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## Article

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# The role of information in the credit relationship

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## Abstract

A relationship between banks and firms that emphasizes the qualitative aspects of the enterprises may represent a response to the increasing difficulties of the credit system in financing a business system in which the intangible assets are the main source of value. In this view, an empirical survey on 61 bank managers of large and small banks has been carried out to verify the following: (1) the role of quantitative and qualitative information in the financing of large companies and small and medium enterprises and (2) how the relationship between bank and firm varies together with the dimensional change of the actors involved in the credit relationship.

**Keywords:** Relationship lending, Soft information, Hard information, Mann–Whitney test

## Background

The development of the Italian economy in the 1950s and 1960s was based on large companies in the Fordist structure, designed to meet ‘mass needs’ of yet immature consumers. The sophistication of market demand, which occurred in the years after the ‘economic miracle,’ prompted a revision of the production model based on economies of scale in favour of more flexible manufacturing systems (Rullani 2004). This caused the crisis of large companies and facilitated the development of small and medium enterprises (SMEs), organized in districts that found their strength in production specialization and, at the same time, flexibility.

The phenomenon of disintegration of large companies, confined to areas that require economies of scale, has not only concerned Italy but also all the developed countries. However, in our country, this event has acquired particularly intense features if it is pointed out that, according to the latest available data, the average company size is about 40% below the European average and is in constant decline (Eurostat 2002). This has generated an extensive debate on the implications of the dwarfism of the entrepreneurial system in Italy’s development. In particular, the Italian family business, closed to venture capital, organized in districts and specialized in the so-called *Made in Italy* according to some scholars, does not appear adequate to withstand international competition of the most technologically advanced countries. It must however be noted that, in most cases, the system of Italian district SMEs has not opposed or replaced the large companies, but it has joined the latter producing on their behalf and satisfying the need to outsource certain activities (Becattini 2000; Becattini et al. 2001). Therefore, the Italian production system is now dominated by a complex network of SMEs, which often form the linked industry of large enterprises.

These complex evolutionary lines of the Italian production system have always had a constant element: the support of the credit system. Since the 1950s, commercial banks have been the protagonists of business development financing, first by encouraging the birth and development of large companies and then the growth of SMEs and their industrial districts. Italy has always been defined as a 'bank-centred' system in which the role of financial market risk capital is marginal. Commercial banks, through collection and use of operations, are an important 'infrastructure' of the national economy, as they invest the considerable amount of national savings in the business system (Allen and Gale 2000).

However, even the banking system has undergone profound structural and regulatory changes in the last 20 years that have had controversial effects on bank-firm relationship (Rajan and Zingales 2003). Following the mergers and acquisitions that characterized the 1990s and the first half of the 2000s, the credit system has gradually concentrated, pursuing objectives of economies of scale and greater efficiency but moving the decision-making centres away from the operational centres (Ozbas 2005). In fact, the directorates general of large banking groups born from extraordinary transactions are located in social and economic contexts that are very different from those where branch offices located in geographically distant areas operate.

Various studies show that bank gigantism has, therefore, made necessary the standardization of bank credit processes and at the same time decreased the decisional autonomy of branch managers who know better the context in which they operate (Alessandrini et al. 2009). Thus, compared to the past, those intangible assets that are beyond the standardized assessment based almost exclusively on quantitative data of economic and financial nature are less important in the assessment of creditworthiness. This has increased the complexity of the relationship between the large banking groups and small and medium businesses that base their success on their intangible assets (Itami and Thomas 1987), but it seems to have favoured the financing of large firms characterized by a greater capacity to generate quantitative information (Berger et al. 1998).

At the same time, regulatory changes introduced between 1989 and 1990 and culminated in 1993 with the Consolidated Banking Act, allowing the establishment of new banks and liberalizing the opening of new branches, have generated a phenomenon of diffusion of the credit system in the territory through the opening of new small local banks (people's banks, cooperative banks) whose decision-making centres are very close to their operational centres. In this case, the local banks are 'immersed' in the territory and are able to collect information about the qualitative aspects of small business owners that are difficult to quantify in a standardized system of creditworthiness assessment (Bonaccorsi di Patti and Gobbi 2001).

