as follows. Section 2 reports the main literature contributions and formalizes the research question. Section 3 describes the considered dataset and the employed variables. Section 4 contains the methodological instruments used for the analysis. Section 5 presents the findings of the analysis, along with a critical discussion of them. Section 6 concludes the paper.

2 | LITERATURE REVIEW AND RESEARCH QUESTION

Several scholars are addressing the issues of how to remedy climate change and generally improve sociality by acting on corporate accountability (see, e.g., Camoletto et al., 2022). In the same perspective, some authors illustrate how sustainable decisions can also be the most profitable ones (see, e.g., Dutta et al., 2012).

In this context, many scholars have investigated green bonds' effects on supply chain actors and—more specifically—on companies' performance.

According to Russo et al. (2021), who analyze the performance of green bonds, there are interesting theoretical and practical implications for issuers as well as investors and governments interested in green bonds.

Meo and Abd Karim (2022), in their study, consider the top 10 economies with the highest capitalization of green finance (green bonds). They employ quantile-on-quantile regression (QQR) to examine the asymmetric impact of green finance on CO_2 emissions. The findings show green finance's negative impact on CO_2 emissions in selected economies. Nevertheless, some scholars point out that

[2]Decreto Sviluppo is a law issued by the Italian government in 2012 to promote the Italian economic development.

[3]The Paris Agreement presents an action plan to limit global warming. It entered into force on November 4, 2016, following fulfillment of the condition of ratification by at least 55 countries representing at least 55% of global greenhouse gas emissions. All EU countries have ratified the agreement.

[4]The European New Green Deal will be a "strategy," that is, a series of different measures—including mainly new laws and investments—to be implemented over 30 years. At the moment, the Commission has planned the first 2 years, which are the most important for setting up a structure that can withstand such an ambitious project. The Green Deal will be financed with a huge amount of public and private money. Over the first 10 years, the aim will be to mobilize around 1000 billion euros to finance it, plus or minus 100 billion per year.

refinancing green bonds[5] leads to a lower decrease in CO_2 emissions (see, e.g., Fatica & Panzica, 2021).

Moreover, this instrument is part of those corporate strategies that benefit society, known as corporate social responsibility (CSR). In particular, the use of financial instruments to reduce emissions from individual activities falls into this field. The correct conceptualization, in our view, is the one provided by Van Marrewijk (2003), who suggests that it is the responsibility of an organization to maximize stakeholder wealth by taking care of the environment and society. In this regard, Bacinello et al. (2020) analyze whether CSR maturity patterns correlate with improved performance. They find that CSR maturity has an influence on sustainable investments, and it positively influences corporate performance. Therefore, the use of these models can support companies to create value, generate competitive advantages and promote superior performance. Interestingly, the study by Lin et al. (2020) analyses the impact of CSR on the performance of companies in the automotive sector. Their empirical results reveal a U-shaped relationship, identifying a threshold that reverses the effects of such a strategy.As said in the Introduction, we here analyze minibonds.

From a business strategy perspective, some scholars have recently investigated the main aspects related to the use of minibonds as an innovative financial instrument.

Altman et al. (2020) show that the average credit quality of minibonds issuers is higher than the average of SMEs in general. Therefore, they state that, in the Italian market, the reasons companies exploit this financing channel is not the lack of alternatives but rather a series of advantages such as access to the capital market, diversification, or reducing bank dependence.

Mietzner et al. (2018) analyze the minibond market in Germany. They highlight the possibility that low-quality firms can exploit this new financing channel to raise funds. It is because rating agencies cannot effectively distinguish the quality of firms. Therefore, high-quality firms tend to issue undervalued minibonds to signal their high quality.

Ongena et al. (2020) propose an interesting study on behalf of the European Central Bank (ECB). The authors came to interesting conclusions. First, they state that diversification of funding sources allows firms to reduce hold-up effects in the relationship between banks and firms, increasing bargaining power towards banks. In addition, the use of minibonds minimizes companies' dependence on the banking system, although the level of financial debt increases. This suggests that firms tend to replace bank debt with market-based debt, thus keeping the cost of debt unchanged. Finally, they point out that using this new financial instrument increases total assets and fixed assets.

However, these scholars have overlooked an aspect that has become increasingly important in recent years. We refer to the green opportunities associated with this financial instrument, as confirmed by Politecnico di Milano (2022).

Therefore, this paper wants to contribute to filling this gap by using a cluster analysis approach based on Voronoi tessellation (see Voronoi, 1908a, 1908b). This statistical tool is based on identifying specific reference points called centroids. Each centroid induces a cluster collecting elements with a short distance to it than the other centroids.

For clustering data, we introduce different versions of the weighted Euclidean distance. In so doing, we can detect information on the variables of interest, hence gaining relevant insights into what the issuance of minibonds entails in terms of performance.

Due to its versatility, this methodology has been applied in many scientific fields, such as neuroscience (see Duyckaerts & Godefroy, 2000), astrophysics (see Ramella et al., 2001), and material science (Gadomski & Kruszewska, 2012). In the past, some scholars have applied this methodology to economic topics, including Liu et al. (2009), Yushimito et al. (2012), Vaz et al. (2014), and Ausloos et al. (2018).

The other hand, cluster analysis is a classical device for quantitative analysis in several contexts of applied science. We mention the breakthrough contributions of Driver and Kroeber (1932) in anthropology, Zubin (1938), Tryon (1939), and Cattell (1943) in psychology.

Nevertheless, cluster analysis is generally used in economics fields. Ausloos et al. (2018) use cluster analysis to relate innovation strategies by companies to the performance of companies in times of crisis. The pioneer who inspired this type of report is Pavitt (1984); he was the first to classify companies according to their innovation activity using an inductive methodological approach. More generally, our analysis seems to align with much of the literature that deals with firm performance using cluster analysis. Indeed, this technique can be used to analyze the performance of countries, industrial districts or at the firm level (see Gligor & Ausloos, 2007, 2008a, 2008b; Zahra & Covin, 1994). Others use cluster analysis to investigate how North American and European firms converge in terms of performance and governance, such as Vâlsan and Druic (2020). Other scholars apply cluster analysis in the context of covenants of bonds issued by firms or in the IPO industry by studying the effects and impact on performance, respectively or also to figure out the IPO's price (see Jain & Kini, 2006; Reisel, 2014; Zhou & Zhang, 2005).Cluster analysis is applied in finance or management context too. We can mention Ercan and Sayaseng (2016), who used cluster analysis aims to conduct an exploratory study on the European banking sector. The study determined similar patterns based on banking sector relationships and changes in cluster groups affected by the financial crisis. Pour and Asarian (2018) investigated the strategy performance relationships and knowledge management (KM) performance relationships. Tola et al. (2008) considered the problem of the statistical uncertainty of the correlation matrix in the optimization of a financial portfolio. They showed that the use of clustering algorithms could improve the reliability of the portfolio in terms of the ratio between predicted and realized risk.

This said, to the best of our knowledge, this is the first study that advances an investigation of firms' performance following the issuance of minibonds in a cluster analysis context.

[5]Refinancing green bonds are issued to refinance existing green projects that were previously presumably financed with regular bonds rather than new projects

We used this wide literature to develop and build our paper, focusing our goal on the following research question:

RQ: What is the effect of the issuance of minibonds on firms' performance?

The Voronoi-based cluster analysis approach allows to provide a response to RQ.

3 | DATA

This analysis is carried out from the list of companies that issued minibonds in 2016. The entire population of issuing firms is extrapolated from the annual report on minibonds by Politecnico di Milano (2017).[6] In 2016, the Politecnico di Milano reported a number of issuances equal to 118. However, some firms decided to issue minibonds several times during the year. Therefore, to make the analysis consistent, we have aggregated these multiple issuances at an individual company level. At the end of this pre-treatment phase, the number of issuing enterprises is 100. In the study population, there are small, medium and large enterprises. The firms' data have been collected from AIDA database,[7] from which the annual financial statements published by the same firms can be checked and compared. We consider the time frame from 2016 to 2019, which is 4 years.

The year 2016 is our base year, from which the cluster analysis will be developed. It will be a reference to assign the relative issuance level of minibonds. Through the amount issued by each firm, we will be able to derive a relative one by eliminating possible distortions due to size inequality. Following this logic, we divided the amount issued by each firm by their total assets.

The 3-year period 2017–2019 is the time span—after issuance—related to the performance of issuing firms. These performances are measured through three growth variations that constitute the group called *Growth Opportunity*—namely, total assets variations, fixed assets variations, and sales variations; three indicators of *Profitability*—namely Return on Investment (*ROI*), Return on Sales (*ROS*), and *EBITDA* margin (earnings before interest depreciation and amortization divided by sales); two indicators of *Productivity* (or efficiency), namely assets turnover and sales per employee.

These data have been carefully handled, avoiding losing too much information and ensuring the empirical tractability of the problem. Specifically, in this research, the variables that make up the performance of firms over the 3-year period following the issue were aggregated through a simple arithmetic mean. By searching for these variables in the AIDA database, the total number of companies available for the analysis is reduced to 66. In the second phase of the study, we cleaned the data from those companies that issued minibonds also in the triennium following our base year. This allows us to manage side effects on the performance that any issuance in the period 2017–2019 could cause to those companies that opted for this strategy. In doing so, the second step of the analysis considers 40 companies.

3.1 | Variables

In this section, we introduce and discuss the variables used in the paper. The first variable we identify is the issuance level of minibonds for the year 2016; the other eight variables are related to the performance of the companies in the years following the issuance. The relative issuance level remains the same for all analyses we perform, while the variables collected over the triennium 2017–2019 are aggregated. The performance variables are aggregated because they give us an overview of what happens in the 3 years following the emissions, without taking into account time trends and evolutive behaviors—that are far from the target of the present paper. The average is performed over the three yearly values of the considered variables for the triennium 2017–2019.The following notations have been used.

