Politecnico di Torino

Master's Degree in Engineering and Management

Credit rationing: literature review and empirical evidence in the survey on access to finance of enterprises

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March 2022

Abstract

This work aims to provide a thorough summary of the main theoretical frameworks for the study of credit rationing. This subject was approached from several theoretical points of view and in the second part of the 20th century many models have been developed. After a first treatment in the context of the availability doctrine, the concept was more deeply defined in the so-called "à la Hodgman" models. Later, Stiglitz and Weiss (1981) developed what is widely recognized to be the canonical framework for credit rationing. From then on, many economists studied the issue from different angles, incorporating elements like the reputation of the firm, the role of collateral, the presence of monitoring and the existence self-rationing. The problem can take many forms: "pure" credit rationing refers to cases in which some individuals obtain loans while observationally identical individuals do not. Size-rationing occurs when borrowers obtain an amount lower than requested. Self-rationing, instead, describes a situation in which firms do not apply for loans being sure not to receive it. The existence of credit rationing has been difficult to verify empirically, and the main methods used in the literature involve the use of surveys, proxy variables and econometric analysis. Using these tools, size, age, and management of the firm were identified as the main determinants of credit rationing. This work focuses on credit rationing for small and medium-sized enterprises (SMEs) in Europe, since they account for more than the 99% of all business in the EU. For this reason, SMEs were involved in many support programs launched by the European Central Bank, and the latest developments in their financial situation are monitored through a bi-annual survey on access to finance for the enterprises (SAFE). The thesis discusses the results of the SAFE for the past ten years, observing how the situation evolved until 2019 and examining which types of credit rationing occurs. The main outcome is that credit rationing effectively occurs more frequently in SMEs than in large firms, an observation supported by the fact that in 2019 almost the 30% of respondents did not apply for a bank loan despite needing it, and among the applicants only the 70% received the desired amount. The survey confirms the presence of self-rationing and size-rationing, while it is not possible to verify the existence of the theoretical pure credit rationing, since the respondent enterprises are not observationally identical. An extensive

analysis is conducted differentiating the business types and the countries, finding out that there is not a clear linear relationship between the variables considered and credit rationing, and that in some countries the rationing occurs more severely than in others. The results are finally compared with the report published by the European Central Bank and with the outcomes of the Bank Lending Survey with the additional objective of analysing the point of view of the banks, which are bound by the conditions of the Basel accords.

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Introduction

The concept of credit rationing has become object of many studies in the second half of 1900. The literature of the Availability doctrine laid the foundation for many authors who attempted to describe a theoretical framework for this phenomenon and to understand its root causes. The topic is particularly relevant and debated because of its meaningful impact on the credit market, influencing the allocation of capitals and more generally the economic growth. Behind all the theoretical formulations, the main characteristic of this market imperfection is that the equilibrium of the market is not the one which clears demand and offer, contradicting one of the most relevant economic theorems. This leads to a situation in which some individuals asking for loans are completely cut off from the credit market, or are not able to get the amount desired, with meaningful consequences on their possibilities to make investments. The availability of credit is a particularly relevant topic for the growth of small firms, and a particular concern regard the access to finance of small and medium-sized enterprises. It has been widely debated in the literature if the size of the firm can have an impact on its access to finance, and a massive strand of the literature considers SMEs more frequently rationed, despite it was never irrefutably demonstrated empirically. In the theoretical literature credit rationing can assume different forms. The canonical one is "pure" credit rationing, describing a situation in which, among a pool of borrowers, some are able to receive a loan and other observationally identical borrowers are not. Another kind of rationing widely discussed in the literature is size-rationing, indicating a situation in which all the borrowers are able to receive a loan, but they are receiving an amount lower than the one requested. More recently it has been taken into consideration the possibility that some enterprises do not even apply for loans because of a possible rejection. This issue has been defined self-rationing. This work aims firstly at providing a summary of the main theoretical and empirical frameworks for credit rationing, describing how the subject was approached in the years. In the first chapter proposes an overview of the main models on credit rationing proposed by the end of the '50s and the end of the '90s. The second chapter analyze the main tools used in the empirical literature to describe and measure the phenomenon with their pros and cons, and it presents a review of the main papers

published on this topic. Afterwards, it is provided a description of the variables that in the literature have been recognized as the main determinants of credit rationing, reporting the empirical literature produced on the topic. The main focus of the work is to underline evidences of credit rationing in the survey on access to finance of enterprises. An analytical work has been conducted on the survey, whose methodology will is explained in the third chapter. The survey SAFE is launched twice per year by the joint effort of the European Central Bank and the European Commission. The survey aims at monitoring the latest development in the financial conditions for small and medium-sized enterprises in the European Union. SMEs in Europe account for more than the 99% of the total businesses, and for this reason their survival is crucial to grant the stability of the economy in Europe. This analysis is focused on the results between 2012 and 2019, with the aim to identify a trend prior to the pandemic. The data from 2019 to 2021 are also shown in the graphs, to depict how the pandemic caused changes in the environment producing different results in the different industries. This transitory phase cannot be considered complete and a new trend has not yet settled. For this reason, and to avoid risky and incomplete assumptions, the analysis is mainly focused on the results until 2019. Three data-sets available in the statistical warehouse of the European Central Bank have been considered as the starting point for the analysis. The former contains the aggregated historical series results from 2009 to 2021, the second contains a breakdown of the answers collected in 2019 by business type and the latter a breakdown of the answers collected in 2019 by business type. For each data-set only some questions considered relevant for the analysis have been considered. The numerical data of some questions have been aggregated to find new variables considered relevant for the analysis. A fixed number of variables have been identified in the three data-sets. The new data-sets have been imported to SPSS statistics to perform descriptive statistics. The results of the analysis at European level are discussed, analyzing formerly the historical series and then making a distinction by country and by business type. These results are then compared with the annual report produced by the ECB. Finally, also the perspective of the banks is taken into account, analyzing the results of the Bank Lending Survey, conducted quarterly by the European Central Bank.

Chapter 1

Theoretical development of credit rationing

1.1 The origins of the literature on credit rationing

1.1.1 The Availability doctrine

At the beginning of the XX$^{\text{th}}$ century, the classical theory of interest served as the main framework for the theory of money. In this view, the rate of interest is determined by the supply of and the demand for savings. After the Great Depression and the Word War II, the interest in the nature of credit market imperfections becomes more and more relevant with the attempt to explain their consequences on monetary policies. The first basis for credit rationing can be found in the *Availability doctrine* [1], whose main exponent was R. V. Roosa, originally derived from the monetary control policies of the Federal Reserve in the US. In that period, empirical studies and theoretical development started relegating the interest rate to a minor role in the entrepreneurial choices on investments. The doubts on the effectiveness of the impact of monetary policies, started to be widespread due to empirical evidences on the low elasticity on the investments with respect to the variation of the interest rate. On this regard, Roosa suggests that the parameters of the monetary policies have much more effect on the total availability of the credit, more than on the interest rates. The importance attached to the Availability Doctrine in this context arises from the emphasis placed on the role of the lender and on the concept of availability of credit. Nevertheless, in these discussions credit rationing is viewed as a non-equilibrium phenomenon, in which markets are just slow to adjust to exogenous shocks. Moreover, the Availability Doctrine is focused only on the supply side, without considering the characteristic of the demand.

As a result, besides a temporary rationing due to a rigidity in the short period, Roosa was not able to effectively explain why the interest rate should not reach his Walrasian equilibrium in the long term and why banks cannot simply increase their interest rates to clear the demand and the supply, earning an higher profits on loans. In that period, it was still difficult to provide a theoretical explanation on the phenomenon coherent with the rational economic behavior. Moreover, despite the Availability Doctrine was fundamental for the introduction of the concept of the availability of credit, in Roosas' framework the emphasis is more on securities market and how the FED can influence the behavior of lenders, taking for granted that this would be automatically translated into less credit in the commercial market.

1.1.2   The model proposed by D.R. Hodgman

An important contribution was given by D.R. Hodgman [2] in 1960. His main turning point was to consider in the framework the borrowers' risk of default, trying to explain for the first time how credit rationing could persist in an equilibrium framework. The main assumption behind his model is that for a lender the attractiveness of a loan depends mainly on the interest rate and the risk. The risk can be expressed as a probability distribution function of possible payoffs and the two elements are systematically interrelated, and can be varied among the borrowers only within specific limits. In particular he specifies that, for the borrower, the risk of loss is an increasing function of the size of the loan, while, for the lender, the expected value of possible gains and losses is an increasing function of what the borrower promises to repay. The main takeaway from Hodgmans' paper is that there is a maximum repayment that the borrower can promise, and it limits how much the lender will offer regardless of the interest rate; higher loans would be too risky and this could not be compensated by higher interest rates. From a mathematical point of view, assuming the existence of the risk of insolvency of the borrower, the supply curve becomes completely inelastic at a certain point with regard to the interest rate. Banks have beliefs concerning the distribution of the gains from a fixed investments and ask for a minimum ratio between expected gains and expected losses. Thus, for each interest rate there is only one dimension of the loan which can grant to the bank this ratio, implying the existence of a maximum dimension of the loan. This dimension is independent from the willingness of the borrower to pay an higher interest rate, since it would not compensate the expected losses deriving from an increase in the dimension of the loan. The demand curve, as we can see from the figure 1.1, intersect the supply curves in the inelastic part. In the figure the intersection between the demand and the supply happens at r_1, but being fixed the dimension of the loan, r_2 would always be preferred by the borrower. In this context, since the credit market is competitive, r_2 is the
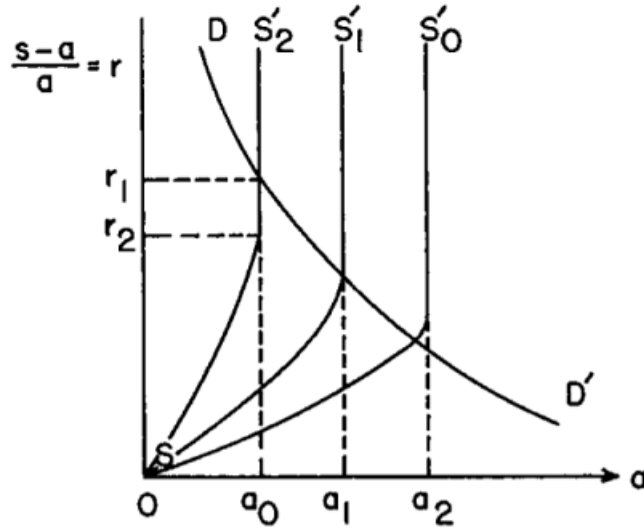
Figure 1.1: Hodgmans' curve

competitive interest rate, despite not being the one clearing the demand and the supply. The paper published by Hodgman was much debated in the subsequent years. M. Miller [3] in 1962, presented some important considerations regarding the phenomenon. Miller argues that the minimum ratio between gains and losses that the bank wants to keep cannot be considered an objective criterion, because it would be completely arbitrary. In this sense, Millers' analysis overcame Hodgmans' one modeling explicitly the risk aversion of the banks. This is done through the incorporation of bankruptcy costs incurred by the lender in case of default of the borrower.

1.1.3 The model proposed by M. Freimer and M.J. Gordon

Another important contribution was given by the model of M. Freimer and M.J. Gordon in 1965 [4]. The authors in their paper provide a distinction between two different kind of credit rationing. The former is related to a situation in which a banker vary the amount he is willing to lend to a borrower with the interest rate up to a limit (they defined it *weak credit rationing*). The latter describes a situation in which a banker sets an interest rate and lends a borrower whatever he wants up to a predetermined level at this rate, refusing to lend more regardless of the rate (defined as *strict credit rationing*). According to this classification, the rationing proposed to Hodgman and Miller belongs to the first category. As in the Hodgmans' model, there is an upper limit to the ideal dimension of the loans, but the curve proposed by the authors is in this case different. While initially the curve is positively shaped as it can be observed in the graph 1.2, increasing the interest
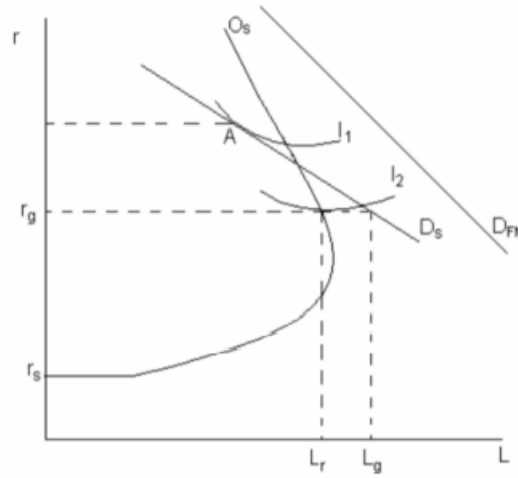
Figure 1.2: Freimer and Gordons' curve

rate the dimension of the optimal loan starts decreasing. The justification for this phenomenon is based on the assumption that increasing the interest rate over a critical point, the potential increase in gains would not be sufficient to compensate the potential losses, decreasing the optimal dimension of the loan. In this sense, according to Freimer and Gordon, rationing occurs every time the supply curve do not coincide with the D_s in the figure 1.2, like in the case of the curve D_{FM}.

1.1.4 The model proposed by D.W. Jaffee and A. Modigliani

The most important important step ahead in the literature before the '70s was made with the model proposed by D.W. Jaffee and A. Modigliani in 1969 [5]. The authors define credit rationing as a situation in which "the demand for commercial loans exceeds the supply of these loans at the commercial loan rate quoted by banks". Moreover, they present for the first time what will then become a canonical distinction between *equilibrium rationing*, which occurs when the loan rate is set at its long-run equilibrium level and *dynamic rationing*, which may occur in the short-run, when the loan rate has not been adjusted to the optimal level. The aim of their paper is to explain the rationality behind limiting the loans to less than the amount demanded by the borrowers. The kind of credit rationing described in the paper will be subsequently defined as *size-rationing* in the classification made by Jaffee and Stiglitz in 1990 [6] and it is referred to a situation in which all the borrowers receive an amount lower than the one requested. The novelty in their model is to consider not only the supply but also the demand and the determinants of commercial loans rates. In this way it it possible to demonstrate the excess

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of the demand and, as a consequence, the existence of rationing. According to their model, the interest rate charged from the banks mainly depends on the time horizon and the competition in the market. As a consequence, if a bank can behave like a discriminating monopolist, being always capable to distinguish the different borrowers, will charge a different interest rate to all the individuals and will maximize its profits. In this scenario, credit rationing is never profitable tor the bank. Nevertheless, when the bank cannot discriminate between the single borrowers, the rationing would be profitable for three main reasons that will explained below. The first reason regards usury laws, which imposes a ceiling on the maximum interest rate chargeable by banks. The second cause is that, when banks cannot perfectly discriminate between borrowers, they will group clients into homogeneous classes charging the same interest rate to the same class of borrowers. The third reason is the competitiveness in the banking sector. In the same class, the bank would choose an interest rate which is between the minimum and the maximum interest rate that would have been charged in case of perfect discrimination. As a consequence, all the clients whose interest would have been less than the one charged in the ideal situation with perfect discrimination, will be rationed. According to this reasoning, the rationing process is mainly due to the aggregation process operated by banks, and it is positively correlated to the heterogeneity of the clients in the same class.
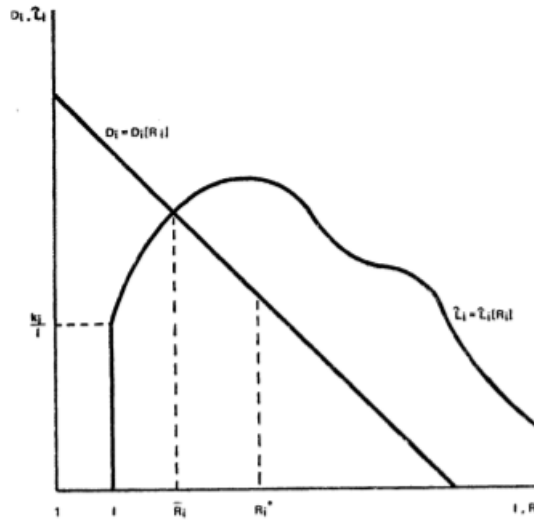

Figure 1.3: Jaffee and Modigliani curve

Jaffee and Modiglianis' model overcame the one proposed by Freimer and Gordon assuming an endogenous interest rate and modelling both the supply and the demand of the market. As it is observable in 1.3, the demand curve is downward

sloping and vanishes for sufficiently high interest rates because of the existence of alternative means of financing to which the firm has limited access (and this also explains the negative slope of the curve). At a zero interest rate the demand for loans is limited by the size of the investment projects. The demand of the firm i and the offer curve of the bank intersect at the interest rate factor $\bar{R}$. If the bank charges an interest rate higher than $\bar{R}$ rationing will not occur since the demand would be lower than the offer, and in this case banks would be happy to provide higher loans to firms in order to increase their profits. On the contrary, if the bank charges a lower interest rate, credit rationing will occur. Thus, the rationality of credit rationing, mainly depends on the rationality of charging an interest rate lower than $\bar{R}$. If the bank has two clients who applied for the loan and if it could perfectly discriminate, it would charge R_1 and R_2 respectively to borrower 1 and 2. Supposing that the banker is constrained to charge all customers the same rate and R* is the common rate factor that maximizes the bank's expected profit, we must have $R_1 \leq R^* \leq R_2$ It is easy to understand that it will not be profitable for the bank to ration customers whose R_i is smaller than the group rate R^*, but it may pay to ration those for whom R_i exceeds R^*. The probability that it is profitable to ration one client is positively related to the heterogeneity of the class (in this case represented just by two individuals). It also need to be considered that in presence of many different classes of clients, and considering the existence of usury ceilings, all the rates charged to the different classes will be compressed into narrow limits meaning that the R* charged by the banks tends to the lower limit. The result is that rationing is profitable for the bank. All the models described so far have been classified as models *à la Hodgman* and were subsequently criticized for the inability to endogenize the phenomenon of credit rationing in the banks' behavior. In all the model developed until 1970, the main cause of the phenomenon is found in external constraints such as usury laws or the need of the banks to group the customers in homogeneous classes [7]. Nevertheless, these works were important because established the idea that credit rationing could persist also in an equilibrium framework, paving the way to the subsequent literature developed between the '70s and the '80s.

1.1.5   The adverse selection described by G. Akerlof

The real turning point for the literature on credit rationing (and more in general for the literature on information asymmetries) is the paper published by G. Akerlof in 1970 [8]. This paper was the first one able to address the problem of the adverse selection and its influence in the markets. The model relies on the assumption that the existence of goods of many grades of quality is a central issue in the theory of market. In some markets buyers use some statistics to judge the quality of future purchases, and in this cases sellers are incentivized to market poor quality goods.

This is the cause of a reduction in the average quality of goods, and in the extreme case the size of the market can become smaller and smaller until collapsing. In his paper Akerlof examined the market for used cars in the US, where are traded "good" cars (defined "peaches") and "bad" cars (also known as "lemons"). The main assumption is that there is asymmetrical information between buyers and sellers regarding the transaction. The seller, owner of the car, is the only one knowing if his car is a "peach" or a "lemon", or at least if the quality of his car is below or over the average. Potential buyers, not having these information, do not want to pay a car more than the average price, which is in the middle between what they would pay for a "good" car and what they would pay for a "bad" car. In the market cars are traded at the same price (otherwise it would be immediate to recognize peaches from lemons) and this price is the average price. The theory of Akerlof is that the owners of peaches, knowing their car would be traded at an average price, are "locked-in" not having incentives to sell their car at a price lower than its true value. On the contrary, owners of a lemon would receive a premium for selling the car. Paradoxically, if these assumptions hold, only lemons would be traded in the market, and consequently there would be no market at all because it would collapse. The result is that, if in the market there is asymmetric information with respect to quality, the bad cars drives out the good cars. The conclusion is even more extreme when there are not only good and bad cars but also intermediate levels, in which every level would drive away the upper one. This paper, despite not addressing the problem of credit rationing, was fundamental to describe the complexity of the relation between the borrower and the lender, and paved the way for two important models of credit rationing, the first one proposed by D. M. Jaffee and T. Russel in 1976 and the second one published J. Stiglitz and J. Weiss in 1981, which above all the criticisms is still considered the canonical framework for the phenomenon.