On the contrary, small banks have greater difficulty in providing particularly complex financial services to large enterprises at a competitive cost. The process of specialization that has led small banks to mainly finance SMEs and wider size banks to preferentially open credit lines to large enterprises (Berger et al. 2005) is also confirmed by some empirical studies carried out in Italy.

In particular, Di Salvo et al. (2004), in a survey on a sample of 1,700 enterprises (most of which were SMEs), show that in the period 2000 to 2002, a significant number of entrepreneurs started relationships with small local banks because of the customer's proximity to the intermediary. Moreover, in the period 1996 to 2005, the market share of these credit intermediaries rose from 24% to 31% of total loans. The outlined evolution of bank-

firm relationship that occurred in recent decades in Italy poses an interesting research question: what is the role of quantitative and qualitative information in large banks and small banks to assess the creditworthiness of large firms and SMEs?

This article attempts to provide an answer to the question, which has important implications. Understanding what role do quantitative and qualitative information play in small banks in the assessment of different size enterprises and whether the same variables are adopted by large banks to evaluate the same categories of firms allows understanding the causes of the process of specialization in the banking industry. Besides the introduction, the article is thus divided into other six sub-sections. The first section deals with the theoretical debate on the role of information in the credit market, while the second gains insight into the advantages and limitations of relational finance in the collection of information. The third section describes the objective of the research and the survey variables, while the fourth explains the statistical test used for the empirical analysis. In the fifth section, the results of the investigation are commented, while the last section is devoted to conclusions.

### **Theses on the role of information in the credit market**

The theory of financial intermediation highlights the aims of lending institutions to reduce information asymmetries between deficit units (borrowers) and surplus units (savers), since confidential information accumulated within stable and long-term credit line relationships with customers is available (Sharpe 1990; Stein 2002; Von Thadden 2004).

Therefore, the credit market would be more efficient in allocating resources than the broader financial market because the establishment of more stable and long-lasting relationships would allow credit intermediaries to reduce the costs associated with moral hazard and adverse selection (Fama and Jensen 1983; James 1987; Fudenberg et al. 1990). Thus, the greater creation of value within the credit relationship consists in the activities of constant selection and control carried out by the bank towards credit applicants.

However, it must be pointed out that among the scholars of financial intermediation, there are two main schools of thought on how to create value attributable to the activities of selection and control of information (Corigliano 2007):

- The thesis on absolute comparative advantage according to which banks benefit from economies of scale resulting from carrying out in a professional manner activities of selection and control of creditors. In this way, the techniques adopted by intermediaries allow obtaining benefits from the information on creditors that outweigh the costs of screening and monitoring. Other lenders in the financial market (venture capital, investment funds) are not able to reach a 'critical mass of customers' capable of achieving the same economies of scale. Therefore, in the credit market, the cost of reducing information asymmetries between the lender and borrower is lower compared to the broader financial market. In this case, the standardized assessment models of creditworthiness allow banks to gain a competitive advantage from the very first contact with the customer. Therefore, according to this theoretical approach, even within individual credit relationships based on single financing transactions but not intended to open up the business to the bank, the intermediary has a cost advantage over other lenders. These relationships are called transaction banking or arm's length financing (Boyd and Prescott 1986; Ramakrishnan and Thakor 1984; Diamond 1984).

- The thesis on relative comparative advantage according to which banks do not have an immediate competitive advantage in terms of cost of collecting information from other lenders. This benefit derives, however, from the information gradually acquired during a stable and long-lasting relationship with the client, gaining access to confidential information. Therefore, as the length of the relationship increases, the incremental cost of additional information acquired by the bank decreases, and in this way, the bank manages to fund the firm more efficiently. According to this view, the value created by the credit relationship lies not only in quantitative information (balance sheets, financial reports) but also in qualitative information collected by the bank on the credit applicant. These relationships are called relationship lending (Hodgman 1961; Sharpe 1990; Petersen and Rajan, 1994; Boot and Thakor 1994; Berlin and Mester 1992, 1999; Boot 2000; Ongena and Smith 2000; Corigliano 2007).

With regard, however, to the firms that are bank customers, many scholars have observed that the progressive 'dematerialization' of business assets that have a strong influence on the generation of value has determined the inadequacy of the technologies adopted by banks for the collection of information. In fact, the increased importance of intangible capital in the firms has created for the banks the problem of collecting information on that particular factor of production and its quantification.