- *RLA* represents the relative issuance level of minibonds by firms in 2016, given by the ratio between the amount issued in 2016 and total assets in 2016. *RLA* is used as a notation.
- *TAVyy* is total asset variation in 20yy. $\widetilde{TAV}$ is the average total assets variation over 3 years: [2017–2019].
- *FAVyy* is the fixed asset variation in 20yy. $\widetilde{FAV}$ is the average fixed assets variation over 3 years: [2017–2019].
- *SAVyy* stands for sales variations in the year 20yy. $\widetilde{SAV}$ represents the average sales variations in the triennium [2017–2019].
- *ROIyy* is the *ROI* in the year 20yy. $\widetilde{ROI}$ is the average *ROI* over 3 years: [2017–2019].
- *ROSyy* is the *ROS* in the year 20yy. $\widetilde{ROS}$ is the average *ROS* over 3 years: [2017–2019].
- *MEBITDAyy* is the *EBITDA* margin in the year 20yy. $\widetilde{MEBITDA}$ is the average *EBITDA* margin over 3 years: [2017–2019].
- *ATOyy* represents the assets turnover in the year 20yy. $\widetilde{ATO}$ represents the average assets turnover in the period [2017–2019].
- *S/Eyy* stands for sales per employee in the year 20yy. $\widetilde{S/E}$ represents the average sales per employee in the period [2017–2019]

We collect the averaged variables related to performance in the set:

$$P = \left\{ \widetilde{TAV}, \widetilde{FAV}, \widetilde{SAV}, \widetilde{ROI}, \widetilde{ROS}, \widetilde{MEBITDA}, \widetilde{ATO}, \widetilde{S/E} \right\}.$$

We can consider $P = P_{GO} \cup P_{Prof} \cup P_{Prod}$, being $P_{GO}, P_{Prof}, P_{Prod}$ the subsets of P related to Growth Opportunity, Profitability and Productivity, respectively, that is:

[6] According to the observatory of the Politecnico di Milano in 2016, there were 106 issues for 88 issuing companies. Through personal communication with Giancarlo Giudici—the Scientific Director of the Mini-Bond Observatory—we have updated the list of issues and issuing companies in 2016. In addition, we got extra-informations as interest rate, the amount issued and maturity.

[7] AIDA is a database owned by Bureau Van Dijk and contains comprehensive information on companies in Italy.

$P_{GO} = \left\{ \tilde{TAV}, \tilde{FAV}, \tilde{SAV} \right\}$; $P_{Prof} = \left\{ \tilde{ROI}, \tilde{ROS}, \tilde{MEBITDA} \right\}$; $P_{Prod} = \left\{ \tilde{ATO}, \tilde{S/E} \right\}$.

4 | METHODOLOGY

The clustering procedure we adopted is based on the Voronoi tessellation with an asymmetric generalization of the Euclidean distance.[8] We used this methodology taking into account our specific setting. In fact, our work aims to provide intuitive results by considering a selection of pre-fixed centroids.

This Voronoi-based cluster analysis allows for easy reading of the results while retaining high levels of information. Indeed, an a priori selection of the centroids allows us to obtain information on the elements belonging to the individual clusters. In our specific case, we have a clear view of the issuance level of minibonds and the performance of companies. The combination of these perspectives provides a comprehensive description of the universe of companies in terms of the interrelation between minibond issuance levels and performance.

We start from a reference year in which minibond issues are recorded, specifically, 2016. Starting from this base year, we explore the connection between the issuance level of minibonds and the performance of firms in the triennium 2017–2019. The performance and the amount allocated have been collected from empirical data in our context. Performance is captured by variables that can be grouped into three macrocategories. In contrast, the issuance level of minibonds is only relativized according to total assets. This study also provides another essential key for understanding two different approaches with which centroids have been defined. We performed two Voronoi tessellation analyses in which the selected centroids followed two alternative paths. In the first case, centroids are uniformly distributed over the unitary interval [0, 1]. In the second case, they are chosen according to the distribution of selected variables.

The main difference between the two approaches stems from the selection of centroids; in the equidistributed case, the analysis conducted could be influenced by some anomalous firms. As a result, distortions in cluster assignment may occur. Indeed, the presence of an outlier (Bioera S.p.A.) pushes the remaining firms into adjacent clusters. On the contrary, this does not happen when centroids are selected based on the variables of interest distribution.

The final aim is to compare companies with respect to their cluster and placement. The clustering procedure is repeated four times: twice for the relative amount variable, observed for the year of issuance 2016, and twice more for the variables expressing the performance of the firms, averaged over the 3 years following the issuance 2017–2019.

The analysis is implemented in both cases of the overall sample of 66 companies as well as in the subcase of the 40 companies issuing minibonds only in 2016. We label the number of considered companies by J—so that $J = 40$ or $= 66$, depending on the case.

In order to avoid scale effects and to make the study consistent, the variables of interest were normalized with respect to their range of variation. Formally, for each company j, with $j = 1, \ldots, J$, we define the normalized variable associated to j as follows:

$$\overline{x_j} = \frac{\tilde{x}_j - m_x}{M_x - m_x} \tag{1}$$

where $\tilde{x}_j$ is the averaged quantity of interest among the eighth performance variable in P and the relative issuance level of RLA for j-th company and $m_x = \min_{j=1,\ldots,J} \tilde{x}_j, M_x = \max_{j=1,\ldots,J} \tilde{x}_j$.

The clustering procedures were then applied for the relative amount variable RLA and for the elements of the set P. All variables were normalized according to Equation (1).

The centroids of the Voronoi tessellation are all positive numbers and will be denoted by $\{\boldsymbol{\Phi}_h\}_{h=1}^{H}$ and $\{\boldsymbol{\psi}_k\}_{k=1}^{K}$ where H and K are opportunely chosen integers, for both cases of the relative amount and performance variables, respectively. Clearly, centroids depend generally on the variables $\overline{x_j}$'s. Such a dependence is omitted when not needed. The number of clusters and the respective distances between it and the enterprises may vary depending on the technique of centroid selection.

We now introduce the concept of weighted and unweighted Euclidean distance for the proposed generalized Voronoi tessellation. Specifically, for the variable RLA, no weight is needed, so the distance is defined from the h-th centroid is defined as follows:

$$d_{RLA}(j, \phi_h) = \left(RLA_j - \phi_h\right)^2 \tag{2}$$

Analogously, for the variables in P, we built the Euclidean distance, but in this case, we have weighted distance:

$$d_P(j, \psi_k) = \sum_{x \in P} \beta_x \left(\overline{x_j} - \psi_k\right)^2 \tag{3}$$

for each centroid ψ_k and where the β's are the non-negative weights of the norm, so that: $\sum_{x \in P} \beta_x = 1$.

The β's let the Euclidean distance measure (3) used for clustering be of weighted type. This means that the variables are not treated as equally contributing to the distance—as in the standard Euclidean case—but play different roles in building the clustering of the available data. The choice of the β's leads to the identification of some scenarios (see the next section).The distances in Equation (3) is in [0, 1] by construction.

By definition, we have that $0 \le d_{RLA}(j, \phi_h), d_P(j, \psi_k) \ge 1$, for each company j and centroid ϕ_h and ψ_k.

We denote the generic Voronoi cells for RLA and performance by V'_h and V''_k, respectively, where:

$$V'_h = \{ j = 1, \ldots, 66 | d_{RLA}(j, \phi_h) < d_{RLA}(j, \phi_{\overline{h}}), \forall \overline{h} \neq h \}$$

$$V''_k = \{ j = 1, \ldots, 66 | d_P(j, \psi_k) < d_P(j, \psi_{\overline{k}}), \forall \overline{k} \neq k \}$$

Any companies j belong only to one cell of type V'_h and only to the one type V''_k.

[8]It is important to clarify a relevant point. The formulas in this section refer to the sample with 66 enterprises; we also replied to the sample with 40 enterprises.

4.1 | Specifications of the cluster analysis

It is important to anticipate and emphasizes that the cardinality of Voronoi regions may change as the centroids change. Indeed, the presence of the j-th firm in a specific region gives us information about the relative issuance level of minibonds and the performance of j.

As anticipated above, the centroid selection technique followed two different paths. By themselves, these different techniques generate two distinct clusterizations. Moreover, we implemented each Voronoi cluster analysis with different scenarios. The differentiation between scenarios and selection of centroids provides us with a broader overview of the situation.

Thus, we have five scenarios with the centroids selected according to a uniform distribution, as many in which the variables' quartiles are selected as individual coordinates in space. The main difference, therefore, is the selection of the centroids. This is due to the fact that in the multidimensional (eight dimensions, one for each variable) performance plan and the one-dimensional (a single variable) plan in the first case, we will have the same coordinate on each axis; in the second case instead, each centroid is calibrated on the specificities of the variables that compose it.

For comparison purposes, we set $H=K$. The analyzed cases are now listed.

For the case of the centroids uniformly distributed (denoted by an index U):

I_U $H=K=4, \{\boldsymbol{\Phi}_h\}_{h=1}^{H}=\{\boldsymbol{\psi}_k\}_{k=1}^{K}=\{1/5, 2/5, 3/5, 4/5\}$. We give unitary weight to the subset P_{GO} and variables in such a set are taken uniformly weighted so that $\beta_x = 1/|P_{GO}| = 1/3$, when $x \in P_{GO}$, while $\beta_x = 0$, when $x \notin P_{GO}$.

II_U $H=K=4, \{\boldsymbol{\Phi}_h\}_{h=1}^{H}=\{\boldsymbol{\psi}_k\}_{k=1}^{K}=\{1/5, 2/5, 3/5, 4/5\}$. As in the previous case, we give unitary weight to P and variables in such a set are taken uniformly weighted so that $\beta_x = 1/|P_{Prof}| = 1/3$, when $x \in P_{Prof}$, while $\beta_x = 0$ otherwise.