1.2   The model of D.M. Jaffee and T. Russel

D.M. Jaffee and T. Russel [9] define credit rationing as a situation in in which *"lenders quote an interest rate on loans and then proceed to supply a smaller loan size than that demanded by the borrowers"*. Also in this case it is described a situation of *size-rationing*, as it will be defined in the later literature. In their paper, they address how imperfect information and uncertainty can lead to rationing in the loan market, and to do so they assume at the extremes the existence of *honest* and *dishonest* borrowers. The framework rotates around the idea that the honest borrowers will repay the loan, while dishonest individuals default on loans when they have the incentive to do so (when the costs of default are sufficiently low). Banks are not able to distinguish ex-ante between honest and dishonest borrowers.

Honest borrowers has utility function

$$U[C_1, C_2]$$

where C is the consumption in the relative period, and receive an income (Y_1, Y_2) at the beginning of each period. Loans are granted at the beginning of the first period (increasing period 1 consumption) and are repaid at the beginning of the second period (reducing period 2 consumption). The aim of the honest borrower is to maximize

$$U[C_1, C_2]$$

with respect to C_1, C_2, subject to

$$C_2 = Y_2 - (C_1 - Y_1)(R)$$

where $R = 1 + r$ is the interest rate factor. As a consequence

$$C_1 = L + Y_1$$

and

$$C_2 = Y_2 - LR$$

where L is the loan principal. Maximizing the utility function with respect to L, the loan demand function will be

$$L^* = L^*[R]$$

where $\frac{dL^*}{dR}$ is negative, L* is zero at a finite value of R and L* approaches to infinity when R approaches to zero. Dishonest borrowers default on their loans when the costs of default are lower than the loan repayment. This means there is a cost of default, that will be indicated as Z and will be subtracted from Y_2 if default occurs. The consumption of the second borrower will be the same as the one of the honest borrower in case of repayment of the loan. In case of default the consumption will be

$$C_1 = Y_1 + L^*$$

and

$$C_2 = Y_2 - Z$$

It is moreover possible to consider that the cost of the default, varies from Z_{max} and Z_{min}, where Z_{max} is defined such that "the individuals with this default cost would never default and behave honestly both for economic and for ethic reasons". Assuming this Z distribution to be continuous, it is possible to define a function $\lambda[LR]$ where λ is the proportion of individual who do not default under the contract LR. In the 1.4 it is shown the trend of the function λ, which is $= 1$ for all values
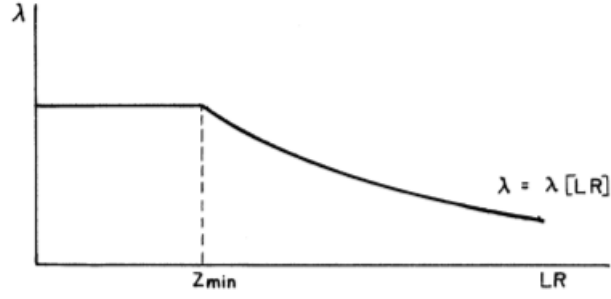
Figure 1.4: Trend of the function λ

$Z < Z_{min}$ and is decreasing for all values of $Z > Z_{min}$ It is possible to suppose that the lender obtain the funds at the constant interest rate i, where $I = 1 + i$. The lender is assumed to maximize the expected value of his profit, that can be written as

$$\pi = LR\lambda[LR] - LI$$

where the first term is the contract value of the loan multiplied by the probability of repayment, and the second term is the cost of lending money for the bank. Since the market is competitive the zero profit condition must hold, and

$$R\lambda[LR] = I$$

This result is defining the supply function shown in the figure 1.5. As it is shown

Figure 1.5: Curve modeled by Jaffee and Russel

in the figure 1.5, $\lambda = 1$ for $R = I$. Beyond point T the supply function can be

positively sloped or backward bending, depending on the distribution of λ, and this is not affecting the overall result because the equilibrium is determined by the intersection of the demand and the supply function. The equilibrium without rati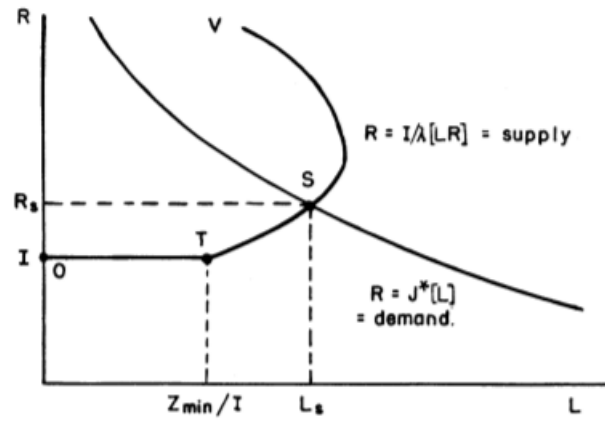oning occurs at point S, where the interest rate exceeds the cost of the loan by the amount necessary to compensate the existence of "dishonest" borrowers. Nevertheless, if we consider the set of zero profit contract which lies below the demand function, as the curve OTS, these contracts would imply rationing. In the figure 1.6, which represents an enlargement of a piece of the supply curve, it is possible to observe this phenomenon. Borrowers who would not default at S, would prefer to be rationed, avoiding to pay premium for the existence of dishonest borrowers, since lowering the interest rate would imply less borrowers who default. As a consequence, they would prefer the contract E, where the iso-utility curves intersect the curve TS. Hence, honest borrowers at contract S would prefer to be rationed and accept the contract E.
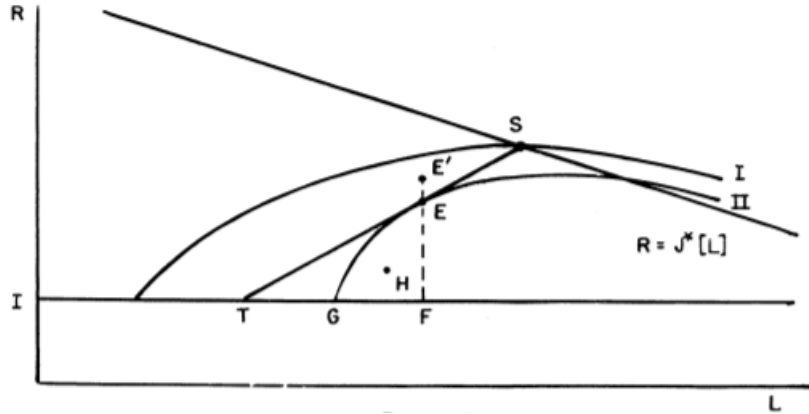
Figure 1.6: Curve modeled by Jaffee and Russel

In addition, a new entrant could find profitable to enter in the market and lend money at a lower interest rate. The new entrant could offer the contract H, which would be preferred by all the borrowers who would not default at E and prefer to be rationed and pay a lower interest rate. The dishonest borrowers, on the contrary, would prefer a larger loan and would choose contract E. This mechanism of self-selection leads to a temporary solution in which there is a sharp distinction between honest and dishonest borrowers. In the long run lenders offering contract E would remain only with dishonest borrowers, and would have to offer contract H, forcing the entire market to the lower interest rate. However, at this point, the new contract lies below the zero-profit locus, meaning losses for the lenders who offer contract H. Contract H would consequently disappear from the market, with the reintroduction of contract E leading to a vicious circle or to a market collapse. The results of the paper would work in the same way for other cases of uncertainty

as long as the default function can be described by a function like $\lambda[LR]$. The same situation would indeed happen if the borrowers can be lucky or unlucky, even if they have no control on what will happen. In the conclusion of the paper, Jaffee and Russel admit that the actual loan market is quite different from the one analyzed because of the presence of collateral, down payment requirements and non-price terms. As a consequence, the paper can be considered of a prediction of what would happen in absence of institutional arrangements. In addition, like the previous authors, also Jaffee and Russel came to the conclusion that monopoly is an innately stable market form, and implies no credit rationing. Hence, if it were possible to reach an oligopolistic cartel (for example through government intervention) there would be no credit rationing.

1.3   Moral hazard and adverse selection: the model of J. E. Stiglitz and A. Weiss

In 1981 Stiglitz and Weiss [10] published what is still considered the canonical model of credit rationing [11]. The authors were able to consider all the main factors involved in the problem: the interest rate, the amount of the loan and the request of collateral. Stiglitz and Weiss, differently form the authors presented above, consider credit rationing as a situation in which either *"(a) among loan applicants who appear to be identical some receive a loan and others do not, and the rejected applicants would not receive a loan even if they offered to pay a higher interest rate; or (b) there are identifiable groups of individuals in the population who, with a given supply of credit, are unable to obtain loans at any interest rate, even though with a larger supply of credit, they would. This means we are not analysing a situation in which every borrower receives an inferior amount of credit, but a situation in which some borrowers are completely cut off from the market, despite appearing identical to the ones who instead are receiving a loan."* In their model credit rationing occurs because the lenders' expected return does not increase monotonically with the interest rate, since it affects the riskiness of the pool of loans in two different ways: the former is the adverse selection effect (the same considered by Akerlof), the latter is that increases in the interest rate can affect the actions of the borrowers, incentivizing them to undertake riskier projects. Since the bank is not directly able to control the actions of the borrowers, it should formulate the contract in a manner designed to induce the borrower to undertake actions which will protect the banks' interest, i.e. undertaking low-risk projects. In their model it is described a situation in which there are many banks and many potential borrowers, and everyone seek to maximize his profits, the former through the choice of the project, the latter through the interest rate charged and the collateral required from the borrowers. It is assumed that the borrower has

a given amount of equity and that both lenders and borrowers are risk neutral, that the cost of the project is fixed and that nobody will be able to undertake the project without receiving the funds from the bank. The paper is developed through fourteen theorems that will be analyzed below. In the first section it is considered the role of the interest rate as a screening device for the banks, since it is assumed that the lenders are not able to distinguish the riskiness of the different projects. Assuming there is a certain number of project θ, each with distribution of returns $F(R, \theta)$ and density function $f(R, \theta)$ and assuming that a greater R corresponds to greater returns, and a greater θ corresponds to greater risks in the sense of mean preserving spread as demonstrated by Rothschild and Stiglitz, it can be assumed that:

$$\int_0^y F[R, \theta_1] dR \geq \int_0^y F[R, \theta_2] dR \tag{1.1}$$

If the individual borrows the amount B at the interest rate r, he default on his loan when the return of the project R plus the collateral C are not sufficient to pay back the loan

$$C + R \leq B(1 + r)$$

The return of the borrower can be written as

$$\pi(R, r) = max(R - (1 + r)B; -C)$$

While the return of the bank can be written as

$$\rho(R, r) = min(R + C; B(1 + R))$$

Theorem 1: For a given interest rate r there is a critical θ' such that a firm borrows from the bank only if $\theta > \theta'$.
This theorem is given observing that profits are a convex function of R and increase with risk. As a consequence, increasing r, the return of the bank $\rho(R, r)$ could decrease because the applicants are the ones with riskier projects.

Theorem 2: As the interest rate increases, the critical value of θ below which individual do not apply for loans increases.
The interpretation of this theorem is that increasing the interest rate, only individuals who want to undertake riskier project will apply for the loan.

Theorem 3: The expected return on a loan to a bank is a decreasing function of the riskiness of the loan.
Considering that $\rho(R, r)$ is a concave function of R this theorem is immediate. The first two theorems shows that increasing the interest rate there is an indirect adverse selection effect decreasing the expected profits of the bank. In some cases, this adverse selection could also outweigh the normal condition in which increasing

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the interest rate the return for the bank increases.

Theorem 4: If there are a discrete number of potential borrowers (or types of borrowers) each with a different θ, $\bar{\rho}(r)$ (the mean return to the bank from the set of applicants at the interest rate r)will not be a monotonic function of r, since as each successive group drops out of the market, there is a discrete fall in.

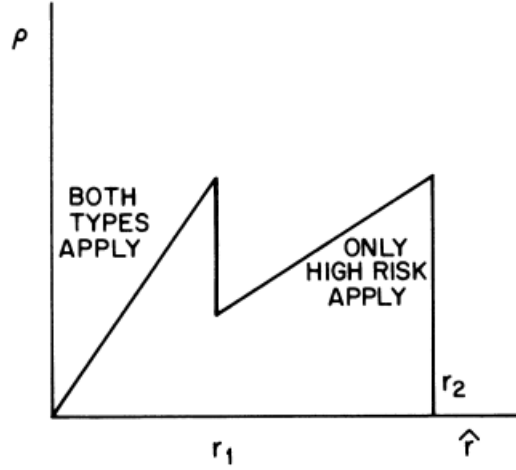The main point of this theorem is easily understandable from the figure 1.7. It is

Figure 1.7: Optimal interest rate

possible to assume that the borrowers can be divided in two groups: the first is composed by "safe" individuals which borrow only at interest rates below r_1 and the second by "risky" individuals which borrow at interest rates below r_2 with $r_1 < r2$. If the interest rate is slightly above r_1, all the "safe" individuals will immediately withdraw. Thus, the safe individuals do not withdrawn gradually, but suddenly all together when the interest rate overcome a certain threshold.

Theorem 5: Whenever $\rho(r)$ has an interior mode, there exist supply functions of funds such that competitive equilibrium entails credit rationing.

This is true in all the cases in which the Walrasian equilibrium interest rate, the one that clears the demand and the supply, is not the interest rate which maximize the returns of the bank. In the figure 1.8 it is illustrated this equilibrium. In the upper right quadrant it is depicted the interest rate and the dimension of the loan L. The demand for loan is a decreasing function of the interest rate, while the supply curve shows its maximum in correspondence of $\hat{r}^*$ causing a credit rationing because of the excess of demand, measured by Z. In this quadrant it is clear that there is another interest rate, r_m, which clears the demand and the offer, but it is
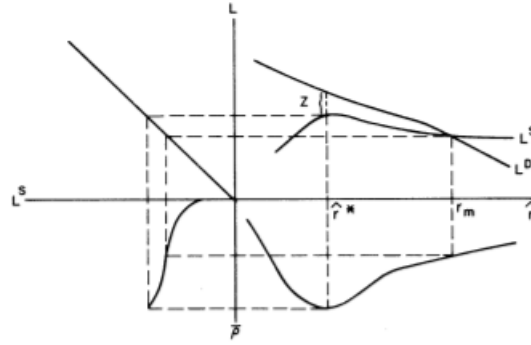
Figure 1.8: Determination of market equilibrium in the model of Stiglitz and Weiss

not the equilibrium rate since the bank could increase its profits setting an interest rate equal to $\hat{r}$. In the lower right quadrant it is shown the non monotonic relation between $\bar{\rho}$, the average expected profit of the bank, and the interest rate charged. In the lower left quadrant it is depicted the relationship between the expected return of the bank $\bar{\rho}$ and the supply of loanable funds L_s. From this theorem it is possible to construct also: *COROLLARY 1: As the supply of funds increases, the excess demand for funds decreases, but the interest rate charged remains unchanged, so long as there is any credit rationing.* Eventually Z will be reduced to zero and further increases in the supply of funds then would reduce the market rate of interest.

Theorem 6: If the $\rho(r)$ function has several modes, market equilibrium could either be characterized by a single interest rate at or below the market-clearing level, or by two interest rates, with an excess demand for credit at the lower one.
To explain this theorem, it is possible to denote as r the interest rate which maximized $\bar{\rho}$, the average expected return of the bank, and r_m the one which clears the demand and the supply. If $r < r_m$ for theorem 5 this entails credit rationing. If $r > r_m$ loans could be made at two different interest rate that can be denoted as r_1 and r_2, where r_1 maximizes the expected return when $r < r_m$ and r_2 is the lowest interest rate greater than r_m which maximizes the expected profits of the banks. For definition r_1 is lower than r_m and implies credit rationing, but the existence of r_2 brings the borrowers rejected at r_1 to apply for loans at r_2. All the funds available to loan at r_1 can be loaned both at r_1 and r_2, and there are no incentives for deviation from these interest rate, because a bank lending at r_3 such that $r_3 < r_1$ would not be able to obtain credit, and neither a bank lending at $r_4 > r_2$ because there would be no more excess of demand at r_2. The second section investigates how the interest rate can affect the behaviour of the borrower,

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incentivizing him to undertake riskier projects. This happen because the major concern of the borrower is to have as much returns as possible as long as the firm does not go bankrupt and this is in contrast with the interest of the lender, whose main interest is related to the possibility of bankruptcy of the borrower. As mentioned at the beginning, the bank has no control on borrowers actions, and the only way to influence their behaviour is through the interest rate charged. The aim of the authors is to show that increasing the interest rate, the lender will induce the borrower to undertake riskier project, decreasing his expected return. As a consequence, credit rationing could be again a valid and rational choice for the bank. It can be considered that each firm can choose between two different projects, named j and k where j has higher probability of bankruptcy than k.

Theorem 7: If, at a given nominal interest rate r, a risk-neutral firm is indifferent between two projects, an increase in the interest rate results in the firm preferring the project with the higher probability of bankruptcy.
This theorem can be explained considering that, if for a certain value of r we have $\pi_k = \pi_j$, increasing r the expected return for the borrower will decrease more for the safer project than for the riskier project. Since the two project has the same mean, despite the bank would prefer the safer project, the borrower would not. As a consequence raising the interest rate could increase the riskiness of the loan and decrease the expected return ρ of the bank.

Theorem 8: The expected return to the bank is lowered by an increase in the interest rate at r if, at r, the firm is indifferent between two projects j and k with distributions $F_j(R)$ and $F_k(R)$, j having a higher probability of bankruptcy than k, and there exists a distribution $F_l(R)$ such that
(a)$F_j(R)$ represents a mean preserving spread of the distribution $F_l(R)$, and
(b) $F_k(R)$ satisfies a first-order dominance relation with $F_l(R)$; i.e., $F_l(R) > F_k(R$ for all R.
Since the probability of bankruptcy of j are higher than the probability of bankruptcy of k, as previously demonstrated an increase in the interest rate r leads firms to prefer project j to k. Because of (a) and Theorem 3, the return to the bank on a project whose return is distributed as $F_l(R)$ is higher than on project j, and because of (b) the return to the bank on project k is higher than the return on a project distributed as $F_l(R)$. In the image 1.9 it is shown the variation of the expected return of the bank with respect to the interest rate. Assuming the existence of two different projects a and b with $R_a > R_b$ and the probabilities of success of a denoted as p_a are lower than the probabilities of success of b denoted as p_b, and assuming the borrower to be indifferent between the two projects, there will be

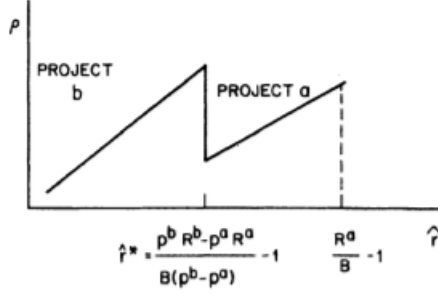$$[R_a - (1+r)B]p_a = [R_b - (1+r)B]p_b$$

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Figure 1.9: Variation of the interest rate between the two projects

From which it is immediate that if the banks ask for a value of r exceeding the $r*$ shown in the picture, the borrower will chose the riskier project. This implies that, to maximize its expected value, the bank will charge an interest rate equal or minor to $r*$, which indeed can imply credit rationing.

