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Minibond issuers: a quantitative exploration of the Italian market

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Contents

Chapter 1

Introduction

After the 2008 global financial crisis, the increase of bank regulatory concerns (Basel agreements) and a structural bank deleveraging process, enterprises looked for more market-based financing. If such a solution is easier for larger caps, more and more small and medium-sized enterprises (SMEs)[1] are concerned about becoming less bank dependent.

According to a study by the European Commission (2017), SMEs represent over 99% of non-financial enterprises, employing over 67% of the total number of employees. Italy has one of the most significant segments among micro and small-medium enterprises. In fact, about 99% of the total is grouped in these categories (ISTAT, 2019). Moreover, the impact of the global financial crisis has been one of the most significant in the world. As a result, in 2009, GDP fell by approximately 6%; however, in addition to the effect of the sub-prime crisis in 2007 in the USA, Italy also suffered from the sovereign debt crisis and the subsequent banking crisis that began in 2011. Some European Union (EU) countries such as Italy, Spain, Greece and Por-

[1]In defining what SMEs are, the European Commission has implemented some criteria. A microenterprise refers to those companies with less than ten employees and which have an annual turnover or annual balance sheet equal to or less than 2 million euros. Small enterprises are companies with 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.

tugal have been hardest hit. In this context, despite the expansive monetary policy of the European Central Bank, Italian companies have been severely affected by the credit crunch. Indeed, Italian's SMEs suffered more than others since the banking channel was the only source of external debt financing they could rely on.

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

To counteract this phenomenon and relaunch the economy, the Italian legislator introduced the "Decreto Sviluppo", 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 establishes in art. 2412, a limit on the issue of bonds, providing that companies could issue bonds for a total sum not exceedingly twice the equity capital, resulting from the latest approved financial statements. This limit may be exceeded only if professional investors subscribed to the excess bonds. This legal rule was 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 Italian legislator 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.

1.1 Minibonds in Italy

The question of using market-based financing for companies in addition to bank credit has thus become a central issue in the debate within the European Union (EU). Indeed, the strong dependence of companies - especially SMEs - on the banking system to finance their needs. As one of the countries most affected by the sovereign

debt crisis and the resulting credit crunch, Italy adopted new regulations in 2012, the primary purpose of which was to encourage small and medium-sized enterprises to issue corporate bonds to diversify their source of debt funding. The context prior to the 'Decreto Sviluppo' was rather penalising for this category of companies, which found it very difficult to finance themselves on the capital market. Cerved group (2013) estimates that there are more than 35,000 potential companies in Italy that could be able to issue minibonds.

Minibonds are nothing else but bonds issued by a specific category of companies that are required to comply with a number of constraints. Therefore, they are issued by corporations and cooperatives - other than banks and microenterprises - that are not listed on lists open to private investors have an annual turnover higher than 2 million euros or at least 10 employees. Moreover, the companies issuing minibonds have to be in a "good standing" situation, i.e. that it is not a party to insolvency proceedings in progress or about to be declared.

Following the entry into force of the new legislation, in February 2013, Borsa Italiana created an ad hoc segment in which this financial instrument can be traded. This new segment falls under multilateral trading facilities (MTF) and is called ExtraMot Pro. This new segment offers flexibility and favourable conditions to both professional investors and companies wishing to enter the capital market. Therefore, listing on ExtraMot Pro is simplified compared to the ExtraMot market (which is also open to retail investors). Since we are talking about an MTF and therefore exclusively accessible to professional investors, it is not subject to the EU Prospect Directive. Consequently, the market is supervised by the Italian supervisory body in charge, i.e. CONSOB[2]. More recently, precisely in 2019, a further segment, i.e. ExtraMot Pro[3] has been created. The latter is very similar to the previous one, but the issue size cannot exceed 50 million euros. This segment has been introduced to reach the widest possible number of SMEs, which has simplified access and lowered costs.

Issuers have to comply with a number of requirements, such as an admission

[2]Commissione Nazionale per le Società e la Borsa, supervisor authority of companies and stock exchange market in Italy.

document and two annual financial statements approved by a registered auditor. Finally, some post-listing requirements concerning market-relevant information must be constantly updated.

The main legislative innovations introduced after 2012 are:

1) "Decreto Destinazione Italia" in 2013: establishes the eligibility of minibonds as underlying assets for securitisation; applies preferential taxation on interest rates and capital gains of minibonds subscribed by investment funds.

2) "Decreto Competitività" in 2014: extends preferential taxation also to those securities not admitted to the MTF.

3) "Decreto Cura Italia": extension of the public guarantee on minibonds.

According to Politecnico di Milano (Osservatorio Minibond, 2021), the issuing companies, until 2020, record 1005 total issuances for 671 companies, SMEs are in total 409, i.e. 61%. 2020 contributed with 194 issuances corresponding to 176 companies. Specifically, the report only collected issuances with a size below 50 million euros. The total nominal value at the end of 2020 is 7.07 billion euros, with 2020 alone contributing 920 million euros. The overall average maturity is 5.47 years; in 2020 alone, it is 6.34 years. As regards the coupon, in most cases, it is fixed, while 15% is indexed. Overall, the average rate of the fixed coupon is 4.48%, while if we consider only 2020, it is in strong decrease - thanks also to the public guarantees - standing at 3.6%. In particular, it is interesting to observe how in 2020, there are 95 issues with a fixed coupon between 2% and 4% compared to 40 in 2019. Moreover, if we look at the link between coupon and maturity for SMEs and large companies, we see a slight difference in rates between them. In some cases, SMEs pay a lower coupon than large companies (for example, the issuances with maturities between 3 and 4 years and those with maturities greater than 7). Another notable piece of data on coupons regards their distribution over time. In fact, between 2 and 5 years, the highest interest rates are recorded for both SMEs and large companies.

An analysis of the sector to which the 671 issuing companies belong shows that the vast majority belongs to the manufacturing sector, around 43%, followed by professional activities and commerce, both around 10%. If we look at issuers' geographical

point of view, there is a preponderance of northern regions; in fact, 67% of companies are located there. Despite this, there has been a significant increase in other geographical areas. In fact, for the first time, the 30% threshold has been exceeded (considering the centre, south and islands Italy overall).

The main actors in the Italian context are:

1) The advisors have the task of guiding the companies in the choice of the main strategies and accompanying them throughout the process, also supporting them in their relations with the other players in the chain. Most active advisors, excluding those who also act as arrangers, are ADB Corporate Advisory, Agenda Corporate Italia, Alantra and AMU Investments SIM.

2) The arranger is in charge of the actual structuring of the placement and will interface with the market on behalf of the company (very often, advisor and arranger coincide). This role is carried out mainly by banks; indeed, in the first places for placement, we find Banca Finint, Unicredit and IntesaSanPaolo.

3) Rating agencies, although not expressly required by law, a large number of companies have decided to go down this route. This is a signal of transparency and quality sent to the market.

4) Typical investors - being an instrument closed to retail - are investment funds, banks, insurance companies, SIM (securities brokerage firms), pension funds, foundations.

5) Banks act as agents and custodians of the contracts.

In Europe, other countries have also introduced policies similar to the Italian one but have adopted different settlement structures.

In Germany, there are several listings dedicated to SME debt securities. In 2010, a regulated market was opened in Stuttgart with several segments, one of which is dedicated to minibonds. The experience was entirely negative, mainly due to numerous defaults by issuing companies (see Mietzner et al. 2018). Much more developed is the market for Schuldscheiddarlehen, a type of hybrid contract with characteristics intermediate to bonds and bank loans. The value of transactions in

2020 amounted to 20 billion euros, an important value but well below those recorded in the record year 2019.

In France, the stock markets dedicated to SME bonds are Euronext, Euronext Growth and Euronext Access. These segments involve several European financial centres, including Paris, Brussels and Dublin. To be subscribed by professional investors, issues must have a minimum denomination of 200 thousand euros, while for public placement, the minimum size must be 5 million. In addition, SMEs are required to obtain a score from a certified rating agency. An important difference with the market is the investor, as these bonds can also be placed retail, provided they are subscribed through banks or brokers during a specific window of duration between 3 and 5 weeks. At the end of 2020, there were 225 bonds similar to minibonds issued in the Euronext segment. It is also worth mentioning that France has started a trial of placing minibonds of up to 2.5 million euros on authorised crowdfunding platforms using blockchain technology. In addition, there is a particular segment in France, very similar to the German one (Schuldschein) called Euro PP [3] (private placements) born in 2012. So far, it has not been very successful because of the other stock exchanges dedicated to French SMEs.

This thesis deals with analysing the companies issuing minibonds under a large set of prospective.

It is essential now to review the main literature related to our problems.

1.2 Literature review

The firms' decision to issue minibonds refers to the capital structure theory models that look at the firm's characteristics to explain the level of debt. The two main theoretical frameworks are the Trade-off Theory (TOT) and the Pecking Order Theory (POT). As those general frameworks are not sufficient to understand the firm's debt structure, we present the main models that want to explain it. Then, we present the main firm's specific characteristics that are tested as possible determinants of debt

[3] Document de Recherche du Laboratoire d'Economie d'Orlean, 2016.

structure. Finally, we offer other exogenous factors affecting a firm's decision and existent literature concerning minibond.

1.2.1 Capital Structure Theory

Capital structure theory has been the subject of numerous studies since its introduction. It deals with defining the perfect blend between the two primary financing options for the company. These sources of funding are debt capital and equity capital. Within the traditional financial theory, the firm's goal is to maximize the shareholder value. Regarding such a target, the debt/equity ratio or the mix between debt and equity must be chosen to maximize the share market value or minimize the cost of capital.

The fathers of the capital structure theory are Modigliani and Miller (1958); they are the first to deal with these issues. They set up a model in which there are a series of assumptions such as the existence of a perfect capital market with no taxes, information asymmetries, transaction costs and bankruptcy costs. Under such strong assumptions, Modigliani and Miller formulate their conclusions. The firm's market value is not influenced by capital structure choice, in particular by its level of financial leverage; the cost of capital is independent of the capital structure.

However, Modigliani and Miller note that the presence of debt increased the risk of default. There would be a balance between the tax benefits and the risk of default if considering the taxes. This new consideration starts the Trade-off Theory. *TOT*, therefore, removes some of the strongest assumptions established by the first work performed by Modigliani and Miller (1958). The presence of taxes on corporate profit is assumed (Modigliani and Miller, 1963), then personal taxes are introduced (Miller, 1977), bankruptcy costs (Kraus and Litzenberger, 1973) and finally, the agency's cost that removes the hypothesis of symmetric information (Jensen and Meckilng, 1976). *TOT* establishes that there is an optimal capital structure that maximizes the value of the company and minimizes the cost of capital (DeAnglo and Masulis, 1980).

On the other hand, the Pecking Order Theory does not predict the existence of an optimal capital structure. Rather, it supports that exists a specific order or preference when firms need funds. According to Myers (1984) and Myers and Majluf (1984), companies, in choosing the financial structure, would follow a specific hierarchy in the use of sources of financing. It is assumed that there is an information asymmetry between the external providers (shareholders and creditors) and managers. For those authors, the asymmetry of information explains the choice between internal and external financing, as well as between debt and equity. This leads to an order of preference, according to which the firm is preferably financed with internal funds (self-financing); the second choice is the request for loans and, finally, the issue of new shares. Using self-financing avoids the issuance costs and the negative signals associated with it. The announcement of a new issue of shares is considered, in fact, not good news for investors: managers are encouraged to issue shares when the market price is higher than the company's real valuation, so investors offset this with lower price (see Ross, 1977 and Asquith and Mullins, 1986). Recognizing the possibility of implementing this strategy, investors perceive the news of newly issued shares as a negative signal that will lead them to review their evaluation of the company and to reduce the market price of the shares of the same. If self-financing is not sufficient and it is necessary to resort to external sources, the company prefers issuing debt what extent to the risk of failure and the related costs are maintained acceptable. New debt is preferred to new equity because, due to asymmetric information, it signals the stock price is undervalued. This theory, therefore, puts the importance of the tax benefits of debt in the background by stating that the choices of financial structure depend on the imbalance between internal cash flow and investment opportunities.

1.2.2 Firms' Lender Choice

Some scholars have investigated the reasons that condition the use of one type of debt over another. Indeed, the TOT and POT theories did not consider the different nature of the debt.

A first distinction is made by Fama (1985). He divided the debt into "inside" and "outside" categories. He argued that bank debt was debt inside, while debt outside is defined as publicly-traded debt. He, therefore, gives a first distinction between debtholders and bondholders by focusing on the type of information available to them. One of the assumptions removed by Modigliani and Miller (1958) concerned perfect information symmetry. According to many scholars, information asymmetries give debtholders an information advantage compared to bondholders. This advantage can influence the financing choice of businesses. Diamond (1991) argues that firms initially use the banking system to build a reputation in the market. Later, after building their reputation, they turn to arm's length markets. Rajan (1992) argues that borrowing from a single banking intermediary can create a sort of information monopoly by making it more costly for the firm to switch to other types of lenders. According to the latter, banking monitoring alters the division of surpluses. Therefore, borrowing from a greater number of sources can limit the bank's ability to extract surplus, leaving its monitoring unaffected. Rajan (1992) and Cantillo and Wright (2000) consider private intermediaries, especially banks, to be excellent reorganizers. They believe that financial intermediaries are much more efficient at reorganizing a business than public investors.

Others, such as Diamond (1991), emphasize instead that intermediaries are excellent screeners. Both theories are distinct and similar. In fact, both assume that intermediaries are much more efficient at extracting information than public investors. The former, however, use more information to renegotiate more efficiently ex-post, while the latter use more information to choose the best project. At the basis of these theories, albeit with the necessary distinctions, the borrowing companies are conditioned in the choice of their lender. Intermediaries offer greater monitoring capacity (Diamond, 1984), the possibility of building a reputation (Diamond, 1991), greater flexibility in the event of financial distress (Chemmanur and Fulgheri, 1994) and access to private information (Fama, 1985). However, the private lender can also negatively affect the borrower by extracting rents and distorting management incentives (Rajan, 1992).

However, it is also necessary to consider the influence of firm characteristics on their debt choice. In addition, we have to distinguish between different types of private debt.

1.2.3 Firms-Specific Characteristics

Other scholars document that the use of public or private debt is due to firm-specific characteristics. Houston and James (1996), Krishnaswami et al.(1999), and Cantillo and Wright (2000) examine the cross-sectional determinants of the mix of public and private debt. These scholars primarily emphasized the importance of growth opportunities and studied the impact of asymmetric information cost, flotation costs, and the number of bank relationships on debt choice. In this regard, they find that the impact of growth opportunities on debt choice is significant, albeit mixed. In particular, Krishnaswami et al.(1999) and Cantillo and Wright (2000) document a positive relationship between growth opportunity and the use of private debt, while Houston and James (1996) find it to be negative in the case where firms have only one banking relationship.

Denis and Mihov (2003) then introduce the possibility of borrowing from private non-bank lenders. They find that the main determinant of a firm's choice of debt is the quality of the issuer. Firms with high credit quality will resort to public debt, firms with medium credit quality will resort to banks, and firms with low quality will resort to private non-bank lenders. Mizen and Tsoukas (2014) explore how regional policies and specific corporate characteristics can influence companies' public bond market decisions. They find that features such as size, leverage, profitability, and collateral are decisive for the choice.

The literature on capital structure theory provides us with several firm characteristics that can influence the firm's decision on the type of debt. Regarding firm size and TOT, scholars suggest that larger firms are less likely to fail than medium and small firms. Indeed, large companies are more diversified and have more stable profits and cash flows (Rajan and Zingales, 1995). Conversely, from the POT's point of view, large firms are expected to face high information asymmetry costs when raising

external finance because these firms are more complex than small ones (D'Amato, 2019). Furthermore, large companies generally have consolidated profits, so they use internal resources before resorting to an increase in public and private debt (Myers and Majluf, 1984). From an empirical point of view, scholars find a positive relationship between the size of a company and the use of public finance instruments. Indeed, larger companies have easier access to the public bond market. Being larger, they have more tangible assets, and therefore collateralizable, whose presence reduces the risk for the creditor (Datta et al., 2000). Houston and James (1996), consistent with what has just been stated, find a decreasing relationship between dependence on the banking system and size. Furthermore, Mizen and Tsoukas (2014) argue that the higher fixed costs inherent in issuing bonds favour large companies or could result from the more significant information asymmetry that the medium and small businesses face. Consistent with the problems of information asymmetry, Johonson (1997), Dennis and Mihov (2003), Cantillo and Wright (2000) support a positive relationship between size and the use of the public debt market.

According to the *TOT*, older companies have greater visibility in the market, their position within the market is more stable, and they have fewer problems of information asymmetry. Furthermore, older firms are less likely to fail than younger ones. However, the *POT* suggests an inverse relationship between firm age and leverage. Older companies have had time to accumulate wealth. Therefore, they will tend to resort to external financing in a lower quantity than younger companies. Prior empirical studies by Houston and James (1996), Johnson (1997), Krishnaswami et al. (1998), and Cantillo and Wright (2000) document a positive relation between the use of public debt financing, firm age and amount issued. Datta et al. (2000) suggest that older, high reputation firms use public debt because their reputation, established over time, implies that they avoid risky behaviour even in the absence of monitoring.

As for the asset structure, according to the *TOT* high levels of tangible fixed assets would lead to an increase in debt as they would guarantee low bankruptcy costs for investors. Therefore, TOT expects a positive relationship between fixed assets and a

high level of debt (Rajan and Zingales, 1995; Myers, 1977). On the contrary, *POT* suggests that high levels of tangible assets favour the issuance of new shares rather than recourse to public or private debt. This is because being in the presence of low information asymmetry due to high levels of tangible assets allows companies to issue shares at a low cost (Frank and Goyal, 2003; Harris and Raviv, 1991). Mizen and Tsoukas (2014), indeed, a greater quantity of tangible assets would allow investors to recover credit easily. Therefore, more tangible assets encourage external financing. Dennis and Mihov (2003) find a positive relationship between the level of fixed assets and the probability of selecting public debt.

Regarding a firm's profitability, *TOT* suggests a positive relationship between profitability and leverage. Indeed, those companies are considered less risky and will consequently have a lower credit risk. This makes them more attractive to potential bondholders and debtholders. Conversely, *POT* suggests that high levels of profitability lead to lower debt. This is because they prefer the use of internal resources, given that high-profitable firms can generate more free cash flow (Fama and French, 2002; Rajan and Zingales, 1995). Rajan and Zingales (1995), consistent with *POT*, argue a negative correlation between leverage and profitability. If dividends and investments are fixed in the short term and if debt financing is the dominant mode of external financing, changes in profitability are negatively correlated with changes in leverage. Mizen and Tsoukas (2014) argue that high levels of profitability push companies to issue bonds. Indeed, in their analysis, they find a positive relationship between the profitability and likelihood to issue bonds. Consistent with Mizen and Tsoukas (2014), Denis and Mihov (2003) argue that public issuers are more profitable than firms that borrow from bank loans and other private debt.