A scarcely intense and short-lasting credit relationship does not allow an efficient collection of this qualitative information (Fudenberg et al. 1990). Furthermore, no statistical-mathematical model is able to effectively quantify this type of news.

Obviously, the difficulties of collecting information on intangible capital are different in large firms than small and medium sized (SMEs). Large firms have a greater capacity to generate information and a greater market visibility. Credit intermediaries can sometimes even indirectly access qualitative information about the company, catching the signalling of the industry in which the company operates (Banks and Sobel 1987; Brighi 2006).

Small- and medium-sized enterprises are, however, more opaque with regard to the informational aspect. Catching the signals of the industry to understand some qualitative aspects of the firm is impossible because in that case entrepreneurial action has no readily detectable influences on the market. Access to quality and confidential information can only occur through a direct source.

However, although with varying degrees of intensity, the evolution toward dematerialization of strategic assets, both of large companies and SMEs, requires an approach between bank and firm that seems to call into question the thesis on relative comparative advantage.

#### **Advantages and limitations of relationship lending in the collection of information on large enterprises and SMEs**

The evolution of the credit market that occurred in recent years has led to a general sharing of the thesis on relative comparative advantage. Based on these considerations, the most recent researches in the field of bank intermediation have focused on the analysis of the following:

- The advantages and limitations of credit relationships characterized by repeated interactions and costly investments by banks to acquire confidential information on the firm that requires financing (relationship lending).

- The nature of information collected in this type of relationship (Boot 2000; Corigliano 2007; Schmeits 2002; Padilla and Pagano 1997; Elsas 2005; Berger and Udell 1995, 2002; Degryse and van Cayseele 2000; Ongena and Smith 2000).

Studies on relationship lending have highlighted that medium- to long-term credit relationships with frequent information interactions between the creditor and debtor allow the revision of the conditions applied to the customer not only in an ameliorative sense but also in a pejorative way (Berlin and Mester 1992).

In this case, the discretion and flexibility of the credit relationship, allowing the adjustment of credit conditions to new information difficult to verify, lead to more efficient investment decisions by the funded firms (Mustilli 1995; Corigliano 2007; Schmeits 2002). Therefore, relationship lending may be a factor that drives companies to create more value by choosing the best investment (Padilla and Pagano 1997).

Furthermore, the possibility to collect qualitative information of a confidential nature allows the credit system to increase its allocative efficiency. However, according to some authors, the benefits of relationship lending are of greater or lesser intensity depending on the size of the actors involved in the credit relationship (Elsas 2005; Berger and Udell 2002; Degryse and van Cayseele 2000).

In particular, large bank groups may not find it convenient to make expensive investments in order to acquire sensitive information on SMEs. The informational benefits arising from a relationship characterized by relationship lending may not offset the costs of collecting information. Large banks may opt for a strategy of diversification of their customer portfolio in order to reduce the specific risk of each exposure to SMEs.

The convenience of a costly investment to collect confidential information may be, however, greater for decisions of opening credit lines to large enterprises, considering the amount of loans. In this way, larger credit intermediaries could be encouraged to adopt different approaches towards small- and medium-sized enterprises and large companies: transaction banking towards SMEs and relationship lending towards large enterprises.

However, the attitude of small banks towards small- and medium-sized enterprises may be different. In this case, SMEs account for almost all of the bank credit, and the benefits of investment in acquiring quality and confidential information may not only offset the costs of its collection but also those resulting from potential default of a portfolio almost exclusively made by SMEs (Berger and Udell 1995).

Furthermore, small banks will adopt however an approach based on relationship lending, whatever the size of the client firm. This is because the relevant exposures to large companies make it convenient for small banks to bear the cost of collecting confidential information. However, the different compositions of the customers of large banks compared to those of smaller size justify a different attitude of intermediaries towards relationship lending. Despite the undoubted advantages that relationship lending gives in the collection and processing of confidential information, it should be emphasized that some hidden pitfalls may nullify the benefits.

In particular, we refer to the phenomenon of debtor capturing (hold up) (Greenbaum et al. 1989; Sharpe 1990; Rajan 1992) and creditor capturing (soft budget constraint) (Boot 2000; Bolton and Scharfstein 1996; Dewatripont and Maskin 1995).