In the section three of the paper, for the first time in the literature on credit rationing it is clearly discussed the presence and the role of collateral. In the analysis presented so far, it was assumed that the lender was asking no collateral to the borrowers, but this situation would not be realistic. Stiglitz and Weiss discuss how, increasing the request for collateral, the expected profits of the bank will not increase, and how this cannot avoid credit rationing. The first example reported is that increasing the debt-equity ratio of the project will make it easier to finance small projects, which are not optimal for the banks because they generally have higher probability of failure. Another evidence is that increasing the collateral will favor wealthy borrowers, which could be the ones in the past who dared more and are more inclined to risk. To give also a mathematical explanation, it is possible to suppose that there are different risk adverse borrowers, with different wealth but the same utility function $U(W)$. Each of them can undertake different projects, with probability of success $p(R)$ where R is the return for the borrower if the project is successful, and zero if the project is not successful. Each borrower could also decide to invest in a safe opportunity $p*$.

Theorem 9: The contract (C, r) acts as a screening mechanism: there exist two critical values of W, W_1 and W_2 such that if there is decreasing absolute risk aversion all individuals with wealth $W_1 < W < W_2$ will apply for loans. The individual borrowing obtains a level of utility:

$$max[U(W_0 p^* - (1+r) + R)p + U((W_0 - C)p^*)(1-p) \equiv V_B(W_O)]$$

Considering that only the individuals with a wealth $W_0 > C$ can borrow, it is possible to assume that there is a value of W_0 that can be denoted as W_1 such that $V_B(W_0) = U(p^* W_0)$. At W_0 borrowing with collateral is a mean preserving

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spread of terminal wealth in comparison to not borrowing and not undertaking the project. Restricting the analysis to the situations in which $W_0 < W_2$, the ones borrowing will be the wealthiest in the interval.

Theorem 10: If there is decreasing absolute risk aversion, wealthy individuals undertake riskier projects.

$$\frac{dR}{dW_0} > 0$$

Theorem 11: Collateral increases the bank 's return from any given borrower:

$$\frac{dp}{dC} > 0$$

Theorem 12: There is an adverse selection effect from increasing the collateral requirements because both the average and the marginal borrower is riskier.
The adverse selection effect can overcome the direct effect of increasing the collateral, and this can be shown through an example. It is assumed that there are individuals with two different wealth defined W_1 and W_2 with $W_1 < W_2$. As long as $C < W_1$ there is no adverse selection, but if C is increased over W_1, all the first kind of borrowers will have to withdrawn, lowering the expected return of the bank. The fourth section of the paper is focused on the case in which there are i potential borrowers that can be distinguished by the bank, each with an optimal interest rate r_i^*. The expected return for the bank charging to the borrower i the interest rate r_i^* is $\rho_i(r_i)$ and it is assumed that if $i > j$, $\rho_i(r_i) > \rho_j(r_j)$.

Theorem 13: For $i > j$, type j borrowers will receive loans only if credit is not rationed to type i borrowers.
The explanation of this theorem is quite intuitive: if the bank aims at maximizing its expected return, will always find profitable to substitute a j loan with a i loan when possible.

Theorem 14:The equilibrium interest rates are such that for all i, j receiving loans,
$\rho_i(r_i) = \rho_j(r_j)$
Assuming that this is not true, the bank would prefer to lend only to type i borrowers, because it would be more profitable. The example can be shown in the picture 1.10. If ρ^* is the equilibrium return for the banks per dollar loaned and it is equal to the cost of loanable funds (considering perfect competition between banks), all i, j borrowers will brings the same expected return to the bank equal to $\rho_i = \rho_j = \rho^*$. If the cost for loanable funds is ρ^*, no type 1 borrower will receive a loan, all type 3 will receive a loan and some type 2 borrowers will receive a loan. If the cost of loanable funds decrease to ρ^{**}, type 2, 3 and a part of type 1 borrowers
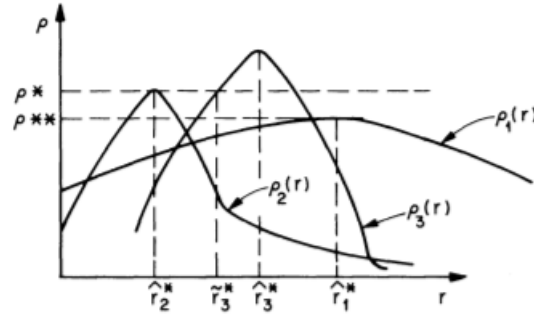
Figure 1.10: Observationally distinguishable borrowers

will receive the loan. Type 1 potential borrowers are defined by Stiglitz and Weiss *red-lined* because, if the price of funds for the bank is higher than ρ^{**}, there would be no interest rate at which they would receive funds, even if in some cases the return for the bank for an investment of the type 1 borrower could be also higher than the return for an investment of the type 3 borrower. As a consequence, at the market equilibrium, there is no reason to assert that the credit is allocated to those for whom the expected return is highest.

To summarize, the model of Stiglitz and Weiss depicts a situation in which borrowers are observationally identical, but some manage to receive a loan while others don't. The ones who are not able to borrow, would not manage to do it even paying an higher interest rate or giving more collateral. This is due to the fact that an increase in the interest rate or in the collateral required the bank will lead to an increase in the riskiness of banks' portfolios. This mechanism happens in two different ways: the former is by discouraging safer investor, the latter is by inducing borrowers to undertake riskier projects. In this circumstances credit rationing limits the number of loans that the bank will make, thus this case is different from the ones of *size-rationing* presented so far. An interesting point raised at the end of the paper is that imperfect information could also lead to the opposite case, where there is an excess of supply. An example is a situation in which banks have higher expected returns on some of their borrowers. Everyone knows who these customers are, but they do not know the ones of their competitors. A bank trying to attract the customers of its competitors cannot lower its interest rate, because it would attract the less profitable customers. Consequently, banks will not try to attract the borrowers of the competitors, and at equilibrium all banks would have an excess of supply even if nobody would lower the interest rate offered.

1.3.1   Comments on the model of Stiglitz and Weiss

The model of Stiglitz and Weiss is based on assumptions that can be considered a simplification of the reality, and consequently there has been some criticism to the model. In general a first observation that can be made is that some borrowers may be subject to rationing while other borrowers are not because their prospects are more observable, or because their behavior is more controllable. As a consequence it is difficult to be sure that, even if credit rationing occurs, it is the one described by Stiglitz and Weiss. This point was raised by Calomiris and Longhofer [11] in their paper on credit rationing published in 2006. A first criticism was moved by Bester (1985) [12] which was able, how will be explained in the next section, to demonstrate how collateral can be used as an instrument to discriminate between the type of borrowers. In the model of Stiglitz and Weiss indeed, in the first section it is considered the interest rate leaving unchanged the collateral, and in the third section the increase in the collateral keeping unchanged the interest rate. Bester tried to demonstrate that there is no rationing when banks can individually select both the collateral required and the interest rate for the contract, starting with the assumption that collateral and interest rate are chosen simultaneously by banks rather than separately, with the possibility to use the different contracts as a self selection mechanism. Another criticism to the model is due to the exogeneity of the dimension of the project (and of the loan), which is considered to be fixed. On this purpose, it is worthily to mention the model proposed by Gale and Hellwig [13] in which they propose a scheme very similar to the one of Stiglitz and Weiss, relaxing instead the assumption of the indivisibility of the investment. Gale and Hellwig do not support the idea of the "all or nothing" behind the model of Stiglitz and Weiss, considering that the fixed size of the project is not a realistic supposition. This case will also be analyzed in the subsection 2.6 in the model proposed by Bester and Hellwig. Moreover, in this model it is criticized the entire definition that Stiglitz and Weiss give to credit rationing. Gale and Hellwig do not consider possible that the credit is completely denied to some borrowers, stating that if a bank denies credit to a firm, the firm can simply go to another bank and ask for credit. In this sense the model of Gale and Hellwig proposes a type of credit rationing similar to the one described by Jaffee and Modigliani in 1969, in which all the borrowers receive a smaller loan than the one requested. The third point that can be criticized, which still regards the main models on credit rationing in the literature, is that the contract considered are uniperiodal, while the projects are generally developed in many periods. Moreover, another remark was made by John Riley in 1987 [14]. In his paper Riley shows that, despite adverse selection occurs in every pool, the phenomenon of credit rationing, as intended by the model presented, happens only in a single marginal pool. The model begins with the same assumption of the ones elaborated by Stiglitz and Weiss: $\rho(r; \mu)$ is the expected

return for the bank per dollar invested, where r is the interest rate and μ is the expected gross return of the project. ρ is negatively correlated to r and positive correlated to μ, and has a unique turning point defined $\rho^*(\mu)$. Supposing the bank pays an interest i on loanable funds, if the market is competitive the equilibrium would be given by the zero profit condition $\rho^*(\mu) = i$. It is obvious that all the applicants for whom i would be too high as interest rate would not apply for the loan, and no bank would grant a loan for a lower interest rate. As a consequence only in the risk pool for which $\rho(\mu) = i$ there can be rationing, but, according to Riley, this is a minor case and cannot be considered empirically relevant. The definition of credit rationing in the model of Stiglitz and Weiss will be deepen even more in the in the subsequent paper published by Jaffee and Stiglitz in 1990 [6]. In this case it is assumed a difference between *pure credit rationing* and *redlining* where the former is referred to the cases in which some individuals obtain loans, while apparently identical individuals, who are willing to borrow at precisely the same terms do not, and the latter indicates cases in which a lender refuses to grant credit to a borrower at any interest rate. It is also clear that redlining may be nearly indistinguishable from pure credit rationing when lenders classify borrowers into a large number of groups. In this case, borrowers in a red-lined group may have nearly the same features as the borrowers in a group that does obtain loans. In more recent years some authors questioned the criterion of the main preserving spread in the model of Stiglitz and Weiss, considering that if the projects can be sorted basing on their riskiness, results could completely change. On this purpose it is possible to mention the model of De Meza and Webb (1987 and 2002) [15] who evidenced how removing the hypothesis of the mean preserving spread it would be possible to observe the opposite phenomenon of over-lending. A criticism moved to the model of Stiglitz and Weiss is that it implies that the equilibrium mode of financing is equity rather than debt since equity does not discriminate against low-risk entrepreneurs, who are the ones contributing more to bank profits. On the contrary according to the authors it is quite clear that bank debt is by far the largest source of external finance for enterprises. This study will be further discussed at the end of this chapter.

1.4   The role of the collateral: the model proposed by H. Bester

The purpose of the model proposed by H. Bester in 1985 [12] is to show that no rationing occurs when banks choose both collateral and interest rate. The main difference with the model of Stiglitz and Weiss, as anticipated in the previous subsection, is that in this case the lender is able to choose simultaneously the two parameters and not separately, and the various kinds of contract can be used as a

self selection mechanism. The model shows how borrowers with a low probability of default prefer to accept an increase in the collateral required, if it implies a decrease in the interest rate charged by the lender. Moreover, if the investors with a high probability of default are denied the contract they would prefer, they can apply for the contracts "created" for less risky borrowers, so the pooling is always present in credit rationing equilibrium. Nevertheless, this is not the case if self selection mechanisms are available through the choice of appropriate contracts, which implies that the equilibrium is characterized by a separation between the low and high risk borrowers. To prove so, it is possible to consider two firms, a, b each with an initial wealth W. Each one has the possibility to choose a project which requires a fixed amount of investment $I < W$ and has a return R with distribution function $F_i(R)$. $R_b > R_a$, implying that the project b is also more risky. The firms finance the project borrowing $B = I - W$. The credit contract $\gamma(r, C)$ is defined by the interest rate r and the amount of collateral C, and the firms face a positive cost for collateralization, which increase linearly with the amount of collateral required. The expected profits of the firm undertaking the project under a credit contract γ are

$$\Pi(\gamma) = E[max[R - (1 + r)B - kC; -(1 + k)C]]$$

while the expected profits of the bank are

$$\rho(\gamma) = E[min[(1 + r)B; R + C] - B]/B$$

The funds banks uses for the lends are the funds from depositors, and pays π so the banks' net profit is $[\rho(\gamma) - \pi]B$. Since banks cannot distinguish the borrowers, they have to propose two different contracts (γ_a, γ_b) which pushes the borrower to a self selection process, considering that each borrower will try to maximize his expected profits. The figure 1.11 depicts the indifference curves for the firms a, b
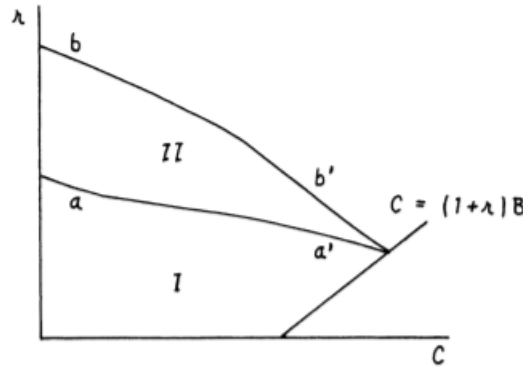

Figure 1.11: Indifference curves of the two firms

for all the contracts γ such that $\Pi(\gamma) = (1 + \pi)W$. Below the curve $b - b'$ all the b

firms would accept a contract while all a investors would accept below $a - a'$. As in the model of Stiglitz and Weiss, an increase in the interest rate over the region I would drive all the type a investors to withdrawn, leaving the bank only with risky borrowers. The investor i facing a pair of contracts $(\gamma_\alpha, \gamma_\beta)$ will first apply for his preferred contract, then if the credit is denied will apply for the other one. The fraction of firms that receive credit under the contract γ_i, when applied for it, will be denoted as λ_i. The tuple

$$[(\gamma_\alpha^*, \gamma_\beta^*), (\lambda_\alpha^*, \lambda_\beta^*), \pi**]$$

is the *credit market equilibrium* if each contract produces zero profits for the borrower. The absence of the excess of supply can be proved by the competition of the market, which would lower the interest rate π on deposits. If the collateral can be provided at no cost, at equilibrium there would not be rationing because lenders can avoid risks associated with loans offering contracts that lies on the curve $C = (1 + r)B$ whose default rate is zero, and an excess of demand could be filled up raising the r and C in the contract remaining on the line. Nevertheless, this solution would not work if the collateralization implies costs $k > 0$. However, banks could use contracts with different collateral requirements. The marginal rate of substitution between r and C is

$$\sigma = -\frac{F((1+r)B - C) + k}{[1 - F((1+r)B - C)]B}$$

Hence, considering $F_b(R) > F_a(R)$, firms of type a will be more inclined to accept an increase in collateral for a given reduction in the interest rate compared to firms b. Therefore, collateral can be used for a self-selection of the riskiness of the borrowers. It can be defined the following theorem: *Let $[(\gamma_\alpha^*, \gamma_\beta^*), (\lambda_\alpha^*, \lambda_\beta^*), \pi*]$ be a credit market equilibrium and let both the contracts γ_α^* and γ_β^* be demanded by entrepreneurs. Then there is no rationing, and both the contracts are incentive compatible. Moreover $\pi^* = \rho_\alpha = \rho_\beta$. If $k > 0$ then $C_\alpha > C_\beta = 0$. If type α* borrowers are rationed, a competing bank could enter in the market and raise r_α^* and all the borrowers whose credit have been denied would apply at this conditions. This means the tuple was not the equilibrium one and this is not possible, so type α would not be rationed.

1.5 Moral hazard and adverse selection: the model of H. Bester and M. Hellwig

The model developed by H. Bester and M. Hellwig in 1988 [16], starts from the same assumptions presented by Stiglitz and Weiss (1981) and Bester (1985). In

this model both the cases of credit rationing are discussed: the former related to a situation in which to some individuals the loan is completely denied, the latter in which the borrower receive an amount of money inferior to the one requested. An important conclusion of this model is that credit rationing, when there is asymmetrical information, can happen even if there is a monopolistic loan market, and this point was never raised before. The first part of the model is explained briefly below, having many points in common with the models explored so far. In the first section, it is considered an entrepreneur who can undertake two different projects a, b where $p_a x_a > p_b x_b$, $x_b > x_a$ and $p_a > p_b$. x_a and x_b are the potential returns of the two projects, which both require an investment I and p_a and p_b are the probability of success of the projects. The entrepreneur needs to be financed to undertake the project, and the debt contract requires a gross interest payment R. If the projects fails the entrepreneur has to declare bankruptcy and the lender does not receive anything. Therefore, the utility function of the entrepreneur is:

$$U(R) = p_i(x_i - R)$$

while the utility function for the lender is its expected payoff and is equal to:

$$\pi(R) = p_i R - I$$

As in the previous cases, the lender cannot observe the behaviour of the borrower, despite he would prefer the borrower to undertake the project with higher probability of success (in this case project a). As a consequence the only mean he has to control the borrower is the choice of the proper interest rate. The borrower will undertake project a if $p_a(x_a - R) > p_b(x_b - R)$ and project b otherwise. It is consequently possible to find an interest rate such that the investor is indifferent between the two projects. If this interest rate is set beyond this limit, the investor will choose the riskier project.

$$\hat{R} = \frac{p_a x_a - p_b x_b}{p_a - p_b}$$

In the case of a monopolistic loan market, and if the funds are scarce the lender can set the terms of the contract to maximize his return. It is possible to consider two cases:

$$p_a R < p_b x_b \tag{1.2}$$

or the opposite case. If the equation 1.2 is not verified, all the entrepreneurs have strict preference for undertaking the investment, and there will be credit rationing at equilibrium because all the entrepreneurs have a strict preference for undertaking the investment, but the lender will have to choose how to distribute the funds. On the contrary, if 1.2 is verified, the entrepreneurs will be indifferent to undertake the project or not, so there will not be credit rationing because the ones not receiving the loan are equally happy as the ones receiving it. Rationing may obviously occur

also when there are many lenders and the market is competitive. The supply function for loanable funds is $L(.)$ and the lenders' rate of return is π/I. If the equation 1.2 is not verified, there is credit rationing if $L(\pi(R)/I < NI$. in this case the supply of fund is to small to satisfy the total demand and the entrepreneurs who do not get the loan will envy those who do.

In the second section of the paper it is taken into consideration the presence of collateral C. In this case the utility of the borrower becomes $V(R,C) = U(R-C)-C$ and the expected return of the lender is $\phi(R,C) = \pi(R - \beta C) + \beta C$ where β is a factor that represent how the lender evaluates the collateral C. As also demonstrated by Bester (1985) and for the same reasons, the use of collateral induces the entrepreneur to choose the less risky project, and collateral have positive incentive effects. The increase in C gives the lender more room for increasing R without any adverse incentive effects. By the way also in this case, especially for some level of wealth W, it is demonstrated that credit rationing can occur at equilibrium. In the third section, it is relaxed the assumption that the level of investment for each project is fixed. The lender could also make the choice to finance all the projects but on a reduced scale. Also in this case it is demonstrated that equilibrium credit rationing is possible if $I^* > 0$ and $L < NI^*$ meaning it would be impossible to provide all loan applicants with minimum efficient scale $I*$. As in the section 2 of the paper, the presence of credit rationing is linked to the equation 1.2. If this equation holds, entrepreneurs are indifferent between undertaking or not the project, so it is not possible to say that the ones to whom credit is denied are rationed in the strict sense of the term. On the contrary if $p_a R > p_b x_b$, the individuals prefer to undertake a project so the ones not receiving a loan would be willing to offer an higher interest rate to have it. To sum up, if the investment level is not fixed credit rationing can exist at equilibrium if the minimum efficient scale of investment is positive and the available funds are insufficient to finance all loan applicants. In this case it can also happen that some applicants receive a smaller loan, but in a different sense compared to the credit rationing defined by Jaffee and Russel or Jaffee Modigliani, because in those cases the lenders quote a constant interest rate and then supply a smaller loan size than what demanded by borrowers. In this sense, the interpretation of the interest rate is considered incorrect by Bester and Hellwig who consider the interest rate to be only one of the parameters of the contract in a market where the information is incomplete, and could not be considered independent from the size of the loan.