Another factor that the two main theories take into consideration is the growth opportunity. According to the *TOT*, firms with high growth opportunities are more likely to fail, and consequently, there is an inverse correlation between the latter and leverage (Harris and Raviv, 1991). Myers (1977, 1984) points out that the presence of high levels of growth opportunities could incentivize opportunistic behaviour on the part of shareholders. In this case, a company should decide on low leverage.

On the contrary, *POT* suggests a positive relationship between leverage and growth opportunities. Companies with a high level of growth opportunities have to increase their debt as they face scarce internal resources (Frank and Goyal, 2009). Leaving the dualism of the main theories on the structure of capital, some scholars point out that the growth opportunity significantly influences the choice of the lender. For example, Houston and James (1996) find that the relationship between bank lending and growth opportunity depends on the number of banks they use and whether a firm has public debt outstanding. They found a negative relationship between firms having a single bank and a positive one for multiple banks. Krishnaswami et al. (1998) and Cantillo and Wright (2000) document a positive relationship between growth opportunity and the use of private debt.

Another essential feature that can influence a company's choices is its financial health. The best indices representing the financial situation are liquidity and financial leverage. Myers and Majluf (1984), Rajan (1992), Pagano et al. (1998) argue that financial characteristics are important determinants for accessing external finance. If we consider the leverage characteristic, its high level could be associated with an unhealthy balance sheet. Therefore, firms with a high level of leverage face greater difficulties in obtaining funds in the market, as Cantor (1990) and Bougheas et al. (2006) argue. Other authors state that the probability of resorting to public fund increases with leverage. A high rate of leverage can be seen as a certification of excellent creditworthiness, Pagano et al.(1998), Datta et al. (2000) and Dennis and Mihov (2003). Furthermore, these companies generally have very high replacement needs; therefore, they will often resort to the bond market. Also, Mizen and Tsoukas (2014), in their analysis of the Asian market, come to the same conclusions: companies with high leverage are successful and have a high borrowing capacity.

As with leverage, liquidity can positively or negatively influence the decision to issue. Hale and Santos (2008) argue that companies with high liquidity levels take longer to resort to the bond market because they have substantial internal funds. Consistent with these scholars, Pagano et al.(1998), Datta et al. (2000), and Dennis and Mihov (2003) argue that firms with less liquidity have a greater incentive accessing

the bond market to find additional finance.

Another important characteristic is the cash flow. This specific feature is typical of the debate on capital structure theory. In fact, according to the *TOT* and, in particular, agency theory, a high level of cash flow could lead to too risky attitudes on the part of the managers. According to Jensen (1986), managers may undertake investments that are harmful to the firm; therefore, increasing debt to reduce cash flows would be necessary to avoid these behaviours (empire building). At the same time, it helps ownership by preserving the shareholder structure. On the contrary, *POT* argues that high cash flows would guarantee a constant source of self-financing. In this way, external forms of financing should be marginally used. In the case of the choice of the lender, Cantillo and Wright (2000) argue that cash flows are the attributes that can most accurately predict a firm's choice of lenders. Therefore, a high level of the latter pushes companies to choose arm's length investors. However, Stulz (1990) argues that there should be the right compromise between the over-investment problem and the under-investment problem, the latter faced by Myers and Majluf (1984) and Myers (1984) alleging the existence of asymmetric information. For this reason, cash flows are difficult to interpret as explanatory variables of the capital structure and are, in fact, little used.

At the and the risk of firms can affect the decision. One of the most used measures to capture the proxy of failure is the Z-score (Altman, 1968). For instance, Denis and Mihov (2003) use Altman's probability of default. These scholars argue that the likelihood of default is higher for firms that borrow from the public market. At the same time, they find that companies with a higher risk of bankruptcy are turning to the latter among private and non-bank banking service providers. Regarding the risk associated with a company, the *TOT* predicts a negative relationship between risk and leverage. As told above, risk firms might be associated with profitability characteristics. This is because firms with high-profit volatility are more likely to fail, Fama and Franch (2002), Frank and Goyal (2009), Harris and Raviv (1991). In addition, *POT* suggests that risky firms are less leveraged to reduce the likelihood of issuing new risky securities or forgoing investments with a positive net present value.

Given that, in this case, the two theories are consistent with each other, Fama and Franch (2002), Frank and Goyal (2009), Harris and Raviv (1991).

1.2.4 Other Factors

The aspects we indicated earlier are undoubtedly important determinants of capital structure. Some scholars have extended the papers quoted in the previous subsection by attributing another essential factor to the firms' environment. We want to highlight, for example, Rajan and Zingales (1995), who analyze the different capital structures within the G-7 countries. Although firms have similar levels of capital structure, they find many differences. For example, they argue that specific institutional characteristics are fundamental and influence the capital structure of firms: taxes, bankruptcy laws, level of bond market development and ownership patterns. Other scholars have done more descriptive studies in this regard. For instance, Mcclure et al. (1999) obtain empirical results that support significant differences in capital structure levels among G-7 countries. In contrast, Wald (1999) investigates the characteristics that influence capital structure in France, Germany, Japan, the UK, and the US. He identifies similar determinants across countries but also finds many differences. These differences in line with Rajan and Zingales (1995) are due to institutional structures. A similar analysis, with results consistent with Rajan and Zingales (1995), is performed in the Spanish context; Miguel and Pindado (2000) find that institutional characteristics influence capital structure. Finally, Mizen and Tsoukas (2014) analyze whether in the Asian continent policies of encouraging the bond market by institutions is a factor that promotes the issuance of minibonds. They find that these types of initiatives are an important factor influencing bond issuance by Asian firms.

Other scholars analyze the eurozone context, Bongini et al. (2021). They find that some country-specific variables have a greater impact than firm-specific variables. For example, they find that their proxy capturing capital market development is the variable that most influences access to market-based financing. Others analyze how different combinations of financial instruments and channels differ across SMEs

in Europe, see Moritz et al. (2016). He finds that the reasons depend on firm characteristics and structural differences between countries. He also analyzes the level of complementarity and substitutability of different financing channels.

In this regard, several scholars have investigated this issue. For instance, Davis and Ioannidis (2004) and Holmstrom and Tirole (1997) argue that bank lending and bond issuance are complementary. On the contrary, Becker and Ivashina (2014) say that when the credit standards are tightening, firms can comply with their need to issue bonds. Kaya and Wang (2015) find the same results and argue that the price difference between bank credit and bond issuance undoubtedly has an important impact on the decision of non-financial firms. Bolton and Freixas (2000) argue that when firms face dilution costs, they replace loans with bonds. At the same time, those who need flexibility will resort to bank loans.

If we analyze the Italian context, there is also a cultural factor. Historically, Italian companies have a strong propensity to rely on the banking system.

Already in 1922, in an article on the crisis of the Banca Italiana di Sconto, published in the Economic Journal, Piero Sraffa observed that in Italy, financing from banks "represents an absolute necessity for the industry" and that "because of the scarcity of capital in the country, of the general reluctance to invest in movable goods [...] industries cannot otherwise obtain the capital they need". Indeed, the close link between banks and companies and the latter's capital weakness has been a major factor in the fragility of the financial system at various stages.

The excessive dependence of companies on banks and the predominant role of debt over risk capital are long-standing problems of the Italian economy. The President of the Bank of Italy, Ignazio Visco, speaking at the Baffi Carefin Research Center (2019), reports much data regarding the dependence of Italian companies on the banking system. In the middle of the last decade, the financial structure of Italian companies has been characterized by high levels of debt concerning both capital and profit margins. In 2007, financial leverage was 39%, two percentage points higher than the average for the eurozone and over ten points higher than in the United States. The incidence of bank loans on total financial debt reached two thirds in Italy, while

it was around 50% in the euro area and less than 40% in the United Kingdom and the United States. On the other hand, recourse to market finance was minimal: bonds accounted for less than 6% of financial debt, two percentage points less than in the euro area, compared with values of over 15% and 30% in the United Kingdom and the United States. In the years immediately following the global financial crisis, corporate leverage increased by more than 10 percentage points to 50 per cent, primarily due to further growth in bank lending and a sharp reduction in the market value of venture capital. In the wake of the sovereign debt crisis, adjusting the financial structure has begun.

Between 2011 and 2017, leverage fell by a total of ten percentage points, returning to pre-crisis levels. Half of the contraction was contributed by the exit of the most financially fragile companies from the market, one-third by the increase in venture capital and the remainder by reducing the debt of companies that remained in business. The return to more balanced financial conditions is, therefore the result, on the one hand, of the very hard selection following the crisis, and on the other, in recent years, of the increase in profitability favoured by the economic recovery, which has allowed, especially for larger companies, to strengthen their assets.

Despite the progress, the differences in the international context are still wide. Italian companies continue to be highly dependent on bank credit. Although it has fallen by more than 7 percentage points since the end of 2011, the incidence of bank loans on total financial debt is now close to 60%, the highest value among the main countries in the area and still more than 25 and 30 points higher than in the United States and the United Kingdom. Although the share of bonds has risen to 13% (a value in line with the average for the euro area), it is still around 10 points lower than in the UK and over 25 points lower than in the USA. The degree of stock market development also remains insufficient: at the end of 2017, the capitalization of unlisted non-financial companies was 25 per cent of GDP, compared to 60 in Germany, over 70 in France and the United Kingdom, and around 125 in the United States.

1.2.5 Minibond Literature

Minibonds represent a group of financial securities that can be issued by non-listed companies. Minibonds are an alternative to traditional financing channels, not yet deeply analyzed by scholars.

Some scholars as Altman et al. (2020) have shown that the average credit quality of minibond issuers is above the average of SMEs in general. Therefore, they have shown that, in Italian market, the reasons that push companies to 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 the reduction of banking dependence.

Mietzner et al. (2017) analyze the minibond market in Germany. They highlight the possibility that low-quality firms can exploit this new funding channel to raise funds. This is because rating agencies are still unable to efficiently distinguish the quality of firms. Therefore, high quality firms tend to issue undervalued minibonds to signal their high quality. In both papers, some weaknesses of the current rating system are highlighted, but the relative level of the issuances should be more deeply analyzed.

Ongena et al. (2020) propose a very interesting study on behalf of the European Central Bank (ECB). These scholars came to interesting conclusions. First of all 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 reduces the dependence of companies on the banking system, despite the fact that 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 the use of this new financial instrument leads to an increase in total assets and fixed assets.

Of particular relevance for the development of our investigation is the research conducted by Politecnico di Milano (Osservatorio Mini-Bond, 2015-2021). This is because every year the prestigious Italian university publishes reports in which it focuses its attention on this particular financial instrument, with specific focus to the

effects that the latter has on small and medium-sized Italian companies. These reports provide updates on any changes in the legislative structure, a complete descriptive analysis of the phenomena and future prospects. Finally, it provides a complete list of companies that have taken advantage of minibonds in Italy.

1.3 Research Questions: statement, plan for development and brief outline of the results

According to existing contributions in the literature, we want to explore a context that has been little or not at all deepened. In fact, the emergence of new sources of financing for companies opens new scenarios and possibilities that need to be investigated. In fact, the theory of capital structure is constantly evolving and needs to be continuously enriched. For these reasons we can state some relevant research questions in this regard, which could contribute and fill an existing gap in the literature of capital structure.
First of all, we face the following general issue:

*RQ*1 What are the determinants that explain the level of minibonds issued by companies that decided to use this type of financial instrument?

Then, we proceed by entering in more detail the context of companies issuing minibonds by facing the following three additional research questions:

*RQ*2 Which is the level of heterogeneity – in terms of the considered financial variables – of the firms issuing minibonds? More specifically: how does such heterogeneity vary around the issuance time?

*RQ*3 How is cohesive the environment surrounding firms issuing minibonds – being high cohesiveness associated with companies having high similarity in terms of the considered financial variables? More than this: how does cohesiveness vary around the minibond issuance date?

*RQ*4 Which is the effect of the issuance of minibonds on firms performance?

Facing the research questions $RQ1$–$RQ4$ provides a panoramic view of the companies issuing minibonds, hence exploring this new and relevant financing channel for firms. Indeed, $RQ1$ discusses how the main firms variables are linked to the level of issued minibonds. At the same time, $RQ2$ and $RQ3$ investigate the mutual connections among the firms issuing minibonds and the characteristics of the overall financial environment surrounding them. Finally, $RQ4$ is devoted to the explanation of the link between minibond issuance and performance.

To carry out our empirical analysis and face $RQ1$, $RQ2$ and $RQ3$, we consider the sample composed of the 198 issues of minibonds. We take 2018 as the reference year.

According to the Politecnico di Milano's minibond observatory (Osservatorio Mini-Bond, 2019), at the end of 2018, 498 companies were registered as having issued minibonds, which raised more than 25 billion of euro through 746 issues. Among these firms, 260 are SMEs that have issued a total amount of debt of 4.6 billion of euro up to 2018. Considering all companies, the average interest rate was 5.1% while the average maturity was around 5.3 years.

Differently, to implement a reliable analysis over a longer period, we take a sample of 117 issuing companies[4] occurred in 2016 for research question $RQ4$.

According to the Politecnico di Milano's minibond observatory (Osservatorio Mini-Bond, 2017), at the end of 2016 there were 222 companies registered as having issued minibonds, which raised more than 11.5 billion of euro through 295 issues. Among these firms, 95 are SMEs that issued a total amount of debt of 1.3 billion of euro up to 2016. Considering all companies, the average interest rate was 5.4% while the average maturity was around 5.7 years.

It is also important to note that their report (Osservatorio Mini-Bond, 2017 and 2019) includes issuances by company capital or cooperatives with their own operations (excluding banks and insurance companies) of less than 500 million of euro, not

[4]According to the observatory of the Politecnico di Milano in 2016 there were 106 issues for 88 issuing companies. Through a personal communication with Giancarlo Giudici - scientific director of the Mini-Bond Observatory - we have updated the list of issues and issuing companies in 2016.

listed on lists open to retail investors. The issuing companies are therefore very heterogeneous and include both small and medium-sized companies as well as large enterprises.

These 198 emissions for $RQ1$, $RQ2$ and $RQ3$ and 117 issuances for $RQ4$ concerned 176 and 100 companies, respectively. For them, we collected a list of financial and non-financial characteristics using the AIDA database[5].

We enter the detail of the contextualization and the methodological devices used for facing the considered four research questions.

For $RQ1$, we are in the scientific context of capital structure, having the celebrated paper by Modigliani and Miller (1958) as a keystone. In the past, scholars have compared the two main financing channels for companies, namely debt and equity, with the clear aim of finding the right mix between them (Trade-off Theory). Others have explored the reasons why some companies prefer a private rather than a public type of loan. Houston and James (1996), Johnson (1997), Cantillo and Wright (2000), Denis and Mihov (2003), in this regard, document a relationship between the use of public debt and specific characteristics of firms. On the other hand, some scholars believe that the choice is not due to the characteristics that may differ from one company to another rather to the significant advantages that private debt has over public debt. Diamond (1991), Fama (1985), Myers (1984), Rajan (1992), in this regard, have hypothesized that the choice of firms is influenced by the level of information asymmetry with lenders. Indeed, the Pecking Order Theory (POT) developed by Myers (1984) and Myers and Majluf (1984) explains the choice between different types of debt. Research question $RQ1$ refers to the large theoretical framework on firm's capital structure with an emphasis on the debt choices. For a more detailed review of our reference literature along with a motivation behind $RQ1$, refer to Chapter 2.

To answer $RQ1$, we run two cross-section regressions with two dependent variables. The first will be given by the amount issued normalized by total assets, and the second normalized by total debt. As independent variables we used a series of firms'

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

specific characteristics and we introduce non usual explanatory variables. To identify our significant variables, we followed the logical of the backward method[6], namely we gradually removed those characteristics that are not statistically significant and those that can create collinearity problems. We applied these methodologies in order to test the robustness so that we have counter-proof about our outcomes. In the end we will obtain such as result a series of variables that will turn out to be the main determinants of the research question.

In facing $RQ1$, we provide two main contributions in the reference literature. First, our study concerns of an alternative debt instrument that reduces, specially, the bank dependence of non-listed companies. Although some studies have dealt with the topic of minibonds in Europe (see, e.g., Mietzner et al. 2017; Altman et al. 2020; Osservatorio Mini-Bond, 2015-2021) none have investigated what are the determinants that lead companies to use more quantity of them. Secondly, some explanatory variables have been introduced in our model which are considered influential in the financial choice. Hence, this study contributes to fill the gap in outstanding literature, providing insights over this new financial instrument.

Thus, the regressions contain all independent variables advise by literature plus those one introduced by us. In particular, the spread between bank rate applied to companies and that relating to the issue rate of the minibonds; free cash flows to the firm ; the difference between return on investments and the rate relating to financial payables. In fact, we think that these variables can play an important role in the firm's decision to issue minibonds. Firstly, the spread between bank interest rates and rates applied to the minibonds is created ad hoc. In this way we can understand if the choice depends on the costs. Secondly, we have created a proxy which aims to capture the risk linked to each individual company. This new variable will be our proxy of failure. At the end cash flows have also been included as it is a measure that,

[6]In the literature there are three procedures of automatic selection: *Backward elimination*, *Forward selection* and *Stepwise regression*. These automatic procedures at first glance might be desirable. However, it must be remembered that no procedure can replace the judgment of the researcher. The final models obtained through the automatic procedures are not necessarily sensible.

in our opinion, can influence financial decisions. In fact it is not an new variables -as there is wide literature in this regard as mentioned in section 1.2- but few scholars used it. In addition, we will also run regression with dummy variable in order to control the determinants effect on SMEs and large companies.

Our results underline a statistical irrelevance for many independent variables included in both models. We also note that the level of issued minibonds issued is negatively related some specific variables that are significant in both models. Moreover, the considered models show a general coherence in terms of significant variables except for the noticeable case of the spread. Regarding the control through dummy variable, there is no statistical significance. This shows that SMEs do not use higher level of minibonds than large enterprises. This result does not seem to be in line with the objective set by the Italian legislator.