III_U $H=K=4, \{\boldsymbol{\Phi}_h\}_{h=1}^{H}=\{\boldsymbol{\psi}_k\}_{k=1}^{K}=\{1/5, 2/5, 3/5, 4/5\}$. Also in this case, we give unitary weight to the subset P_{Prod} and variables in such a set are taken uniformly weighted so that $\beta_x = 1/|P_{Prod}| = 1/2$, when $x \in P_{Prod}$, while$\beta_x = 0$, when $\beta_x = 0$ otherwise

IV_U $H=K=4, \{\boldsymbol{\Phi}_h\}_{h=1}^{H}=\{\boldsymbol{\psi}_k\}_{k=1}^{K}=\{1/5, 2/5, 3/5, 4/5\}.\beta_x = 1/|P| = 1/8$, for each $x \in P$.

V_U $H=K=4, \{\boldsymbol{\Phi}_h\}_{h=1}^{H}=\{\boldsymbol{\psi}_k\}_{k=1}^{K}=\{1/5, 2/5, 3/5, 4/5\}$. We assign the same weight to the macrocategories of firms' performance (1/3 for growth opportunity, profitability and productivity). We give to each variable within each category, so that $\beta_x = 1/|P_{GO}| \times 1/3 = 1/9$, when $x \in P_{GO}$, $\beta_x = 1/|P_{Prof}| \times 1/3 = 1/9$, when $x \in P_{Prof}$ and $\beta_x = 1/|P_{Prod}| \times 1/2 = 1/6$, when $x \in P_{Prod}$.

For the case of quartiles (denoted by an index Q), we consider the same weights of the scenarios $I-V$. We have:

IQ $H=K=3, \{\Phi_h\}_{h=1}^{H}=\{\psi_k\}_{k=1}^{K}=\left\{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\right\}$, *being* $Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}$ *the first, the second and third quartiles of the distribution of the variableof interest* x*, respectively. The weights* β*'s are taken as in IU.*

IIQ $H=K=3, \{\Phi_h\}_{h=1}^{H}=\{\psi_k\}_{k=1}^{K}=\left\{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\right\}$ *The* β*'s are taken as in IIU.*

IIIQ $H=K=3, \{\Phi_h\}_{h=1}^{H}=\{\psi_k\}_{k=1}^{K}=\left\{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\right\}$*. The* β*'s are taken as in IIIU.*

IVQ $H=K=3, \{\Phi_h\}_{h=1}^{H}=\{\psi_k\}_{k=1}^{K}=\left\{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\right\}$*, and the* β*'s are taken as in IVU.*

VQ $H=K=3, \{\Phi_h\}_{h=1}^{H}=\{\psi_k\}_{k=1}^{K}=\left\{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\right\}$*. The* β*'s are those in VU.*

As can be seen, two different approaches are carried out to select centroids. Each process examines five different scenarios. In both approaches, the variable *RLA* remains identical in all scenarios, as it has only one component within it.

The first approach has five different scenarios (case of uniformly distributed centroids). It is because we wanted to investigate each macrocategory's effects on the assignment of clusters. In the first scenario, we assign an identical weight to the variables set in P_{GO} while assigning zero weight to the other variables that complete P, that is, P_{Prof} and P_{Prod}. In this way, we want to investigate the effects of the variable *RLA* on the selected macrocategory. In scenarios II_U and III_U, we proceed similarly to scenario I_U, but this time the effects of *RLA* are explored for P_{Prof} and P_{Prod} respectively. In the IV_U and V_U scenarios, we apply weights to all components of P. Specifically, in the IV_U scenario, the weights are equally distributed among all the variables that compose P. In the V_U scenario, on the contrary, it is the macrocategories P_{GO}, P_{Prof} and P_{Prod} that have an equally distributed weight.

In the second approach—that is, in the case where the distribution of variables is considered—we run the same scenarios just described above. In particular, the main difference consist in the selection of centroids, which is not done a priori, but rather by observing the individual distributions of the variables that compose $P = \left\{\tilde{TAV}, \tilde{FAV}, \tilde{SAV}, \tilde{ROI}, \tilde{ROS}, \tilde{MEBITDA}, \tilde{ATO}, \tilde{S/E}\right\}$. In this way, the multidimensional space in which the centroids are positioned will depend on the quartiles $Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}$ of each variable x.

The difference between uniformly distributed and quartiles-based centroids can be obtained by definition. Indeed, in the former case, the presence of outliers might lead to "corner clusters"—those with the largest and the smallest values—quite empty. Differently, the definition of clusters through quartiles guarantees clusters having about the same number of elements, reducing the effects of the outliers.

5 | RESULTS AND DISCUSSIONS

In the discussion, we refer simply to *TAV*, *FAV*, *SAV*, *ROI*, *ROS*, *MEBITDA*, *ATO*, S/E for simplicity, to be intended that such variables are averaged and—when needed—normalized.

As we will see below, our analysis leads us to answer our research question *RQ*. In fact, the overlaps among clusters allow us to make hypotheses on how the relative issuance level of minibonds may or may not influence companies' performance. The choice of 3 years

TABLE 1 Main statistical indicators of the relative level of amount and performance variables.

	Minibonds	Performance							
		Growth			Profitability	Productivity			
Descriptive Statistics	*RLA*	*TAV*	*FAV*	*SAV*	*ROI*	*ROS*	*MEBITDA*	*S/E*	*ATO*
Mean	0.11	0.08	0.28	0.87	0.07	−0.98	−0.51	513.48	68.87
Standard deviation	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
Mean/standard deviation	1.06	0.51	0.26	0.19	0.63	−0.10	−0.11	0.61	1.67
Min	0.00	−0.26	−0.43	−0.49	−0.29	−78.40	−37.75	13.87	0.18
Max	0.56	0.67	8.09	35.43	0.54	14.00	0.82	5921.00	168.06
Q1	0.04	0.00	−0.00	0.00	0.03	−0.00	0.04	187.62	40.30
Median	0.09	0.06	0.07	0.07	0.07	0.02	0.10	298.84	60.95
Q3	0.14	0.14	0.18	0.16	0.09	0.07	0.20	458.83	103.10
Skewness	2.08	1.24	5.82	7.07	0.72	−7.51	−7.86	4.75	0.31
Kurtosis	8.38	6.57	39.25	54.06	10.41	60.11	63.21	28.79	2.25

Note: Total assets, fixed assets, sales growth, *ROI*, *ROS* must be multiplied to 100 if we want to see the percentage variation.

following the issue provides a sufficiently wide period to test the effects of issuances on performance. Although different scenarios and approaches are performed, the analysis relationships between the relative issuance level of minibonds and performance is not always straightforward.

As a premise, Table 1 shows the main descriptive statistics of the variables of interest.

The distribution of the *RLA* turns out to be both positively skewed and leptokurtic. It means that the mean lies to the right of the peak, its tails are relatively thick, and the shape is very sharp. This suggests a significant heterogeneity in the sample of firms used. This means that firms have undertaken very different policies regarding the issuance level of minibonds. Some firms issue a high issuance level of minibonds, but most prefer a more cautious approach as this instrument is a new method of financing. Nevertheless, our average is a good indicator as the standard deviation is small.

Again, regarding the growth opportunity macrocategory, we observe a distribution far from the normal one. As in the previous case, we observe positive asymmetric and leptokurtic distributions for all the variables that compose it (total assets variation, fixed assets variation and sales growth). Specifically, in contrast to the relative amount, we notice a considerable standard deviation that exceeds the mean by a significant margin for the three components. Although the averages are positive, it can be seen from the minimum and maximum values that there are extreme values within the sample that can create distortions. Despite the high variability of the growth opportunity components, the observation of the quartiles suggests that the issuing firms in the following 3 years, on average, had good growth in terms of total fixed assets and sales growth, in fact, less than 25% of the firms have a growth close to or below zero on average.

As far as the profitability macrocategory is concerned, we observe one of the different distributions between its components. *ROI* seems close to a normal distribution even if it is rather sharp and with heavy tails, while *ROS* and *MEBITDA* are strongly and negatively asymmetric. This might be due to the substantial variability to which the components of this macrocategory are subject. In fact, if we look at the averages and standard deviations, we notice a marked difference between the two. It means that the average of these variables is not a good summary measure. In this respect, we could look at the position indices, which give a clear overview of the situation. We observe that less than 25% of the firms record values close to or below zero for all three profitability variables of interest. From this, we can deduce the presence of companies that, on average, in the 3 years following the issue, find themselves in difficulty or perhaps try to finance themselves on the markets or through non-banking channels because they are not creditworthy by the standards of classic channels (see Denis & Mihov, 2003; Diamond, 1991; Mietzner et al., 2018; Rajan, 1992). For the following macrocategory, therefore, a strong heterogeneity of the sample is also recorded.

Finally, looking at the productivity macrocategory, we find a markedly positive asymmetry with a notable leptokurtosis for the sales per employee component. On the contrary, the asset turnover component is close to a normal distribution. Moreover, the latter variable has a relatively low standard deviation than the former. In general, this macrocategory provides information in line with the previous ones, that is, a high sample heterogeneity. Looking at the minimum and maximum values and indices of position, we find companies that are highly different in terms of sales per employee and asset turnover.

To provide comments on the results, first of all, we have to specify that in all scenarios (I_U–V_U and I_Q–V_Q), the first cluster is associated with the smallest centroid and in increasing ways, the last one is associated with the highest centroid value. Furthermore, in all scenarios, the relative level of the amount variable does not change since the issuance level of minibonds is the only constituent variable. On the contrary, if we consider our macrocategories (P_{GO}, P_{Prof}, and P_{Prod}), we adopt weighting criteria that vary from one scenario to another. Finally, we refer hereafter to "pair of clusters *i*–*j* as the overlap of cluster *i* in *RLA* and cluster *j* in performance."