1.6 The role of monitoring: the models of S.D. Williamson

Two important model were proposed by Stephen Williamson in 1986 and 1987 [17] [18]. Despite these models are heavily based on the ones presented above, they introduce a new variable in the system: the idea of monitoring. The models, according to the later literature, have been classified as as models with *ex-post* asymmetric information since in this case credit rationing does not arise due to adverse selection like in Stiglitz and Weiss or Bester and Hellwig, but due to the asymmetric information on the return on the borrowers' investment project, which is not known to the lender. The borrower is the only one knowing the return of the project and the lender that wants to control it has to sustain a so-called *monitoring cost*. The monitoring will happen only in case of default of the borrower, implying that an increase in the loan interest rate increases the expected return to the lender but increases also the probability of default of the borrower, increasing consequently the expected cost of monitoring for the lender. The model aims at demonstrating that, in a situation with ex post asymmetric information, credit rationing as intended by Stiglitz and Weiss can occur at equilibrium. In the environment described by Williamson there are i agents, which can be classified as l lenders or e entrepreneurs and each one lives a planning period 0 and a consumption period 1. Each lender has an indivisible endowment of one unit of an investment good in period 0 and can decide to invest it in a project with a certain return t or lend it to an entrepreneur. On the other side the entrepreneur has no endowment but has access to projects that produces a random return $\hat{w}$ of consumption in period 1, where the returns are distributed between the entrepreneurs with probability density function f and probability distribution function F. Each entrepreneur can observe the return $\hat{w}$ of his project without costs, while the lender can observe a particular $\hat{w}$ with γ units of effort in monitoring. Monitoring decisions are taken in period 1. Lenders aim at maximizing their utility function $u(c, a) = c - a$ where c is the consumption and a is the effort, while entrepreneurs aim at maximizing the consumption. In the environment there are α lenders and $1 - \alpha$ entrepreneurs, and it is assumed $\alpha > \frac{1}{2}$. As previously mentioned lenders can decide, instead of lending their endowment to entrepreneurs, to invest it in a project with a return r. A first point of discussion is related to the kind of contract optimal for the lender to offer in exchange of one unit of the investment good. The contract must contain the possibility of the monitoring in some states, or the entrepreneurs can maximize their consumption claiming the return of the project to be zero, independently on what the real return is. When in period 1 the borrower observes the return $\hat{w}$, he communicates it to the lender specifying if it implied bankruptcy (and consequently monitoring) or not. In this case the lender will receive $R(w)$. Otherwise the

payment for the lender is a constant that is defined x. The optimal contract is a payment schedule $R(w), x$ which maximizes entrepreneurs' expected utility with the constraint of being higher than r. *Proposition: The optimal payment schedule is $R(w) = w$, independent of x.* The consequence is that the optimal contract is the debt contract where the entrepreneur must pay to the lender the amount x in period 1 or go bankruptcy, implying that monitoring will occur and the lender will appropriate the entire return of the project. For the lender, the expected utility is:

$$\pi_l(x) = \int_0^x w f(w) \, dw + x[1 - F(x)] - \gamma F(x)$$

where γ is the cost of monitoring, while the expected utility for the entrepreneur is:

$$\pi_e(x) = \int_x^w w f(w) \, dw - x[1 - F(x)]$$

This implies that the return for the lender is not monotonically increasing in x because of the presence of the monitoring costs, while the expected profit of the borrower is monotonically decreasing in x. Assuming $\pi_l(x)$ to be concave:

Definition: An equilibrium is a loan interest rate x*, a market expected return r*, and an aggregate loan quantity q*, which satisfy:

1. *x* solves $\max \pi_e(x)$ subject to $\pi_l(x) > r$*

2. *$q^* = H(r*)$*

3. *Either (a) $q^* = 1 - \alpha$ or (b) $q^* < 1 - \alpha$*

This definition implies the existence of two different situations, the first without rationing (3a) and the second with rationing (3b). In the rationing equilibrium entrepreneurs have a probability equal to $\frac{q^*}{(1-\alpha)} < 1$ of receiving a loan. Regarding the entrepreneurs cut out from the market, there is no contract they could offer to receive the loan because x^* is the interest rate which maximized lenders' expected profits, and an higher x would imply an higher probability of default and higher monitoring costs for the lenders.

1.7 The influence of the reputation: the model of D.W. Diamond

In his paper published in 1989, D.W. Diamond [19] introduced a concept that can be considered a turning point in the relationship between the borrower and

the lender. The aim of his model is to analyze the reputation formation and the evolution over time of the incentives effects of reputation to mitigate conflicts of interest between the borrower and the lender. The main result of the paper is that when borrowers manage to acquire a good reputation, it is easier for them to obtain a loan. In this section, it will be explained a simplified version of the model. In Diamonds' view, reputation arises from past behaviours of the borrowers and as soon as the lender is able to produce long track record of repayments without default the effects of adverse selection are mitigated. It is immediate to understand that if no adverse selection occurs, reputation can begin to work immediately. Thus, if the reputation takes time to work, new borrowers will have more incentives problems at the beginning. The agents of the model are risk neutral and have characteristics similar to the ones of the model of Williamson. Lenders receive an endowment of inputs each period, and can decide to invest it in a safe project with a fixed return of r units of output or lend it to a borrower. Borrowers do not receive any endowment. There are three types of borrowers and have access to indivisible projects. Type G borrowers always choose safe projects, receiving at the end $G > r$. Type B borrowers only choose risky projects and with probability $\Pi < 1$ the project returns B (with $B > G$) while in the other cases it returns zero. Borrowers BG can choose between the two projects. The borrowers' type is a private information, and the realized output can be only observed by the borrower. Lenders know that in the initial population there are f_G borrowers of type G, f_B of type B and $f_B G$ of type BG. Lenders live for one period, but in that period can observe each borrowers' history of default. It is assumed that borrowers aim at maximizing their expected consumption over T period, with T finite but very large. Moreover, it is assumed that with a single time period horizon, type BG borrowers choose risky projects. In each period borrowers offer contracts to lenders and lenders decide whether to accept or not, borrowers who are able to receive a loan choose their projects, observe the return on the project and decide how much to pay lenders. If it is stipulated a debt contract, borrowers must repay at least r_t otherwise there will be liquidation. Since the choice of type B and G borrowers is predetermined, it is possible to analyse how the scenario varies if BG borrowers choose the safe or the risky project. In the former case their expected utility is $G - r_t$ at the end of the period, while in the latter is $\Pi(B - r_t)$ so safe projects will be preferred if

$$r_t \leq \frac{G - \Pi B}{1 - \Pi}$$

It is immediate to understand that with higher values of r_t is it more probable that BG borrower will choose the riskier project. With r_t^g is denoted the value the interest rate that makes the expected return for the lender equal to r if safe projects are chosen and r_t^b the face value providing that expected return if the borrower chooses the risky project. At the beginning it was assumed that BG borrowers will

select risky project, so the interest rate r_b will prevail in the one period horizon. Moreover, the interest rate r_t will decrease over time if the borrower will not default. From these information it is possible to extract:

Lemma 1: At the final period T, (a) all borrowers offer the debt contract with the lowest interest rate that provides an expected return of r (b) all borrowers who can repay their debt do so, and all others default and (c) only those borrowers with track records that imply a sufficiently high probability of being of type G are able to borrow. Now moving into a multi-period analysis, *Lemma 1* is valid in each period. In the second period lenders can see the previous default rate of each borrower, implying that

Lemma2: If a borrower is revealed at time t to be of either type B or type BG, no one will lend to him thereafter..

This also implies what is subsequently expressed in

Lemma 5: Any default by a borrower at t leads to no lending for all future dates. If a loan is made at t, the face value $r_t \in [r, G]$, this is easily deductible by the fact that no lender would accept a loan if the repayment is lower than r and no borrower could repay an amount higher than G. By the way, if the payment of less than what agreed at the beginning implies default, the borrower will always offer the lowest interest rate that provides lenders with an expected value of r. Defining V_t^b and V_t^g as the value for borrowers of choosing risky and safe projects
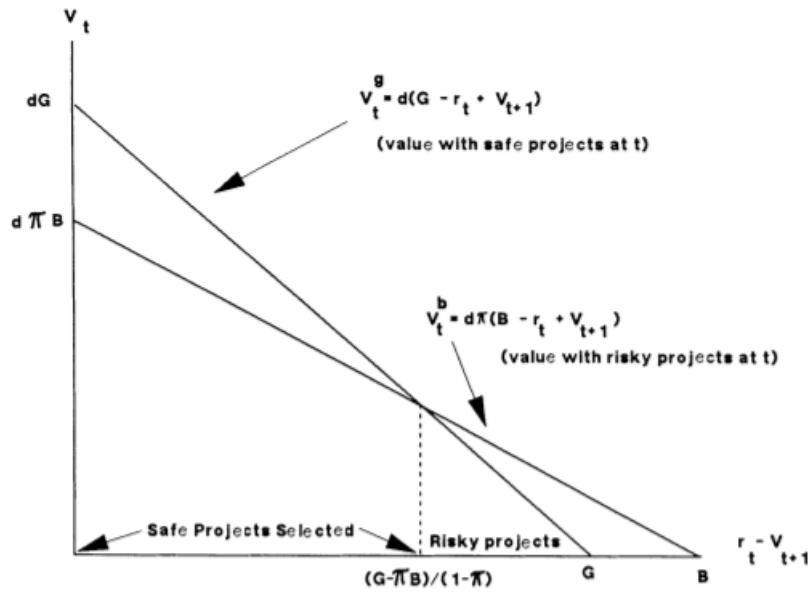

Figure 1.12: Value of safe and risky projects at date t

there will be $V_t^b = d\Pi(B - r_t + V_{t+1})$ and $V_t^g = d(G - r_t + V_{t+1})$ so safe projects

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will be chosen if:

$$r_t - V_{t+1} \leq \frac{G - \Pi B}{1 - \Pi} \qquad (1.3)$$

which is the intersection point shown in figure 1.12. As already observed, lowering the interest rate makes the safe projects more attractive for BG borrowers. From 1.3 is it possible to deduct that, since the loss of reputation from a default results in a cutoff of credit and, if the rents on the safe project are not exceeding those of risky project, the loss of reputation will not be enough to avoid the choice of risky projects even if $T- > \infty$. On the contrary, if the future interest rates are below a given level at all dates in the future, safe projects are optimal at time t. It is defined *endgame* the moment τ in which BG switches to (or back to) risky projects, this moment happens as previously observed when $V_t^g < V_t^b$. It is demonstrated in the paper that if the loan market is active, then the endgame is of bounded length as $T- > \infty$ if and only if 1.3 is verified. It is subsequently proved that *If r_t falls over time and a type BG borrower optimally selects safe projects at t^+ and selects risky projects at some $t' < t^+$, then risky projects are optimal for all $t < t'$. This implies that if safe projects are best on two dates t_1 and t^+ $(t_1 < t^+)$, then the optimal project selection is safe projects for all $t \in [t_1, t^+]$.* This proposition implies that the reasons for the borrower to choose risky projects are a short time horizon (as mentioned as assumption at the beginning) or an interest rate too high. The paper is able to demonstrate that the incentive problems in the debt market are more severe when firms have a short track records. This effect is increased if the adverse selection at the beginning is high, leading to particularly high interest rate for borrowers with short track record. In this case, the present value of loans in the future (the effects of having a good reputation) could be low enough to induce borrowers to pursue the short term optimum and choose risky projects. In the end, a fraction of those choosing risky projects will succeed in repaying the loan, decreasing the interest rate and leading the borrowers to switch to the long run optimum choosing the safer projects. This will increase their reputation, making easier for them to receive a loan. In this model, the part regarding one-period is similar to the model proposed by Stiglitz and Weiss in the sense that the asymmetry in information is *ex-ante*. The concept of reputation nevertheless was not mentioned by Stiglitz and Weiss, which always considered the borrowers to be identical from the perspective of the lenders.

1.8 Self credit rationing in small businesses: the model proposed by A. R. Levenson and K. L. Willard

The model proposed in 2002 by Levenson and Willard [20] considers an important variable that was never analysed before. In their empirical analysis, they consider the idea that many firms do not apply for loans because they are anticipating a rejection. Therefore this model is also facing a concept quite different from the one considered in the historical literature, introducing the idea of *self-rationing*. The first consideration made in the model is related the concept of duration: a firm could be unable to access to credit at time t, but then it can receive credit at time $t + \delta$. If δ is small, the effects of credit rationing on the firm may be quite limited, making the phenomenon negligible. Increasing the value of δ the effects may be larger, even affecting the possibility of the firm to expand and survive. Firms which anticipate a large δ may be discouraged from applying for credit, meaning that the effects of the phenomenon on the market are even worse than the ones considered in the models analysed so far. In the model there is the attempt to estimate the probability that a firms that wants a loan is denied the funding implicitly or explicitly for reasons different from its reputation. Since, according to some firms, the probability to receive the loan is low, their cost of applying exceed the expected benefits. It is possible to deduce that if the cost of applying were lower or the expected benefits were higher the firms would have applied for the loan. The analysis is conducted using the results of a survey called *NSSBF*. The survey considers not only loans by banks but from all the financial institutions, and classifies as credit rationed all the firms to which some or all credit was denied, dividing them in long run and short run rationed depending on whether they received the loan after a period δ or not. From the survey it was observed that the firms not applying for credit are smaller in terms of sales and number of employees, meaning that in general small firms are more skeptical in asking for loans. This can be interpreted considering that financial intermediaries in general are less willing to lend to smaller firms. Surprisingly in the end it is calculated that only a small percentage of small firms were rationed, suggesting that the phenomenon should be even less relevant for bigger firms. Despite the final result does not confirm the importance of credit rationing, a surprising result is that, among the firms rationed, 2/3 did not apply for the loan, suggesting that the problem of self rationing could be more relevant and complex of what expected, implying that credit rationing may be not only related to the supply but also to the demand.

1.9 An opposite view: The problem of over-lending in the model of D. De Meza and D. Webb

In their model De Meza and Webb [15] discuss the policy addressed to sustain SMEs who are generally considered more probable to be rationed. The authors consider that despite the presence of imperfections in the credit market, the use of subsidies can bring to the opposite result, decreasing the overall level of efficiency. First, the presence of information asymmetries is an incentive for some agents to start a business which exceed the social return. This can be explained considering that there is no incentive for an able individual to be employed and work for someone else, because they would be paid an average salary which is low compared to their capacity. From this it can be deducted that able individuals prefer to work for themselves despite it involves other costs. For this reason there is a negative externality on those remaining employees because the average quality and as a consequence the average salary is depressed bringing even more people to self employment. In addition to this effect there is another reinforcing effect. Since the entrepreneurs are on average more able, there are low default rates which bring down the cost of finance to the less able. In equilibrium, individuals marginal between self-employment and paid employment tend to be the most able of the employees and the least able of the entrepreneurs. If the information was not private, they would not choose to become entrepreneurs. The second point regards the fact that an agent who has enough resources to finance his project, will effectively do it only if he truly believes that the project has a positive expected value. A third motivation is related to psychological topics. It has been proved from the mid '90s that individuals have on average a tendency to optimism. This is also true for entrepreneurs, influencing the private sector with to unrealistic expectations on the future and the development of the projects. This brings less able entrepreneurs to apply for loans, lowering the average expected return of the banks. The model explained in the paper of 2002 can be considered a simplified model of the one described in 1987. On one side there is a collection of risk neutral entrepreneurs, each with an investment project. The projects yields 0 in case of failure and H in case of success. The only difference between the entrepreneurs if the probability of success which depends on the ability of the entrepreneur. The ability of the entrepreneur is a private information. It is supposed at the beginning that no moral hazard occurs. All potential entrepreneurs owns a wealth W which is invested in the project but it is not sufficient, so they also need a loan from a bank L=K-W on which the repayment is D. Entrepreneur i applies for funds if

$$P_i(H - D) \geq W$$

Where P is the success probability. There is a threshold value P* under which loans are not requested. If the average success probability is $\bar{P} > P$, $\bar{P}D = R > P^*D$

where R is the payment made by the bank on a deposit size L. The marginal entrepreneur despite being indifferent to apply for the loan generates a loss for the bank equal to $(\bar{P} - P^*)D$. If information was complete the marginal entrepreneur would be charged with an higher D meaning that he would not ask anymore for the loan. In this sense with imperfect information it is possible to say that there is excessive lending. This situation is exacerbated by the excessive optimism of the entrepreneurs, who believe the probability of success of the project to be higher than what effectively are. This means that for every D the marginal entrant would be even less able than before.

Chapter 2

Measures and determinants of credit rationing

This chapter provides an analysis of the literature on measures and determinants of credit rationing. [7] Mostly from the '80s a wide literature has been developed trying to verify on an empirical level the existence of the phenomenon, and this was done through different measures and considering different variables. A central issue on this purpose has been the difficulties in finding an appropriate measure for the phenomenon. For this reason the most reliable studies are based on surveys or on econometric analysis. An extensive literature was also produced to identify the main determinants of credit rationing.

2.1 Measures of credit rationing

Despite the existence of credit rationing and the rationality behind the choice to ration credit to some individuals have been widely demonstrated, almost none of the models presented so far contained an idea on how to measure this phenomenon. This can be easily explained considering that, while the relationship between borrower and lender is not difficult to understand in theory, it becomes much more difficult if the aim is to measure this excess of demand. As a result, the analysis on the phenomenon still appears to be incomplete since an accurate measure could only derive from possible demand and supply functions collected by nations. In the literature the main methods of investigation on credit rationing have been the use of proxy variables, the use of surveys and the econometric analysis. According to Calomiris and Longhofer [11] these methods can be distinguished in direct and indirect. The direct methods include surveys and econometric analyses while indirect methods include the use of proxy variables.

2.1.1 The use of proxy variables

The first authors to use proxy variables were Jaffee and Modigliani [5] in their model discussed in chapter one. In their model, they attempt to develop an operational measure of credit rationing based on the theoretical framework explained in their model. According to their theory the volume of credit rationing should be measured considering the difference between loan demanded and bank supply. In this way the degree of credit rationing $\hat{H}$ could be measured as the difference between the demand and the supply for rationed customers.

$$\hat{H} = \frac{D_2 - L_2}{D_2}$$

where D_2 is the demand of rationed customers and L_2 the volume actually granted to them. It could be useful to remember that in the model proposed by Jaffee and Modigliani credit rationing does not imply that some borrowers are cut out from the market as in Stiglitz and Weiss, but that all the borrowers receive a lower amount compared to what requested. In any case, it would not be possible to calculate L_2 and D_2 precisely, so their analysis is based on a proxy measure of the degree of dynamic credit rationing. Dynamic rationing in the model is associated with the proportion of the total loan portfolio accounted for by the risk free prime customers. Risk free prime customers demand (and volume of loans granted) are indicated as L_1 while L_2 and D_2 are respectively the loan granted and the loan demanded for all the other customers. On this purpose it is defined the proxy variable

$$H_1 = \frac{L_1}{L_1 + L_2}$$

which should be positively related to the degree of rationing because it indicates the percentage of loans granted to risk free customers. The intuition is that prime borrowers have lower risk and are less likely to be rationed. For their analysis they use data from the Federal Reserve's "Quarterly Interest Rate Survey" which recorded the volume of new loans granted by rate ans size class. They found out that increases in the average commercial loan rate are associated with higher levels of rationing, which seems to demonstrate the appropriateness of their proxy. In more recent theories, two main signals were proposed to measure credit rationing. The former is that borrowers tend to switch to alternative sources of financing, even if more expensive (and this implies firms were previously rationed by banks). Another signal identified in the literature is the stickiness of a loan rates with respect to changes in base rates. Supporting this thesis, there is a wide literature produced between the '60s and the '70s sustaining that commercial loan rates are very slow to adjust to changes in open market rates, and considers this as an evidence of credit rationing. An important analysis for the SMEs based on proxy variable is the one conducted by Calcagnini, Jacobucci e Ticchi [21], which tried to

make an analysis very close to the model of Stiglitz and Weiss. Their analysis tries to demonstrate that the supply curve, as previously demonstrated by Stiglitz and Weiss, is not monotonically increasing with respect to the interest rate because of moral hazard and adverse selection. They also demonstrate that the probability of credit rationing is strictly related with the decreasing part of the curve, whose length depends on the distribution of the projects (or the firms) classified basing on the expected return. If this concentration is very high for low values of the expected return, the probability of rationing is on average higher. The authors use the ROI of the firms as a proxy variable for the expected return and test their theory on a sample of manufacturing companies. The conclusion of their analysis is that the small and medium enterprises do not have an higher probability to be rationed compared to the bigger ones, and their conclusion is moreover supported by the results of the survey they took as main data-set.