For research questions $RQ2$ and $RQ3$, we adopt a complex network approach. In particular, we advance a novel methodological approach where firms are considered as nodes of a weighted undirected network (for an overview of complex networks, see Newman, 2018 and Barabasi, 2016). The weights of the links are built by taking into account that two highly similar firms are strongly connected. The similarity is here intended in the light of several variables related to the characteristic of firm – total asset, return on asset and leverage, just to mention a few.

The ground of our proposal is that firms with similar variables tend to show the same level of development in terms of the considered characteristics (see e.g. Xi et al., 2021, Cerqueti et al., 2021). In doing so, networks allow to provide a view of the overall structure of the investigated sample. As pre-announced above, the network analysis is carried out on a yearly basis around the date of the minibond issuance, to observe the evolution of the structure of the set of firms around this relevant financial decision. In this respect, we build one network for each year and for each financial variable.

The considered networks are investigated through highly informative centrality measures. Among them, the degree and the clustering coefficient play a prominent role in our study. Indeed, the degree describes the homogeneity of the structure of firms

interconnections, with a detailed focus on their entities. In doing so, the analysis of the nodes degree gives insights on the modification of the similarities among the firms – of course, in terms of their main financial variables – when considering also the minibond issuance. Thus, the degree is the instrument used to face $RQ2$. The clustering coefficient is a proxy of the cohesiveness of the nodes of a network. In our financial setting, it provides information on the variation of the embeddedness of the nodes in the overall financial context when such a cohesiveness is generated by similar financial variables and in presence of minibonds issuance. Therefore, the clustering coefficient is the quantity used to provide a response to $RQ3$.

We can summarize the difference between degree and clustering coefficient information content as follows: the degree is used to see if firms present similar characteristics (high degree) or dissimilar ones (low degree); the clustering coefficient is used to see if firms are close to other firms presenting similar characteristics (high clustering coefficient) or dissimilar ones (low clustering coefficient). Therefore, high degree can be obtained also when the clustering coefficient is low. Indeed, a firm can be highly similar to a large set of other companies (high degree) but, at the same time, its neighbourhoods can show different characteristics (low clustering coefficient).

To the best of our knowledge, this is the first study advancing the study of firms' characteristics when introducing minibonds in a complex networks context. However, there are some relevant contributions that deal with corporate finance issues from a complex networks perspective. We can mention Huang et al. (2009) who first analysed the topological characteristics of networks and problems in stock markets. In their paper, they use a threshold method to construct the correlation network of Chinese stocks and then study the structural properties of the network and topological stability. We mention Xi et al. (2021), whose computed the structural similarity of financial indicators using normalised Euclidean distance, they constructed networks based on firm performance and analyse the topological characteristics and parameters of the networks to represent the level of similarity between firms; Xi and An (2018) used a network based on the similarity of financial indicators constructed through Pearson's correlation coefficient, providing a quantitative approach to investment and

financial management of the firm. Some researchers used the power of complex networks to gain insight on supply chain management and managerial decision-making, as suggested by Borgatti and Li (2009). In this context, Carter (2007) uses social network analysis models to study the logistics and supply chain management of firms, while Fracassi (2017) proves that the professional and educational connections of managers have important implications in decision-making. These social connections also have implications for the value of firms, in fact those that are more socially connected show better economic performance.

Some important results emerge from $RQ2$ and $RQ3$: on the one hand, we observe a sort of isomorphism between the clustering coefficient and the strength centrality degree, which means that firms maintain substantially the same level of heterogeneity both in terms of similarity with other firms and in terms of cohesiveness. On the other hand, there is evidence of a quite high level of homogeneity for all the analysed characteristics in both the analyzed parameters; thus, there a broad similarity among the firms using this new financial instrument, despite the noticeable differences of the firms in the sample. Finally, we point out that some characteristics – such as liquidity and growth opportunity – are more sensitive to the introduction of minibonds.

Finally, research question $RQ4$.

To answer $RQ4$ we use a cluster analysis approach. In particular, we present a method based on the Voronoi tessellation (Voronoi, 1908).

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, and Zubin (1938), Tryon (1939) and Cattell (1943) in psychology.

This statistical tool is based on identifying specific reference points, called centroids. Each centroid induces a cluster collecting elements with a shorter 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.

Therefore, the ground of this proposal is to compare those firms that belong to the same cluster in terms of performance and level of minibonds issued. In this respect, cluster analysis seems to be particularly effective in providing a global analysis of the relationship between such financial quantities. We also present a disaggregated analysis of the individual performance components.

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

However, this is the first study that relates this new financial instrument and firms' performance.

As announced above, in carrying out this work, 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 level of minibonds issued and the performance of firms in the triennium 2017-2019. The performance and the amount issued have been collected from empirical data in our context. The former is captured by variables that can be grouped into three different macro-categories. In contrast, the amount of minibonds issued is only relativised according to total assets. This study also provides another important key to understanding the two different approaches with which centroids have been defined. In the first approach, they are chosen equidistant, while in the second approach, they are determined based on the distribution that every single variable of interest shows. The main difference between the two approaches stems from the selection of centroids; in the equidistributed case, the analysis conducted could be influenced by the presence of some anomalous firms. As a result, distortions in cluster assignment may occur. Indeed, the presence of an outlier pushes the remaining firms into adjacent clusters. On the contrary, this does not happen when centroids are selected based on the distribution of the variables of interest.

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

Although our context and methodology are very specific, cluster analysis is generally used in economics fields. We can mention Ausloos et al. (2018), which 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 was Pavitt (1984); he is 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 analyse the performance of countries, industrial districts or at the firm level (see Zahra and Covin, 1994; Gligor and Ausloos 2007, 2008a, 2009b). Others use cluster analysis to investigate how North American and European firms converge in terms of performance and governance, such as Valsan and Druica (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 Reisel, 2014; Jain and Kini, 2006; Zhou and Zhang, 2005).

Some significant results emerge from the analysis of $RQ4$. On the one hand, there is a high level 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 macro-category growth opportunity. The macro-category profitability seems to be affected by outliers within it. The last macro-category 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. Therefore, according to the analysis carried out, there seems to be a slight relationship between the relative level of minibonds issued and the performance of firms. Still, unfortunately, it cannot be said that performance is strongly linked to the issuance of minibonds.

1.4 Organization of the Thesis

The structure of the PhD thesis is the following. Chapter 2 provides an answer to $RQ1$. In particular, it is concerned with identifying the main characteristics that drive firms to issue a higher or lower level of minibonds.

In Chapter 3, we deal with research questions $RQ2$ and $RQ3$. Specifically, we focus on heterogeneity and cohesiveness of companies in the context of minibonds issuances.

In Chapter 4, we face the firms' performance problem of issuing companies. Here, we use cluster analysis approach in order to answer $RQ4$.

Finally, in Chapter 5 we report the summary of our work, its limits and trace line for future research.

Chapter 2

The determinants of the level of minibonds in Italy

In this chapter we face research question $RQ1$.

It is organized as follows. Section 2.1 describes the empirical sample and the employed methodology. This section also presents the variables used in the analysis and some descriptive statistics. Section 2.2 describes and discusses the empirical findings and the robustness of the results. Finally, section 2.3 gives some conclusive remarks.

2.1 Data, Variables, Statistics and Employed Methodologies

This section describes the empirical sample, variables, statistics and methodology employed to face $RQ1$. The first subsection 2.1.1 presents the sample selection procedure. Subsection 2.1.2 reports the variables and their measurements.The subsection 2.1.3 presents the descriptive statistics and relative comments. Last subsection 2.1.4 describes the methodology we applied to get our results.

2.1.1 Data

This study uses a cross-sectional approach to investigate the $RQ1$ through an empirical instance based on a dataset referring to Italian firms.

The analysis is performed from the companies that issued minibonds in 2018. The entire population of issuing companies is extrapolated from Politecnico di Milano's annual report on minibonds (Osservatorio Mini-Bond, 2019). During this period, Politecnico di Milano reported an amount of minibond issuance of 198. However, some companies use this financial instrument on more than one occasion, so we record the possibility of having multiple issues. Therefore, the number of issuing companies drops to 176. There are small, medium and large enterprises in the studied population.

The firms' data are collected from the AIDA database, from which the annual financial statements published by the same firms can be checked and compared. The period that requires this analysis also includes 2016 and 2017 as we see below[1].

The year 2018 is our base year, from which the regression analysis is developed. It serves as the baseline for assigning the relative level of minibonds issued. In fact, through the amount issued by each firm, we are able to derive a relative one from eliminating possible distortions due to inequality in terms of firm size.

Given these premises, we exclude those companies that did not publish their 2017 and 2016 annual financial statements in the AIDA-BVD database. We do not include companies that did not issue their financial statements in 2018. Finally, we eliminate those companies that, although they regularly publish their annual financial statements, do not make available and usable some financial statement items and indicators essential to develop our study. As a result, our sample is composed of 127 issues out of a total of 198 issuances recorded in 2018 by Politecnico di Milano and covers all economic sectors.

We want to specify that the emissions in our analysis are 104 and 99, respectively. This difference is given by the use of two different dependent variables, each of which

[1]Through personal communication with Giancarlo Giudici - scientific director of the Mini-Bond Observatory - we have been able to add information about issuances, such as applied interest rate, maturity and amount issued by companies in 2018.

performed independent regression. Moreover, multiple emissions are not aggregated in our models.

Data are treated with care, avoiding the loss of too much information and ensuring the empirical tractability of the problem. Specifically, in this research, the variables described in the next section are collected and processed manually.

2.1.2 Variables

As previously mentioned, this study investigates minibond issuance by firms in an Italian context. Moreover, performing a cross-sectional regression, there are two types of variables, dependent and independent.

Regarding the dependent variables in our study, there are two. They are defined as the ratio between the amount of minibonds issued by firms -of the selected population, see Osservatorio Mini-Bond, 2019- and their total debt and assets, respectively. The amount issued is appropriately transformed into a relative term to avoid distortions due to the different sizes of firms in the population.

Regarding the independent variables, we used a standard set of firm-specific variables that are consistent with the theory literature presented in section 1.2. In addition, our independent variables include some factors consistent with the innovative nature of this research.

Our dependent and explanatory variables are the following:

- The ratio between amount issued in 2018 over total debt accounting in 2017 (A/TD).
- The ratio between amount issued in 2018 over total assets accounting in 2017 (A/TA).
- Age is the seniority of firms reported before the issuing time, i.e. 2017.
- Size, this variable has two main proxies in literature, the first is given by total assets and the second by sales. Each is taken in the year preceding the issuance,

namely 2017.

- Growth opportunity is measured as the annual sales growth rate recorded in the year preceding the issuance of minibonds, i.e. 2017.
- Leverage is defined as the ratio between total debt and total assets in 2017.
- Collaterals are calculated as the ratio between the fixed assets and total assets or between tangible assets and total assets, respectively. Both refer to the year 2017.
- Liquidity is measured as the ratio between current assets and current liabilities in 2017.
- Spread, this variable is calculated as the difference between the average bank interest rates applied to corporate loans minus the interest rate at which the companies issued minibonds on the market. We take into account the average bank rates applied to Italian companies in three periods: short (less than 1 year), medium (between 1 and 5 years), and long (more than 5 years) term. Therefore, we subtract the average bank interest rate from each coupon according to the above time intervals.
- Profitability measured as the return on investment (ROI) in 2017.
- Cash Flows, this variable represents the cash flows for the company or those flows that are available both to repay debts and remunerate shareholders. We take free cash flow to the firm in 2017.
- Proxy of failure, we take the difference between the return on investment (ROI) in 2017 from which we subtract the ratio given between the finance charges in the year preceding issuances and the financial debt relating to two years before the issuances.
- Dummy, this dichotomous variable tells us that the firm is an SME when our observation is equal to 1 and is equal to 0 otherwise.

The following notation have been used:

- Y1 represent the first dependent variable (A/TD).
- Y2 denote second dependent variable (T/TA).
- AGE represent the variable age.
- TA is the first measure of size given by total assets.
- SAL is the second measure of size given by sales.
- SG represent variable growth opportunity.
- LEV denote leverage variable.
- COL1 is the first measure of collaterals given by the ratio between fixed assets and total assets.
- COL2 is the second measure of collaterals given by the ratio between tangible assets and total assets.
- LIQ denote firms liquidity.
- SPR stands the spread variable.
- ROI denote the profitability variable.
- FCFF represent free cash flow to the firms.
- FR denote our proxy of failure
- D is the dummy variable.

We summarize definitions, calculation and symbol in Tables 2.1 and 2.2.

	Maturity		
	<1	1-5	>5
First quarter	1,87	1,32	2,80
Second quarter	1,83	1,77	2,91
Third quarter	2,02	1,61	2,78
Fourth quarter	1,85	1,70	2,60
MEAN	1,89	1,60	2,77

Table 2.1: The table shows the values - in percentage terms - of the average interest rates applied to Italian companies in 2018 in the respective quarters. The data are collected from the Banca d'Italia website. Last row is the average interest rate applied to Italian in the respective time frame.

2.1.3 Summary Statistics

In this section, we show the composition of the sample and the descriptive statistics of our main variables. Politecnico di Milano reports (Osservatorio Mini-Bond, 2019), 176 firms that issued minibonds in 2018, of which 123 are entered this type of market for the first time. These 176 corporate enterprises issued 198 minibonds. This number is increased compared to the previous year.

In 2018, 95 SMEs issued minibonds (54% of the population), the remaining 81 being large companies (46% of the population). In terms of maturity, the average value for 2018 is 5.2 years (up slightly from 4.9 years in 2017). The average issuance value is 21.6 million, and the average interest rate applied to minibonds is 5.1% (lower than 2017).

Going into detail, we can see the different nature of the companies:

- 127 issuers turning out to be joint-stock companies, equal to 72.2% of the total;
- 45 are limited liability companies, equal to 25.6% of the total;
- 4 are cooperative companies equal to 2.3% of the total.

VARIABLE	PROXY	SYMBOL
T/TD	Amount(2018)/Total debt (2017)	Y1
T/TA	Amount(2018)/Total assets (2017)	Y2
Age	Seniority in 2017	AGE
Size 1	Total assets (2017)	TA
Size 2	Sales (2017)	SAL
Growth opportunity	[(Sales(2017)-Sales(2016))/Sales(2016)]x100	SG
Leverage	Total debts(2017)/Total assets(2017)	LEV
Collateral 1	Fixed assets(2017)/Total assets(2017)	COL1
Collateral 2	Tangible assets(2017)/Total assets(2017)	COL2
Liquidity	Current assets(2017)/Total liabilities(2017)	LIQ
Spread	Bank interest rate(2018) - Minibond interest rate(2018)	SPR
Profitability	[EBIT (2017)/Total assets(2017)]x100	ROI
Cash-flow	EBIT(2017)*(1-%Tax)+$D\&A$(2017)$\pm$ Δ WC(2016/2017)	
	$\pm$ Δ CAPEX (2016/2017)	FCFF
Proxy of failure	ROI(2017)-[(Financial charges(2017)/Financial Debt(2016))]x100	FR
Dummy	SMEs=1 ; No-SMEs=0	D

Table 2.2: Provides descriptions of dependent and independent variables. In the first column we find our variables. In the second one we report all proxy and if necessary the calculation procedure. Last column reports the symbology used for each proxy in the continuation of chapter.

Tables 2.3, 2.4 and 2.5 collect the descriptive statistics of minibonds concerning maturity, interest rate and amount issued for whole, SMEs, and no-SMEs sample respectively.

Table 2.3 reports some descriptive statistics for our sample, which does not coincide with the population of issuing firms as explained in section 2.1.1. Of the 127 remaining issuances, we record an average maturity of 5.14 years, while the average coupon is 4.34%; finally, the average amount issued is 20.6 million euros. Looking at the characteristics of the sample, we record a certain heterogeneity of the sample. This could be due to the presence of very different companies, especially in terms of the amount issued. Despite this, a relatively low variability is observed for maturity and coupon, suggesting that the average could be a good estimator.

Tables 2.4 and 2.5 divide our sample between SME and no-SME. that 76 SME (58%) and 51 no-SME (42%). Looking at the tables, we notice that large companies have lower coupons, even though the minimum interest rate is applied to an SME. Small and medium-sized companies are also among those that pay a higher coupon. As far as variability is concerned, we find rather low values for coupon and maturity in both groups. On the contrary, the variability of the amount is high for both.

Tables 2.6, 2.7 and 2.8 collect the descriptive statistics of minibonds concerning dependent and explanatory variables for whole, SMEs, and no-SMEs sample, respectively.

Table 2.6 shows that, on average, companies that decide to use this new financial instrument make extensive use of it. We see that issuances are about 20% and 12% of debt and total assets recorded in 2017, respectively. In addition to this, we note a notable difference between the minimum and maximum values, with the latter possibly being anomalous. With the data at our disposal, we cannot know what kind of operations are behind, probably concealing acquisition or merger policies. There could also be a complete reorganization of debt between 2017 and 2018. Finally, we are seeing a lot of variability for our dependent variables. The same is true for the statistics of the independent variables; in fact, all of them show an important variability except for leverage and liquidity. The data suggest heterogeneity of the

	Observations	Mean	Std.Dev.	Min	Max	Std.Dev./Mean
Maturity (years)	127	5,14	2,79	0,09	20	0,54
Interest rate (%)	127	4,34	1,55	0,8	10	0,36
Amount (ml.)	127	20,6	59,7	0,3	455	2,9

Table 2.3: Descriptive statistics of the whole sample.

	Observations	Mean	Std.Dev.	Min	Max	Std.Dev./Mean
Maturity (years)	76	4,95	2,94	0,09	20	0,59
Interest rate (%)	76	4,5	1,66	0,8	10	0,37
Amount (ml.)	76	10,4	32,6	0,3	225	3,14

Table 2.4: Descriptive statistics for SMEs.

firms that compose our sample, probably also in the core business. This heterogeneity is probably also due to the different quality of the issuing companies.

Tables 2.7 and 2.8 report descriptive statistics divided by size. The data suggest that, on average, SMEs are younger, have a higher spread, and are riskier than large companies. In addition, profitability and sales growth are more pronounced among large companies. On the other hand, liquidity and leverage levels are very similar, as is the use of minibonds concerning total debt and assets. In both groups, there is high variability except for liquidity and leverage. This suggests that there is also a high level of heterogeneity among the groups.

	Observations	Mean	Std.Dev.	Min	Max	Std.Dev./Mean
Maturity (years)	51	5,4	2,55	0,54	12	0,48
Interest rate (%)	51	4,13	1,36	0,98	6,75	0,32
Amount (ml.)	51	35,9	83,6	0,5	455	2,33

Table 2.5: Descriptive statistics for No-SMEs.