The first phenomenon is attributable to the effects of information monopoly of the lending bank on the funded enterprise. If, on the one hand, the exclusivity of a unique relationship with the bank, typical of relationship lending, creates the conditions for the offer of an implicit insurance service because the bank is ready to grant emergency credit lines in case of a liquidity crisis (Corigliano 2007) by virtue of a fiduciary relationship, it exposes, on the other hand, the firm to the risk that the bank may increase interest rates indiscriminately dispossessing it of part of its profits (Greenbaum et al. 1989; Sharpe 1990; Rajan 1992). Several authors have shown that the risk of hold up can be appropriately mitigated through multiple credit lines and sharing of information with other banks (Bannier 2007; Thakor 1996), though reducing the benefits associated with relationship lending.

The phenomenon of creditor capturing occurs, instead, when the entrepreneur understands that excessive exposure of the bank towards him does not give further credibility to the threat of revoking bank credits that have been granted (Corigliano 2007). This situation encourages opportunistic behaviour by the actor that has received funds.

Another field of study of relationship lending regards the nature of information that may be collected during the credit relationships. Hard information is distinguished from soft information (Petersen 2004; Goetzmann et al. 2009; Liberti 2004). Hard information is readily available and quantifiable because it arises from official and public documents (balance sheets, financial reports and press releases) (Petersen 2004). This type of information is produced with high frequency and reliability by large companies that, given the great number of stakeholders, need to make the performance they have achieved visible to the market.

Less frequent and reliable is the production of information by SMEs which have small-size administrative functions. Furthermore, the lowest number of SME stakeholders reduces the external pressure for the release of hard data relating to firm performance.

Instead, soft information is qualitative and difficult to obtain because of its confidential nature (Petersen 2004; Liberti 2004). The news, in fact, relates to the future strategies of the firm, the future projects under development, the research and development activities that the firm intends to carry out and the managerial skills and leadership of the entrepreneur. In this case, soft information is difficult to obtain in both large enterprises and SMEs because it relates to the potential growth of the enterprise and is also very appealing to the competition among firms (Faure-Grimaud et al. 2003).

Therefore, relationship lending seems to play a key role in obtaining hard and, above all, soft information regarding credit applicants (Uzzi 1999). However, some distinctions seem to emerge between large enterprises and SMEs. In the first case, relationship lending allows obtaining mainly soft information, as the hard is already available in large quantity. Instead, in the case of SMEs, relationship lending also allows the collection of hard information, considering the increased opacity of such firms.

Therefore, a situation emerges in which the relational approach of large intermediaries towards larger firms and SMEs is different from the one adopted by small banks because of the following:

- Large banks may opt for a strategy of risk reduction of their customer portfolio made by SMEs through an appropriate diversification and, instead, find convenience

in an approach based on relationship lending towards large enterprises. In fact, only in this last case the benefits arising from the possession of confidential information exceed the cost of its collection. Moreover, the interest of large banks should be focused on the collection of soft information considering the large amount of quantitative information produced by large firms and available at low cost.

- Small banks must necessarily adopt a relational approach regardless of the size of the firms because SMEs account for almost all of the exposures.

Therefore, it is important to ensure that the portfolio of SMEs does not become too risky altogether, while a few but significant exposures to large companies also recommend making large investments in the collection of confidential information regarding such clients. In this case, small banks are interested in collecting hard and soft information with regard to SMEs while employing resources to collect only soft information on large enterprises.

### **Results and discussion**

In order to better highlight the differences between large size intermediaries and small banks in the assessment of hard and soft information relating to large companies and SMEs, it was deemed appropriate to focus the review of the results on the information variables that show a statistically significant difference in medians (significance less than 0.1) according to the Mann–Whitney test.

Regarding the quantitative information on large companies (Table 1), the 2010 data point out the following:

- Large bank managers attach high importance to information from the central credit register, while they assign a medium-high importance to information on granted guarantees.
- Small bank managers attach less importance to information from the central credit register and a high relevance to guarantees (Table 1).

Regarding the quantitative information on SMEs (Table 1), the survey results show, however, the following:

- Large bank managers attach an average relevance to the trend analysis of the credit relationship and a great importance to guarantees.
- Small bank managers assign high relevance to the performance of the credit relationship and a high relevance to guarantees. For the remaining information variables related to large companies and SMEs, the Mann–Whitney test shows no statistically significant differences between the managers of large banks and small banks.