		Performance				
		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
I_U Relative amount	Cluster 1	53	1	1	0	55
	Cluster 2	6	0	0	0	6
	Cluster 3	2	1	0	0	3
	Cluster 4	1	1	0	0	2
	Total	62	3	1	0	66
II_U Relative amount	Cluster 1	1	0	3	51	55
	Cluster 2	0	0	0	6	6
	Cluster 3	0	0	0	3	3
	Cluster 4	0	0	0	2	2
	Total	1	0	3	62	66
III_U Relative amount	Cluster 1	37	15	3	0	55
	Cluster 2	4	2	0	0	6
	Cluster 3	1	2	0	0	3
	Cluster 4	2	0	0	0	2
	Total	44	19	3	0	66
IV_U Relative amount	Cluster 1	6	48	1	0	55
	Cluster 2	0	6	0	0	6
	Cluster 3	0	2	1	0	3
	Cluster 4	0	2	0	0	2
	Total	6	58	2	0	66
V_U Relative amount	Cluster 1	2	50	3	0	55
	Cluster 2	0	6	0	0	6
	Cluster 3	0	2	1	0	3
	Cluster 4	0	2	0	0	2
	Total	2	60	4	0	66

TABLE 2 Joint cluster analysis and clusters overlap for the relative level of amount and performance: the case of uniformly distributed centroids. Entire sample of 66 companies.

Tables 2 and 6 show the distribution of companies among the clusters in the case of centroids uniformly distributed. The tables report results concerning the entire and small sample, 66 and 40 companies, respectively.

In I_U, we assign a unit weight to the macrocategory growth opportunity. It allows us to see the possible effects of issuing minibonds in the described context. The variables of interest that compose growth opportunities are total assets variation, fixed assets variation and sales growth. Therefore, this scenario suggests whether a certain issuance level somehow affects the growth capacity. As far as the relative level of the amount is concerned, we see that most of the firms are positioned in cluster 1—that is, the one associated with the lowest centroid—and a limited number of firms are positioned within the others. Similarly, when considering growth opportunities, we see that almost all the firms end up in cluster 1. We also notice that no firm ends up in cluster 4 (only one in the small sample)—that is, no firms are associated with the largest centroid. The information we can extract from our first scenario is the following. Firms issuing low minibonds levels are placed in clusters with low growth opportunities; therefore, we cannot state an evident positive relationship between the issuance level of minibonds and the firms' growth. Moreover, the number of firms in cluster 1 of the growth opportunity is higher than in cluster 1 of the relative amount level. It is true in both entire and small samples. This outcome suggests that even some firms that used to issue more minibonds in relative terms do not significantly impact their growth opportunity.

In II_U, results change. Indeed, now the unit weight is assigned to the profitability macrocategory. We note a significant change from the previous case. The firms fall *en bloc* into cluster 4 of performance. It allows us to assume that this innovative financial instrument significantly drives firms to improve their profitability ratios. However, if we combine this result with the previous descriptive statistics, we could assume the presence of a firm that pushes all the others towards the cluster with a higher centroid. Thus, we cannot confidently state that the issuance level of minibonds can cause companies to improve their profitability ratios. Indeed, we suppose the outlier's presence pushes firms' performance into cluster 4. We found this outcome in both samples, which means that this company did not issue exclusively in 2016.

III_U considers the productivity macrocategory with unit weight. In this case, the distribution of performance clusters is more fragmented. We note that cluster 4 is empty, and the highest concentration is in

TABLE 3 Joint cluster analysis and clusters overlap for the relative level of amount and performance: the case of centroids according to variable distributions. Entire sample of 66 companies.

		Performance			
		Cluster 1	Cluster 2	Cluster 3	Total
I_Q Relative amount	Cluster 1	17	6	1	24
	Cluster 2	9	3	8	20
	Cluster 3	2	6	14	22
	Total	28	15	23	66
II_Q Relative amount	Cluster 1	12	3	9	24
	Cluster 2	8	6	6	20
	Cluster 3	6	4	12	22
	Total	26	13	27	66
III_Q Relative amount	Cluster 1	6	6	12	24
	Cluster 2	11	5	4	20
	Cluster 3	7	7	8	22
	Total	24	18	24	66
IV_Q Relative amount	Cluster 1	7	5	12	24
	Cluster 2	10	6	4	20
	Cluster 3	3	10	9	22
	Total	20	21	25	66
V_Q Relative amount	Cluster 1	10	3	11	24
	Cluster 2	9	7	4	20
	Cluster 3	3	10	9	22
	Total	22	20	24	66

the first cluster. An additional peculiarity of this scenario is that we have more firms in the pair of clusters 1–1, that is, in the one where we have a limited relative issuance level of minibonds associated with low performance. We mention the pair of clusters 1–2. Here we see that a fair number of firms, 15 and 9, fall into the second performance cluster. Thus, we can assume that the choice to issue somehow induces firms to improve their efficiency.

Finally, we deal with scenarios IV_U and V_U . We used a weight equidistributed among the variables of interest and equidistributed among the macrocategories. This small difference means that the weights assigned to growth opportunity, profitability, and productivity to measure performance slightly emphasize the variability. Results in these two different scenarios are pretty similar. Cluster 2 of the performance is the most crowded. This result is relevant; indeed, crossing the clusters, we find that the highest concentration of firms occurs for a low relative amount level (cluster 1) and a medium performance level (cluster 2); moreover, cluster 4 is empty for both *RLA* and *P*. It suggests that firms that decide to issue minibonds perform discretely in the 3 years following issuance. Therefore, scenarios IV_U and V_U underline for the first time the presence of a positive relationship between *RLA* and *P*. This is also true for the small sample, that is, the representative sample of companies that issued minibonds exclusively in 2016.Tables 3 and 7 show the distribution of companies among the clusters in the case of centroids chosen according to variable distributions. The results obtained with the two samples, entire and small, of companies are superimposable in terms of interpretations.

We use a different approach in the following scenarios to avoid possible distortions in the previous cases. The distributions of the variables of interest condition the selection of centroids in the space. One of the main problems this approach solves is undoubtedly that of outliers. Indeed, some firms may present anomalous values concerning the issuance level of minibonds and performance, pushing the majority of the companies in a cluster when normalizing the variables according to Equation (1). In this approach, firms are divided according to their position to avoid such an effect. The three reference quartiles (25%, 50%, and 75%) have been used. In so doing, we obtain three clusters. The considered scenarios are five, as in the previous approach.

In I_Q, we notice a higher concentration in the pairs of clusters 1-1 and 3-3. The relative quantity emitted might influence the growth capacity of firms. Thus, we find a first important difference with previous empirical data. This first result leads us to think that a positive relationship exists between *RLA* and P_{GO}. Despite this, we find a not straightforward link; in fact, the arrangement of firms within clusters seems rather heterogeneous.

In II_Q, we obtain similar outcomes described above. Indeed, although cluster pairs 1-1 and 3-3 are the most crowded, the distribution between the other cluster pairs does not show a clear pattern. However, it is important to emphasize the difference between this case and uniformly distributed centroids. In fact, the effect of outliers is removed by selecting quartiles as centroids. Therefore, even in this scenario, although we can detect a slight positive relationship

TABLE 4 Statistical analysis of the relative level of amount and performance variables within clusters: the case of uniformly distributed centroids. Entire sample of 66 companies.

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Entire Sample		Mean	0.11	0.08	0.28	0.87	0.07	−0.98	−0.51	513.48	68.87
		Standard deviation	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
		Mean/standard deviation	1.06	0.51	0.26	0.19	0.63	−0.10	−0.11	0.61	1.67
Relative amount I_U–V_U	First cluster	Mean	0.07	0.05	0.24	0.78	0.05	−1.18	−0.64	513.68	67.48
		Standard deviation	0.05	0.12	1.14	4.80	0.09	10.78	5.11	881.58	41.48
		Mean/standard deviation	1.56	0.40	0.21	0.16	0.61	−0.11	−0.13	0.58	1.63
	Second cluster	Mean	0.20	0.18	0.77	0.09	0.11	0.05	0.16	294.14	78.12
		Standard deviation	0.02	0.11	1.29	0.13	0.09	0.09	0.13	167.42	35.79
		Mean/standard deviation	9.92	1.68	0.59	0.68	1.19	0.58	1.21	1.76	2.18
	Third cluster	Mean	0.33	0.28	0.19	3.19	0.25	0.24	0.39	1036.04	84.18
		Standard deviation	0.03	0.28	0.19	4.98	0.25	0.22	0.29	1014.46	63.84
		Mean/standard deviation	10.07	1.00	0.99	0.64	1.01	1.09	1.36	1.02	1.32
	Fourth cluster	Mean	0.49	0.35	0.11	2.08	−0.00	−0.37	−0.15	382.08	56.29
		Standard deviation	0.10	0.45	0.31	2.81	0.02	0.22	0.21	327.06	32.29
		Mean/standard deviation	4.79	0.79	0.36	0.74	−0.23	−1.68	−0.69	1.17	1.74
Performance I_U	First cluster	Mean	0.10	0.06	0.16	0.27	0.06	−1.05	−0.55	519.59	68.92
		Standard deviation	0.10	0.12	0.55	1.25	0.09	10.15	4.82	861.27	41.18
		Mean/standard deviation	1.06	0.48	0.29	0.22	0.67	−0.10	−0.11	0.60	1.67
	Second cluster	Mean	0.28	0.46	2.94	1.59	0.20	0.03	0.08	483.77	83.87
		Standard deviation	0.15	0.30	4.46	2.16	0.30	0.23	0.35	196.51	42.96
		Mean/standard deviation	1.83	1.52	0.66	0.74	0.66	0.11	0.24	2.46	1.95
	Third cluster	Mean	0.07	0.26	0.11	35.43	0.05	−0.10	0.21	223.31	20.73
		Standard deviation									
		Mean/standard deviation									
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
Performance II_U	First cluster	Mean	0.11	−0.20	−0.14	0.18	−0.13	−78.40	−37.75	13.87	0.49
		Standard deviation									
		Mean/standard deviation									
	Second cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
	Third cluster	Mean	0.07	−0.04	0.01	0.22	−0.20	−0.85	−0.57	291.01	68.21
		Standard deviation	0.04	0.31	0.16	0.53	0.08	0.58	0.54	213.33	40.17
		Mean/standard deviation	1.82	−0.12	0.05	0.41	−2.60	−1.47	−1.07	1.36	1.70