	Min	Max	Mean	Std. Dev.	Std. Dev./Mean
Y1	0,003	3,936	0,204	0,420	2,05
Y2	0,002	1,259	0,119	0,176	1,48
AGE	3	87	26,7	16,1	0,60
TA	5.385.886	47.436.537.000	499.203.679	4.202.353.917	8,4
SAL	0	1.506.719.171	97.443.063	184.301.191	1,89
SG	-97,4	10.535,6	95,2	934,1	9,81
LEV	0,157	1,110	0,683	0,167	0,244
ROI	-33,0	26,2	3,8	5,6	1,46
COL1	0,007	0,98	0,415	0,248	0,59
COL2	0,000	0,81	0,178	0,187	1,05
LIQ	0,08	1,9	0,80	0,35	0,43
SPR	-8,4	2,7	-2,0	1,7	-0,83
FR	-39,9	20,3	-0,95	6,4	-6,73
FCFF	-29.034.107	101.795.680	4.764.414	15.485.615	3,25

Table 2.6: Reports descriptive statistics of dependent and independent variables. Whole sample

	Min	Max	Mean	Std. Dev.	Std. Dev./Mean
Y1	0,016	2,1	0,20	0,3	1,47
Y2	0,009	0,95	0,12	0,15	1,27
AGE	3	72	23,7	16,0	0,68
TA	5.385.886	924.522.000	69.538.447	137.122.332	1,97
SAL	0	73.954.523	20.418.197	14.782.273	0,72
SG	-97	10.535	150	1207	8,0
LEV	0,157	1,1	0,68	0,19	0,28
ROI	-33,0	17,5	3,2	6,0	1,9
COL1	0,02	0,98	0,43	0,26	0,6
COL2	0,000	0,81	0,184	0,20	1,1
LIQ	0,08	1,87	0,78	0,37	0,47
SPR	-8,4	2,7	-2,21	1,88	-0,85
FR	-39,9	15,0	-1,77	6,9	-3,9
FCFF	-19.409.560	16.462.029	378.485	4.770.567	12,6

Table 2.7: Reports descriptive statistics of dependent and independent variables. SMEs sample.

	Min	Max	Mean	Std. Dev.	Std. Dev./Mean
Y1	0,003	3,936	0,20	0,55	2,67
Y2	0,002	1,259	0,117	0,20	1,74
AGE	5	87	31,2	15,4	0,5
TA	14.006.957	47.436.537.000	1.139.489.123	6.616.317.900	5,8
SAL	11.576.962	1.506.719.171	212.225.215	250.624.310	1,2
SG	-18,9	85,6	13,5	17,4	1,3
LEV	0,21	0,9	0,7	0,14	0,2
ROI	-2,96	26,2	4,8	4,96	1,0
COL1	0,007	0,9	0,4	0,23	0,6
COL2	0,00	0,72	0,17	0,17	0,98
LIQ	0,12	1,76	0,85	0,32	0,38
SPR	-4,6	1,8	-1,8	1,4	-0,78
FR	-8,55	20,280	0,27	5,5	20,5
FCFF	-29.034.107	101.795.680	11.300.307	22.301.520	1,9

Table 2.8: Reports descriptive statistics of dependent and independent variables. No-SMEs sample.

2.1.4 Methodology

To explore what are the main determinants that drive a firm to issue minibonds, we used a cross-sectional analysis such that :

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_k X_{ki} + \varepsilon_i \tag{2.1}$$

where, Y_i is the $i-th$ observation of the dependent variable, $X_{2i}...X_{ki}$ are the $i-th$ observations of each of the k regressors and ε_i is the error. β_0 is the intercept and β_k are the coefficients associated with the regressor X_k.

The model can be represented in matrix notation in the following way:

$$\vec{y} = \vec{X}\vec{\beta} + \vec{\varepsilon} \tag{2.2}$$

where $\vec{y}$ is the vector $n \times 1$ consisting of the ordered set of n observations on the dependent variable, realisations of the random variable Y; $\vec{X}$ is the $n \times k$ matrix obtained from the ordered set of n observations on the $k-1$ explanatory variables; $\vec{\beta}$ is the vector consisting of the k coefficients of the explanatory variables $\vec{X}_i$; $\vec{\varepsilon}$ is the vector $n \times 1$ of unobservable occurrences of the stochastic disturbance component at the n times to which the sample surveys refer.

Our dependent variables are two. The first one is the ratio of the amount of minibonds issued in 2018 to total debt in 2017 (A/TD). The second is the ratio of the amount of minibonds issued in 2018 to total assets in 2017 (A/TA). The explanatory variable are age, size, growth opportunity, leverage, collateral, liquidity, spread rate, profitability, a proxy of failure and dummy.

In both models, the first step is to clean up the data. The identification and elimination of outliers are made through a careful graphical evaluation of each variable. All marked outliers values are eliminated through the interquartile method (i.e. box plot). In addition, cleaning is performed using multivariate outlier identification, i.e., Mahalanobis distance. We then identified the best combination of independent variables to include in our model. Following some unreported regressions, the choice

fell on TA and COL2 as proxies for size and collateral, respectively.

In the next step, we realise the non-linearity of the relationships. Partial regression plots are used to see where the non-linearity existed. Furthermore, this approach, which examines one variable at a time, can simultaneously facilitate the identification of possible outliers. We identify and eliminate all potential outliers using univariate, bivariate, and multivariate outlier analysis.

Following verification of the individual relationships between each independent variable and our two dependent variables our regression equations are as follows:

$$\begin{aligned} Y_1 = {} & \alpha_0 + e^{\alpha_1(AGE)} + e^{\alpha_2(TA)} + \alpha_3(SG) + \alpha_4(SG)^2 + \alpha_5(SG)^3 + \alpha_6(LEV) + \alpha_7(LEV)^2 + \alpha_8(LEV)^3 + \\ & + \alpha_9(ROI) + \alpha_{10}(ROI)^2 + \alpha_{11}(ROI)^3 + \alpha_{12}(COL2) + \alpha_{13}(COL2)^2 + \alpha_{14}(COL2)^3 + \\ & + \alpha_{15}(LIQ) + \alpha_{16}(LIQ)^2 + \alpha_{17}(LIQ)^3 + \alpha_{18}(SPR) + \alpha_{19}(SPR)^2 + \alpha_{20}(SPR)^3 + \\ & + \alpha_{21}(FR) + \alpha_{22}(FR)^2 + \alpha_{23}(FR)^3 + \alpha_{24}(FCFF) + \alpha_{25}(FCFF)^2 + \alpha_{26}(FCFF)^3 + \\ & + \alpha_{27}(D) \end{aligned} \tag{2.3}$$

and

$$\begin{aligned} Y_2 = {} & \beta_0 + \beta_1(AGE) + \beta_2(AGE)^2 + \beta_3(AGE)^3 + e^{\beta_4(TA)} + e^{\beta_5(SG)} + \beta_6(LEV) + \beta_7(LEV)^2 + \beta_8(LEV)^3 + \\ & + \beta_9(ROI) + \beta_{10}(ROI)^2 + \beta_{11}(ROI)^3 + \beta_{12}(COL2) + \beta_{13}(COL2)^2 + \beta_{14}(COL2)^3 + \\ & + \beta_{15}(LIQ) + \beta_{16}(LIQ)^2 + \beta_{17}(LIQ)^3 + \beta_{18}(SPR) + \beta_{19}(SPR)^2 + \beta_{20}(SPR)^3 + \\ & + \beta_{21}(FR) + \beta_{22}(FR)^2 + \beta_{23}(FR)^3 + \beta_{24}(FCFF) + \beta_{25}(FCFF)^2 + \beta_{26}(FCFF)^3 + \\ & + \beta_{27}(D), \end{aligned} \tag{2.4}$$

where the parameters α's and β's are the regression coefficients, to be calibrated.

Equation 2.3 contains 104 emissions while 2.4 have 99 issuances. The relationships between the individual dependent variables and each independent variable are nearly identical with the exception of the explanatory variables AGE and SG.

The last step was the standardisation of the independent variables. By regressing the values of the independent variables thus obtained, we get the standardised regression coefficients. We use the well-known Variance Inflation Factor (VIF) to identify

the collinearity. We excluded variables that have a value greater than 5. Finally, we eliminate those regressors with a lower significance until we obtain a set of explanatory variables with a statistical significance of less than 5%. Several regressions are performed to arrive at the optimal combination that maximises R^2.

Each methodological step was performed with SPSS statistical software and assisted by EXCEL.

2.2 Results and Discussions

Table 2.9 presents the results of our model using the dependent variables amount of minibond issuance on total debt (Y1) and that of minibond issuance on total assets (Y2). As illustrated above, each regression is run considering the amounts issued in the 2018 period and their denominators in 2017. We use ordinary least squares (OLS) regression to obtain the results. After removing outliers, we have different observations for the respective dependent variables. The analysis carried out confirm the absence of multicollinearity among the independent variables. Size (TA), leverage (LEV), collateral (COL2), liquidity (LIQ), spread (SPR) and proxy of failure (FR) are not affected by this problem for the regression model run with the dependent variable Y1. The second model that considers the dependent variable Y2 is not affected by the multicollinearity issue for variables size (TA), leverage (LEV), collateral (COL2), liquidity (LIQ), and proxy of failure (FR). Table 2.9 is divided into 5 columns. In the first, we find the complete list of independent variables and their non-linear relationships with the dependent variables; in columns 2 and 3, we report the models related to the dependent variable Y1. Finally, in columns 4 and 5 we report the models related to the dependent variable Y2. Columns 2 and 4 show the results of the complete model of Y1 and Y2. Specifically, these regressions suffer from the presence of multicollinearity, and many variables turn out to be non-significant. We arrived at the best possible combination by running several unreported regressions as columns 3 and 5 show. Indeed, they report only the dependent variables that turn

out to be significant after a gradual elimination.

As we can see in column 3 only those variables are present that have a statistical significance greater than 5%. We have an adjusted R^2, which is 0.414. The statistically significant variables are size (TA), leverage(LEV), collateral (COL2), liquidity (LIQ), spread (SPR) and proxy of failure (FR). We can see that the signs of our determinants are negative for size, leverage, collateral and liquidity, while we see a positive relationship with spread and proxy of failure. The standardised coefficients show that liquidity has the most significant impact on the amount of minibonds issued. Since our coefficient has a negative sign, this suggests that firms with more liquidity will resort to smaller issuances.

This seems to be in contrast with the results of Mizen and Tsoukas (2014); the latter find a positive relationship between the probability of issuing bonds and a certain liquidity level of a firm, beyond which the probability decreases given the non-linear nature of the relationship. Our result seems to be consistent, on the other hand, with POT; in fact, firms that have a high level of liquidity prefer to draw on their resources rather than resorting to issuing new debt or, more generally, go to external forms of financing.

We can then see that leverage is quite influential on the amount of minibonds issued. LEV has a negative sign, which tells us that the higher its value, the smaller the amount of minibonds issued.

This seems consistent with that part of the literature that associates an unhealthy equilibrium with high leverage (Cantor, 1990) and Bougheas, Mizen, and Yalcin (2006). In contrast, Mizen and Tsoukas (2014) find that the probability of using bonds increases with the level of leverage. It is also interesting to relate our results to Dennis and Mihov's (2003). They find a positive relationship between the probability of using public debt and leverage. At the same time, they find a lower likelihood of using private non-bank debt when leverage is higher. Indeed, although minibonds appear to be public debt, they might also be classified as non-bank debt. However, it often happens that the subscribers of minibonds are the same banks that provide logistical support to firms. Therefore, we can say that our results are consistent with

these scholars.

Next, in order of importance, we find collateral (COL2). The sign of the latter is negative. This tells us that firms with high levels of assets will issue fewer minibonds.

It seems to be inconsistent with previous literature. In fact, according to Mizen and Tsoukas (2014), a high level of tangible assets would ensure an easy recovery of the amounts invested by lenders. This, therefore, should be true for whatever type of financing channel the firms choose. However, our results suggest the opposite. This relationship would seem consistent with Dennis and Mihov (2003). They suggest a lower probability of turning to private non-banks with a higher fixed asset level (used as a collateral variable). Therefore, if a firm has high assets, it would prefer issuing a lower level of minibond.

Next, in order of importance, we have size (TA). The relationship between size and our dependent variable is negative. This sign also tells us that firms with higher total assets issue lower levels of minibond.

Compared to the existing literature, our results are not straightforward to all literature. Indeed, let's consider the probability of using bond issuance. Our results are inconsistent with that part of the literature that finds a positive relationship between the probability of issuing bonds and total assets, see Dennis and Mihov (2003), Cantillo and Wright (2000) and, Mizen and Tsoukas (2014). On the contrary, it seems consistent with Dennis and Mihov (2003), who show a lower probability of financing through private non-banks with higher total assets. Moreover, it appears to be consistent with the legislator's idea who, through a specific law ("Decreto Sviluppo"), want to facilitate access to credit for small and medium-sized enterprises.

On the other hand, we test whether there is an actual causality between being an SME or not. We include a dichotomous variable among our independent variables (SME = 1, no-SME = 0). In this model, however, we do not find the significance of this variable. Therefore, we cannot say with certainty that SMEs will issue larger amounts of minibonds than no-SMEs.

By checking our standardised coefficients reported in column 3 of Table 2.9 we find two innovative variables explicitly created to study the phenomenon of minibonds.

It is very interesting to see that the spread (SPR) is very significant, and that of the proxy of failure (FR) is significant. Both signs this time turn out to be positive; therefore, companies with more favourable coupons and lower risk issue larger quantities of minibonds.

As far as the spread variable is concerned, we see that the greater the cost advantage over the banking alternative, the more companies resort to this new financial instrument. However, this result must be interpreted with care. Cost may not be the only possible explanation why more and more companies are turning their attention to minibonds. This instrument is developed to help companies reduce their dependence on the banking system, focusing on small and medium-sized companies. Therefore, the company could choose this channel to eliminate downstream banking control. In fact, the banking system could erode the surplus; this behaviour could influence the future choices of firms, see Rajan (1992). This result suggests to us that not only do firms issue a higher level of minibonds when SPR increases, but also when it is decreasing. It is because we have the only significant quadratic term. The complete model partly confirms the special relationship; in fact, we find significance for the quadratic and cubic terms only.

Moreover, the positive sign of the FR variable tells us that less risky firms will issue more minibonds. This result seems consistent with Rajan(1992) and Diamond (1991). Indeed, firms that are able to build credibility over time have easier access to financing channels outside the bank channel. It is also since the screening and monitoring effectiveness of the banking system acts as a guarantee for other types of investors. Riskier or low-rated enterprises need the knowledge and skills of the banking system to grow. At the same time, Denis and Mihov (2003) find that firms resort to bank debt rather than public debt if firms are risky. Whereas if the choice is between non-bank and bank debt, they prefer to avoid the banking system, and finally, companies choose the latter between public and non-bank debt. In our case, an exhaustive interpretation is not straightforward, given the innovative nature of this instrument and the problematic placement of minibonds.

Columns 4 and 5 of Table 2.9 present the results of our model using the depen-

dent variable amount of minibond issuance over total assets (Y2). After eliminating outliers, we have 99 observations. We also have an adjusted R^2 that settles at a value of 0.321, therefore lower than the previous one. The statistically significant variables are size (TA), leverage (LEV), collateral (COL2), liquidity (LIQ) and proxy of failure (FR).

This new model consolidates the previously-mentioned results; in fact, the determinants are the same and have a high significance. The signs of the coefficients are in line with those obtained in the previous regression model, so the interpretation presented previously on the individual variables remains the same. This result suggests that the determinants we find are essential in minibond issuance. These results add robustness and goodness of fit to our study, allowing us to argue that the determinants we found may indeed be relevant in the decision to use a given level of minibond. In the second regression, we find some differences in terms of the importance of the independent variables. Finally, we see that the variable SPR does not turn out to be more significant.

2.3 Conclusions

This chapter analyses the effects of diversifying sources of financing through the issue of corporate bonds by taking advantage of the introduction of a recent regulatory reform in Italy aimed at removing existing restrictions on the topic of corporate bonds by unlisted companies.

This reform represents an interesting experiment in deregulation. It allows companies that previously relied solely on bank credit to obtain financing from capital markets through the issue of so-called minibonds. This chapter focuses on the issuance of minibonds in 2018, investigating the characteristics that drive firms to use greater levels of this new source of financing.

Therefore, this analysis aims to find the main determinants of the level of minibonds issued, considering the limited information and available data. One of the few -to date- focuses on this new form of financing for companies, so we would like to

contribute to filling the gap in the literature. Indeed, few scholars have explored this new market. We recall Altman et al (2018), Mietzner et al (2019) and Onega et al (2020). In addition to these, we recall the annual reports carried out by Politecnico di Milano (Osservatorio Mini-Bond, 2015-2021).

Therefore we draw from the pre-existing literature many of the characteristics included in our regressions (see section 1.2); moreover, we introduce some innovative variables that could capture some crucial aspects of the new financing channel available to them.

To identify the determinants of issuance, we performed a non-linear OLS regression. Our analysis finds that characteristics such as liquidity, leverage, collateral, size, spread and proxy of failure are determinants of entrepreneurial choices.

More liquid firms tend to use less of this new source by having available internal resources. Very often, the level of liquidity is also associated with the firm's health. However, low liquidity does not necessarily mean that a firm is in difficulty; in fact, sometimes, the problem can be resolved only by harmonizing maturities.

The leverage determinant tells us that a high level of debt drives firms to issue low levels of minibonds. At the same time, our analysis shows an attempt by issuing firms to replace their debt partially, probably due to the need and desire to reduce dependence on the banking system. Minibonds allow companies to have a longer time horizon to capitalize on the investments made. It seems to be in line with the results obtained by Ongena et al. (2020), who find that although companies' level of financial debt increases, they record a decrease on the part attributable to bank debt. High leverage could configure an unhealthy balance sheet and consequently make a company less attractive. On the contrary, it could be due to excellent creditworthiness (Mizen and Tsoukas 2014).

The presence of more collateral, on the other hand, would make this new financing channel less attractive. This is mainly due to the more favourable market conditions that the banking system can still offer to firms with more assets to offer as collateral to banks.

It is why we find a positive relationship on the SPR variable. This result suggests

that the more subtle this difference is, the more companies prefer issuing minibonds. Nevertheless, it seems strange to see how firms turn to this new market even though it still has higher costs. An interpretation that could justify our result is that companies are willing to pay more today to have better conditions tomorrow by having more negotiating power with the banking channel. It seems consistent with the results obtained by Ongena et al. (2020).

Moreover, firms that, according to our proxy of failure, are less risky issue higher levels of minibonds. This result seems to be in contrast with Mietzner et al. (2019). In fact, the latter find that less risky firms issue lower levels of minibonds. Recall, however, that the reference market for these scholars is the German one.