From these observations, a picture emerges in which large and small banks appear to show a similar approach with respect to quantitative variables, regardless of the size of the firms they are granting credit to. Moreover, the differences observed in 2010, in most cases, are not found in 2007 (Table 2). In that year, in fact, only the information variables regarding SMEs show statistically significant differences.

**Table 1 Degree of relevance of quantitative information in the year 2010**

	Large enterprises				Small and medium enterprises			
	Median relevance (large banks)	Median relevance (small banks)	Mann-Whitney <i>U</i> test	Significance	Median relevance (large banks)	Median relevance (small banks)	Mann-Whitney <i>U</i> test	Significance
Balance sheets	4	4	159.5	0.316	3	3	172	0.420
Territorial data	4	3	157.5	0.302	3	3	143	0.120
Central credit register	4	3	65	0.0	3	3	171	0.449
Credit relationship	4	4	169.5	0.503	3	4	97.5	0.003
Guarantees	3	4	78	0.01	4	4	111.5	0.018

Information relating to large enterprises and SMEs for managers of large banks and small banks. 1 = no relevance, 2 = low, 3 = medium-high, 4 = high, 5 = very high, 6 = decisive.

**Table 2 Degree of relevance of quantitative information in the year 2007**

	Large enterprises				Small and medium enterprises			
	Median relevance (large banks)	Median relevance (small banks)	Mann-Whitney <i>U</i> test	Significance	Median relevance (large banks)	Median relevance (small banks)	Mann-Whitney <i>U</i> test	Significance
Balance sheets	3	4	143	0.2387	4	3	46	0.000
Territorial data	4	4	175.5	0.8668	3	4	153.5	0.385
Central credit register	3	4	168	0.6978	3	3	146.5	0.238
Credit relationship	4	3	148	0.2898	3	4	130	0.064
Guarantees	3	4	158.5	0.4046	4	4	130	0.107

Information relating to large enterprises and SMEs for managers of large banks and small banks. 1 = no relevance, 2 = low, 3 = medium-high, 4 = high, 5 = very high, 6 = decisive.

In particular, information derived from financial statements (balance sheets) is considered most relevant by large banks, while information on the progress of the relationship between bank and enterprise (credit relationship) is deemed most important by small banks (Table 2). In the latter case, the greater sensitivity of small bank managers to information on the trend of the credit relationship with SMEs is confirmed.

The substantial homogeneity between large banks and small banks in the evaluation of quantitative information in order to grant credit to companies of all sizes is not confirmed when the same credit institutions have to assess qualitative information. In fact, almost all the medians of qualitative information variables show statistically significant differences between large banks and small banks (Table 3).

This occurs both when the firms entitled to bank credit are large and when they are SMEs. In particular, small banks in evaluating the creditworthiness of large firms attach high importance to private information, brand image, the organization's quality and the reliability of the information produced by the information system, R & D, entrepreneurial culture, and relationship length, and such information greatly influences the determination of credit pricing (Table 3).

Large banks, instead, attach little importance to the same information. Even with regard to SMEs, smaller banks appear to show greater interest in qualitative information than large banks. In most cases, in fact, smaller financial intermediaries deem relevant qualitative information relating to SMEs in order to grant a credit line (Table 3).

Less attention, instead, has been declared by large bank managers to this type of information produced by SMEs. Furthermore, the different approach of large intermediaries compared to small banks towards qualitative information is confirmed by the 2007 data (Table 4). Small banks deem the soft information relevant to the assessment of the creditworthiness of both large and small firms (Table 4).

Instead, large banks consider this kind of information scarcely relevant on businesses of any size. In summary, analysis of the results of the interviews shows the following:

- Managers of large banks base their analysis of firm creditworthiness on quantitative information (hard information), while they judge qualitative information (soft information) scarcely relevant, regardless of the size of the firms requiring a credit line.
- Managers of small intermediaries believe both quantitative and qualitative information are relevant to assess the creditworthiness of both large firms and SMEs.

## Conclusions

The empirical investigation seems to confirm some of the assumptions of the literature on relationship lending, outlining better some of its features. In particular, the data confirm the existence of a different information approach by large bank managers compared to small banks managers. The empirical analysis seems to show the indifference of the great institutions towards the collection of qualitative information regardless of the size of the firms requiring a credit line. Therefore, both large companies and SMEs are valued by the larger credit institutions only on the basis of quantitative information. The information approach of small banks appears to be different: they assess with the same attention both qualitative and quantitative aspects of the firms regardless of their size.