TABLE 4 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
	Fourth cluster	Mean	0.11	0.09	0.31	0.91	0.08	0.26	0.10	532.30	70.00
		Standard deviation	0.11	0.14	1.14	4.65	0.08	1.79	0.34	857.99	40.92
		Mean/standard deviation	1.05	0.63	0.27	0.20	0.98	0.15	0.28	0.62	1.71
Performance III_U	First cluster	Mean	0.11	0.07	0.38	1.14	0.04	−1.46	−0.81	361.54	45.78
		Standard deviation	0.11	0.15	1.34	5.49	0.08	12.06	5.72	361.31	24.26
		Mean/standard deviation	1.05	0.46	0.28	0.21	0.50	−0.12	−0.14	1.00	1.89
	Second cluster	Mean	0.10	0.12	0.12	0.36	0.11	0.02	0.09	366.39	117.72
		Standard deviation	0.10	0.16	0.25	0.95	0.13	0.13	0.11	206.00	15.63
		Mean/standard deviation	1.06	0.74	0.46	0.38	0.85	0.14	0.88	1.78	7.53
	Third cluster	Mean	0.08	−0.04	−0.07	0.03	0.12	−0.31	0.03	3673.50	98.11
		Standard deviation	0.07	0.11	0.15	0.19	0.11	0.57	0.03	1956.30	67.40
		Mean/standard deviation	1.10	−0.34	−0.43	0.14	1.17	−0.54	1.01	1.88	1.46
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
Performance IV_U	First cluster	Mean	0.06	−0.09	−0.01	−0.06	−0.04	−10.80	−6.74	194.81	6.64
		Standard deviation	0.04	0.12	0.10	0.26	0.08	33.60	15.23	155.61	10.14
		Mean/standard deviation	1.67	−0.79	−0.13	−0.23	−0.54	−0.32	−0.44	1.25	0.65
	Second cluster	Mean	0.11	0.09	0.32	0.98	0.07	−0.01	0.11	519.13	72.56
		Standard deviation	0.10	0.14	1.18	4.80	0.08	0.20	0.15	850.53	35.58
		Mean/standard deviation	1.05	0.66	0.27	0.20	0.83	−0.03	0.73	0.61	2.04
	Third cluster	Mean	0.18	0.32	0.08	0.40	0.31	0.14	0.22	1305.39	148.53
		Standard deviation	0.16	0.40	0.44	0.34	0.32	0.16	0.24	1481.73	27.62
		Mean/standard deviation	1.09	0.78	0.18	1.18	0.96	0.85	0.91	0.88	5.38
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
Performance V_U	First cluster	Mean	0.10	−0.23	0.00	−0.03	−0.14	−39.95	−19.47	38.14	12.44
		Standard deviation	0.01	0.05	0.21	0.30	0.02	54.37	25.86	34.32	16.90
		Mean/standard deviation	12.60	−4.85	0.02	−0.11	−7.58	−0.73	−0.75	1.11	0.74
	Second cluster	Mean	0.11	0.08	0.17	0.35	0.06	0.25	0.08	506.65	69.32
		Standard deviation	0.10	0.13	0.55	1.36	0.08	1.82	0.35	837.89	38.42
		Mean/standard deviation	1.02	0.59	0.31	0.26	0.79	0.14	0.22	0.60	1.80
	Third cluster	Mean	0.14	0.25	2.09	9.08	0.19	0.05	0.20	853.60	90.32
		Standard deviation	0.11	0.25	4.01	17.57	0.24	0.14	0.14	1012.54	69.70
		Mean/standard deviation	1.28	1.00	0.52	0.52	0.78	0.37	1.41	0.84	1.30

(Continues)

TABLE 4 (Continued)

		RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean/standard deviation									

TABLE 5 Statistical analysis of the relative level of amount and performance variables within clusters: the case of centroids according to variable distributions. Entire sample of 66 companies.

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Entire Sample		Mean	0.11	0.08	0.28	0.87	0.07	−0.98	−0.51	513.48	68.87
		Standard deviation	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
		Mean/standard deviation	1.06	0.51	0.26	0.19	0.63	−0.10	−0.11	0.61	1.67
Relative amount I_Q-V_Q	First cluster	Mean	0.03	0.01	0.00	0.06	0.06	0.07	0.10	545.13	79.54
		Standard deviation	0.02	0.07	0.18	0.10	0.08	0.25	0.19	656.91	44.39
		Mean/standard deviation	1.54	0.09	0.01	0.54	0.76	0.27	0.51	0.83	1.79
	Second cluster	Mean	0.09	0.07	0.09	2.06	0.02	−3.31	−1.96	252.41	51.37
		Standard deviation	0.01	0.15	0.12	7.91	0.10	17.96	8.45	199.47	34.93
		Mean/standard deviation	6.17	0.46	0.72	0.26	0.24	−0.18	−0.23	1.27	1.47
	Third cluster	Mean	0.21	0.17	0.77	0.67	0.11	−0.01	0.14	716.27	73.13
		Standard deviation	0.11	0.19	1.84	2.04	0.12	0.28	0.19	1242.94	39.28
		Mean/standard deviation	1.90	0.91	0.42	0.33	0.93	−0.04	0.75	0.58	1.86
Performance I_Q	First cluster	Mean	0.06	−0.04	−0.03	0.00	0.03	−2.35	−1.38	680.82	60.16
		Standard deviation	0.04	0.08	0.14	0.14	0.08	15.14	7.15	1201.61	46.70
		Mean/standard deviation	1.42	−0.48	−0.21	0.03	0.39	−0.16	−0.19	0.57	1.29
	Second cluster	Mean	0.13	0.07	0.25	0.65	0.10	0.06	0.17	445.23	80.07
		Standard deviation	0.15	0.02	0.65	2.29	0.06	0.20	0.17	505.97	41.51
		Mean/standard deviation	0.86	2.77	0.39	0.28	1.58	0.30	1.00	0.88	1.93
	Third cluster	Mean	0.16	0.23	0.69	2.06	0.09	0.01	0.11	354.26	72.16
		Standard deviation	0.09	0.15	1.75	7.37	0.14	0.16	0.18	253.20	32.25
		Mean/standard deviation	1.70	1.57	0.39	0.28	0.62	0.04	0.63	1.40	2.24
Performance II_Q	First cluster	Mean	0.10	0.05	0.05	1.57	−0.01	−2.57	−1.56	422.83	54.16
		Standard deviation	0.13	0.19	0.14	6.95	0.08	15.72	7.40	506.82	36.43
		Mean/standard deviation	0.82	0.27	0.37	0.23	−0.12	−0.16	−0.21	0.83	1.49
	Second cluster	Mean	0.10	0.08	1.12	0.38	0.07	0.06	0.17	361.43	61.51
		Standard deviation	0.06	0.09	2.36	1.17	0.01	0.06	0.09	302.99	35.63
		Mean/standard deviation	1.55	0.88	0.48	0.32	8.43	1.10	1.78	1.19	1.73
	Third cluster	Mean	0.12	0.11	0.11	0.42	0.14	0.05	0.18	673.97	86.57
		Standard deviation	0.09	0.14	0.23	1.71	0.10	0.23	0.14	1187.80	42.49
		Mean/standard deviation	1.26	0.78	0.47	0.25	1.40	0.21	1.29	0.57	2.04

TABLE 5 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Performance III_Q	First cluster	Mean	0.12	0.04	0.52	1.84	0.04	−2.67	−1.53	389.51	28.23
		Standard deviation	0.12	0.13	1.75	7.38	0.07	16.39	7.74	460.76	16.31
		Mean/standard deviation	0.97	0.34	0.30	0.25	0.57	−0.16	−0.20	0.85	1.73
	Second cluster	Mean	0.12	0.09	0.21	0.31	0.05	−0.08	0.06	641.83	61.23
		Standard deviation	0.09	0.19	0.60	0.96	0.11	0.29	0.18	1332.38	10.57
		Mean/standard deviation	1.25	0.47	0.36	0.32	0.42	−0.26	0.32	0.48	5.79
	Third cluster	Mean	0.10	0.11	0.10	0.31	0.11	0.02	0.09	541.17	115.24
		Standard deviation	0.09	0.15	0.24	0.85	0.12	0.12	0.10	648.41	20.67
		Mean/standard deviation	1.01	0.73	0.43	0.36	0.89	0.18	0.95	0.83	5.57
Performance IV_Q	First cluster	Mean	0.11	0.01	0.18	2.21	0.03	−3.20	−1.87	381.34	25.24
		Standard deviation	0.13	0.11	0.76	8.07	0.07	17.98	8.47	485.49	16.34
		Mean/standard deviation	0.85	0.05	0.24	0.27	0.47	−0.18	−0.22	0.79	1.54
	Second cluster	Mean	0.11	0.09	0.59	0.08	0.05	−0.05	0.09	602.91	56.93
		Standard deviation	0.05	0.13	1.80	0.21	0.10	0.27	0.16	1239.39	11.10
		Mean/standard deviation	2.02	0.69	0.33	0.37	0.51	−0.19	0.57	0.49	5.13
	Third cluster	Mean	0.11	0.13	0.11	0.46	0.10	0.01	0.08	544.06	113.80
		Standard deviation	0.11	0.18	0.23	1.12	0.12	0.12	0.12	634.92	21.49
		Mean/standard deviation	0.96	0.71	0.47	0.41	0.85	0.10	0.62	0.86	5.30
Performance V_Q	First cluster	Mean	0.10	−0.01	0.14	2.01	0.03	−2.92	−1.70	353.63	29.20
		Standard deviation	0.13	0.11	0.73	7.71	0.07	17.13	8.08	468.89	19.72
		Mean/standard deviation	0.80	−0.09	0.20	0.26	0.42	−0.17	−0.21	0.75	1.48
	Second cluster	Mean	0.11	0.10	0.64	0.08	0.05	−0.07	0.09	649.64	58.06
		Standard deviation	0.05	0.13	1.84	0.21	0.12	0.29	0.17	1260.08	15.68
		Mean/standard deviation	2.27	0.79	0.35	0.40	0.43	−0.25	0.53	0.52	3.70
	Third cluster	Mean	0.11	0.14	0.12	0.47	0.11	0.03	0.08	546.53	114.23
		Standard deviation	0.11	0.18	0.23	1.14	0.11	0.08	0.11	648.45	21.84
		Mean/standard deviation	0.98	0.81	0.52	0.42	1.04	0.39	0.75	0.84	5.23

between the variables, heterogeneity prevails in the distribution of firms between the clusters.