As far as the size variable is concerned, we see that smaller companies tend to issue higher levels of minibonds; thus, the legislator's intention seems to be fulfilled. Despite this, we cannot say with certainty that this financing channel is used more by SMEs, as the dummy variable is not significant in our regressions.

In conclusion, this analysis has significant implications for the design and planning of the development of the minibond market both in the Italian and European context. Although much remains to be done to fully explore the mechanisms behind this new financial channel, our work is a small step that can add additional elements in this direction. Many of our results may have different interpretations, denoting a marked heterogeneity in the reasons that lead companies to use this instrument. Furthermore, it would be interesting to analyze the determinants of the minibonds only in the paradigmatic context of the SMEs; such research would allow for a deeper understanding of the mechanisms involved in the employment of such a financing instrument.

	Y1		Y2	
	1	2	3	4
Constant		***		***
	(1,113)	(5,142)	(1,270)	(4,810)
AGE (exp)	-0,168*			
	(-1,817)			
AGE			-0,136	
			(-0,810)	
AGE (square)			0,119	
			(0,458)	
AGE (cubic)			-0,142	
			(-0,455)	
TA (exp)	-0,365***	-0,376***	-0,409***	-0,392***
	(-3,610)	(-4,760)	(-3,199)	(-4,439)
SG (exp)			0,171	
			(1,663)	
SG	-4,915			
	(-1,403)			
SG (square)	-10,013			
	(-1,409)			
SG (cubic)	-5,109			
	(-1,380)			
LEV	-0,514***	-0,453***	-0,314	-0,294***
	(-3,120)	(-4,924)	(-1,508)	(-3,012)
LEV (square)	0,194		0,026	
	(1,478)		(0,128)	
LEV (cubic)	0,238		0,019	
	(1,173)		(0,066)	
ROI	0,195		0,023	
	(0,899)		(0,092)	
ROI (square)	0,438*		0,376*	
	(1,960)		(1,939)	
ROI (cubic)	-0,525		0,408*	
	(-1,604)		(1,698)	
COL2	-0,499***	-0,442***	0,407***	-0,491***
	(-3,203)	(-4,639)	(-2,158)	(-4,595)
COL2 (square)	-0,519		-0,529	
	(-1,512)		(-1,165)	
COL2 (cubic)	0,512		0,421	
	(1,347)		(0,877)	
LIQ	-0,846***	-0,595***	-0,665***	-0,556***
	(-5,237)	(-6,161)	(-3,527)	(-5,576)
LIQ (square)	-0,13		-0,051	
	(-0,075)		(-0,281)	
LIQ (cubic)	0,232		0,083	
	(1,031)		(0,380)	
SPR	-0,174		-0,037	
	(-1,271)		(-0,231)	
SPR (square)	0,264**	0,303***	0,066	
	(2,491)	(3,762)	(0,441)	
SPR (cubic)	0,260*		0,059	
	(1,788)		(0,306)	
FR	0,177	0,211**	0,437	0,332***
	(0,811)	(2,597)	(1,640)	(3,646)
FR (square)	-0,056		0,121	
	(-0,266)		(0,594)	
FR (cubic)	0,043		-0,221	
	(0,177)		(-0,835)	
FCFF	0,252		0,038	
	(1,479)		(0,186)	
FCFF (square)	0,148		-0,008	
	(1,218)		(-0,071)	
FCFF (cubic)	-0,260		0,008	
	(1,343)		(0,039)	
D	-0,42		-0,177	
	(0,418)		(-1,456)	
Observation	104	104	99	99
R^2	0,602	0,449	0,473	0,355
Adjusted R^2	0,461	0,414	0,273	0,321

Table 2.9: Regression results. We run standard OLS (using non-linear relationships) to identify the factor that determine minibond issue. The standardized coefficients and respective t statistics are in parentheses below. Constants coefficient are absent because of standardization. Outliers are excluded from a univariate, bivariate, multivariate analysis. Investigating the variance inflection factors (VIFs) reveals no multicollinearity in models 2 and 4. The ***,**,* indicate statistical significance at the 1%, 5%, 10% levels, respectively.

Chapter 3

Similarity-based heterogeneity and cohesiveness of companies in the context of minibonds issuances: the case of Italy

This chapter investigates research questions $RQ2$ and $RQ3$.

It is organized as follows. Section 3.1 offers some preliminaries and notation related to complex networks, which is the methodological device used to explore the research questions. Section 3.2 provides a description of the empirical sample and defines the variables used for the analysis. Section 3.3 presents the financial network models and the centrality measures employed to face the research questions. Section 3.4 contains the results of the analysis, along with a critical discussion of them. Section 3.5 concludes.

3.1 Preliminaries and Notations

A graph is expressed as a set of nodes and links, mathematically denoted as follows $G = (V, E)$, where V represents the set of n nodes and E is the set of m links.

From now on we will consider nodes as $i, j \in V$ or similarly $i, j = 1, ..., n$, and the link (i, j) denotes the connection between nodes i and j.

The links are captured by the n-square adjacency matrix $\mathbf{A} = (a_{ij})_{i,j}$ whose generic entry a_{ij} is one if there exists a link between nodes i and j and zero otherwise. When the links are associated to real numbers giving the entity of their connections, we are in the case of a weighted network. In this context, the adjacency matrix is of weighted type. It is given by $\mathbf{W} = (w_{ij})_{i,j}$, with $w_{ij} = 0$ when $(i, j) \notin E$ – i.e., there is not a link between i and j – and $w_{ij} > 0$ otherwise. If one has in general that $w_{ij} \neq w_{ji}$, then the network is directed. Differently, if $\mathbf{W}$ is symmetric, then the network is undirected.

A weighted network is denoted as $N = (V, \mathbf{W})$.

A large amount of research concerning network analysis deals with the issue of centrality measures. Indeed, the different measures of centrality allow us to understand which are the most important nodes in some sense.

In our networks we will use two different types of measures, i.e. degree centrality and clustering coefficient. In the following, we briefly describe such centrality measures.

The degree centrality of a node $i \in V$ in a weighted undirected network counts the number of the nodes which are adjacent to i, by including also the links' weights (see Freeman, 1979).

In the case of weighted network, the degree centrality –call strength degree– of a node $i \in V$ is defined as :

$$k_i = \sum_{k \in V} w_{ik} \tag{3.1}$$

The (local) clustering coefficient C_i of a node $i \in V$ concerns the level of embeddedness of i in the whole network.

It is the ratio between the existing triangles around i and the hypothetical ones, where triangles are evaluated by including also the weights of the links. Therefore, the local clustering coefficient of a node ranges between 0 and 1. For a weighted

network, the clustering coefficient C_i for a node $i \in V$ is defined as follows (Onnela et al., 2005):

$$C_i = \frac{1}{(n-1)(n-2)} \sum_{j,k} \left(w_{ij} w_{jk} w_{ki}\right)^{\frac{1}{3}}. \tag{3.2}$$

3.2 Data

The theoretical network models, as specified above, are implemented through an empirical study based on datasets referring to Italian firms. The empirical data refer to a group of firms, which share the issuance of minibonds. The dataset is based on the information provided by the annual report dedicated to minibonds and published by Politecnico di Milano, in our case, in a specific year, i.e. 2018(see Mini-bond Osservatorio, 2019). This sample of firms includes small, medium and large enterprises. This list provided by the Politecnico di Milano is composed of 176 companies for an overall total of issuances of minibonds are equal to 198. As we will see, in the treatment phase his number has been reduced to 94. Our empirical study compares a list of economic-financial characteristics of these 176 upstream and downstream issuing firms. Precisely, we explore a time interval from 2016 to 2019. Starting from the initial sample, we retrieved the financial statements of the upstream and downstream issuing firms through Bureau Van Dijk's (BVD)-AIDA portal. AIDA-BVD is a portal in which a range of information, including the financial statements, of over 500.000 Italian companies is collected. Therefore, the number is reduced as not all firms provided complete documentation to the portal, automatically causing them to be excluded from the our sample. In this sense, we have 7 variables which are observed from 2016 to 2019 and 5 in the issuing time (2018)[1]. As results we have 33 different networks, each of which has 94 nodes. For a complete and undirected network, the number of possible links can be expressed as: $\binom{n}{k} = \frac{n!}{k!(n-k)!}$. For us,

[1]Through personal communication with Giancarlo Giudici - scientific director of the Mini-Bond Observatory - we have been able to add information about issuances, such as applied interest rate, maturity and amount issued by companies in 2018.

$n = 94$ and $k = 2$, hence we have 4371 links.

3.2.1 Firm Variables

In this section we report the variables used to develop our network theoretical model. First of all, we created two different groups. In the first are those features used to capture time at a particular moment, that of the emission. In the second group are a set of economic-financial and risk characteristics observed before, during and after the issuance.

In group 1 we have:

- *Age*, is expressed in years tell us how old firms are at the time of issue i.e. 2018;
- *Amount*, is expressed in millions of euro and captures the amount of the bond issued in 2018, and multiple issuances by the same company have been aggregated;
- *Minibond interest rate*, is expressed as a percentage and represents the rate at which investors are remunerated, we only took companies that issued minibonds in 2018; where multiple issues were present, minibond interest rate is aggregated through a simple weighted average in which the weights were given by the amount of minibonds issued;
- *Spread*, is given by the difference between bank interest rate applied in 2018 to companies and minibond interest rate. It is expressed in percentage. To make the measure more homogeneous, we have considered three different levels of bank interest rate, as shown in table 3.1. We have divided it in less than 1, among 1 & 5, and more the 5 years (see "Banca d'Italia" website). We averaged the respective quarters;
- *Maturity*, is expressed in years and tells us the natural maturity of the securities issued in 2018. In the case of multiple issues, the data were aggregated according to a weighted average where the weights are given by the amount of minibonds issued.

	Maturity		
	<1	1-5	>5
First quarter	1,87	1,32	2,80
Second quarter	1,83	1,77	2,91
Third quarter	2,02	1,61	2,78
Fourth quarter	1,85	1,70	2,60
MEAN	1,89	1,60	2,77

Table 3.1: The table shows the values - in percentage terms - of the average interest rates applied to Italian companies in 2018 in the respective quarters. The data were collected from the Banca d'italia website. Last row is the average interest rate applied to Italian in the respective time frame.

In group 2 we have:

- *Size*, collects the total assets of the issuing undertakings for the years 2016 to 2019. It is expressed in millions of euro;
- *GrowthOpportunity*, is given by the growth rate of sales from 2016 to 2019, it is expressed in percentage.
- *Collateral* is a proxy for the guarantees offered by the issuing companies, it is given by the ratio of tangible assets to total assets in same year. It has been calculated for the period from 2016 to 2019.
- $Profitability$, is commonly associated with return on investment (ROI). It is given by the ratio between earnings Before Interest Taxes Depreciation and Amortisation (EBITDA), which is one of the main measures used to assess the cash flows of companies and the health of their accounts, and total assets. In our case, profitability has been measured over the years 2016 to 2019, it is expressed in percentage;
- *Risk Firm*, is a given by the volatility of profitability (ROI) and is considered a proxy for risk. It is expressed in percentage. We measured the risk as the

absolute difference between the annual profitability of a given firm i in year y and the average annual profitability of firm i across the sampled period. Four years are covered, from 2016 to 2019;

- *Liquidity* is given by the ratio of current assets to current liabilities, it is calculated for the period 2016 to 2019;
- *Leverage* is a proxy that collects a series of indices expressing the company's level of indebtedness. The surveys cover a four-year period from 2016 to 2019. It is given by the ratio of financial debts to total assets.

The following notations have been used.

- AGE_18 represents variable age in the year 2018;
- AM_18 denotes the amount issued in 2018;
- MIR_18 represents the minibond interest rate in 2018;
- SPR_18 denotes the variable spread in 2018;
- MY_18 denotes the maturity of minibond issued in 2018;
- TA_yy is the size variable, in the year 20yy;
- GO_yy stands for sales variations in year 20yy;
- COL_yy denotes collateral in the year 20yy;
- ROI_yy is the ROI, in the year 20yy;
- FR_yy represents the variable firm risk, in the year 20yy;
- LIQ_yy denotes liquidity variable in the year 20yy;
- LEV_yy represents leverage variable in the year 20yy.

VARIABLES	MEAN	ST.D.	KURT.	SKEW.	V.C.	MIN	MAX
MIR_18	4,21	0.02	0.14	0.11	0.38	0.05	8,5
AM_18	21.95	55.43	12.03	3.52	2.52	0.40	300.00
SPR_18	-1,97	0.02	0.29	-0.17	-0.85	-6,90	1,79
MY_18	5.23	2.77	8.02	1.41	0.53	0.50	20.02
AGE_18	29.40	16.31	0.96	0.78	0.55	5.00	88.00
TA_19	733.37	5160.54	91.31	9.50	7.03	5.86	49887.23
TA_18	709.46	5042.33	91.53	9.52	7.10	5.94	48764.71
TA_17	677.15	4902.60	91.82	9.54	7.24	5.39	47436.54
TA_16	670.49	4937.41	92.19	9.56	7.36	4.65	47807.99
GO_19	3,95	0.21	10.24	2.15	5.22	-53,95	116,02
GO_18	8,55	0.28	18.47	2.52	3.32	-96,89	188,25
GO_17	124	10.86	93.92	9.69	8.72	-97,43	10535
GO_16	24,5	1.60	90.62	9.44	6.53	-34,82	1548,3
COL_19	0.21	0.19	0.84	1.14	0.94	0.00	0.85
COL_18	0.20	0.19	0.77	1.17	0.96	0.00	0.83
COL_17	0.20	0.20	1.48	1.37	0.98	0.00	0.81
COL_16	0.21	0.21	1.87	1.46	1.01	0.00	0.94
ROI_19	6.09	5.28	4.88	-0.81	0.87	-18.66	22.14
ROI_18	6.60	4.60	1.05	0.62	0.70	-3.17	21.47
ROI_17	6.94	5.26	1.71	0.81	0.76	-3.27	23.55
ROI_16	7.16	7.53	6.54	-0.43	1.05	-29.26	33.42
FR_19	2.02	2.81	7.43	2.62	1.39	0.00	15.19
FR_18	1.32	1.61	6.51	2.30	1.22	0.02	8.46
FR_17	1.50	1.87	7.97	2.60	1.25	0.00	10.07
FR_16	2.43	4.17	17.09	3.79	1.72	0.01	27.60
LIQ_19	1.42	0.80	6.99	2.20	0,56	0.34	5.23
LIQ_18	1.53	0.89	9.42	2.66	0.58	0.34	6.00
LIQ_17	1.37	0.79	8.90	2.59	0.58	0.27	5.46
LIQ_16	1.58	1.80	56.57	6.90	1.14	0.21	16.83
LEV_19	0.41	0.17	-0.61	0.10	0.41	0.07	0.82
LEV_18	0.40	0.16	-0.39	0.04	0.40	0.08	0.86
LEV_17	0.37	0.16	-0.52	0.06	0.43	0.03	0.82
LEV_16	0.54	0.24	0.88	0.30	0.45	0.04	1.38

Table 3.2: Descriptive statistics are respectively mean (MEAN), standard deviation (ST.D.), kurtosis (KURT.), skewness (SKEW.), coefficient of variability (V.C.), minimum (MIN) and, maximum (MAX).

Table 3.2 shows the main descriptive statistics for the correlated variables over the firms.

Variables observed only at the time of release show a controversial pattern. In fact, if the coupon and maturity and seniority have a contained variability, on the one hand, the amount is highly heterogeneous. At the same time, the spread has a relatively high variability but still less than one. As far as their distribution is concerned, we see that the spread, coupon and seniority tend to be normal, while the amount and maturities suffer a significant kurtosis and an asymmetry to the right. On average, we would also point out that minibonds register a higher cost than bank credit by 200 basis points. The average coupon paid and the average maturity of minibonds, on the other hand, is around 4% and 5 years, respectively.

The other variables belong to the group observing the years 2016 to 2019. In this case, we observe marked variations in some variables, negligible in some and not significant in others. For the variable TA_yy and GO_yy, we note high variability as well as for FR_yy even if the magnitude is smaller than the previous one. Other variables have the variability under 1; in particular, LEV_yy have this value under 0.5. Nevertheless, we cannot state that sample of firms is homogeneous by observing the statistical value.

If we observe their distribution immediately, we note strong kurtosis and low skewness for TA_yy, GO_yy, FR_yy and LIQ_yy. This tells us that the distribution is skewed to the right, the tails are very thick, and the shape is very pointed. Also, the median is to the left of our mean, which means that most firms have a value below the calculated mean. The ROI_yy variable, on the other hand, is difficult to interpret because it varies radically between years. Despite that, we can say that it is a symmetric curve with some thick tails across time. The variables COL_yy and LEV_yy instead seem to tend towards a normal distribution, in particular the level of indebtedness.

Finally, we want to emphasize the trend of issuing companies to increase their total assets, a positive level of sales, and profitability. However, these last two values are lower than the pre-issuance level. As far as collateral, liquidity and leverage are

concerned, we note certain values stability over the years. Whereas for the firm risk, we see a more uncertain trend.

3.3 Financial Network Models

The set of nodes V collects the considered firms. For each firms characteristic f and for year y, we build a network $N^{(f,y)} = (V; \mathbf{W}^{(f,y)})$. The weighted adjacency matrix $\mathbf{W}^{(f,y)}$ is constructed by considering the similarity of the nodes with respect to the variable f at year y. For comparison purposes, the elements of f are suitably standardized.

We define the distance between two enterprises as follows:

$$d_{ij} = |f_i - f_j| \tag{3.3}$$

where f_i and f_j are the values of indicator f for companies $i, j \in V$, respectively.

We take that the connection between nodes i, j is strong when such firms are quite similar, which means that the distance d_{ij} is small. Thus, to capture the entity of the connection between i and j, we define

$$w_{ij}^{f,y} = \frac{1}{d_{ij} + 1} \tag{3.4}$$

$w_{ij}^{f,y}$ in eq. (3.4) ranges between $(0, 1]$. In particular, we can say that the weight with which the two nodes are connected is maximum when the distance is 0, i.e., $f_i = f_j$. As a result, the weight connecting two nodes i and j is maximum when it is 1, while it will get close to 0 when the connection between nodes becomes weaker.

3.4 Results and Discussions

Tables 3.3 and 3.4 report the descriptive statistics of strength degree and clustering coefficient in all the considered networks, respectively.

The results are performed through the software R assisted by EXCEL.