2.1.2   The use of surveys

Surveys have been widely used to confirm the existence of credit rationing and to evaluate its effect. Despite this tool can reveal to be valid (if the survey is correctly prepared and analysed), it presents the defects typical of all the sample surveys. Important disadvantages of this tools regard the limited number of questions that can be asked, the impossibility to help the respondents in a better understanding of the questions, the possibility to find answers that are incoherent and the difficulty in submitting the survey to an heterogeneous sample. Nevertheless, a survey allows to collect data on many aspects that otherwise would be difficult to measure. An example regards the self-rationing, which can be easily assessed with a specific question on the topic but would be difficult to individuate in other cases. Considering the paper of Levenson and Willard [20], it is possible to take into consideration the duration of the phenomenon: credit rationing is "short-term" if the loan is initially denied but eventually granted. The main limit is related to the difficulties in understanding the whole process of negotiation. When a firm is denied credit, it is not easy to know if they would have received it proposing to pay an higher interest rate or offering higher collateral. Moreover, without knowing the point of view of the lender, it is not possible to determine if all the applicants were considered observationally indistinguishable. Consequently, it is not easy to calculate the pure credit rationing described in the literature. The main questions used on the surveys regards:

- If the interviewed applied for a loan;

- If the interviewed received the loan;

- If the applicants received the whole amount requested;

- If there interviewed avoided to apply for a loan because of the fear of a rejection.

The second question can be considered as a measure of the credit rationing in the pure sense. The third question can be used as a measure of what is defined in the literature size-rationing. Eventually, the third question is used to determine the presence of self-rationing. Among the most important surveys on credit rationing, it is worth recalling the Survey of Small Business Finances (SSBF) [**FRB**] which was used to collect information on small businesses (fewer than 500 employees) in the United States. This survey was performed in 2003, 1998, 1993, and 1987 and considered, among others, the size of the firm, the use of financial services, the income, and data from the balance sheet of the firms. The last iteration, performed in 2003, also collected the firm measurement of characteristics such as race, ethnicity, sex and ownership concentration. Another survey, performed by the FED every year, is the SBCS [**SBCS**] and collects data on firms with less than 500 employees. In Europe, the European Central Bank conduct four times a year the bank lending survey BLS [22], which provides information on bank lending conditions in the euro area. Last survey was conducted between 20 September and 5 October 2021. A total of 146 banks were consulted with a response rate of 100%. Another important survey conducted by the European Central Bank is the survey on the access to finance of enterprises (SAFE) [23]. The survey is conducted twice a year: once by the ECB covering euro area countries and once in cooperation with the European Commission covering all EU countries plus some neighbouring countries. The survey provides information on the latest developments in the financial situation of enterprises, and documents trends in the need for and availability of external financing. The survey results are broken down by firm size, branch of economic activity, country, firm age, financial autonomy, and ownership. Another important survey is the Business Environment and Enterprise Performance Survey (BEEPS) administrated to firms in 34 countries of Eastern Europe and Central Asia from 1999 to 2008. In total three rounds of the survey have been conducted and the last one covered more than 11,000 firms.

2.1.3   Econometric analysis

A rich strand of literature used regression analysis to estimate models of disequilibrium in credit markets. Prior studies [7] have separated firms into those that are more likely to be credit rationed and those that are less likely to be credit constrained, a priori. Various determinants, such as dividend policy, corporate structure, collateral, or banking relationship, are used to identify the two groups. One problem is that those determinants do not allow firms to switch between the two groups over time, and as some of them depend on the firms' policy decisions, they are not suitable for the CR measures. Many empirical studies on

credit rationing tried to verify the hypothesis according to which SMEs are mostly interested by the phenomenon of credit rationing. As it will be analysed later, one of the major reasons for this is their difficulty in accessing financial markets, needing more often loans from banks. The use of econometric analysis acquired a big relevance starting from the '70s with the aim to isolate and quantify dynamic credit rationing. All the models are based on the contribution by Fair-Jaffee [24] of 1972 who were the first able to isolate dynamic credit rationing and to quantify it. In the more recent years the econometric analysis became the most used method, but the attention was moved mainly on the equilibrium rationing. Nevertheless, due to their complexity, this kind of analysis are still few and mainly based on the models proposed by Fair-Jaffee or Maddala-Nelson [25]. Using this model, it still appears to be unclear the distinction between equilibrium and dynamic rationing because of the strong inter-linkage between the two. It will be analysed below the main principles of the model of Fair-Jaffee which, as previously mentioned, has been widely used as a starting point for many following studies on this measure. The paper provides four methods to estimate supply and demand in disequilibrium markets, where the fourth one, the *quantitative method* is the one then used by the authors for their model on the housing sector explained in the last section of the paper. The general model is assumed to consist of one demand and one supply equation:

$$Dt = \alpha_0 X_t^D + \alpha_1 P_t + \mu_t^D \tag{2.1}$$

and

$$St = \beta_0 X_t^S + \beta_1 P_t + \mu_t^S \tag{2.2}$$

Where D and S are the respectively the quantity demanded and supplied in the period t, P is the price of the good in the same period, X_t^S and X_t^D are the variables other than price and μ is the error term that influence the demand and the supply. Equations 2.1 and 2.2 are standard equation of demand and supply, where price is assumed to have negative effect on the demand $\alpha < 0$ and positive effect on the supply $\beta > 0$. It is moreover assumed that

$$Q_t = min(D_t; S_t) \tag{2.3}$$

The equation 2.3 is an important assumption in the model of Fair and Jaffee: this implies that the quantity observed is the minimum between the one demanded and the one offered. The consequence of this consideration is that the market is not always at equilibrium, meaning that prices are not always able to adjust so as to ensure that demand and supply are equal. The main issue implied from equation 2.3 is that, whenever a quantity is observed, it would be impossible to establish if is is the quantity demanded or the one supplied. They also consider that it is possible to formulate the change in price as a function of the excess demand (or supply)

existing in the market. In this way changes in price could be used as an indicator to establish the excess of demand (or supply). Consequently they suppose that:

$$\Delta P_t = \gamma(D_t - S_t) \tag{2.4}$$

Equation 2.4 implies that the amount of the price change is directly proportional to the amount of excess demand. The coefficient of proportionality γ, depends on the length of the time unit: if it is equal to zero is the polar case of no adjustment and if it is equal to infinity is the polar case of perfect adjustment. This equation is used as a starting point for the development of the *quantitative method* in the paper. Basing on what expressed so far, it is possible to reformulate the quantity equation on this way:

$$Q_t = D_t - \frac{1}{\gamma}\Delta P_t = \alpha_0 X_t^D + \alpha_1 P_t - \frac{1}{\gamma}\Delta P_t + \mu_t^D \tag{2.5}$$

If $\Delta P \geq 0$ and

$$Q_t = S_t - \frac{1}{\gamma}\Delta P_t = \beta_0 X_t^S + \beta_1 P_t - \frac{1}{\gamma}\Delta P_t + \mu_t^S \tag{2.6}$$

If $\Delta P \leq 0$. The model is used by the authors to verify the existence of rationing in housing markets, and then used in the credit market to analyse the behaviour of central banks toward the financing of commercial banks. In the paper of Fair and Jaffee, besides the *quantitative method* it is also explained another method called *directional method*. This approach has been used as starting point from another key contribution on the equilibrium modeling which is the paper of Maddala-Nelson published in 1974 [25]. This model relies on three equations: demand and supply equations are estimated using a set of explanatory variables, and a subsequent transaction equation represents the amount of bank credit received by the borrowers. This methodology identifies the gap between supply and demand of credit using an appropriate maximum likelihood estimation procedure. Many empirical studies have used this methodology to measure CR in different countries and at certain periods in time. Despite the importance acquired in the literature, two main limits can be found in the previous models. The first one is the impossibility in isolating equilibrium rationing from dynamic rationing, the second is the impossibility in quantifying rationing at equilibrium.

2.2   Determinants of credit rationing

In the empirical literature the main characteristics that have traditionally been considered as determinants of credit rationing are mainly three: the firm size, the firm age, and the credit risk of the firm [7]. Another strand of literature sees the

reasons behind credit rationing related to the manager of the firm. This theory seems to be applicable to the small firms, in which the person managing the firm is also the owner or the majority shareholder. These studies are focused on different characteristics of the manager/owner. A wide literature studies the possibility that the race or the ethnicity of the manager are taken into consideration by banks before granting a loan, but also other studies are related to the gender, the age and the level of instruction of the manager. In the following subsection it will be browsed all the main theories behind these studies [7].

2.2.1 Firms' characteristics

The size of the firm

The size of the firm is commonly estimated by the total asset or net sales, and recently by employment. Each member of the European Union traditionally used its own definition of small and medium-sized enterprises. Today, the European Union uniformed the concept of SMEs giving precise requirements. To be defined a SME a firm has:

1. less than 250 employees and

2. less than 50 millions of revenues or

3. less than 43 millions of balance-sheet total

Small and medium-sized enterprises have a big importance in the economy of the majority of the industrialized states and represents the large majority of the firms in Italy. Nevertheless, these kinds of enterprises are generally considered unstable. First, it is complex for the banks the process of acquiring information on investment projects and the history of the company, increasing the information asymmetries. Moreover, it is easily observable that SMEs presents higher rates of bankruptcy, meaning that on average the quality of the projects is lower. Moreover, the costs of monitoring both ex-ante and ex-post are higher for small and medium-sized enterprises. Another important point is the easiness through which bigger firms can have access to many kinds of financing, while SMEs in the majority of the cases are strictly dependent from financial intermediaries like banks. This aspect is also linked to the easiness in having access to information regarding big firms, increasing the information asymmetries for the small ones. Often the requirement of collateral, despite not increasing the probability of repayment of the loan, gives to the bank a higher safety. It has been observed that collateral allow to reduce rationing, because it higher the probability of receiving a loan for a company that has not high probability of repayment. It is clear that not all the firms are able to offer collateral, and this is particularly true for small businesses like start-up which

indeed presents an high level of risk and often are not able to survive. Another important element, already seen in the model of Diamond, regards the reputation of the firm. It has been demonstrated by Diamond that the interest rate required are lower if the borrower has a good reputation, and there will also be less probability that he will be rationed. It is quite intuitive that also SMEs with a long history of repaid loans with banks can have access to better conditions for loans because the bank is able to accumulate information on the firm reducing in this way information asymmetries. Nevertheless, it is also intuitive that for SMEs it is also more difficult to build a reputation because they do not always have a credit history and in case they have it, it should be not take for granted that these information are easy to collect. In Europe there are around 25 million small and medium-sized enterprises which represent over 99% of businesses in the EU. They employ two out of every three employees, create 85% of all new jobs and generate about three-fifth of the EU value-added. [1] An important measure was taken by the European Central Banks in 2014. The program for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) is improving access to finance for SMEs. COSME has a budget of over €1.4 billion to fund financial instruments that facilitate access to loans and equity finance for SMEs where market gaps have been identified. Thanks to this budget, it would be possible to mobilise up to €35 billion in financing from financial intermediaries via leverage effects. The financial instruments are managed by the European Investment Fund (EIF) in cooperation with financial intermediaries in EU countries. In Italy it was established a guarantee fund for small and medium enterprises to allow some categories to have access to credit thanks to a state guarantee. In the literature, many empirical studies tried to verify the hypothesis according to which SMEs are more interested by the phenomenon of credit rationing. The main assumption, as also previously mentioned, is that SMEs have more difficulties in accessing regulated financial markets, and for this reason are the ones making more use of internal financing and short-term loans from banks. An important contribution on this level is the study from Fazzari, Hubbard and Petersen [26] who have as subject of study enterprises in USA. In their paper they observe that most large firms, when faced with a reduction in current earnings, can substitute either external finance or reduce dividends. For smaller firms, however, any contraction in earnings reduces the total finance. At the same time internal finance exhibits greater volatility over the business cycle in small and medium—sized corporations than in large corporations. Moreover, during downturns, large firms have more access to short—term and long—term debt markets. Hence, business recessions and changes in corporate tax policy that affect internal finance will likely have a much greater effect on the growth rates and

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[1]Source: European Commision website

investment behavior of small, immature enterprises. Another contribution is the one provided by Calcagnini, Iacobucci and Ticchi in 1998 [21]. They start from the assumption that SMEs are generally more rationed because of the same reasons explored so far. As previously mentioned the conclusion of their analysis is that the small and medium enterprises do not have a higher probability to be rationed compared to the bigger ones, and their conclusion is also supported by the results of the survey they took as main data-set. Finally Levenson and Willard, in the model explained in the past chapter, found that the smallest SMEs are both more discouraged (self CR) and more rationed (pure CR and size CR) than other firms, using the total sales and the number of full-time employees as proxies for firm size.

The age of the firm

Several empirical studies have shown that CR decreases when the age of the firm increases for two primary reasons. The first reason is the reduced amount of asymmetric information between the lender and borrower when the age of the firm increases. As also easily deductible from the considerations made in the past section, young firms are the subject to more financial constrains. The second reason is that the age is a reputation indicator. Start-ups and young companies do not have a reputation on financial markets, and therefore, banks need time to obtain public information through the business life-cycle and to obtain private information through the lending relationship. According to some empirical studies, firm age is the most powerful driver of CR in developing countries. In conclusion, it is possible to say that the drivers of credit rationing based on the age of the firms are the same as the ones based on the dimension, since it is intuitive that younger firms are often smaller and vice-versa.

Credit risk indicators

The previous characteristics of firms—age and size are not independent from the firms' level of credit risk. From the perspective of the banks an important driver was given by the Basel Accords. The Basel Accords are a series of three sequential banking regulation agreements (Basel I, II, and III) set by the Basel Committee on Bank Supervision (BCBS). The Committee provides recommendations on banking and financial regulations, specifically, concerning capital risk, market risk, and operational risk. The accords ensure that financial institutions have enough capital on account to absorb unexpected losses. The last agreement was developed in the wake of the Lehman Brothers collapse of 2008 and the ensuing financial crisis. After this event the BCBS decided to update and strengthen the Accords. The main causes of the crisis of 2008 have been individuated by BCBS as poor governance and risk management, inappropriate incentive structures, and an over-leveraged banking industry. Basel III imposes capital requirements for financial institutions, leading

banks to develop models based on internal ratings or to rely upon external credit assessment institutions, such as rating agencies. Contrary to a scoring method, a rating model is not only derived from financial variables; instead, it also includes qualitative indicators of default risk. These techniques aim to reduce asymmetric information and provide guidance to banks in evaluating borrowers. The framework includes additional requirements for the so-called "systemically important banks," or those financial institutions that are considered "too big to fail." The terms of Basel III were eventually finalized in December 2017. However, its implementation has been delayed, due to the impact of the 2020 global crisis, and the reforms are now expected to take effect in January 2023. It is intuitive that, in this regulated framework, banks are quite reluctant to finance risky projects. An important role today is played by Business Credit Scoring. A business credit score is a number that indicates whether a company is a good candidate to receive a loan. These numbers are calculated by Credit scoring firms basing their judgment on a company's credit obligations and repayment histories with lenders and suppliers; any legal filings such as tax liens, judgments, or bankruptcies; how long the company has operated; business type and size; and repayment performance relative to that of similar companies. The three major business credit scoring firms are Equifax, Experian, and Dun and Bradstreet. Business credit scores generally range from 0 to 100. In Italy, Becchetti et al. in 2010 [27] conducted a study with the aim of determining the impact of the score on credit rationing. For their study it was used the Capitalia data survey on Italian firms. Their results confirmed that most credit rationed firms were the ones with the lowest credit scores.

2.2.2   The characteristics of the manager

Another strand of empirical studies is focused on the possibility that a determinant of credit rationing is the manager of the firm [7]. According to this view even if the firm has a high credit risk, the bank will not systematically deny credit to the applicant firm if it trusts the business model of the firm's manager. Regarding SMEs, it is possible to say that generally the manager of the firm is also the owner of the shares and in this cases, it can happen that banks pay attention to his/her personal characteristics as components of the reputation to judge the firm. On this regard some empirical studies have been conducted especially in developed countries which used personal characteristic of the firm's owner/manager as a measure of the firms' reputation and credibility. The characteristics taken into consideration include age, professional experience, educational level, race, ethnicity, gender, and credit quality. These studies highlighted that in some countries the race or ethnicity did not affect the decision of the banks, while there is abundant evidence that they do in the US and the UK. A possible explanation is that ethnicity statistics have been at the centre of controversies in some countries and the states have

taken measures to avoid any kind of discrimination. Many studies support the thesis of the discrimination of ethnic minority, but this seems to be particularly relevant in loans to private citizens. There is wide room for thinking that the same results could be applied if the bank judge the firm according to its manager. This is confirmed by many studies conducted at the beginning of the XXIth and seems to be particularly true in the US. According to these studies businesses owned by minorities are more likely to be denied credit from banks compared to other business, and they pay higher interest rates. For the same reasons business owned by minority seems to be less inclined to apply for loans because they expect to be denied, bringing us back to the concept of self-credit rationing. It is still quite debated anyway if these results are also influenced by a poor credit history of the firm or by a bad reputation. Another discriminating criterion seems to be gender. On this purpose it should also be considered that the first empirical studies were conducted at the end of the '80s in an entrepreneurial context that is slightly different from the one of today. It is widely documented that still today the majority of the ones who hold a role of power in a company are males, but it should also be recognized that many steps ahead have been done. From a survey conducted to Buttner and Rosen in 1988 [28], it is quite clear that banks were more confident in businesses run by males, perceiving women entrepreneurs as less successful. In a more recent study conducted by Cavalluzzo et al. in 2002 [29] there is evidence of higher credit rationing for women applicants, meaning higher refusal rate by banks, but also higher rates of self-rationing among women, meaning that they are often also more discouraged from applying for loans. In any case, the empirical results of these analysis are still quite debated. Another point of studies is the educational level of the manager. With regard to this item a negative relationship with credit rationing would be expected because highly educated managers are supposed to reduce the asymmetry of information by providing clearer and more detailed financial information and business plans to their banks compared with managers with a lower level of education. It could also be observed that highly educated managers are more likely to anticipate a possible rejection, so they might belong to the fraction of self-rationed borrowers. However, like the results based on the gender, the results of empirical studies on the educational level are inconsistent. A last consideration could be made on the age of the entrepreneurs. On this purpose it would be possible to make different and opposite consideration. If it is true that young entrepreneurs are more likely to apply for a loan because on average they have low aversion to risk, it is also true that a young entrepreneur could inspire less confidence to the bank. In conclusion, it is possible to say that the studies focusing on the managers' characteristics seems to be less consistent than the ones focused on the firms' characteristics.