In III_Q, firms are fairly randomly positioned within clusters. This suggests that the effect on productivity is heterogeneous. In other words, the relative issuance level of minibonds does not affect the macrocategory of productivity. This result could be due either to the different sizes of the firms or to a disparate use of the resources received. Nevertheless, we notice a particular effect in cluster 1 of *RLA*; many firms register a high-efficiency level. In this respect, a limited injection of funds would incentivize firms to improve their productivity.

Finally, the results in the different scenarios IV_Q and V_Q are pretty similar. This regularity means that the different weights assigned to growth opportunity, profitability, and productivity to measure performance emphasize the variability in a small way. It should be noted that crossing clusters 1-3 of *RLA* with those of *P* shows a significant performance improvement. This is a weak signal that taking this line of credit could create fertile ground for entrepreneurs in terms of performance. In contrast, cluster 2 of *RLA* delivers a more complex and less straightforward reading.

Tables 4 and 5—entire sample—and 8 and 9—small sample—show the units of the mean for the relative amount of minibonds' issuance

		Performance				
		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
I_U Relative amount	Cluster 1	28	3	1	0	32
	Cluster 2	3	1	1	0	5
	Cluster 3	1	0	0	0	1
	Cluster 4	1	0	0	1	2
	Total	33	4	2	1	40
II_U Relative amount	Cluster 1	1	0	3	28	32
	Cluster 2	0	0	0	5	5
	Cluster 3	0	0	0	1	1
	Cluster 4	0	0	0	2	2
	Total	1	0	3	36	40
III_U Relative amount	Cluster 1	21	9	2	0	32
	Cluster 2	3	2	0	0	5
	Cluster 3	0	1	0	0	1
	Cluster 4	2	0	0	0	2
	Total	26	12	2	0	40
IV_U Relative amount	Cluster 1	2	26	4	0	32
	Cluster 2	0	4	1	0	5
	Cluster 3	0	1	0	0	1
	Cluster 4	0	1	1	0	2
	Total	2	32	6	0	40
V_U Relative amount	Cluster 1	2	25	5	0	32
	Cluster 2	0	2	3	0	5
	Cluster 3	0	1	0	0	1
	Cluster 4	0	1	1	0	2
	Total	2	29	9	0	40

TABLE 6 Joint cluster analysis and clusters overlap for the relative level of amount and performance: the case of uniformly distributed centroids. Small sample of 40 companies.

and performance for their whole sample; they refer to all the scenarios inherent in performance and minibonds' issuance relative amount for the two different approaches, respectively. Looking at the clustering concerning minibonds' issuance, we reasonably find that the mean increases as the clusters grow—that is, when we move to clusters with a higher centroid and, consequently, a higher label. This is true for both approaches, as expected, but not for performance clusters. Such tables present some "trends"—where trend means here the behavior of the variables over consecutive clusters.

Looking at Tables 4 and 8, we observe a rather non-straightforward trend by disaggregating relative amount's clusters, where only *TAV* grows when we move to clusters with a higher centroid. The average *RLA* of the first cluster is lower than that of the entire sample, while for the other clusters, it is higher as well as performances except for the *S*/*E* variable. The performance follows a rather ambiguous trend in the second, third, and fourth clusters. The mean/standard deviation value provides some information on the homogeneity within the clusters. Its level turns out to be low in all the cases. This suggests that within the clusters lie very different firms. Therefore, minibonds do not produce a homogeneous effect on the firms that use them.

In the I_U, II_U, and III_U scenarios, the *RLA* trend is mixed within clusters. It means that there is not a linear relationship between *RLA* and P_{GO}, P_{Prof}, and P_{Prod}, respectively. In contrast, in IV_U and V_U scenarios—where we consider all macrocategories—we see an increasing trend in *RLA* as overall performance increases. This might suggest that, overall, minibonds help firms improve their ratios. This result is relevant in that it shows that firms issuing the highest levels of minibonds perform better than the others.

Looking at Tables 5 and 9 with the clustering concerning relative amounts, we find out that performance trends are rather non-straightforward except *TAV* and *FAV*; indeed, such variables grow when we move to clusters with a higher centroid. The average *RLA* of the first and second clusters is lower than that of the entire sample, while the third one is higher. The performance-related averages are rather scattered among the clusters. Therefore, if we consider *RLA*, minibonds do not produce a homogeneous effect on the firms that use them. For the first time, we find slightly different results when comparing the two samples. Looking at entire sample I_Q, II_Q, and III_Q scenarios, we see that *RLA* is mixed. In I_Q and II_Q scenarios, *RLA* grows when we move to clusters with a higher label, while it decreases in III_Q. This outcome suggests that there is a straightforward relationship between

TABLE 7 Joint cluster analysis and clusters overlap for the relative level of amount and performance: the case of centroids according to variable distributions. Small sample of 40 companies.

		Performance			
		Cluster 1	Cluster 2	Cluster 3	Total
I_Q Relative amount	Cluster 1	8	4	2	14
	Cluster 2	5	3	4	12
	Cluster 3	3	1	10	14
	Total	16	8	16	40
II_Q Relative amount	Cluster 1	6	3	5	14
	Cluster 2	4	3	5	12
	Cluster 3	5	3	6	14
	Total	15	9	16	40
III_Q Relative amount	Cluster 1	4	1	9	14
	Cluster 2	9	2	1	12
	Cluster 3	3	6	5	14
	Total	16	9	15	40
IV_Q Relative amount	Cluster 1	4	1	9	14
	Cluster 2	7	4	1	12
	Cluster 3	2	6	6	14
	Total	13	11	16	40
V_Q Relative amount	Cluster 1	4	2	8	14
	Cluster 2	7	4	1	12
	Cluster 3	1	7	6	14
	Total	12	13	15	40

TABLE 8 Statistical analysis of the relative level of amount and performance variables within clusters: the case of uniformly distributed centroids. Small sample of 40 companies.

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Entire Sample		Mean	0.12	0.08	0.23	0.27	0.06	−1.67	−0.91	509.42	67.04
		Standard deviation	0.11	0.17	0.67	0.92	0.11	12.64	5.99	955.00	41.65
		Mean/standard deviation	1.09	0.46	0.35	0.29	0.53	−0.13	−0.15	0.53	1.61
Relative amount I_U-V_U	First cluster	Mean	0.08	0.04	0.14	0.19	0.05	−2.08	−1.17	555.50	64.09
		Standard deviation	0.05	0.14	0.47	0.77	0.11	14.15	6.69	1061.43	42.85
		Mean/standard deviation	1.69	0.29	0.29	0.25	0.44	−0.15	−0.17	0.52	1.50
	Second cluster	Mean	0.21	0.18	0.90	0.08	0.12	0.06	0.18	233.94	81.15
		Standard deviation	0.02	0.12	1.40	0.14	0.09	0.10	0.13	88.64	39.14
		Mean/standard deviation	12.36	1.57	0.65	0.58	1.34	0.63	1.36	2.64	2.07
	Third cluster	Mean	0.33	0.15	0.17	−0.01	0.11	0.01	0.10	667.14	112.46
		Standard deviation									
		Mean/standard deviation									
	Fourth cluster	Mean	0.49	0.35	0.11	2.08	−0.00	−0.37	−0.15	382.08	56.29
		Standard deviation	0.10	0.45	0.31	2.81	0.02	0.22	0.21	327.06	32.29
		Mean/standard deviation	4.79	0.79	0.36	0.74	−0.23	−1.68	−0.69	1.17	1.74
Performance I_U	First cluster	Mean	0.11	0.03	0.06	0.06	0.07	−2.01	−1.11	545.03	66.40
		Standard deviation	0.11	0.12	0.15	0.16	0.09	13.93	6.60	1047.81	44.01

(Continues)