VARIABLES	MEAN	ST.D.	KURT.	SKEW.	V.C.	MIN	MAX	V.% M.
TA_16	87.89	9.47	56.13	-7.20	0.11	8.73	90.01	
TA_17	87.77	9.55	54.52	-7.11	0.11	8.74	89.94	-0.13
TA_18	87.58	9.62	52.91	-7.00	0.11	8.75	89.81	-0.22
TA_19	87.47	9.66	52.09	-6.95	0.11	8.75	89.73	-0.12
ROI_16	54.96	10.36	2.34	-1.63	0.19	16.11	63.48	
ROI_17	52.28	8.83	1.98	-1.52	0.17	24.17	60.07	-4.87
ROI_18	51.35	8.34	1.37	-1.32	0.16	23.33	59.38	-1.78
ROI_19	53.05	9.04	2.81	-1.67	0.17	16.60	60.56	3.31
LIQ_16	68.53	11.03	10.71	-2.99	0.16	9.75	75.52	
LIQ_17	58.35	11.44	3.44	-1.88	0.20	15.40	67.34	-14.86
LIQ_18	58.13	11.23	3.49	-1.84	0.19	15.84	67.16	-0.38
LIQ_19	55.86	10.06	4.21	-2.01	0.18	16.49	63.65	-3.90
LEV_16	51.15	7.55	2.59	-1.48	0.15	21.91	58.42	
LEV_17	49.98	5.86	2.94	-1.65	0.12	26.32	55.52	-2.28
LEV_18	50.21	6.67	0.95	-1.04	0.13	25.92	57.45	0.45
LEV_19	49.82	6.16	0.90	-1.30	0.12	29.90	55.38	-0.77
GO_16	81.94	9.06	47.48	-6.30	0.11	8.77	85.65	
GO_17	89.40	8.48	90.96	-9.47	0.09	8.70	90.87	9.11
GO_18	60.18	11.91	3.23	-1.83	0.20	12.70	69.31	-32.68
GO_19	56.70	10.76	3.30	-1.81	0.19	14.64	65.25	-5.79
FR_16	65.11	12.93	5.29	-2.39	0.20	13.35	72.77	
FR_17	58.88	11.14	4.74	-2.32	0.19	17.46	65.78	-9.57
FR_18	58.01	11.37	2.45	-1.76	0.20	17.88	66.24	-1.47
FR_19	61.09	12.81	3.00	-1.95	0.21	16.86	69.68	5.31
COL_16	54.32	9.63	2.24	-1.68	0.18	22.18	62.13	
COL_17	53.74	9.22	2.31	-1.74	0.17	24.36	61.06	-1.08
COL_18	53.12	8.88	1.46	-1.47	0.17	22.64	60.83	-1.14
COL_19	52.69	8.35	2.26	-1.71	0.16	22.87	59.10	-0.80
AM_18	74.02	15.81	6.42	-2.77	0.21	16.01	80.95	
AGE_18	51.17	6.82	5.36	-2.16	0.13	21.11	56.52	
MIR_18	50.63	7.31	1.93	-1.55	0.14	27.21	56.79	
MY_18	56.29	10.73	1.33	-1.30	0.19	14.81	64.82	
SPR_18	50.94	7.91	1.04	-1.20	0.16	25.15	59.06	

Table 3.3: Summary statistic for weighted centrality degree (strength degree) of variables. Descriptive statistics are mean, standard deviation, kurtosis, skewness, coefficient of variability, minimum, maximum, and mean's variation respectively.

As shown in Table 3.3, looking at the averages, we notice that the size proxy (TA_yy) has a very high-rank value that remains constant over the period considered,

VARIABLES	MEAN	ST.D.	KURT.	SKEW.	V.C.	MIN	MAX	V.% M.
TA_16	0.94	0.08	64.78	-7.76	0.09	0.20	0.96	
TA_17	0.94	0.08	62.86	-7.65	0.09	0.20	0.95	-0.14
TA_18	0.93	0.09	61.23	-7.54	0.09	0.20	0.95	-0.23
TA_19	0.93	0.09	60.29	-7.49	0.09	0.20	0.95	-0.13
ROI_16	0.57	0.08	3.15	-1.78	0.14	0.26	0.63	
ROI_17	0.54	0.07	2.31	-1.60	0.12	0.32	0.60	-5.17
ROI_18	0.53	0.06	1.67	-1.39	0.12	0.32	0.59	-1.83
ROI_19	0.55	0.07	3.61	-1.80	0.12	0.26	0.61	3.53
LIQ_16	0.72	0.09	15.07	-3.48	0.12	0.20	0.78	
LIQ_17	0.61	0.09	4.49	-2.10	0.15	0.25	0.67	-15.95
LIQ_18	0.61	0.09	4.73	-2.08	0.14	0.26	0.67	-0.40
LIQ_19	0.58	0.08	5.26	-2.20	0.13	0.26	0.64	-3.94
LEV_16	0.53	0.06	2.58	-1.49	0.11	0.31	0.58	
LEV_17	0.52	0.04	2.43	-1.50	0.09	0.34	0.56	-2.52
LEV_18	0.52	0.05	0.74	-1.01	0.10	0.34	0.57	0.53
LEV_19	0.52	0.05	0.70	-1.23	0.09	0.37	0.56	-0.75
GO_16	0.87	0.08	58.83	-7.16	0.09	0.20	0.90	
GO_17	0.96	0.08	92.21	-9.56	0.08	0.20	0.97	9.31
GO_18	0.63	0.09	4.71	-2.09	0.15	0.23	0.70	-34.13
GO_19	0.59	0.08	4.45	-2.02	0.14	0.24	0.65	-6.00
FR_16	0.68	0.10	6.69	-2.62	0.15	0.24	0.74	
FR_17	0.61	0.09	5.69	-2.48	0.14	0.27	0.67	-9.99
FR_18	0.60	0.09	3.34	-1.95	0.15	0.27	0.66	-1.83
FR_19	0.64	0.10	3.84	-2.13	0.16	0.27	0.70	5.64
COL_16	0.56	0.07	2.76	-1.81	0.13	0.31	0.62	
COL_17	0.56	0.07	2.78	-1.85	0.13	0.32	0.61	-1.06
COL_18	0.55	0.07	1.81	-1.58	0.12	0.31	0.60	-1.31
COL_19	0.54	0.06	2.57	-1.78	0.12	0.31	0.59	-0.78
AM_18	0.77	0.13	7.14	-2.89	0.17	0.28	0.83	
AGE_18	0.53	0.05	5.42	-2.12	0.10	0.30	0.57	
MIR_18	0.52	0.05	1.89	-1.53	0.10	0.35	0.57	
MY_18	0.58	0.08	1.96	-1.43	0.14	0.25	0.65	
SPR_18	0.53	0.06	1.05	-1.21	0.11	0.33	0.59	

Table 3.4: Summary statistic for weighted clustering coefficient of variables. Descriptive statistics are mean, standard deviation, kurtosis, skewness, coefficient of variability, minimum, maximum, mean's variation, respectively.

around 87. The other characteristics have low values. ROI_yy (between 51 and 54), LIQ_yy (between 55 and 68), LEV_yy (between 49 and 51), FR_yy (between 56 and

65) and COL_yy (between 52 and 54), noteworthy is the proxy GO_yy (between 56 and 81) it records a very high range. Regarding the characteristics analyzed in 2018 alone, only AM_yy has a considerable level (74), while AGE_yy (51), the MIR_yy (50), MY_yy (56) and SPR_yy (50) have values that are not high.

If we look at the standard deviation, we note that its value remains relatively small for the sample analyzed, considering the characteristics observed over time and those inherent in the year of the issue alone. The minimum value is recorded for the variable AGE_yy (6.8) and the maximum for AM_yyy (15.8). Our dispersion index (coefficient of variation) confirms this low volatility, which reaches its maximum value for the AM_yy proxy (0.21). This shows that the variability is low, and our average can be considered a good indicator. Finally, looking at the kurtosis and symmetry values, we can see that none of the strength degree distributions can be assimilated to a normal distribution. In fact, all variables are either leptokurtic or asymmetric. However, it is worth specifying that many distributions do not suffer from a pronounced kurtosis, being in several cases in the presence of a value close to 0. Even some variables have a level of skewness not much high.

Table 3.4, on the other hand, shows the descriptive statistics related to the clustering coefficient; if we look at its average for the characteristics observed over time, we notice a very high value for the variable TA_yy (about 0.93). For the other features we observe smaller values: ROI_yy (between 0.53 and 0.59), LIQ_yy (between 0.58 and 0.72), LEV_yy (between 0.52 and 0.53), FR_yy (between 0.61 and 0.69), COL_yy (between 0.54 and 0.56). As in the previous case, we want to emphasize the large range for the GO_yy proxy (between 0.59 and 0.96).

The features concerning only the issuing time have an average clustering coefficient of 0.77 for AM_yy, 0.53 for AGE_yy, 0.52 for MIR_yy, 0.58 for MY_yy and 0.52 for SPR_yy.

As in the case of strength degree centrality, we have a relatively small standard deviation for all characteristics with the maximum value recorded in AM_yy, about 0.13 and the minimum value from the variable AGE_yy, approximately 0.052. Interestingly, the maximum and minimum values are for the same features observed in

Table 3.3. So is the max value of the coefficient of variation, which is still recorded by the AM_yy characteristic, about 0.17. Also, for the clustering coefficient as for strength degree centrality, these values confirm a low variability of the proxies. Finally, let's look at the various levels of Kurtosis and Skewness. We observe that all the variables (over time and not) have a distribution different from normal. However, it is worth specifying that many distributions do not suffer from a significant kurtosis, being in several cases in the presence of a value close to 0. Some variables have a level of skewness not very far from 0.

Now, if we analyze in detail, the average strength degree from 2016 to 2019 concerning the economic-financial variables considered, we notice that the size proxy (TA_yy) remains almost unchanged. This means that issuing firms were very similar in terms of total assets before issuance, remaining similar during and after issuance. This tells us that minibond issuances did not lead to a disjointness of the homogeneity found on size. In other words, we can say that the introduction of this instrument does not lead to a disarticulation (heterogeneity) of the network. Moreover, the oscillation of homogeneity, recorded by our standard deviation, is minimal in all four years considered. We can say that the 94 nodes that make up the network (i.e., the issuing firms in 2018) have -on average- a high similarity for the size characteristic. The level of skewness and kurtosis is more challenging to interpret. First, we do not notice significant fluctuations in the size variable over time. Instead, there is marked kurtosis and negative skewness. A kurtosis greater than 50 tells us a very high concentration around the mean and very thick tails. If we also consider the strong negative skewness, around -7, we see a very sharp strength degree distribution of centrality, with a very elongated and thick left tail. The most straightforward reason behind the high kurtosis could be the existence of outliers, underlining the presence of some firms with very different sizes from the others. It seems to be in line with our sample, which includes SMEs and large companies.

A very similar argument can be made for the ROI_yy variable in terms of changes over time. Indeed, all descriptive statistics remain relatively stable over time. The main difference between this feature and the previous one is the networks' homogene-

ity level. In fact, in this case, we are in the presence of a higher heterogeneity of the firms while keeping this level of diversity unchanged over time. In other words, we can say that the issuance of minibonds does not lead to changes in terms of homogeneity/heterogeneity of networks for the economic-financial variable ROI over time. Also, in this case, we are in the presence of a substantial distribution of 94 firms, which is not the normal distribution. We notice a positive but contained kurtosis and a negative skewness in this case. The result is a more pointed distribution with an elongated and thicker left tail. In this case, the kurtosis might be more contained also because there are no outliers as in the case of the size feature.

As far as the proxy of Liquidity (LIQ_yy), we find a level of homogeneity for the average statistic that decreases over time. In 2016 this value stood at 68 to decline in the following years, reaching 55 in 2019, i.e. one year after the issuance of minibonds. Therefore, we have a reduction of the average centrality value around 19%. This underlines a tendency of the sample firms to heterogeneity. In other words, the firms that use this financial instrument present more dis-homogeneous levels of liquidity, which is also noticeable in the preliminary phase, i.e. before the issuances. We can affirm that this trend may result from a different strategic approach. For example, some companies might decrease this ratio a priori to subsequently transform short-term debt into long-term debt by issuing minibonds. In contrast, others might decide to issue this short-term financial instrument because they have excellent liquidity. On the other hand, if we look at the level of homogeneity, we note that firms are not so similar according to LIQ_yy. Our distribution is always leptokurtic and has negative skewness.

LEV_yy denote the lowest value of homogeneity according to the strength degree centrality measure. In fact, in 2019, the average level is around 49. If we look at the trend over time, we see certain stability. We can deduce from this result that minibonds do not affect the level of heterogeneity of firms in the time span considered. For Leverage, we find a negative skewness and leptokurtic distribution of node centralities for all other characteristics. But in this case we note that the distribution in quite close to the normal one. In fact we have the lowest value for

kurtosis and skewness measures.

Looking at the next proxy (GO_yy), we see that it undergoes the most significant variation in node homogeneity. The Growth opportunity registers an average centrality value of 89 in 2017 and drops to a minimum of 56 in 2019. The reduction recorded between the maximum and minimum value equals 37%. This tells us that the value of the average sales growth in the years preceding the issuance is very similar among firms, changing markedly in the year of the issuance and afterwards. Therefore the effect of this financial instrument would seem to have an important impact on the growth of average sales. This analysis cannot know what leads to greater heterogeneity of the network for this specific feature; we just report the data inferred from this type of analysis. As far as its fluctuations on the average are concerned, also, in this case, they are somewhat contained, while the level of kurtosis recorded in 2016 and 2017 suggests that there are anomalous values of sales growth in the mentioned years.

Another critical characteristic analysed is the proxy of firm risk (FR_yy). In this case, the average level of homogeneity is medium-high in 2016; in fact, it is around 66. Therefore, firms have a similar overall level of risk. We record a reduction in the year preceding the issuance around 10%. This greater heterogeneity might have a double interpretation. This financial instrument has become necessary for some firms because they have seen its risk increase, or some entrepreneurs have rebalanced their firm to face the capital market more serenely. In 2018 we see stability in terms of heterogeneity, and in 2019, we see homogeneity increase, which suggests that minibonds tend to make nodes have a more similar level of risk. Again, we would need a broader trend to understand whether this instrument tends to level the risk among issuing firms. The standard deviation is not very high, and the distribution of centralities seems to be in line with the others.

Finally, among the proxy observed over time, we have COL_yy. The average values of centrality are practically unchanged in span time. We record a value of 54 in 2016, which decreases slightly and constantly to 52 in 2019. We also note that this feature has a low level of homogeneity. It tells us that we are in the presence of firms that can offer very different guarantees. Its fluctuations are negligible, and the

distribution of centralities suffers from a slight kurtosis and negative asymmetry.

If we look at the networks built on the characteristics collected in 2018 alone. The highest level of homogeneity is recorded with AM_yy -about 74- although there are companies with very different sizes in the sample, this is quite surprising. The average value of centrality is quite high, suggesting that this instrument could be a testing ground for some companies (using this instrument for the first time) or a way to make themselves known to the financial markets by issuing amounts of minibonds that can sound out the market. As for the network built on the AGE_yy, we see a low level of homogeneity, suggesting that this instrument is transversal, i.e. it is used by both younger and older companies. The last characteristics we observe for in table 3.3 are the interest rate of the minibonds (MIR_yy), maturity (MY_yy) and spread (SPR_yy). These three characteristics are interconnected, specially MIR_YY and SPR_yy. It is no coincidence that we see that the average centrality values of MIR_yy and SPR_yy are almost the same. In all these features, we notice a rather weak homogeneity showing that the issuance strategies and the risk of the individual firm (as also seen in the FR_yy feature in 2018) are rather heterogeneous.

Now we observe the development of the clustering coefficient for the selected economic-financial variables. This measure is within a range of $[0, 1]$, unlike the strength degree centrality. It expresses the ability of its neighbouring nodes to form a graph in which each vertex is connected to all remaining vertices. In other words, these metrics are helpful to measure the ability of a network to be interconnected and underline the influence of each node in generating links between nodes close to it. Looking at the characteristics from 2016 to 2019, we realize that the changes follow those of strength degree centrality over the years. This might be explained in part because our network is full.

Having said that, we note that by analyzing the networks based on similarities, isomorphisms have been created for some specific economic-financial characteristics. For example, the network constructed on the size (TA_yy) variable shows a very high and constant cluster coefficient over the observed period. This underlines that the 94 firms are already very cohesive and interconnected in terms of total assets before

the minibond is issued and remaining so afterwards. Therefore, this result confirms the inability of this financial instrument to create significant shocks to the analyzed variable.

More remarkable effects are found for the Liquidity (LIQ_yy) and Growth opportunity (GO_yy) variables, in which the average level of interconnection after issuance is significantly reduced, 20% and 38% respectively. This confirms that the most significant effects on companies are realized on these two characteristics. Therefore, not only firms are less related to each other (as shown by strength degree), but nodes lose their ability to create links to their neighbours.

Although presenting different levels of clustering coefficient, all the other variables remain almost constant over time, creating stable networks and interconnections. So, we can say that the use of minibonds does not lead to a strong destabilization of networks. The cohesiveness for LEV_yy, ROI_yy and COL_yy present levels of homogeneity pretty low around 0,5 even considering along time. The homogeneity of FR_yy is over 0,6. All variables measured over time present a strong isomorphism in terms of results with the strength degree centrality.

Finally, looking at the characteristics chosen for 2018 only, we record a marked isomorphism with the results obtained through the strength degree centrality. The interconnectedness between nodes is relatively high for the amount (AM_yy) of minibonds issued and low for age (AGE_yy) of firms, coupon paid (MIR_yy), maturity (MY_yy) and spread (SPR_yy). Thus, AM_yy is a variable that seems to link rather well not only individual nodes but also their neighbours, while this trend is weaker for the others.

In conclusion, with regard to the analysis's intentions, it is legitimate to affirm the existence of homogenization/heterogenization effects of the networks when this innovative financial instrument is introduced. In particular, we observe that some characteristics such as liquidity (LIQ_yy) and growth opportunity (GO_yy) undergo significant effects following the decision. This choice - being essential for the company's life - is not extemporaneous but instead pondered and carefully evaluated even in the years preceding the issue. If we then consider the timing of the issuance,

we can see that there is a preparatory phase behind the issuance. Furthermore, we want to underline how the tendency of the variables is that of a decrease, considering the level of similarity and cohesiveness. In other words, the firms after the issue are more different from each other and less embedded in the network. Finally, we noticed that, on average, nodes/firms that issue minibonds do not have very high homogeneity levels. This leads us to suppose that the firms interested in this kind of financial instrument are transversal but predisposed to financial innovation.