Chapter 3

Credit rationing for SMEs: an empirical evidence

3.1 Small and medium-sized enterprises in the European Union

The majority of the firms in the euro area are small and medium-sized enterprises (SMEs) [1]. These enterprises are fundamental since they account for a major share of euro area turnover and employment. As mentioned in the website of the European commission, SMEs represent the 99% of all businesses in the EU, employ around 100 million people and account for more than half of the European Unions' GDP. Furthermore, SMEs bring innovative solutions to challenges like climate change, resource efficiency and social cohesion and help spread this innovation throughout EUs' countries. They are therefore central to the EUs' transition to a sustainable and digital economy and moreover they are essential to EUs' competitiveness and prosperity, industrial ecosystems, economic and technological sovereignty, and resilience to external shocks. Small and medium-sized enterprises are defined uniquely in the European Union due to the importance of having a clear and unequivocal identification to exploit the support that is often needed from SMEs. These kind of firms, indeed, are more often subject to market failures, and this makes more complex the context in which they operate. For example, these enterprises are not always able to have access to finance, to invest in research and development or to put aside the resources needed to comply with new regulations (e.g. new regulations on climate). Furthermore, these enterprises not always have the competencies to manage rigidness in the market of labour, shocks in the interest

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[1]Europen Central Bank website

rates or problems in the management framework. For all the reasons mentioned above, it is crucial to involve SMEs in support programs, and an example is the program for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME), mentioned in the previous chapter. COSME has a budget of over €1.4 billion and aims at funding financial instruments that facilitate access to loans and equity finance for SMEs where market gaps have been identified. Thanks to this budget, it was possible to mobilise up to €35 billion in financing from financial intermediaries via leverage effects. The financial instruments are managed by the European Investment Fund (EIF) in cooperation with financial intermediaries in EU countries. Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361. This Commission Recommendation is composed by 9 Articles that specify which kind of firms can be considered SMEs[2]. According to this recommendation it is possible to define micro, small and medium-sized enterprises, the ones employing less than 250 persons and having an annual turnover not exceeding €50 million and/or an annual balance sheet total not exceeding €43 million. Within SMEs category, it is also possible to make the distinction between micro, small and medium enterprises. A micro enterprises employs fewer than 10 persons and its annual turnover and/or balance sheet total does not exceed € 2 million, while a small enterprise employs fewer than 50 people and has an annual turnover and/or annual balance sheet total not exceeding €10 millions. SMEs cannot be considered "scaled-down" versions of large businesses since it is likely that the monetary policy transmission mechanism is different for SMEs compared with large firms because of SMEs' higher dependence on financing from banks.

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[2]Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (Text with EEA relevance) (notified under document number C(2003) 1422)

Source	% relevant	% nor relevant
Bank loans	46%	52%
Other loans	19%	79%
Retained earnings	25%	71%
Grants or subsidised bank loan	43%	55%
Credit line, bank overdraft	48%	50%
Trade credit	28%	69%
Equity capital	11%	85%
Debt securities	2%	93%
Leasing or hire-purchase	47%	51%
Factoring	8%	88%
Other sources of financing	4%	91%

In the table above it is possible to observe the main sources of financing that SMEs asserted to consider relevant in the SAFE survey of 2019 [23].[3] As it is clear from the table, bank loans figure between the main sources of financing for SMEs, together with grants or subsidised bank loans and credit line or bank overdraft. With *Other loan* in the survey are indicated loans from family, friends, a related enterprise or a shareholder. For many reasons, including some listed above or in the previous chapter, SMEs have always been considered more subject to credit rationing compared to large businesses. As mentioned in Chapter 2 small and medium-sized enterprises are often considered unstable, due to the difficulties in the process of acquiring information about their projects and their history, leading to information asymmetries from the point of view of the banks. In general it has also been observed that SMEs presents higher rates of bankruptcy compared to larger firms. As it is evident from the table 3.1, SMEs make often use of bank loans, and this variable has been linked in the literature to higher difficulties in having access to other kinds of financing.

3.2   The survey on the access to finance of enterprises: explanation and analysis

For all the reasons listed above, the European Commission and the European Central Bank launched the *Survey on the access to finance of enterprises (SAFE)* which provides information on the latest developments in the financial situation of small and medium-sized enterprises. The survey is conducted twice a year:

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[3]The remaining % of firms considered the source as "Not applicable"

once by the ECB covering euro area countries and once in cooperation with the European Commission covering all EU countries plus some neighbouring countries. The survey on access to finance of enterprises (SAFE) provides information on the financing conditions faced by SMEs compared with those of large firms during the six months prior to the survey. The results are broken down by firm size, branch of economic activity, country, firm age, financial autonomy and ownership. The survey sample is selected randomly according to three criteria:

1. Country: 27 EU member states plus Albania, Bosnia and Herzegovina, Iceland, Kosovo, Montenegro, North Macedonia, Serbia, Turkey, United Kingdom

2. Enterprise size: micro, small, medium-sized and large (250 or more employees)

3. Sector of the industry: Industry(NACE B C D E) , Construction (NACE F), Trade (NACE G), Services (NACE H I J L M N R S)

The distribution of the different kind of firms interviewed does not always reflect the distribution of the population of enterprises within the countries and for this reason calibrated weight are used with regard to company size and economic activity. Respondents have the possibility to participate to the survey by phone or online, and have to answer to around 110 cross questions. The survey was completed by 15427 firms in 2019. This section is divided into four subsections. The first one will provide an overview of the methodological approach used for the analysis. The second one provides an analysis of aggregated data based on historical series comparing the average results in the European Countries between 2012 and 2019. The third one is focused on the results of the 2019 survey by business characteristics. The fourth subsection provides an analysis of the results of the 2019 by countries.

3.2.1 Methodological approach

To perform this analysis three data-sets have been considered. The former is the one containing all the historical series of aggregated data from 2009 to 2021, the second is the one with the answers to the survey conducted between April and September 2019 aggregated by business characteristics, the third one contains the answers aggregated by countries. The data-sets are available in excel format in the statistical warehouse of the European Central Bank. The data-sets have been downloaded and the results of the irrelevant questions have been deleted. For this analysis 24 questions of the survey have been considered relevant. In the 3.3 it is possible to find the list of the questions used to prepare this analysis. In the original survey the sources of financing taken into consideration are: bank loans, other loans, retained earnings, grants or subsidised bank loan, credit line, bank overdrafts,trade credit, equity capital, debt securities, leasing or hire-purchase, factoring and other sources of financing. To address this analysis on credit rationing,

only three sources have been considered: bank loans, other loans, other sources of financing. The row data-sets have been cleaned and analyzed to identify relevant variables. On this purpose the results of some questions have been aggregated (the results were added or subtracted) to create new variables that were considered of interest (e.g. the financial gap). The row data were then imported into SPSS to perform descriptive statistics. All the graphs presented in this section are the result of an authors' original work. The first step involved the analysis of the historical series. As previously said the questionnaire is conducted since 2009, but different questions have been added in 2012. To standardize the analysis, only data from 2012 to 2021 have been considered, covering a ten year time frame and 19 iterations (2 each year and 1 in 2021). For this part of the analysis is has been performed an examination of the aggregated results of the survey without considering the differences among the countries and the type of business. Therefore the data shown in this section represents an average of all the answers of the respondents. Between the questions considered, nine of them had the possible answers listed below:

- The value is increased

- The value is decreased

- The value is unchanged

In this case, to analyze the evolution of the variables in the years, it has been considered the net value between the % of respondents who perceived an increase and the % of respondents who perceived a decrease in the value. It is evident from all the illustrations presented in the following sections, that there is a trend between 2012 and 2019, but from the first iteration conducted in 2020 this trend stopped due to a structural shock in the market caused by the pandemic, which caused different reactions in the different countries and business structures. On this purpose the analysis is mainly focused on the results until 2019 as from that moment on a long term equilibrium has not been reached yet, and it would be very difficult to make assumptions on what will happen in the next years. For completeness, all the graphs in this section show also the results of the iterations between 2020 and 2021 but the assumptions made only regard the time frame 2012-2019.

3.2.2 Analysis of the historical series

This first review aims at giving a picture of the average situation in Europe, but it should be underlined that it is not detailed enough to assess the severity of the problem of credit rationing in general, which might be more relevant in some countries or for some business types. The starting point of the analysis is to consider what are the main problems faced by SMEs in the last ten years.
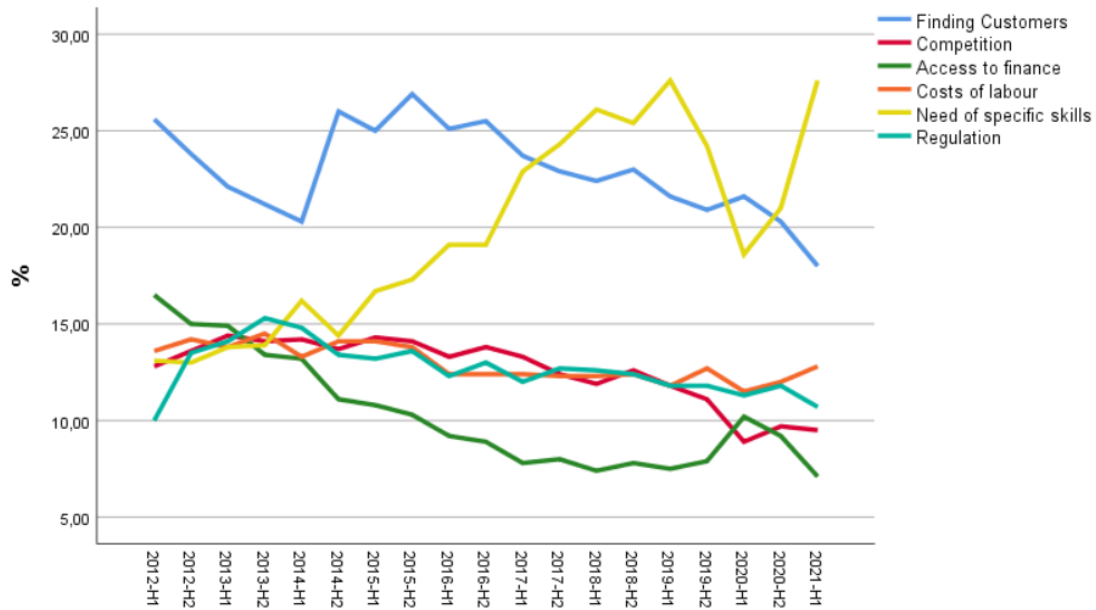
Figure 3.1: Main problems faced by SMEs between 2012 and 2021

From the figure 3.1 it emerges that the access to financial resources in 2019 was the most relevant problem for the 7.1% of the respondent enterprises. As it is evident from the graph, the issue appears to be much more relevant between 2012 and 2013, when the 16.5% of the firms considered access to finance their central problem to face. This number is more than halved in the survey conducted in 2019. The results of the last two years are certainly influenced by the pandemic, which gave rise to new and unexpected challenges for the companies creating also new needs in the market. Nevertheless, asserting that other problems are more relevant compared to having access to sources of finance, does not define the severity of the problem itself. In order to start isolating the phenomenon it is possible to analyze the results of the question asking to rank from 1 to 10 the importance of the problem of accessing to finance. To perform an easier analysis of the results, scores have been grouped into the following categories:

1. Low: scores from 1 to 3

2. Medium: score from 4 to 6

3. High: score from 7 to 10

For each of these categories it has been summed the percentage of respondents that gave a score included in that category. At first glance, the graph 3.2 confirms the results found above: access to finance was a problem much more severe in
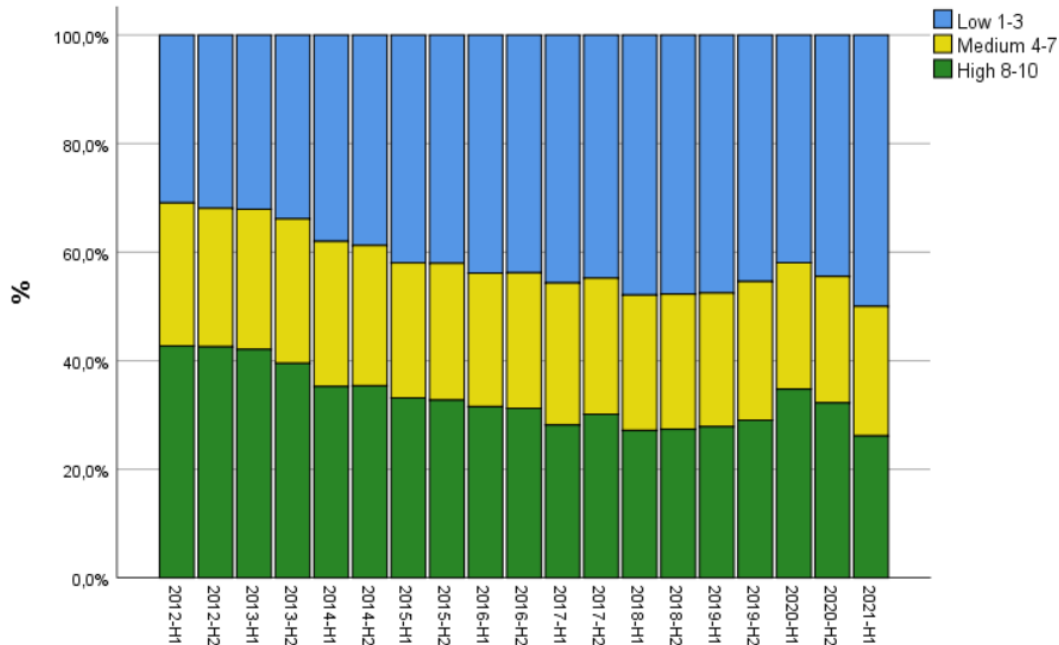
Figure 3.2: Perceived severity of the problem of accessing to finance for SMEs

2012 than in 2019. Nevertheless, looking more carefully at the graph it is possible to make another observation. Despite in 2012 access to finance was considered a severe issue by one half of the respondents, and the percentage today almost halved, still one participant out of four (25.1%) in 2019 considers the issue to be highly relevant and another 23% considers the issue of medium relevance. From this two graphs it is possible to start assuming that the access to credit for small and medium-sized enterprises is a delicate topic, confirming some results available in the recent literature. From the table 3.1 it emerges that the 52% of the respondents to the survey in 2019 do not see bank loans as a relevant source of financing (i.e. did not use this source in the six month prior to the survey and do not plan to use it in the future). On this purpose it is possible to analyze another variable shown in the graph 3.3. It appears that almost the 80% of the ones that considered bank loans not to be relevant (the 40% of the total population) do not actually need a loan, while the remaining 20% (the 10% of the total population) do not have sufficient collateral or believe the costs of the loans are too high, or even thinks that no loans are available. Hence, it is possible to assume that this 10% of the population is in someway rationed, because they would apply for a loan if the conditions were different. Another interesting variable that can be analyzed is the perception of the availability of bank loans by the firms. In each survey firms were asked to judge if, in their perception, the availability of bank loans was increased,
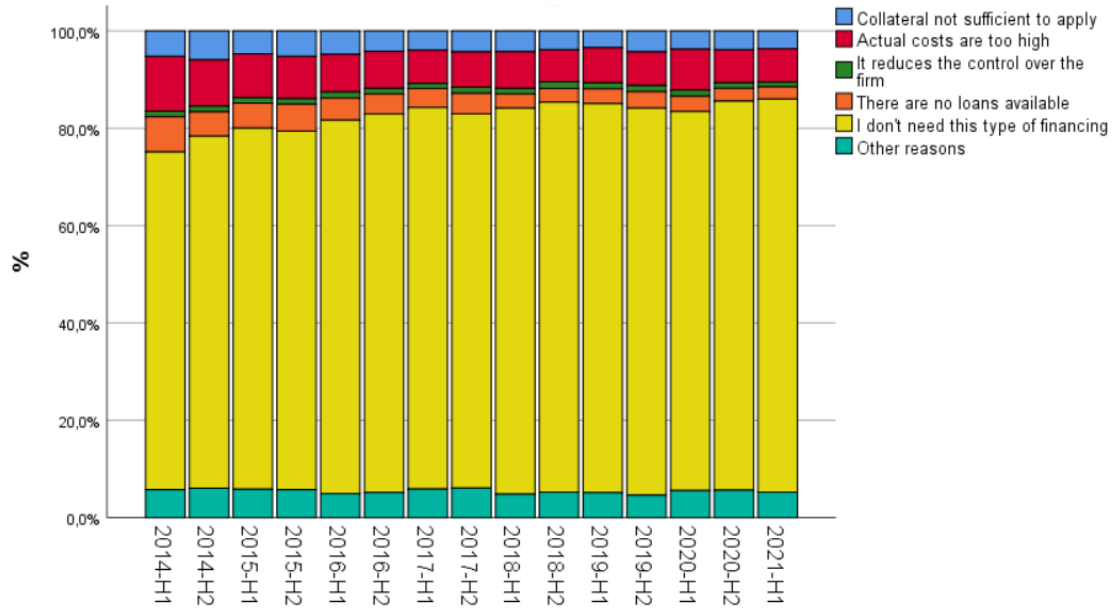
Figure 3.3: Why SMEs do not consider bank loans a relevant source of financing

decreased or remained unchanged in the six months prior to the survey.
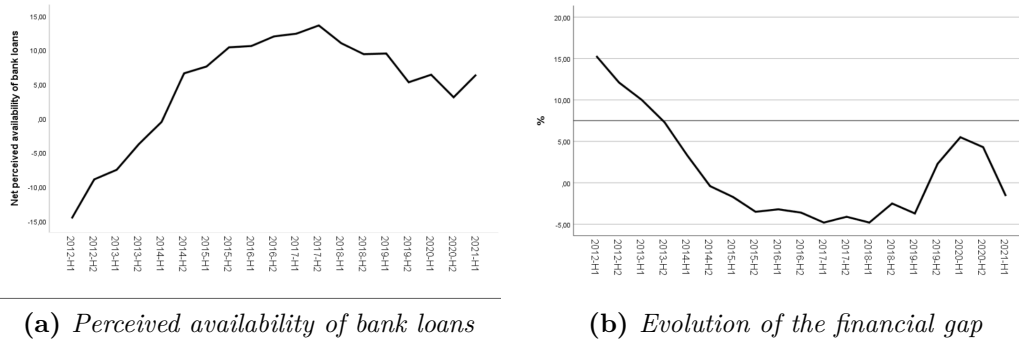
(a) *Perceived availability of bank loans*