TABLE 8 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
		Mean/standard deviation	0.26	0.36	0.35	0.71	−0.14	−0.17	0.52	1.51	
	Second cluster	Mean	0.14	0.25	0.92	0.15	−0.01	−0.11	0.01	353.97	70.38
		Standard deviation	0.04	0.16	1.12	0.44	0.21	0.33	0.31	152.27	25.81
		Mean/standard deviation	3.63	1.58	0.82	0.35	−0.03	−0.34	0.04	2.32	2.73
	Third cluster	Mean	0.13	0.18	1.73	2.12	0.06	0.03	0.15	180.76	64.93
		Standard deviation	0.09	0.09	2.30	2.99	0.01	0.02	0.13	24.28	58.83
		Mean/standard deviation	1.55	1.92	0.75	0.71	9.18	1.64	1.18	7.45	1.10
	Fourth cluster	Mean	0.42	0.67	0.33	4.07	−0.02	−0.21	−0.29	613.35	79.13
		Standard deviation									
		Mean/standard deviation									
Performance II_U	First cluster	Mean	0.11	−0.20	−0.14	0.18	−0.13	−78.40	−37.75	13.87	0.49
		Standard deviation									
		Mean/standard deviation									
	Second cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
	Third cluster	Mean	0.07	−0.04	0.01	0.22	−0.20	−0.85	−0.57	291.01	68.21
		Standard deviation	0.04	0.31	0.16	0.53	0.08	0.58	0.54	213.33	40.17
		Mean/standard deviation	1.82	−0.12	0.05	0.41	−2.60	−1.47	−1.07	1.36	1.70
	Fourth cluster	Mean	0.13	0.09	0.26	0.28	0.08	0.39	0.08	541.39	68.79
		Standard deviation	0.12	0.15	0.69	0.96	0.07	2.34	0.42	1000.75	41.37
		Mean/standard deviation	1.08	0.63	0.38	0.29	1.24	0.17	0.19	0.54	1.66
Performance III_U	First cluster	Mean	0.13	0.08	0.30	0.21	0.03	−2.53	−1.44	291.83	43.79
		Standard deviation	0.12	0.18	0.80	0.82	0.10	15.72	7.43	205.84	25.69
		Mean/standard deviation	1.12	0.44	0.37	0.25	0.34	−0.16	−0.19	1.42	1.70
	Second cluster	Mean	0.10	0.09	0.15	0.45	0.08	−0.00	0.07	376.26	111.78
		Standard deviation	0.10	0.14	0.24	1.20	0.10	0.15	0.10	186.19	12.70
		Mean/standard deviation	0.94	0.67	0.63	0.38	0.81	−0.03	0.77	2.02	8.80
	Third cluster	Mean	0.11	−0.07	−0.13	−0.01	0.16	−0.47	0.02	4137.06	100.82
		Standard deviation	0.07	0.14	0.15	0.25	0.11	0.70	0.04	2522.86	95.09
		Mean/standard deviation	1.65	−0.50	−0.89	−0.05	1.44	−0.67	0.59	1.64	1.06
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
Performance IV_U	First cluster	Mean	0.10	−0.23	0.00	−0.03	−0.14	−39.95	−19.47	38.14	12.44
		Standard deviation	0.01	0.05	0.21	0.30	0.02	54.37	25.86	34.32	16.90
		Mean/standard deviation	12.60	−4.85	0.02	−0.11	−7.58	−0.73	−0.75	1.11	0.74

TABLE 8 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
	Second cluster	Mean	0.12	0.07	0.25	0.07	0.05	0.44	0.07	333.75	64.08
		Standard deviation	0.11	0.11	0.73	0.20	0.09	2.48	0.45	196.73	37.86
		Mean/standard deviation	1.06	0.65	0.34	0.35	0.60	0.18	0.14	1.70	1.69
	Third cluster	Mean	0.15	0.20	0.22	1.43	0.14	−0.15	0.04	1603.43	101.02
		Standard deviation	0.14	0.29	0.34	2.11	0.12	0.42	0.19	2269.58	44.18
		Mean/standard deviation	1.04	0.69	0.65	0.68	1.24	−0.36	0.21	0.71	2.29
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									
Performance V_U	First cluster	Mean	0.10	−0.23	0.00	−0.03	−0.14	−39.95	−19.47	38.14	12.44
		Standard deviation	0.01	0.05	0.21	0.30	0.02	54.37	25.86	34.32	16.90
		Mean/standard deviation	12.60	−4.85	0.02	−0.11	−7.58	−0.73	−0.75	1.11	0.74
	Second cluster	Mean	0.11	0.07	0.06	0.07	0.05	0.48	0.05	335.39	63.73
		Standard deviation	0.11	0.11	0.14	0.19	0.09	2.61	0.47	203.40	37.39
		Mean/standard deviation	0.98	0.60	0.46	0.36	0.56	0.18	0.11	1.65	1.70
	Third cluster	Mean	0.16	0.18	0.83	0.98	0.12	−0.08	0.09	1174.91	89.84
		Standard deviation	0.12	0.24	1.25	1.81	0.10	0.35	0.18	1907.25	46.46
		Mean/standard deviation	1.37	0.73	0.66	0.54	1.14	−0.24	0.51	0.62	1.93
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Standard deviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/standard deviation									

TABLE 9 Statistical analysis of the relative level of amount and performance variables within clusters: the case of centroids according to variable distributions. Small sample of 40 companies.

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
Entire Sample		Mean	0.12	0.08	0.23	0.27	0.06	−1.67	−0.91	509.42	67.04
		Standard deviation	0.11	0.17	0.67	0.92	0.11	12.64	5.99	955.00	41.65
		Mean/standard deviation	1.09	0.46	0.35	0.29	0.53	−0.13	−0.15	0.53	1.61
Relative amount I_Q-V_Q	First cluster	Mean	0.03	0.02	0.02	0.38	0.06	0.01	0.14	485.93	85.12
		Standard deviation	0.02	0.10	0.19	1.11	0.09	0.18	0.22	563.34	47.06
		Mean/standard deviation	1.51	0.21	0.11	0.34	0.70	0.04	0.67	0.86	1.81
	Second cluster	Mean	0.10	0.05	0.09	0.07	0.01	−5.48	−3.32	267.42	39.88
		Standard deviation	0.01	0.17	0.11	0.30	0.13	23.33	10.87	254.49	29.10
		Mean/standard deviation	6.17	0.46	0.72	0.26	0.24	−0.18	−0.23	1.27	1.47

(Continues)

TABLE 9 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
	Third cluster	Mean	0.23	0.16	0.57	0.33	0.09	−0.09	0.09	740.34	72.24
		Standard deviation	0.12	0.20	1.04	1.08	0.08	0.31	0.17	1500.61	34.80
		Mean/standard deviation	1.83	0.79	0.54	0.31	1.07	−0.28	0.55	0.49	2.08
Performance I_Q	First cluster	Mean	0.10	−0.06	−0.05	−0.00	0.03	−4.22	−2.45	739.19	56.88
		Standard deviation	0.13	0.09	0.12	0.17	0.10	20.10	9.44	1484.32	54.70
		Mean/standard deviation	0.79	−0.59	−0.46	−0.01	0.26	−0.21	−0.26	0.50	1.04
	Second cluster	Mean	0.07	0.06	0.11	0.06	0.08	0.08	0.13	340.76	75.91
		Standard deviation	0.07	0.02	0.07	0.07	0.03	0.07	0.08	189.63	28.43
		Mean/standard deviation	1.06	2.34	1.61	0.88	3.04	1.14	1.71	1.80	2.67
Third cluster	Mean	0.16	0.22	0.58	0.64	0.07	0.00	0.10	363.99	72.76	
		Standard deviation	0.10	0.15	0.95	1.39	0.13	0.19	0.20	239.22	30.89
		Mean/standard deviation	1.65	1.42	0.61	0.46	0.57	0.01	0.49	1.52	2.36
Performance II_Q	First cluster	Mean	0.14	0.07	0.05	0.36	−0.03	−4.51	−2.71	301.48	54.17
		Standard deviation	0.15	0.24	0.16	1.06	0.10	20.77	9.72	171.80	43.79
		Mean/standard deviation	0.89	0.29	0.30	0.34	−0.32	−0.22	−0.28	1.75	1.24
	Second cluster	Mean	0.10	0.07	0.68	0.48	0.07	0.07	0.17	219.29	62.70
		Standard deviation	0.07	0.11	1.31	1.41	0.01	0.06	0.10	128.29	38.02
		Mean/standard deviation	1.52	0.63	0.52	0.34	7.31	1.06	1.68	1.71	1.65
	Third cluster	Mean	0.12	0.09	0.15	0.06	0.13	0.02	0.16	867.57	81.54
		Standard deviation	0.08	0.11	0.21	0.11	0.07	0.27	0.09	1450.64	39.35
		Mean/standard deviation	1.38	0.78	0.74	0.55	1.98	0.06	1.70	0.60	2.07
Performance III_Q	First cluster	Mean	0.12	0.02	0.24	−0.01	0.03	−4.11	−2.39	278.12	27.36
		Standard deviation	0.12	0.14	0.85	0.16	0.08	20.13	9.46	236.15	15.72
		Mean/standard deviation	0.98	0.11	0.29	−0.09	0.35	−0.20	−0.25	1.18	1.74
	Second cluster	Mean	0.16	0.17	0.40	0.58	0.06	−0.13	0.06	927.24	61.84
		Standard deviation	0.11	0.23	0.82	1.34	0.16	0.40	0.25	1879.52	13.91
		Mean/standard deviation	1.53	0.73	0.49	0.43	0.40	−0.32	0.23	0.49	4.45
	Third cluster	Mean	0.10	0.09	0.12	0.38	0.08	0.00	0.07	505.46	112.48
		Standard deviation	0.10	0.13	0.23	1.07	0.09	0.13	0.09	537.46	20.70
		Mean/standard deviation	0.97	0.68	0.52	0.36	0.89	0.01	0.85	0.94	5.43
Performance IV_Q	First cluster	Mean	0.12	−0.03	0.24	−0.01	0.02	−5.06	−2.97	204.47	23.81
		Standard deviation	0.14	0.10	0.94	0.18	0.08	22.38	10.48	129.95	15.34
		Mean/standard deviation	0.88	−0.29	0.26	−0.08	0.25	−0.23	−0.28	1.57	1.55
	Second cluster	Mean	0.13	0.14	0.37	0.10	0.07	−0.08	0.11	865.77	55.06
		Standard deviation	0.05	0.14	0.73	0.28	0.14	0.36	0.21	1694.26	13.60

TABLE 9 (Continued)