3.5 Conclusions

In this chapter, we first compute the structural similarity of many financial and descriptive indicators of issuing firms in years y, after which we build 33 different networks weighted according to this similarity. Second, we analyze each network's structure, investigating their levels of homogeneity and connectivity. To analyze this, we use specific network indicators such as degree of strength centrality and clustering coefficient that allowed us to find out. Finally, we verified through many descriptive statistics the evolution of the networks over time - variables belonging to group 2 - and a snapshot of the issue - variables belonging to group 1.

In particular, our investigation configures networks where the nodes represent an entire population of firms undertaking the same market decision and where a set of economic-financial affinities gives the architecture of this network. In such a scenario, we wanted to understand the implications of adopting this tool in line with the objective of the research. The results underline that there is a strong decrease in homogeneity in some cases – LIQ_yy and GO_yy– both in terms of strength degree centrality and clustering coefficient. In most of the variables, regardless of the homogeneity/heterogeneity level, we substantially have stability with a slight tendency to decrease in the instrument's preparatory and post-use phases. In addition, levels of heterogeneity observed are not excessively marked but not negligible in all of our variables except for the AM_yy and TA_yy variables.

Beyond the clear financial implications of our study, we also observe that the

versatility of our method allows scholars to apply it in several real-world instances – not only in finance.

We have one main limitation in this study based on our analysis's structural characteristics. Indeed, heterogeneity and cohesiveness are global features of the networks. Therefore, it is not possible to infer the behaviours of the individual companies from them. In this respect, we present a static analysis, where a modification in the homogeneity or heterogeneity of the networks over time does not provide insights into the related changes of the companies' variables. This says the global analysis of the companies issuing minibonds is worthy because it describes a universe – hence, leading to more general policies to be implemented for modifying the overall industrial structure of a set of companies in the light of some prefixed targets.

Chapter 4

Clustering companies issuing minibonds in the Italian case

This chapter deals with research question $RQ4$.

It is organized as follows. Section 4.1 describes the considered dataset and the employed variables. Section 4.2 contains the methodological instruments used for the analysis. Section 4.3 presents the findings of the analysis, along with a critical discussion of them. Section 4.4 concludes.

4.1 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 (2016). In 2016, the Politecnico di Milano reported an amount of issuances equal to 118. However, there are firms that decided to issue minibonds on several occasions during the year. Therefore, in order to make the analysis consistent, we have aggregated multiple issues, so that each issue will be associated with only one firm. Thus, the number of issuing enterprises is 100. In the study population there are small, medium and large enterprises. The data of the firms have been collected from AIDA database, from which the annual financial statements published by the same firms can be checked and compared. The time

frame we consider is from 2016 to 2019, so that is 4 years.

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

The three-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 *GrowthOpportunity*, 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 (earn before interest depreciation and amortisation 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 three-year period following the issue were aggregated through a simple arithmetic mean. As results of the search for these variables in the AIDA database, the total number of firms available for my analysis is reduced to 66.

4.1.1 Variables

The following notations have been used.

- RLA represent the relative level of amount issued by firms in year 2016, is given by the ratio between amount issued in 2016 and total assets in 2016.
- TAVyy is total asset variation in 20yy.
- FAVyy is the fixed asset variation in 20yy.
- SAVyy stands for sales variations in the year 20yy.

- ROIyy is the ROI in the year 20yy.
- ROSyy is the ROS in the year 20yy.
- MEBITDAyy is the EBITDA margin in the year 20yy.
- ATOyy rapresents the assets turnover, in the year 20yy.
- S/Eyy stands for sales per employee, in the year 20yy.

The first item identifies the level of minibond issued for the year 2016; the other eight items are related to the performance of the companies in the years following the issuance. The relative level of emissions will remain the same for all analyses we perform, while for the variables collected over the three-year period 2017-2019, we will use the following aggregation and notation.

- $T\tilde{A}V$ is the average total assets variation over three years: [2017-2019];
- $F\tilde{A}V$ is the average fixed assets variation over three years: [2017-2019]
- $S\tilde{A}V$ represents the average for sales variations in triennium [2017-2019] ;
- $R\tilde{O}I$ is the average ROI over three years: [2017-2019];
- $R\tilde{O}S$ is the average ROS over three years: [2017-2019];
- $ME\tilde{B}ITDA$ is the average EBITDA margin over three years: [2017-2019];
- $A\tilde{T}O$ represents the average assets turnover, in time-span [2017-2019];
- $S\tilde{/}E$ represents the average for sales per employee, in time-span [2017-2019].

We collect the averaged variables related to performance in a set

$$\mathcal{P} = \{T\tilde{A}V, F\tilde{A}V, S\tilde{A}V, R\tilde{O}I, R\tilde{O}S, ME\tilde{B}ITDA, A\tilde{T}O, S\tilde{/}E\}.$$

We can consider $\mathcal{P} = \mathcal{P}_{GO} \cup \mathcal{P}_{Prof} \cup \mathcal{P}_{Prod}$, being $\mathcal{P}_{GO}, \mathcal{P}_{Prof}, \mathcal{P}_{Prod}$ the subsets of $\mathcal{P}$ related to Growth Opportunity, Profitability and Productivity, respectively, i.e.:

$$\mathcal{P}_{GO} = \{T\tilde{A}V, F\tilde{A}V, S\tilde{A}V\}, \qquad \mathcal{P}_{Prof} = \{R\tilde{O}I, R\tilde{O}S, MEB\tilde{I}TDA\}, \qquad \mathcal{P}_{Prod} = \{A\tilde{T}O, S\tilde{/}E\}.$$

4.2 Methodology

The clustering procedure we adopted is based on the Voronoi tessellation, with an asymmetric generalisation of the Euclidean distance. We used this methodology taking in to account our specific setting. For this purpose, we performed two different Voronoi tessellation analyses in which the selected centroids follow two alternative paths. In the first case centroids are uniformly distributed, in the second case they are chosen according to the distribution of selected variables.

The final aim we want to achieve is to compare companies with respect to their cluster and placement. The cluster 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 performance of the firms, averaged over the three years following the issuance 2017-2019.

In order to avoid scale effects and to make the study consistent, the variables of interest were normalised with respect to their range of variation. Formally, for each company j, with $j = 1, \ldots, 66$, we define:

$$\bar{x}_j = \frac{\tilde{x}_j - m_x}{M_x - m_x}, \tag{4.1}$$

where $\tilde{x}_j$ is the averaged quantity of interest among the eighth performance variables in $\mathcal{P}$ and the relative level of amount issued RLA for the j-th company and

$$m_x = \min_{j=1,\ldots,66} \tilde{x}_j, \qquad M_x = \max_{j=1,\ldots,66} \tilde{x}_j.$$

The clustering procedures were then applied for the relative amount variable RLA and for the elements of the set $\mathcal{P}$. All variables were normalised according to the equation 4.1.

The centroids of the Voronoi tessellation are all positive numbers and will be denoted by $\{\phi_h\}_{h=1}^{H}$ and $\{\psi_k\}_{k=1}^{K}$ 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 variable $\bar{x}$. Such a dependence is omitted when not needed. The variation ranges of the centroids depend on two different ideas, it follows that the number of clusters and the respective distances between it and the enterprises may vary depending on the technique of centroid selection.

I am now going to introduce the concept of weighted and unweighted Euclidean distance for the proposed generalised 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:

$$d_{RLA}(j, \phi_h) = (RLA_j - \phi_h)^2, \tag{4.2}$$

Analogously, for the variables in $\mathcal{P}$, we built the Euclidean distance, but in this cases we have weighted distance:

$$d_{\mathcal{P}}(j, \psi_k) = \sum_{x \in \mathcal{P}} \beta_x (\bar{x}_j - \psi_k)^2, \tag{4.3}$$

for each centroid ψ_k and where β's are the non-negative weights of the norm, so that:

$$\sum_{x \in \mathcal{P}} \beta_x = 1.$$

The distances in eq. (4.3) is in $[0, 1]$ by construction.
By definition, we have that $0 \leq d_{RLA}(j, \phi_h), d_{\mathcal{P}}(j, \psi_k) \leq 1$, for each company j and centroid ϕ_k and ψ_k.

We denote the generic Voronoi cells for RLA and performance by V_h' and V_k'', respectively, where:

$$V_h' = \{j = 1, \ldots, 66 \,|\, d_{RLA}(j, \phi_h) < d_{RLA}(j, \phi_{\bar{h}}),\ \forall\, \bar{h} \neq h\};$$

$$V_k'' = \{j = 1, \ldots, 66 \,|\, d_{\mathcal{P}}(j, \psi_k) < d_{\mathcal{P}}(j, \psi_{\bar{k}}),\ \forall\, \bar{k} \neq k\}.$$

Any company j belongs only to one cell of type V_h' and only to one of type V_k''.

4.2.1 Specifications of the Cluster Analysis

It is important to premise and emphasise 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 level of minibonds issued 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.

Therefore, in total we have five scenarios for the centroids selected according to a uniform distribution and as many for the case in which the quartiles of the variables are selected as single 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 purpose, we set $H = K$. The analyzed cases are now listed.

For the case of the centroids uniformly distributed:

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

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

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

IV_U $H = K = 4, \{\phi_h\}_{h=1}^H = \{\psi_k\}_{k=1}^K = \{1/5, 2/5, 3/5, 4/5\}$, $\beta_x = 1/|\mathcal{P}| = 1/8$ for each $x \in \mathcal{P}$.

V_U $H = K = 4, \{\phi_h\}_{h=1}^H = \{\psi_k\}_{k=1}^K = \{1/5, 2/5, 3/5, 4/5\}$. We assign the same weight to the macro-categories of firms' performance (1/3 for growth opportunity, profitability and productivity). We give an equal weight to each variable within each category, so that $\beta_x = 1/|\mathcal{P}_{GO}| \times 1/3 = 1/9$, when $x \in \mathcal{P}_{GO}$, $\beta_x = 1/|\mathcal{P}_{Prof}| \times 1/3 = 1/9$, when $x \in \mathcal{P}_{Prof}$ and $\beta_x = 1/|\mathcal{P}_{Prod}| \times 1/3 = 1/6$, when $x \in \mathcal{P}_{Prod}$.

For the case of quartiles, we consider the same weights of the scenarios I-V. We have:

I_Q $H = K = 3, \{\phi_h^{(x)}\}_{h=1}^H = \{\psi_k^{(x)}\}_{k=1}^K = \{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\}$, being $Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}$ the first, second and third quartiles of the distribution of the variable of interest x, respectively. The weights β's are taken as in I_U.

II_Q $H = K = 3, \{\phi_h^{(x)}\}_{h=1}^H = \{\psi_k^{(x)}\}_{k=1}^K = \{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\}$. The β's are taken as in II_U.

III_Q $H = K = 3, \{\phi_h^{(x)}\}_{h=1}^H = \{\psi_k^{(x)}\}_{k=1}^K = \{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\}$. The β's are as in III_U.

IV_Q $H = K = 3, \{\phi_h^{(x)}\}_{h=1}^H = \{\psi_k^{(x)}\}_{k=1}^K = \{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\}$, and the β's are taken as in IV_U.

V_Q $H = K = 3, \{\phi_h^{(x)}\}_{h=1}^H = \{\psi_k^{(x)}\}_{k=1}^K = \{Q_1^{(x)}, Q_2^{(x)}, Q_3^{(x)}\}$. The β's are those in V_U.

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.

We have five different scenarios in the first approach (case of uniformly distributed centroids). It is because we wanted to investigate the effects that each macro-category has on the assignment of clusters. In the first scenario, we assign an identical weight to the variables set in $\mathcal{P}_{GO}$, while assigning zero weight to the other variables that complete $\mathcal{P}$, i.e. $\mathcal{P}_{Prof}$ and $\mathcal{P}_{Prod}$. In this way, we want to investigate the effects of the variable RLA on the selected macro-category. In scenarios II_U and III_U, we proceed similarly to scenario I_U, but this time the effects of RLA are explored for $\mathcal{P}_{Prof}$ and $\mathcal{P}_{Prod}$ 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 $\mathcal{P}$. In the V_U scenario, on the contrary, it is the macro-categories $\mathcal{P}_{GO}$, $\mathcal{P}_{Prof}$ and $\mathcal{P}_{Prod}$ that have an equally distributed weight.

In the second approach (case where the distribution of variables is considered) we perform the same scenarios just mentioned in a specular way. In particular, the main difference consists in the selection of the centroids, which is not done a priori, but rather by observing the individual distributions of the variables that compose $\mathcal{P} = \{T\tilde{A}V, F\tilde{A}V, S\tilde{A}V, R\tilde{O}I, R\tilde{O}S, MEB\tilde{I}TDA, A\tilde{T}O, S\tilde{/}E\}$.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, respectively.

4.3 Results and Discussions

As we will see below, our analysis leads us to answer our research question $RQ4$. Indeed, the cluster overlap performed with the two different approaches allows us to advance hypotheses on how the relative level of minibonds issued may or not affect firms' performance. The choice of a three-year period 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 suggests the presence of not always clear and straightforward relationships between the relative level of minibonds issued and performance.

Table 4.1 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 of the sample of firms used. This means that firms have undertaken very different policies regarding the amount of minibonds issued. Some firms issue a high level of minibonds, but most prefer a more cautious approach as this instrument is a new method of financing. Nevertheless, our average seems to be a good indicator as the standard deviation appears to be small.

Again, as far as growth opportunity macro-category, we observe a distribution far from normal. As in the previous case, we observe positively 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 healthy 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 three 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 macro-category is concerned, we observe one of the different distributions between its components. While ROI seems to be close to a normal distribution even if rather sharp and with heavy tails, ROS and EBITDA margins are strongly and negatively asymmetric. This might be due to the substantial variability for which the components of this macro-category 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 clearer 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 three years following the issue, find themselves in difficulty or perhaps try to finance themselves in the markets for lack of alternatives. For the following macro-category, therefore, a strong heterogeneity of the sample is also recorded.

Finally, looking at the productivity macro-category, we find a markedly positive asymmetry with a notable leptocurtosis for sale per employee component. On the contrary, the asset turnover component seems close to a normal distribution. It is no coincidence that the latter has a relatively low standard deviation instead of the former. In general, this macro-category provides us with information in line with the previous ones, i.e., some efficient companies and firms are much less so in the sample. 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 two set of five scenarios (I_U-V_U and I_Q-V_Q), the first cluster is associated with the smallest centroid, and following this, we have the second and third so that last cluster is associated with the highest centroid value. Furthermore, in all scenarios, the relative level of amount variable does not change since the level of issued minibonds is the only constituent variable. On the contrary, if we consider our macro-categories ($\mathcal{P}_{GO}$, $\mathcal{P}_{Prof}$ and $\mathcal{P}_{Prod}$), we adopt weighting criteria that vary from one scenario to another.

Table 4.2 shows the distribution of companies among the clusters in the case of centroids uniformly distribution.

In I_U, we assign a unit weight to the macro-category growth opportunity. This 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 level of issuance somehow affects the growth capacity of a firm. As far as the relative level of the amount is concerned, we see that firms are positioned in cluster

1, i.e. the one associated with the lowest centroid, and a limited number of firms are positioned within the others. Similarly, when we consider 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, i.e. the one associated with the largest centroid. The information we can extract from our first scenario is that firms issuing low minibonds levels are placed in clusters with low growth opportunities; therefore, we can suppose that the amount of minibonds issued can drive 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. This suggests that even some firms that used to issue more minibonds in relative terms do not significantly impact their growth opportunity.

In II_U, the results change. Indeed, now the unit weight is assigned to the profitability macro-category. 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 drives firms to improve their profitability ratios significantly. 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 state with certainty that the amount of minibonds issued can force companies to improve their profitability ratios.

III_U considers the productivity macro-category with unit weight. In this case, the distribution of performance clusters appears to be more fragmented. We note that cluster 4 is empty and that the highest concentration is in the first cluster. An additional peculiarity of this scenario is that we have more firms in the pair of clusters 1-1, i.e., in the one where we have a limited relative level of issued minibonds associated with low performance. Of note is the pair of clusters 1-2. Here we see that a fair number of firms, 15, fall into the second performance cluster. Thus, we can assume that the choice to issue somehow induces firms to improve their profitability ratios.

Finally, in IV_U and V_U, we use a weight equidistributed among the variables of interest and equidistributed among the macro-categories, respectively. Results in these two different scenarios are pretty similar. This small difference means that

the different weights assigned to growth opportunity, profitability, and productivity to measure performance slightly emphasise the variability. Cluster 2 of performance seems to be the most crowded. This result is to be underlined because by 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). In addition, cluster 4, which collects performance, is empty in both scenarios. It suggests that firms that decide to issue minibonds perform discretely in the three years following issuance.

Table 4.3shows the distribution of companies among the clusters in the case of centroids are chosen according to variable distributions.

In the following scenarios, we use a different approach that allows us to avoid some possible distortions present in the previous cases. In fact, the selection of the coordinates of centroids in the space is conditioned by the distributions of the variables of interest. One of the main problems that this approach solves is undoubtedly that of outliers. Indeed, some firms may present them, both with respect to the amount issued and to performance. In this way, those firms with outliers are no longer able to push the others into adjacent clusters. In fact, this effect is created when an outlier is not able to push others into adjacent clusters. Indeed this effect occurs when variables are normalized according to eq. 4.1. Following this approach, firms are divided according to their position. The three reference quartiles (25%, 50% and 75%) have been used for this purpose. The scenarios are again five, and similarly to what is made previously, the weights are manipulated in the same way. Another factor that differs from the previous one, however, is the number of clusters, being three in all scenarios.

In I_Q, we note a greater concentration in the pairs of clusters 1-1 and 3-3; this suggests that the relative amount level might affect firms' growth capacity. Despite this, we find a not straightforward relationship between clusters.

In II_Q the same scenario described above is repeated. Indeed, despite the pairs of clusters 1-1 and 3-3 being more crowded, the distribution among other cluster pairs is not straightforward. However, it is important to underline the difference with the

previous approach, which confirms the suitability of this one.

In III_Q in this case, the companies position themselves quite homogeneously within the clusters. This suggests that the effect on productivity is heterogeneous. In others words, the relative level of minibonds issued doesn't affect the productivity macro-category. This result could be due both to the different sizes of the companies and to a disparate use of the resources received.

Finally, IV_Q and In V_Q the results in these two different scenarios are quite similar. This small difference means that the different weights assigned to growth opportunity, profitability and productivity to measure performance slightly emphasize the variability. It should be noted that cluster 3 relating to performance is the most crowded, considering the number of companies placed in cluster 3 relating to the relative level of amount. This could be a faint signal that could lead us to think that taking on this broad credit line of this instrument could create fertile ground for entrepreneurs in terms of performance.