(b) *Evolution of the financial gap*

This data was extracted considering in each iteration the difference between the percentage of respondents that considered that the value was increased and the percentage of respondents that considered that the value was decreased in the previous six month. From the graph 3.4a it is striking that the perception of the availability of bank loans is quite different from ten years ago. This variable shows that in 2012 the percentage of respondents considering the availability decreased was exceeding of 15 percentages point the respondents considering the availability increased. From 2014 on the number become positive, therefore it is possible to suppose an increased trust in the banking system. It is also true that this

increase remained linear more or less until 2017, year in which it reached a plateau. Comparing the financial availability with the financial need it is possible to make an estimation of the financial gap. This variable has been calculated considering the difference between the variation of the financial need and the perceived availability. The trend of the financial gap, shown in the graph 3.4b confirms the results found so far. In 2014 the difference between the need of bank loans and its perceived availability became negative, meaning that, on average, in the perception of the respondents there were more loans available than the effective need. Obviously this observation cannot exclude the presence of potential borrowers that are rationed. It must be specified that the two graphs are not independent each other, since the financial gap is the difference between the need and the availability. A next step involves considering, between the respondent, what is the rate of enterprises that effectively applied for a loan and what was the outcome of the application. Firstly, it is possible to look at the number of SMEs that effectively applied for a loan in the six months prior to the survey. In the graph 3.4 it is shown that the percentage of
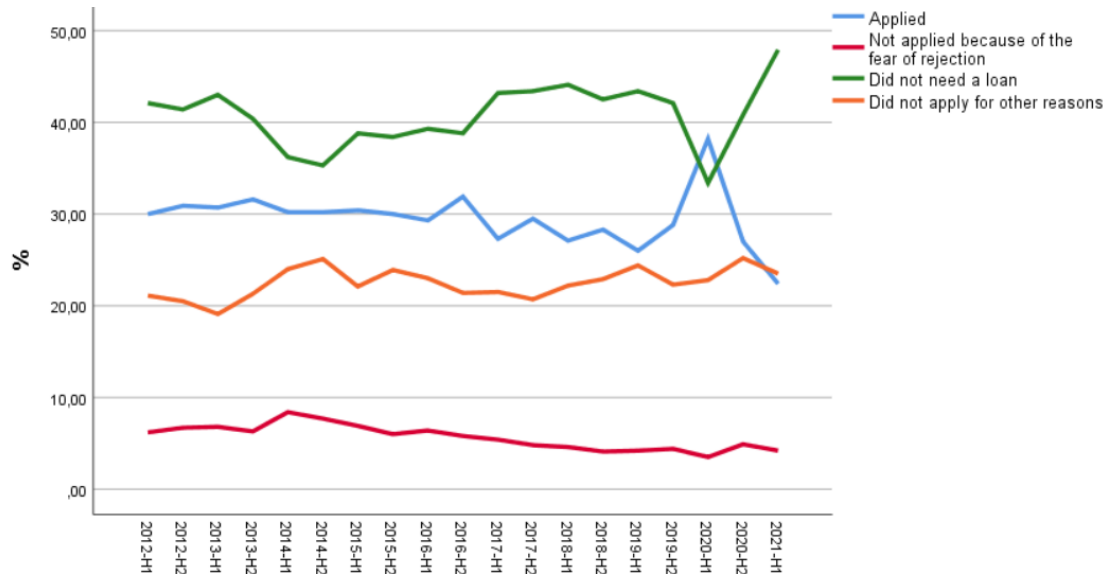
Figure 3.4: % of enterprises that applied for a loan

firms that applied for loans was on average the 30% from 2012 to 2019. In 2020 and 2021 the pandemic caused a shock in the financial system with a sharp variation of the trend. From this graph there is another interesting variable that emerges and it is the percentage of firms that did not apply because of the fear of rejection. This issue has been mentioned more than once in the literature and identified as *self-rationing* and this graphs shows an empirical evidence of its existence. The percentage of respondents not applying because of the fear of a rejection is around

the 7% and remains almost constant during the years. This number shows that, despite not being the central problem for SMEs, it exist a not negligible amount of firms for whom the access to finance is a relevant issue. It is worth considering at this point the outcomes of the application for the SMEs that effectively applied for a loan. From the graph 3.5 it results that the majority of the applicants received the
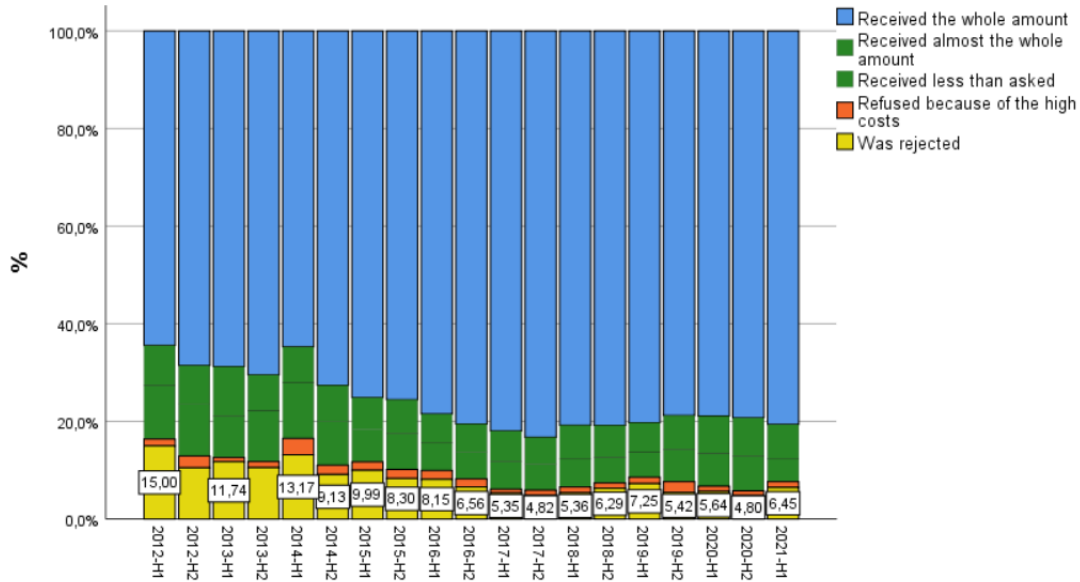

Figure 3.5: Outcome of the applications

whole amount requested, but there is a percentage of applicants that did not receive the whole amount (size-rationing) or was rejected. This number is decreased from 2012 to 2019, confirming the considerations made above. The number of applicants that was rejected in 2019 was the 5.42% while the number of applicants that was size rationed is the 12%. From the graph it can also be observed that a small minority (around 1%) refused the loan because of the unfavourable conditions offered. This percentage is quite small and not relevant itself for the analysis, but also these respondents can be considered somehow rationed. From the considerations made above it emerges that around the 20% of the applicants have been rationed in 2019 and in the majority of the cases size-rationed. All the observations made so far seem to confirm that the phenomenon of credit rationing for SMEs exists and have a relevance for a not negligible percentage of firms. Nevertheless, these results are not sufficient themselves to assert that the phenomenon of rationing is more relevant for SMEs than for large firms. On this purpose it is possible to make a comparison of the results for small and medium-sized enterprises with the ones of the large firms.

In the graph 3.6 it is evident that the percentage of SMEs that encountered
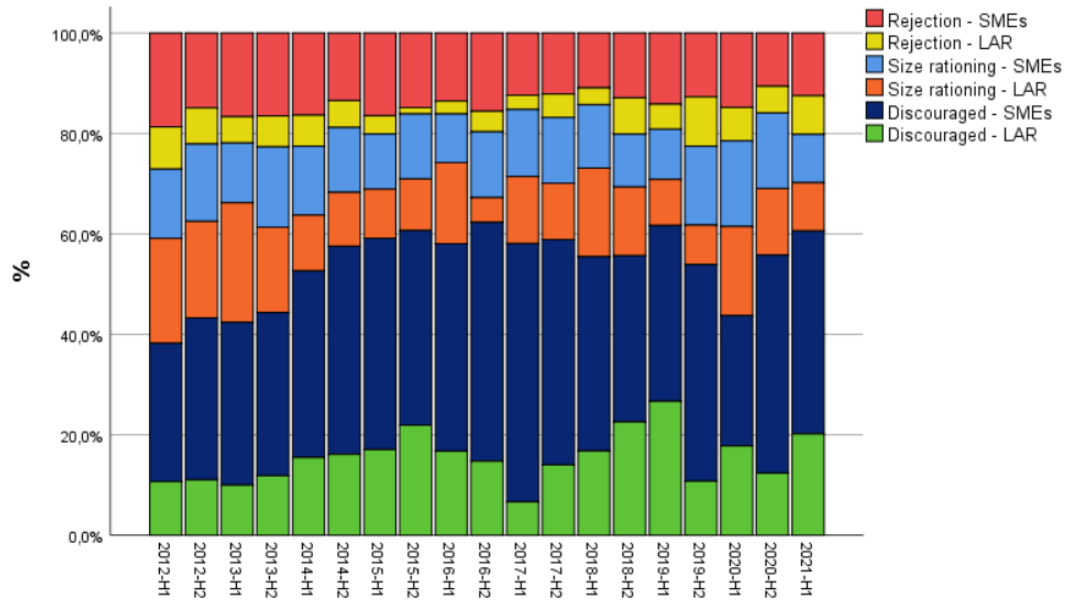
Figure 3.6: Main obstacles in receiving a loan: SMEs and large firms

an obstacle is always higher than the percentage of large firms encountering the same obstacle. This seems to be particularly true if we look at the percentage of firms that are discouraged from asking a loan: in this case the number is almost three times higher for SMEs compared to large firms. This result confirm what was also found in the graph 3.4: self-rationing occurs and is much more severe for small and medium-sized companies. In the same way the percentage of enterprises whose main obstacle is rejection is always higher for SMEs. For what concerns size-rationing instead, looking at the graph it seems that there are no big differences between SMEs and large firms.

Proxy variable of credit rationing: an empirical observation

In the literature many proxy variables have been considered to measure the presence of credit rationing. The variable that was considered relevant in the majority of the papers was the switch to other sources of financing, assuming that in this case the applicants had already been rejected by banks. Two questions of the survey can be useful to address this issue. Firms are asked to indicate if they made use of other loans or other sources of financing in the six months prior to the survey. Assuming that often these other sources can be more expensive and less safe, an increase in their use in the past ten years could mean an increase in rationing. In the graph 3.7 it is shown that effectively in 2014 the percentage of firms that used
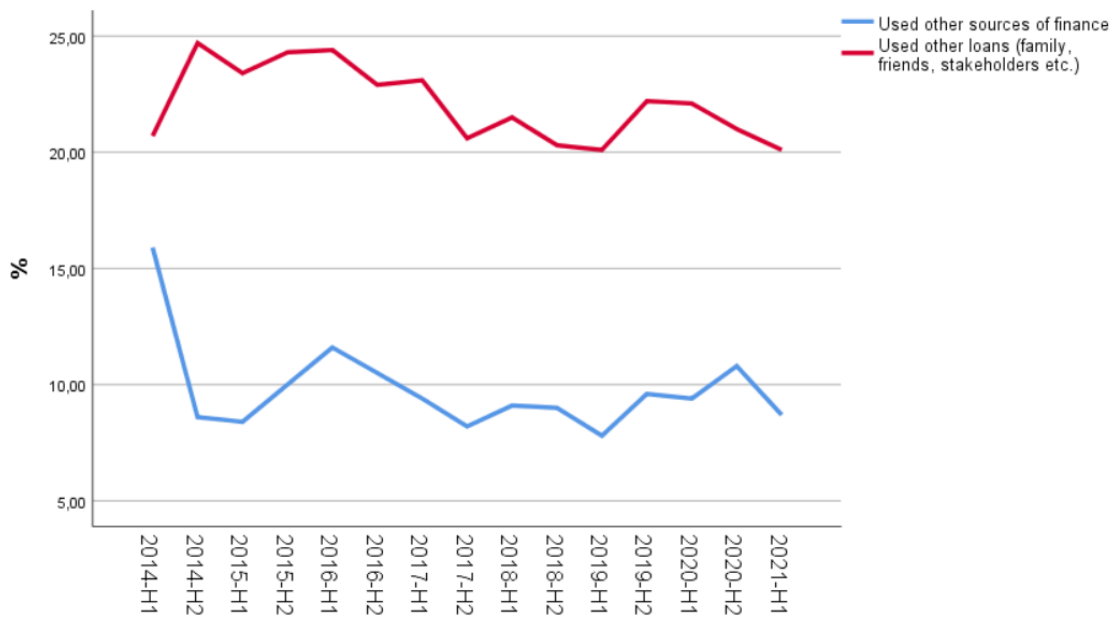
Figure 3.7: Switch to other loans or other sources of financing

other sources of financing was more than the 16% but decreased in the past years, and this element confirms all the considerations made so far.

Conclusions

In this subsection were analyzed the average results of the SAFE survey from 2012 to 2019. The variables taken into considerations are:

- The main problems faced by SMEs;

- The perceived severity of the problem of accessing to finance;

- Why SMEs do not consider bank loans to be a relevant source of financing;

- The perceived availability of bank loans and the financial gap;

- The % of firms that applied for a loan;

- The outcome of the application;

- The main obstacles in receiving a bank loans for SMEs and Large firms.

The main result is that from 2012 to 2019 the number of enterprises considering access to finance a severe problem decreased consistently and in addition to that, the perceived availability of bank loans increased. Nevertheless, in 2019 there was a 50% of respondent firms considering the issue to be relevant. Around the 10% of the respondent enterprises considers bank loan not a relevant source of financing because of difficulties in receiving a bank loan, due to high collateral requested or high interest rate. The % of SMEs that applied for loans was almost constant in the past ten years while there was a slight decrease in the % of enterprises not applying because of the fear of a rejection. Among the applicants a considerable % of enterprises was not able to get all the amount requested, and it is not negligible the amount of rejected firms. Moreover, the decrease in the use of other loans and other sources of financing can be considered a proxy variable of the issue. It is possible to deduct that despite decreasing from 2012 to 2019 the problem of credit rationing exists and has a relevance for a non negligible percentage of enterprises. Among the types of credit rationing described in the previous chapters, the more relevant ones seem to be size-rationing and self-rationing, while it is not possible to assert the existence of pure credit rationing as it is described in the literature. This is mainly due to the fact that the firms in scope are not observationally identical, hence the choice of rejecting their application could result from observation that are known only to banks. Finally from the comparison between SMEs and large firms it is striking that the problem of self-rationing is much more relevant for SMEs, while there are no noticeable differences for what concerns size-rationing.

3.2.3 Determinants of credit rationing: results by business characteristics

In this section it is analysed how the different kind of enterprises answered to the survey in 2019, in order to underline differences among their needs. This analysis is focused on four characteristics:

1. The main shareholders: public shareholders (as the enterprise is listed on the stock market), family or entrepreneurs (more than one owner), other enterprises or business associates, venture capital enterprises or business angels, one owner only, other,

2. The age of the firm: less than 2 years, between 2 and 5 years, between 5 and 10 years, more than 10 years,

3. The turnover of the firm: up to € 500,000, more than € 500,000 and up to €1 million, more than €1 million and up to €2 million, more than €2 million and up to €10 million, more than €10 million and up to €50 million, more than €50 million

4. The number of employees: 1-9, 10-49, 50-249, 250+.

These characteristics have been chosen since they were mentioned in the past chapter as possible drivers of credit rationing. It was assumed many times in the literature that younger firms or smaller ones (with a low turnover or a low number of employees) are more frequently rationed, and according to some strands, also the main shareholders of the firms have an impact on its access to finance. The different percentages of firms in the population of the survey are shown in figure 3.8. It should be observed that there is not the same percentage of respondents in each category, meaning that the results need to be taken carefully because could not be faithful representations of the reality.

(a) *Breakdown of the firms by age*

(b) *Breakdown of the firms by annual turnover*

(c) *Breakdown of the firms by shareholders*

(d) *Breakdown of the firms by number of employees*
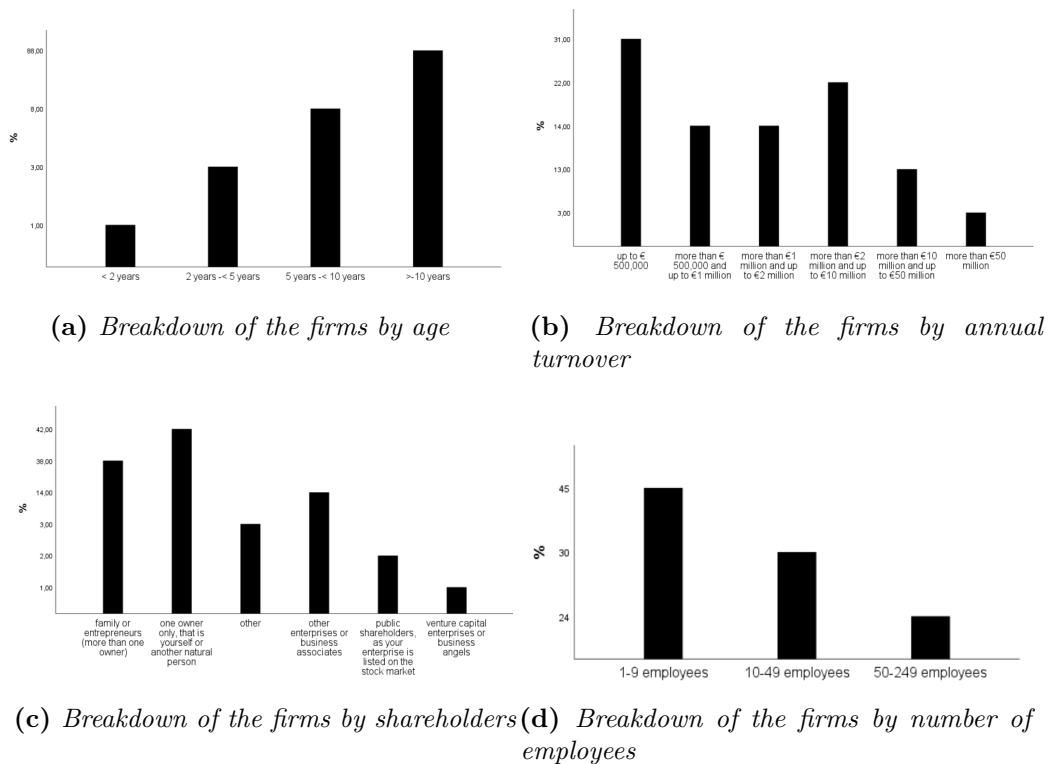
Figure 3.8: Breakdown by business type

As previously done it is possible to start the analysis comparing the kind of firms that consider access to finance their main problem.