			RLA	TAV	FAV	SAV	ROI	ROS	MEBITDA	S/E	ATO
		Mean/standard deviation	2.84	0.97	0.50	0.36	0.49	−0.23	0.51	0.51	4.05
	Third cluster	Mean	0.12	0.12	0.14	0.61	0.08	−0.01	0.05	512.20	110.40
		Standard deviation	0.12	0.19	0.23	1.38	0.09	0.14	0.12	519.93	21.67
		Mean/standard deviation	0.93	0.64	0.58	0.44	0.82	−0.08	0.41	0.99	5.09
Performance V_Q	First cluster	Mean	0.12	−0.04	−0.02	−0.02	0.02	−5.48	−3.23	207.88	23.86
		Standard deviation	0.14	0.10	0.13	0.18	0.08	23.32	10.90	135.12	16.02
		Mean/standard deviation	0.81	−0.43	−0.15	−0.09	0.20	−0.23	−0.30	1.54	1.49
	Second cluster	Mean	0.13	0.11	0.55	0.09	0.05	−0.10	0.10	782.45	56.33
		Standard deviation	0.05	0.15	1.09	0.26	0.14	0.35	0.21	1561.34	20.74
		Mean/standard deviation	2.32	0.72	0.51	0.37	0.35	−0.29	0.46	0.50	2.72
	Third cluster	Mean	0.12	0.14	0.16	0.65	0.09	0.02	0.06	514.03	110.87
		Standard deviation	0.13	0.18	0.23	1.43	0.07	0.08	0.11	538.13	22.34
		Mean/standard deviation	0.96	0.79	0.69	0.46	1.29	0.22	0.56	0.96	4.96

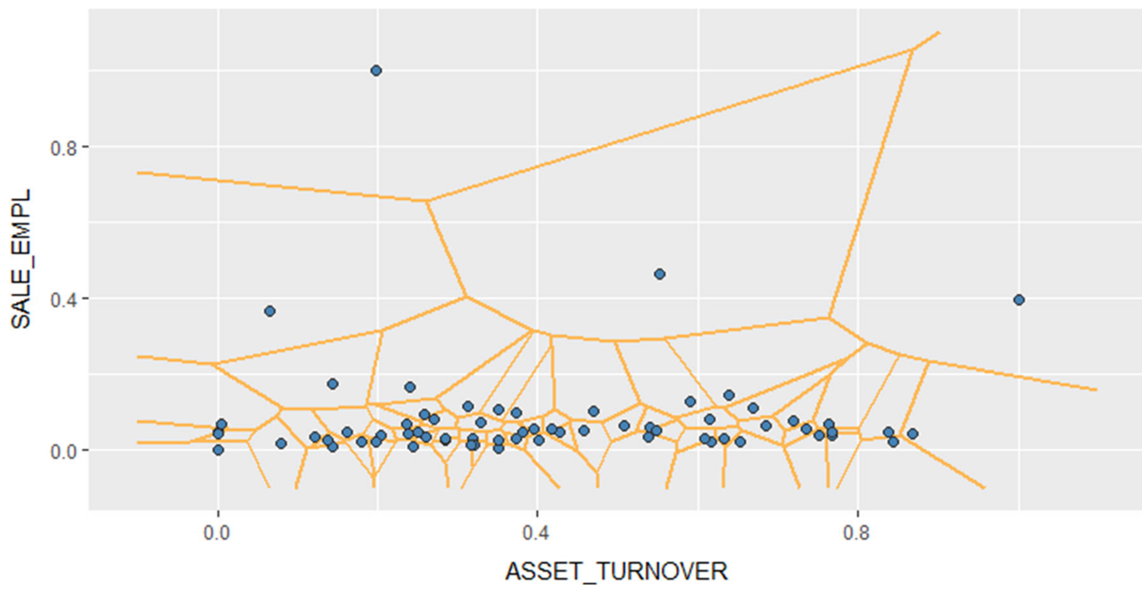

FIGURE 1 Graphic representation of Voronoi tessellation of the productivity macrocategory. On the abscissa, we find the sales per employee variable; on the ordinate, the assets turnover variable. Both variables are normalized. Entire sample of 66 companies. [Colour figure can be viewed at wileyonlinelibrary.com]

RLA and P_{GO} and P_{Prof}, while this is not valid for P_{Prod}. In IV_Q and V_Q scenarios—where we consider all the macrocategories—we see stability or a tendency to rise in *RLA* when overall performance increases. These results are consistent with the analysis presented in Table 4 by confirming the obtained outcomes.

On the other hand, if we look at the results obtained with the small sample, no particular relationship is found, we note a heterogeneity in the relationship between *RLA* and Performance, particularly in the scenarios IV_Q and V_Q. These results are not consistent with the analysis presented in Table 8.

Finally, we present the Voronoi tessellation graph for the productivity macrocategory (see Figures 1 and 2). In this case, empirical data are the endogenous centroids, and the Voronoi cells are derived from them. We cannot show other instances because the other macrocategories are three-dimensional, and therefore the graphs would not be clear. For the same reason, it was not possible to construct a

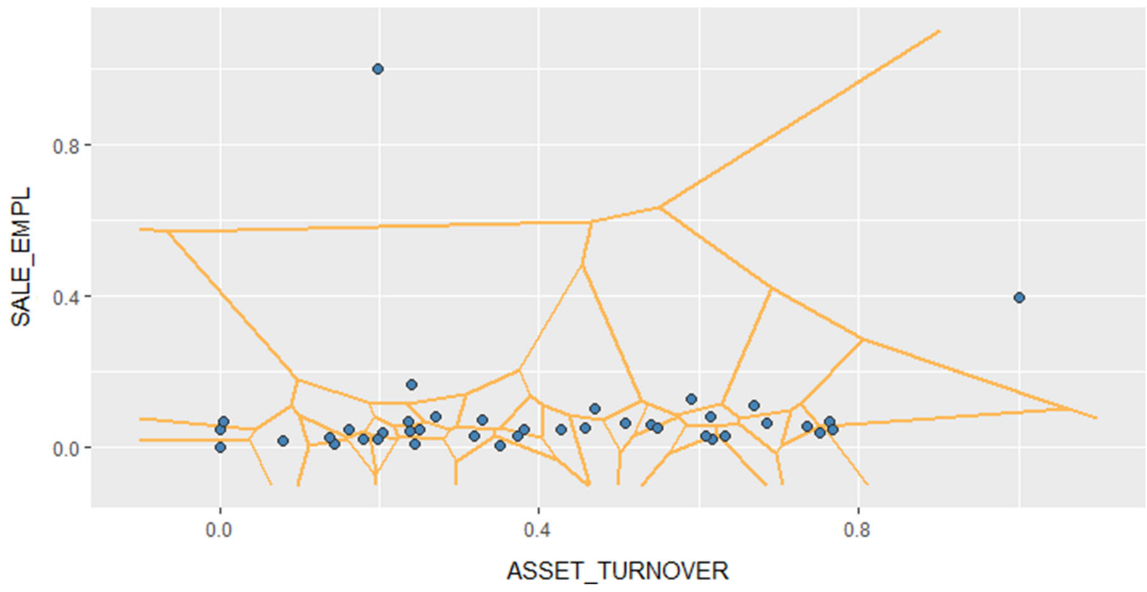

FIGURE 2 Graphic representation of Voronoi tessellation of the productivity macrocategory. On the abscissa, we find the sales per employee variable; on the ordinate, the assets turnover variable. Both variables are normalized. Small sample of 40 companies. [Colour figure can be viewed at wileyonlinelibrary.com]

multidimensional graph (eight dimensions) with all variables of interest. Therefore, we believe that a single partition is sufficient to convey the operation and concept of Voronoi tessellation.

Figure 1 contains all issuing companies in 2016, but with the possibility that they also issue in the following triennium. Differently, Figure 2 only considers companies that were issued in 2016.

Figures 1 and 2 show how the enterprises are positioned according to Voronoi's partition. Larger spaces identify those enterprises that are further apart than the others. Specifically, in both cases, we note two enterprises of coordinates (1; 0.39) and (0.19; 1) that are particularly distant from the rest of the group. This suggests that within the productivity macrocategory, which is composed of asset turnover and sales per employee, we have two firms with a much higher value than the others—especially for the variable sales per employee. In fact, the other values are all below 0.5. Whereas for the variable asset turnover, there is some heterogeneity between the companies, especially in the sample with 66 companies.

6 | CONCLUSIONS

In the context of green finance, minibonds play a prominent role. This paper explores this new financial instrument by exploring the relationships between the relative issuance level of minibonds of companies and their performances. The sample considered is given by the companies that issued minibonds in 2016, and their performance is evaluated over the subsequent triennium 2017–2019. The issuance level of minibonds and the other eight variables that compose performances were manually collected from companies' non-consolidated annual reports.

The analysis performed through cluster methodology is based on the Voronoi tessellation. We iterated the clustering for the overall set of companies but also for the subcase of companies issuing minibonds only in 2016.

As far as we know, the context of minibonds is rather neglected in the scientific literature, even though this instrument has a high "green" potential. This instrument can therefore facilitate green transactions, as repeatedly emphasized by the Osservatorio Mini-Bond (2018, 2019, 2020, 2021, 2022), thus making it very environmentally relevant. Moreover, our results are consistent with the existing literature. Specifically, Altman et al. (2020) state that the quality of the companies issuing minibonds is above average. This outcome does not invalidate what we found, as we do not claim that the average quality of companies is below average. However, there is a possibility that undeserving companies could exploit this new channel to finance themselves, as has been proven by Mietzner et al. (2018).

From a different perspective, we notice that Ongena et al. (2020) are in line with us, especially for their results on the connection between the issuance of minibonds and performance related to the macrocategory growth opportunity.

Looking at single macrocategories, the impact of the relative level of amount on post-issuances performances is debatable, with heterogeneous clusters. In a general context, minibonds positively affect firm performance. Indeed, there is a slight tendency for companies to be placed in the same clusters when considering the relative issuance level of minibonds and performances.

We emphasize that this study is the first step toward discussing the effect of minibonds on performance. We will implement our work with further data as they become available, focusing on the relationship between green minibonds, understood as a CSR-enhancing instrument, and performance. Indeed, this is still a relatively unexplored topic that deserves further research and specification, not only in the context of green finance. Therefore, a specific focus will be made on those types of minibonds issued specifically and strategically addressing environmental and social issues—although this analysis has empirically demonstrated how minibonds could potentially have a positive effect on performance.

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ORCID

Roy Cerqueti https://orcid.org/0000-0002-1871-7371

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