Tables 4.4 and 4.5 show the units of the mean for relative amount and performance for the entire sample and refer to all scenarios inherent in performance and relative amount for the two different approaches, respectively.

Looking 4.4 the clustering concerning relative amounts, reasonably we find that the mean is increasing as the clusters grow; this is true for both approaches, obviously. This is not true for performance clusters. Looking at the performance trends by starting from the relative amount cluster, we see a rather non-straightforward trend indeed, only $T\tilde{A}V$ grows between clusters. The average RLA of the first cluster is lower than that of the entire sample, while for the other clusters, it is higher. The mean referred to performances is always below except for the $S\tilde{/}E$ variable. In the second, third and fourth clusters, the performance follows a rather ambiguous trend. The Mean/Std. Dev. value provides some information on the homogeneity within the clusters. Its level turns out to be low in all 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 first three performance scenarios, we see that RLA is mixed; in the first and second scenarios is growing, while it decreases in

the third one. In contrast, in the fourth and fifth scenarios –where we consider all macro-categories– we see an increasing trend in RLA as overall performance increases. This might suggest to us that overall, the use of minibonds helps firms improve their ratios. We would like to point out that this result is very important as it is proven for the first time that firms that use the highest levels of minibonds perform better than those that use it less.

Looking 4.5 the clustering concerning relative amounts, we find out that performance trends are rather non-straightforward except $T\tilde{A}V$ and $F\tilde{A}V$ in fact, they grow between clusters. The average RLA of the first and second clusters is lower than that of the entire sample, while in the third one is higher. The mean referred to performances is quite puzzling between clusters. Therefore, if we considered RLA, even here, minibonds do not produce a homogeneous effect on the firms that use them. In the first three performance scenarios, we see that RLA is mixed; in the first and second scenarios is growing between clusters, while it decreases in the third one. In the fourth and fifth scenarios –where we consider all macro-categories– we see stability or tendency to rise in RLA when overall performance increases. This, in part, confirm outcomes previously.

	Minibonds	PERFORMANCE							
		Growth			Profitability		Productivity		
Descriptive Statistics	Relative amount	Total assets (variation)	Fixed assets (variation)	Sales growth (variation)	ROI	ROS	Ebitda margin	Sale per employee	Asset turnover
Mean	0.11	0.08	0.28	0.87	0.07	-0.98	-0.51	513.48	68.87
Std. Dev.	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
Mean/Std. Dev.	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

Table 4.1: Main statistical indicators of the relative level of amount and performance variables. Total assets, fixed assets, sales growth, ROI, ROS must be multiplied to 100 if we want see the percentage variation.

		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 4.2: Relationship among cluster for relative level of amount and performance: the case of uniformly distributed centroids.

		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

Table 4.3: Relationship among cluster for relative level of amount and performance: the case of centroids according to variable distributions.

			Relative amount	Total assets (variation)	Fixed assets (variation)	Sales growth (variation)	ROI	ROS	Ebitda margin	Sale per employee	Asset turnover
Entire Sample		Mean	0.11	0.08	0.28	0.87	0.07	-0.98	-0.51	513.48	68.87
		Std. Dev.	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
		Mean/Std. Dev.	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
		Std.Dev.	0.05	0.12	1.14	4.80	0.09	10.78	5.11	881.58	41.48
		Mean/Std. Dev.	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
		Std.Dev.	0.02	0.11	1.29	0.13	0.09	0.09	0.13	167.42	35.79
		Mean/Std. Dev.	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
		Std.Dev.	0.03	0.28	0.19	4.98	0.25	0.22	0.29	1014.46	63.84
		Mean/Std. Dev.	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
		Std.Dev.	0.10	0.45	0.31	2.81	0.02	0.22	0.21	327.06	32.29
		Mean/Std. Dev.	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
		Std.Dev.	0.10	0.12	0.55	1.25	0.09	10.15	4.82	861.27	41.18
		Mean/Std. Dev.	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
		Std.Dev.	0.15	0.30	4.46	2.16	0.30	0.23	0.35	196.51	42.96
		Mean/Std. Dev.	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
		Std.Dev.									
		Mean/Std. Dev.									
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/Std. Dev.									
Performance II_U	First cluster	Mean	0.11	-0.20	-0.14	0.18	-0.13	-78.40	-37.75	13.87	0.49
		Std.Dev.									
		Mean/Std. Dev.									
	Second cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/Std. Dev.									
	Third cluster	Mean	0.07	-0.04	0.01	0.22	-0.20	-0.85	-0.57	291.01	68.21
		Std.Dev.	0.04	0.31	0.16	0.53	0.08	0.58	0.54	213.33	40.17
		Mean/Std. Dev.	1.82	-0.12	0.05	0.41	-2.60	-1.47	-1.07	1.36	1.70
	Fourth cluster	Mean	0.11	0.09	0.31	0.91	0.08	0.26	0.10	532.30	70.00
		Std.Dev.	0.11	0.14	1.14	4.65	0.08	1.79	0.34	857.99	40.92
		Mean/Std. Dev.	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
		Std.Dev.	0.11	0.15	1.34	5.49	0.08	12.06	5.72	361.31	24.26
		Mean/Std. Dev.	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
		Std.Dev.	0.10	0.16	0.25	0.95	0.13	0.13	0.11	206.00	15.63
		Mean/Std. Dev.	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
		Std.Dev.	0.07	0.11	0.15	0.19	0.11	0.57	0.03	1956.30	67.40
		Mean/Std. Dev.	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
		Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/Std. Dev.									
Performance IV_U	First cluster	Mean	0.06	-0.09	-0.01	-0.06	-0.04	-10.80	-6.74	194.81	6.64
		Std.Dev.	0.04	0.12	0.10	0.26	0.08	33.60	15.23	155.61	10.14
		Mean/Std. Dev.	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
		Std.Dev.	0.10	0.14	1.18	4.80	0.08	0.20	0.15	850.53	35.58
		Mean/Std. Dev.	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
		Std.Dev.	0.16	0.40	0.44	0.34	0.32	0.16	0.24	1481.73	27.62
		Mean/Std. Dev.	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
		Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/Std. Dev.									
Performance V_U	First cluster	Mean	0.10	-0.23	0.00	-0.03	-0.14	-39.95	-19.47	38.14	12.44
		Std.Dev.	0.01	0.05	0.21	0.30	0.02	54.37	25.86	34.32	16.90
		Mean/Std. Dev.	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
		Std.Dev.	0.10	0.13	0.55	1.36	0.08	1.82	0.35	837.89	38.42
		Mean/Std. Dev.	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
		Std.Dev.	0.11	0.25	4.01	17.57	0.24	0.14	0.14	1012.54	69.70
		Mean/Std. Dev.	1.28	1.00	0.52	0.52	0.78	0.37	1.41	0.84	1.30
	Fourth cluster	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Std.Dev.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mean/Std. Dev.									

Table 4.4: Statistical analysis of the relative level of amount and performance variables within clusters: the case of uniformly distributed centroids.

			Relative amount	Total assets (variation)	Fixed assets (variation)	Sales growth (variation)	ROI	ROS	Ebitda margin	Sale per employee	Asset turnover
Entire Sample		Mean	0.11	0.08	0.28	0.87	0.07	-0.98	-0.51	513.48	68.87
		Std. Dev.	0.10	0.16	1.11	4.51	0.10	9.83	4.67	835.88	41.17
		Mean/Std. Dev.	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
		Std.Dev.	0.02	0.07	0.18	0.10	0.08	0.25	0.19	656.91	44.39
		Mean/Std.Dev.	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
		Std.Dev.	0.01	0.15	0.12	7.91	0.10	17.96	8.45	199.47	34.93
		Mean/Std.Dev.	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
		Std.Dev.	0.11	0.19	1.84	2.04	0.12	0.28	0.19	1242.94	39.28
		Mean/Std.Dev.	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
		Std.Dev.	0.04	0.08	0.14	0.14	0.08	15.14	7.15	1201.61	46.70
		Mean/Std.Dev.	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
		Std.Dev.	0.15	0.02	0.65	2.29	0.06	0.20	0.17	505.97	41.51
		Mean/Std.Dev.	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
		Std.Dev.	0.09	0.15	1.75	7.37	0.14	0.16	0.18	253.20	32.25
		Mean/Std.Dev.	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
		Std.Dev.	0.13	0.19	0.14	6.95	0.08	15.72	7.40	506.82	36.43
		Mean/Std.Dev.	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
		Std.Dev.	0.06	0.09	2.36	1.17	0.01	0.06	0.09	302.99	35.63
		Mean/Std.Dev.	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
		Std.Dev.	0.09	0.14	0.23	1.71	0.10	0.23	0.14	1187.80	42.49
		Mean/Std.Dev.	1.26	0.78	0.47	0.25	1.40	0.21	1.29	0.57	2.04
Performance III_Q	First cluster	Mean	0.12	0.04	0.52	1.84	0.04	-2.67	-1.53	389.51	28.23
		Std.Dev.	0.12	0.13	1.75	7.38	0.07	16.39	7.74	460.76	16.31
		Mean/Std.Dev.	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
		Std.Dev.	0.09	0.19	0.60	0.96	0.11	0.29	0.18	1332.38	10.57
		Mean/Std.Dev.	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
		Std.Dev.	0.09	0.15	0.24	0.85	0.12	0.12	0.10	648.41	20.67
		Mean/Std.Dev.	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
		Std.Dev.	0.13	0.11	0.76	8.07	0.07	17.98	8.47	485.49	16.34
		Mean/Std.Dev.	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
		Std.Dev.	0.05	0.13	1.80	0.21	0.10	0.27	0.16	1239.39	11.10
		Mean/Std.Dev.	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
		Std.Dev.	0.11	0.18	0.23	1.12	0.12	0.12	0.12	634.92	21.49
		Mean/Std.Dev.	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
		Std.Dev.	0.13	0.11	0.73	7.71	0.07	17.13	8.08	468.89	19.72
		Mean/Std.Dev.	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
		Std.Dev.	0.05	0.13	1.84	0.21	0.12	0.29	0.17	1260.08	15.68
		Mean/Std.Dev.	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
		Std.Dev.	0.11	0.18	0.23	1.14	0.11	0.08	0.11	648.45	21.84
		Mean/Std.Dev.	0.98	0.81	0.52	0.42	1.04	0.39	0.75	0.84	5.23

Table 4.5: Statistical analysis of the relative level of amount and performance variables within clusters: the case of centroids according to variable distributions.

4.4 Conclusions

This chapter dealt with exploring the relationships between the relative level of amount issued by companies and the firms' performance in the three years following the issue. The sample considered is given by the companies that issued minibonds in 2016. The reference period is instead a four-year period 2016-2019. The relative level of amount and the other eight variables that compose performances were manually collected in the section from companies' non-consolidated annual reports.

The analysis performed through cluster methodology is based on Voronoi tessellation. It aims at reducing the existing gap between complex science – with a focus on cluster analysis through Voronoi tessellation – and the rather innovative context of minibonds, with a focus on the relationship between the relative level of amount and the performance of the firms, accounted for after issuance. In particular, two different clustering approaches are implemented and discussed.

This study is one of the first ones dealing with this new financing instrument, introduced by the Italian Government in 2012.

The impact of the relative level of amount on post-emission performance has been rather uncertain looking at single macro-categories, while in a general context, minibonds seem to affect positively firm performances. Indeed, our results seem to be interesting – especially in the second approach – as there is a slight tendency for companies to be placed in the same clusters when considering the two categories (relative level of amount and performance). Despite this, we cannot say that there is a straightforward relationship between the level of minibonds issued and the performance of firms. Indeed, our analysis denotes a high heterogeneity of companies that belong to the clusters.

With our study, we are also able to discuss the relevance of the macro-categories within the identification of the performance of the companies issuing minibonds.

We point out that this study is a first step towards the complete discussion of the effect of minibonds on performance. However, this is a topic still rather unexplored that deserves further research.

Chapter 5

Conclusions and future research

Our work is focused on a particular financial instrument that has recently become available as a new source of financing for European companies, namely minibonds. Although it can take different nomenclature, forms and market positioning among European countries, the concept remains the same everywhere, i.e. corporate bonds issued mainly by small and medium-sized unlisted companies.

Our attention is concentrated on the Italian market, on which we set up the entire research. One of the reasons why we decide to investigate the Italian context is due, in part, to the high dependence of Italian companies on bank credit - hence the high growth potential - the possibility of finding data and, finally, the fact that Italy is one of the countries where this instrument has been most successful. Moreover, we think that dealing with a young, expanding and not yet analyzed market could be not only interesting but also useful for those who want to deepen the contents.
The thesis is structured in four chapters.

In Chapter 1 we provide a series of preliminary information necessary for a full understanding of the investigation done. We contextualize the problem of integration between bank credit and market-based financing, focusing in particular on the Italian context. We explain, as exhaustively as possible, the legislative context, the development of the market and its segments, and the main differences with the most important European economies (Germany and France). Subsequently, we briefly retrace the path of capital structure theory, citing its main exponents and their most

important conclusions. This is because although it is a very recent channel of financing for businesses, in general, our research deals with debt issued by companies and, therefore, an important part of the capital structure. We also pay attention to research by scholars who address the topic. In the section that concludes the chapter, we list the research questions highlighting the plans, the related datasets, the methodologies applied and the literature of reference.

In the chapter, we deal with $RQ1$; the statistical technique with which this chapter is treated is an OLS regression model in which the real relationships existing between the explanatory and dependent variables are entered. There are four models developed for two dependent variables. For each of the variables in question, we have run a full model and an optimised model following the logic of the backward method.

Chapter 3 deals with $RQ2$ and $RQ3$; this time, we use the complex network to answer the questions posed. In particular, we chose two centrality measures to analyze the level of integration of issuing firms. These two centrality measures are the strength degree and the clustering coefficient.

Finally, in the Chapter 4, we answered $RQ4$; now, we use a specific technique, namely cluster analysis through Voronoi tessellation with the asymmetric generalization of the Euclidean distance. Also, in this, we use two different approaches. The first one assigns to the centroids a uniform distribution among the variables; the second one assigns to the centroids the values of the respective quartiles of the variables.

Through these ad hoc methodologies aimed at answering specific research questions, we performed an exploratory analysis using quantitative techniques that allowed us to learn about previously unexplored aspects of the minibond context. First of all, we found a series of variables that influence the level of minibonds issued. These variables were total assets, leverage, liquidity, collateral, spread and the proxy of failure in the first regression performed, while in the second regression, the variable spread is not among the determinants. These results helped us to understand the factors that can influence the choice, in terms of issue levels, of companies once they have decided to use this new channel of financing. Consistent with the idea

of exploring and understanding in greater depth the choices and reasons for which firms and entrepreneurs make this choice, we have analyzed the level of homogeneity/heterogeneity of issuing companies. Therefore, Chapter 3 is in perfect harmony with Chapter 2. Through complex network analysis, we have obtained a series of results that are complementary to the previous results. First, by analyzing the level of homogeneity/heterogeneity of firms at the time or immediately prior to issuance, it helped us to understand whether there are any main characteristics that firms share in terms of strength degree and clustering coefficient. From this observation, we found a high level of homogeneity for the variables total assets and growth opportunity, while a lower level of homogeneity, but still significant, have been found for the variables liquidity and firm risk. This first result is complementary to that obtained through regressive analysis. In fact, if Chapter 2 found the determinants that push companies to issue greater levels of minibonds, Chapter 3 suggested what could be the main determinants of the issue of minibonds. This is because there are some variables that are widely shared, quantitatively, among firms. In addition, Chapter 3 gave us some insight into the main consequences of issuing minibonds. In fact, even if we noted a general increase in the heterogeneity of the sample following the issuance, the greatest effect (considering the four years) can be found on the variables liquidity and growth opportunity. Of course, we are not able to know specifically what the effects are on these variables, but at the same time, we advanced the hypothesis that these two characteristics are those that suffer the greatest effects of this entrepreneurial choice. Finally, we pointed out that the level of homogeneity is relevant only in some cases, while the level of heterogeneity generally increases over the four years and in all the variables analyzed. In the last chapter (4), we have understood how a high level of minibonds issued corresponds to high performances. Also, in this case, we wanted to explore an additional aspect that can help us in understanding the context of minibonds, so it is not only consistent with the previous chapters (2; 3), but it is perfectly complementary with them. As we saw in the Chapter 1, it was decided to take a different year as the reference year from the 2 and 3 chapters. The reason for this is due to the fact that we wanted to allow time for minibonds to manifest their

effects on performance. Furthermore, the recent pandemic has made the data from the last two years non-negotiable. The results obtained in the last chapter (4) are not entirely univocal; in fact, in some cases, we noted a certain heterogeneity and in others a homogeneity in the results. Considering the internal clusters within the single macro-categories and in the case of the internal clusters at the level of relative amount, we note heterogeneity. On the contrary, if we observe the clusters within the total performance, it seems that higher performance corresponds to higher levels of minibonds issued.

Therefore, this exploratory analysis of ours should be seen as a type of holistic information, i.e. it is not a mere sum of outcomes. In fact, even if the results do not provide a complete view of the context of minibonds and certainly much more should be done in this regard, our study proposes and opens an unexplored field where scholars can contribute as we have done.

In the coming investigations, we would like to face and develop many other studies on this subject. First of all, we had the opportunity to accumulate data of the issuing companies from 2016 until now (2021). This will allow us to tackle a regression analysis with more data (panel data) and compare it to a control sample to be able to confidently determine what the main determinants of minibonds are. This analysis would also be done by including environmental variables, thus understanding whether different policies and regulations across the European Union countries can explain the different levels of development of the minibond market. In addition, we could compare the different forms of debt in probabilistic terms, thus coming to know what are the characteristics of companies and the surrounding environment that influence the decision of the manager or entrepreneur at a probabilistic level. This analysis could be accompanied by particular performance analysis. For example, the power of complex network analysis could be combined with econometric methods. Another idea, therefore, would be to collect the levels of some centrality measures such as betweens, eigenvector, closeness, to name a few of all the companies and configure them as explanatory variables. At this point, we could collect the performance of the firms by configuring them as a dependent variable. So that, by running our regression,

we could see how the different measures of centrality behave in this regard. These are just some ideas that could be developed in the coming months.

In conclusion, we can say that our work traces a path in the right direction. In fact, understanding how the integration of old channels of financing for companies – such as banking – with new instruments and forms of debt -such as minibonds- affects choice, performance and more generally, the effects on companies is a work that not only completes the theory of capital structure but also provides important information to decision-makers.

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