**Table 3 Degree of relevance of qualitative information in the year 2010**

	Information regarding large enterprises				Information regarding small and medium enterprises			
	Median relevance of information for large banks	Median relevance of information for small banks	Mann-Whitney <i>U</i> test	Significance	Median relevance of information for large banks	Median relevance of information for small banks	Mann-Whitney <i>U</i> test	Significance
Private information	2	4	48.5	0.0000	3	4	102	0.0060
Brand image	2	4	29.5	0.0000	3	4	102	0.0080
Information system organization	3	4	33.5	0.0000	3	4	46	0.0000
R & D	3	4	120.5	0.0344	4	4	153	0.2410
Entrepreneurial culture	2	4	34	0.0000	2	3	54.5	0.0000
Pricing	3	4	61.5	0.0002	3	4	126	0.0520
Relationship length	2	4	80	0.0011	2	3	118	0.0250

Information relating to large enterprises and SMEs for managers of large banks and small banks. 1 = no relevance, 2 = low, 3 = medium-high, 4 = high, 5 = very high, 6 = decisive.

**Table 4 Degree of relevance of qualitative information in the year 2007**

	Information regarding large enterprises				Information regarding small/medium enterprises			
	Median relevance of information for large banks	Median relevance of information for small banks	Mann-Whitney <i>U</i> test	Significance	Median relevance of information for large banks	Median relevance of information for small banks	Mann-Whitney <i>U</i> test	Significance
Private information	3	4	53	0.0001	2	4	9	0.0000
Brand image	3	4	57	0.0001	3	4	59	0.0000
Information system organization	3	4	44.5	0.0000	2	4	29.5	0.0000
R & D	3	4	52.5	0.0001	2	4	58.5	0.0000
Entrepreneurial culture	2	4	38	0.0000	2	3	9.5	0.0000
Pricing	2	3	125	0.0530	2	3	79	0.0010
Relationship length	2	3	150	0.2297	3	4	67.5	0.0000

Information relating to large enterprises and SMEs for managers of large banks and small banks. 1 = no relevance, 2 = low, 3 = medium-high, 4 = high, 5 = very high, 6 = decisive.

The attention to soft information seems, in this case, to be justified by the impossibility of an efficient diversification of the customer portfolio that is inevitably concentrated on a territorial basis and, sometimes, also on an industrial basis. This obliges small intermediaries to pay more attention to firms enhancing the knowledge of the qualitative aspects. Instead, the specialization of large banks in the assessment of hard information, may find its explanation in the need for standardization of the assessment processes.

However, the current crisis and the consequent increase in the frequency of default events, not only of entire entrepreneurial systems but also of entire countries, should lead larger credit intermediaries to pay more attention to relationship lending, investing more decisively in the collection of qualitative information on their customers in debt. By coordinating only this activity of soft information collection and by constantly developing quantitative models for the assessment of hard information, an improvement in the quality of customer portfolios may be achieved, stabilizing the credit market.

## Methods

The aim of the survey is to assess whether large credit institutions attach different importance to qualitative information (soft information) and quantitative information (hard information) compared to small banks, when they have to assess the creditworthiness of large companies and SMEs. Therefore, it is necessary to study the attitudes of large bank managers with regard to quantitative and qualitative information from enterprises of different sizes and compare this phenomenon with the behaviour of small bank managers.

For this reason, a questionnaire regarding firms which had been granted credit lines in the period 2007 to 2010 was administered to a sample of 61 managers of various banks throughout the national territory (29 large banks and 31 small banks).

In particular, managers were asked to express an opinion on the relevance of certain categories of quantitative information (hard information) and qualitative information (soft information) in order to assess the creditworthiness of large firms and SMEs.

The questionnaire was structured using the Likert scale with six increasing scores: 1 = no relevance of the information, 2 = low relevance, 3 = average relevance, 4 = high relevance, 5 = very high relevance and 6 = decisive relevance to the opening of the credit line.

Relevance assessment primarily focused on 'hard information' variables as defined in the following: *balance sheets* indicates the relevance of financial statements in the assessment of the firm's reliability by the bank manager, *territorial data* measures the relevance of quantitative data related to the territory (GDP per capita, infrastructure, etc.) on the assessment of firm creditworthiness, *central credit register* detects the influence of the news about exposures detectable by the central credit register on the manager's decisions to grant credit, *credit relationship* indicates the relevance of the trend of the credit relationship between the firm requesting credit and the bank granting it regarding the decision itself and *guarantees* measures the importance of economic and financial information on those who have provided personal guarantees and collateral in the debtor's interest.

Moreover, relevance assessment has also focused on the 'soft information' variables as specified in the following: *private information* measures the importance attached by banks to information on the firm's performance released by the entrepreneur himself or by those close to him such as the stakeholders, *pricing* measures the influence exerted by qualitative information on the determination of credit pricing, *brand image* measures the

importance of the firm's brand image in its industry on lending decisions, *information system organization* measures the influence of information on the quality of the business organization and the information system on credit decisions, *R & D* indicates the importance attached by the banks to the news on investment in research and development and the existence of partnerships with universities or research centres; *entrepreneurial culture* measures the importance attached by bank managers to information such as the age of the entrepreneur, his qualifications, the governance system and the entrepreneurial leadership that represent a proxy for business problem-solving skills and *relationship length* measures the relevance to managers of the length of the lending relationship.

In this research, given the small sample size, the nonparametric Mann–Whitney test was used to highlight significant differences between the responses provided by large bank managers and those provided by small bank managers with regard to the variables described previously.

### The Mann–Whitney test

The Mann–Whitney  $U$  test (Mann and Whitney 1947) or robust rank-order test is a nonparametric statistical test (it does not require *a priori* assumptions about the characteristics of the population) and is equivalent to  $t$  statistics for independent samples. It is used to test the null hypothesis that two samples come from the same population (the same median) or, alternatively, if the observations belong to two different populations (different medians).

The Mann–Whitney test arises from H. B. Mann and D. R. Whitney's proposal to generalize Wilcoxon's method (Wilcoxon 1945) and requires no assumptions about the symmetry of the two samples. Moreover, it can also be applied when the two samples have different sizes. The Mann–Whitney test is divided into the following steps:

Step 1. Sorting data in ranks<sup>a</sup> ( $r$ ), including the two samples in the same order. If samples are not balanced, we say that the size of the smallest sample is  $n$  and the size of the largest is  $m$ . The sum of the ranks of the two samples is as follows:

$$\sum_r = \frac{(n+m)(n+m+1)}{2}. \quad (1)$$

The null hypothesis of random assortment of values in the two groups provides that both groups have the same mean rank  $r_m$ :

$$r_m = \frac{(n+m)(n+m+1)}{2} \frac{1}{n+m} = \frac{n+m+1}{2}. \quad (2)$$

Multiplying the mean rank by the respective sample sizes, the sum of the ranks expected for the condition of indifference is obtained.

Step 2. Summing the ranks of the smaller sample ( $U$ ). This amount is already the result of the test. In fact, the more the sum of the ranks of the smaller sample differs from the expected one, the more the probability that the two samples are random assortments of rank-loss consistency. The verification in the table will tell us whether to keep or reject the null hypothesis beyond the different critical thresholds of significance. For each level of significance, two extreme values are inscribed in the table: a very small and a very large one. The significance is reached if  $U$  is smaller than the smallest value or higher than the highest value in the table. If the samples are large

enough, it is possible to do without the table and exploit the fact that  $U$  tends to be normally distributed around the expected value of the null hypothesis:

$$z_U = \frac{U - m_U}{s_U}, \quad (3)$$

where

$$m_U = n \frac{n + m + 1}{2} = nr_m, \quad (4)$$

$$s_U = \sqrt{\frac{n \cdot m(n + m + 1)}{12}}. \quad (5)$$

Formulas 4 and 5 are respectively the mean rank multiplied by the sample size of the first group and the standard deviation. If  $z_U$  exceeds in absolute value of 1.96, the two groups may be considered significantly different.

## Endnotes

<sup>a</sup>The rank represents the increasing ordered position of observations.

### Competing interests

The authors declare that they have no competing interests.

### Authors' contributions

MRDP authored the background and the summary literature review, MDG structured the research methodology and FC was in charge of the results, discussion and conclusions. All authors read and approved the final manuscript.

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