In the graph 3.9 it is shown how in the many cases a small firm faces higher problems in having access to finance. In general looking at the graph there are more firms with a lower turnover and a smaller number of employees selecting this as their main problem compared to the other categories, and it seems to be particularly true for younger firms with less than two years of activities. This result
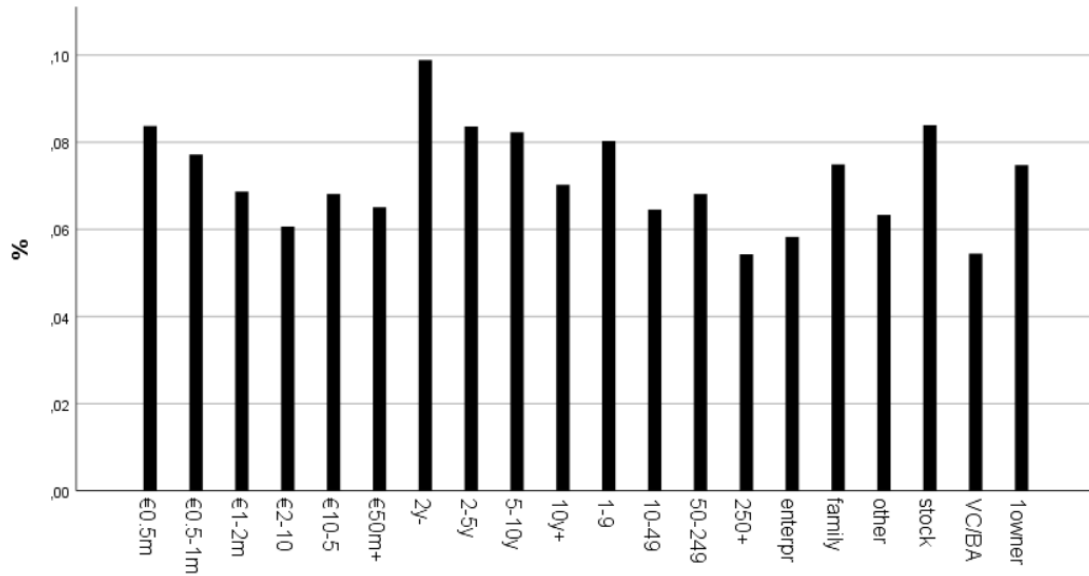
Figure 3.9: % of enterprises whose main problem is the access to finance

is not surprising considering the results of the empirical literature analyzed in the chapter 2. For the banks it is more difficult to find information on the projects undertaken (if any) by younger firms. For what concerns the kind of shareholders, the number of enterprises managed by venture capitalists or by other enterprises selecting the access to finance as their main problem are fewer in number. This could lead to the assumption that when the firm is managed by a family or a single owner the access to finance is a more severe issue. It is also shown that firms already listed on the stock market with public shareholders are the ones suffering this problem more than the others. This result is actually in contradiction with what analyzed so far because it would be possible to assume that if a firm is quoted on the stock market it is relatively easier for a bank to collect information on its history. The relevance of the different sources of financing in 2019 are illustrated in the figure 3.10. It is useful to recall that a source is relevant for a firm if it was used in the months prior to the survey or planned to use in the future. Looking at the graph it seems that firms with a low turnover and a lower number of employees consider less relevant bank loans as a source of financing. It is not possible instead to individuate the same trend for what concerns the age of the firm. In general an observation that can be done is that firms that consider the access to finance their main problem also consider bank loans not to be a relevant source of financing for them. For what concerns the other two sources it is observable that while other sources of financing are considered more or less in the same way among the various business types, other loans are more used by firms with less than 2
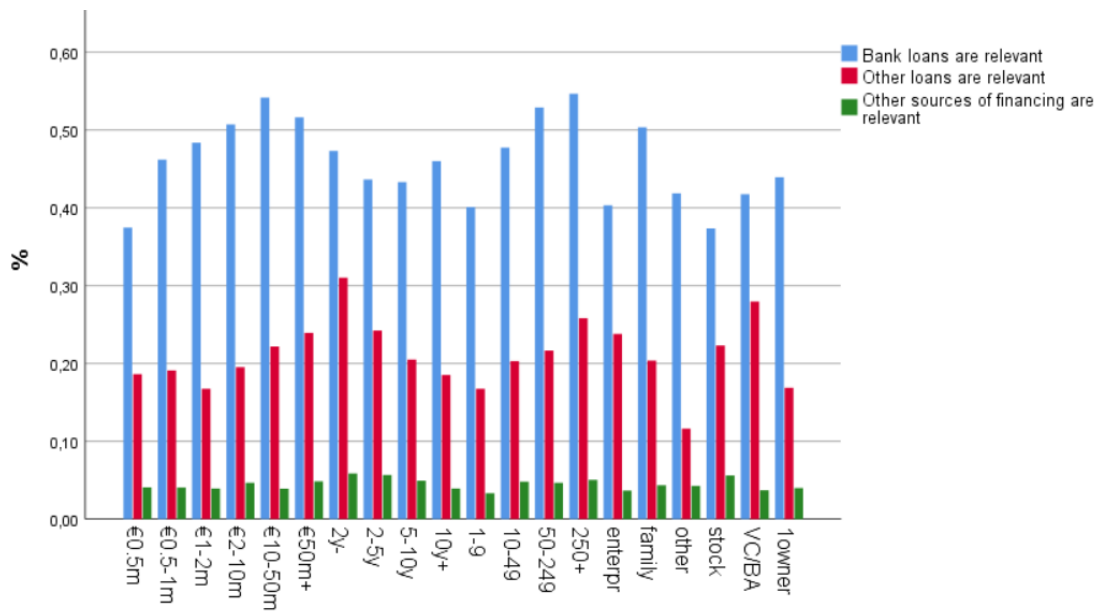
Figure 3.10: Relevance of bank loans for SMEs

years of activities, and their use decrease increasing the years of experience of the firm, while there is exactly the reverse trend for the number of employees. Before making any kind of consideration it should be analyzed why for certain firms bank loans are not a relevant source of financing. In the graph 3.11 it emerges that in the majority of the cases the respondent firm does not need this kind of financing independently from the business type. At the same time it is evident that when the turnover of the firm is lower the reason can be found more in a disadvantaged starting condition than in an unwillingness to apply for a loan. Moreover the firms with a lower turnover are also the ones considering bank loans less relevant for them. The same happens for firms with a lower number of employees. It is not possible instead to make considerations related to the age of the firm. It has been considered also above that firms which do not meet the requirements to receive a loan because they do not have sufficient collateral or because they cannot afford to pay the interest rate, are someway rationed. Looking at the data it also emerges that firms with one unique owner of the shares or managed by a family are more rationed compared to the others, and these two are the same kind of firms which considered bank loans to be less relevant for them. On these last two graphs it is possible to observe that in the majority of the cases firms not considering bank loans a relevant source of financing are also the ones with more difficulties in having access to bank loans. This means that for SMEs loans are not considered an irrelevant source because of a lack of need, but more because of difficulties in receiving a loan. Another interesting variable that can be considered is the financial
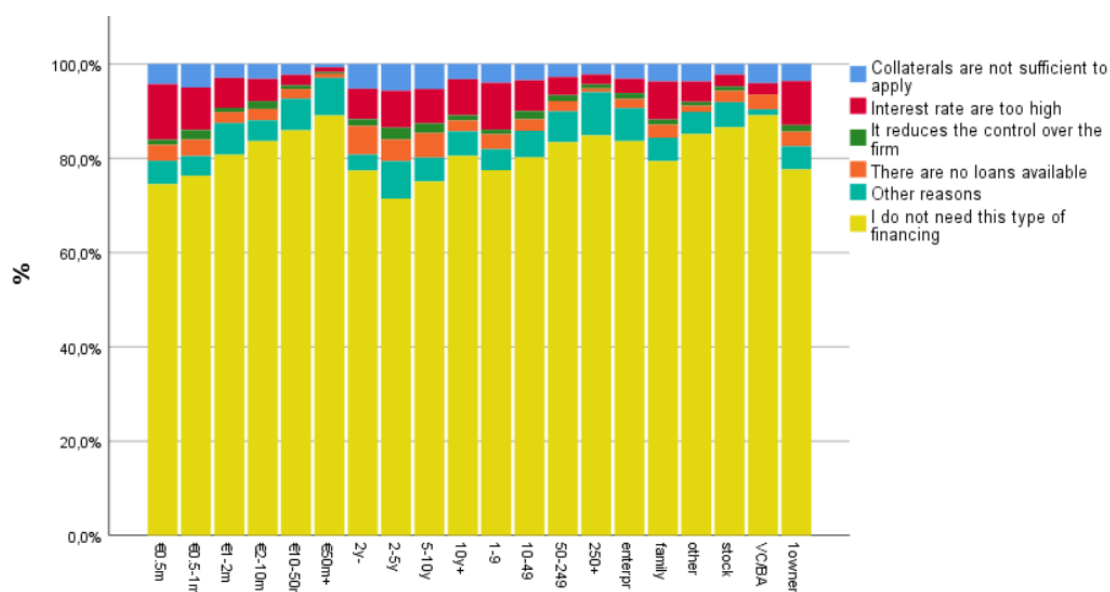
Figure 3.11: Why SMEs do not consider bank loans a relevant source of financing

gap, calculated as the difference between the actual need of bank loans of the firms and their perceived availability. Observing the graph 3.12 it is possible to make
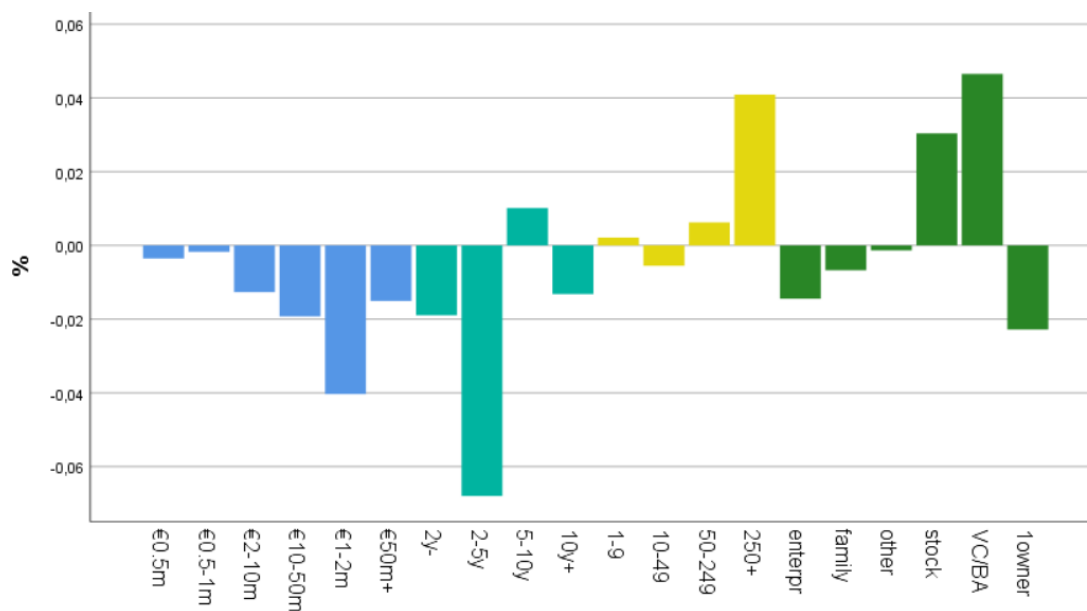

Figure 3.12: Financial gap

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various considerations. One big visual leap is that in the majority of the cases the financial gap is negative, except for firms with more than 250 employees (which are not SMEs), firms already quoted in the stock market and firms financed by venture capitalists. A contradiction that can be observed instead is that the financial gap is even lower increasing the turnover of the firm. This result is not coherent with the answers of the questions analyzed so far, from which is was deducted that firms with a lower turnover face more issues in having access to credit. For what concerns the number of the employees of the firm it seems instead quite evident that there is a sharp difference between the ones with more than 250 employees and the SMEs.

It is now possible to look at how many firms effectively applied for a bank loan, and what was the outcome of the application. In the graph 3.13 it is presented an overview of the enterprises that applied for bank loans in the six months prior to the survey. The first variable that can be analyzed is the annual turnover of the firms. It is shown in the graph that as the turnover increases, there is also an increase in the number of firms that applied for loans, and a decrease in the number of firms that did not apply because of possible rejections. This percentage is around the 7% for firms with a turnover lower than €0.5m and around the 2% for the enterprises with an annual turnover greater than €50m. The same results are noticeable considering the number of employees. The number of firms with more than 250 employees that applied for a loan is almost the double compared to the number of enterprises with less than 9 employees which applied for a loan. For what concerns the age of the firm, increasing the variable increases the number % of applicants among the respondents, but the firms with less than two years constitute an exception, despite having an higher % of respondents not applying because of possible rejections. Nevertheless, it is worth mentioning that firms with less than two years of activities only represents around the 2% of the total sample and for this reason their results could not be so accurate. Finally no other considerations can be made looking at the shareholders of the enterprises.

The outcomes of the applications are represented in the figure 3.14. It is striking that the large majority of the applicants received the whole amount requested. On one hand it is noticeable that the % of enterprises that received everything increases with the turnover and with the number of employees. In the same way the number of rejected firms decreases with the turnover and the number of employees. On the other hand the number of enterprises that have been size-rationed seems to be unrelated to the variables considered. Looking at the main shareholders, from this graph it appears that the enterprises more rejected in the six months prior to the survey are the ones financed by venture capitalists and the ones listed in the stock exchange, and this result is not in line with the observations made so far, considering that these kind of enterprises are also the ones with the lower financial gap.

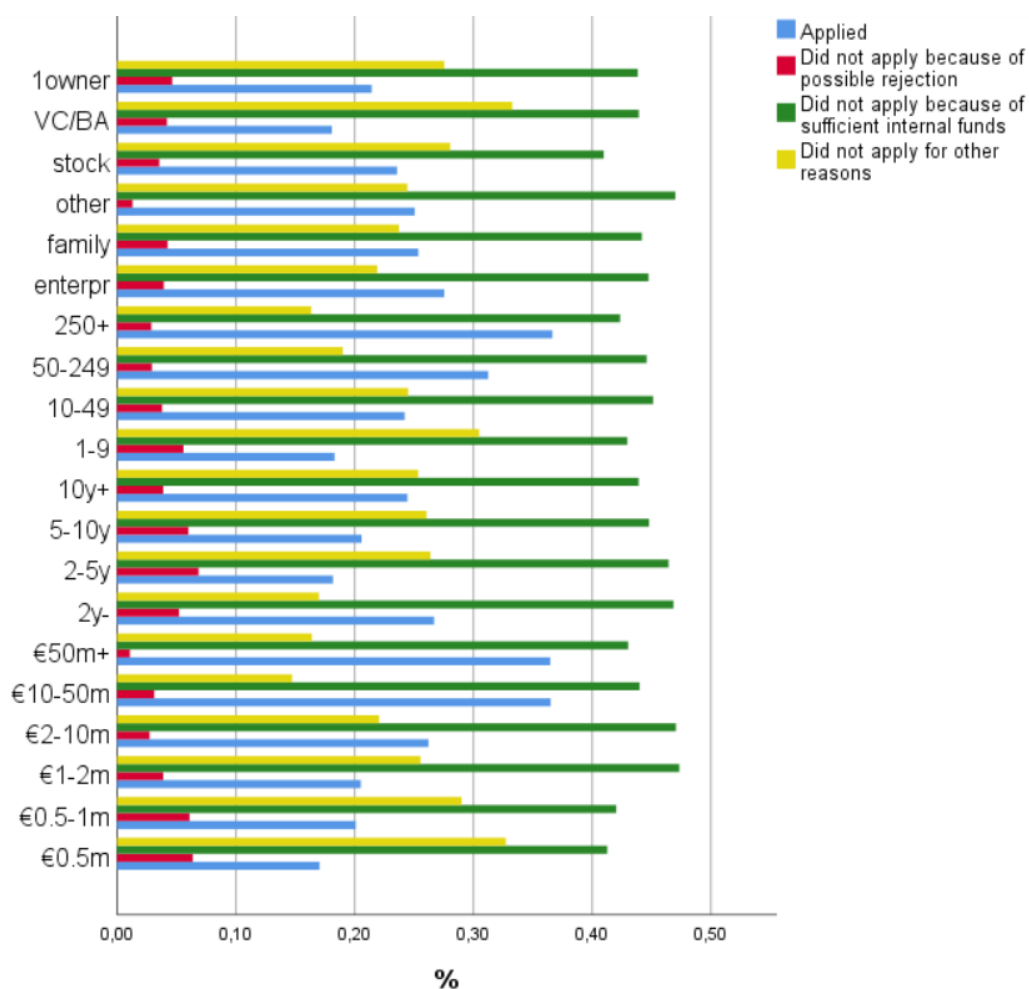It it now possible to turn the attention to the main obstacles that enterprises face

Figure 3.13: % of enterprises that applied for a loan

in having access to bank loans. The graph 3.15 depicts the main limiting factors in receiving a bank loan according to the enterprises. From the diagram it emerges that the number of firms selecting that "*There are no obstacles*" in receiving a loan is decreasing as the turnover of the enterprise increases and the same happens for the number of firms considering that "*there are no loans available.* In the same way it is shown that the enterprises considering the interest rate too high are decreasing as the annual turnover increases. The evidence from this graph is that firms with a lower turnover are facing more issues in having access to finance. The second variable considered in the analysis is the age of the firm. In this case there are no striking differences between the enterprises, and the only element that can be observed is that the majority of the firms with insufficient collateral to apply are the ones with less than two years of activities. This data itself is not sufficient to
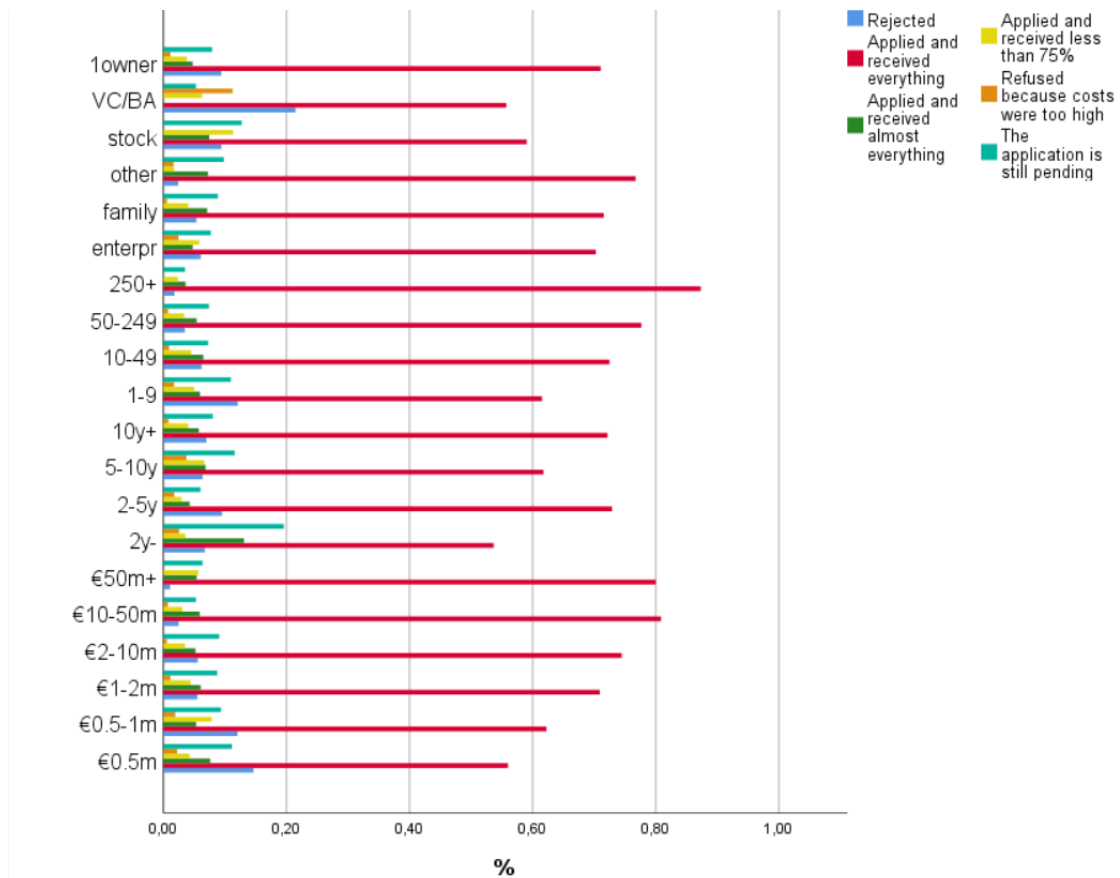
Figure 3.14: Outcome of the application

draw conclusion, since it is possible to imagine that younger firms do not have large amount of assets and for this reasons cannot easily satisfy the requests for collateral from the bank. From the graph it also emerges how the request for collateral is an interesting element when considering the number of employees of the firm. In this case the number of respondent firms with insufficient collateral decrease increasing the number of the employees. This result can be interpreted in two ways. The former is, supposing that firms with more employees are also the ones with a higher value of assets, less and less firms are able to meet this criteria as the number of employees decreases. The latter interpretation could be that banks consider loans to small firms (with a low number of employees) to be less safe, and for them the request for collateral from banks is more stringent. The last variable considered is the main shareholders of the firm. For what concerns this variable it emerges that there are no differences among the enterprises in the insufficiency of collateral. On the other hand something that can be observed is that the categories of enterprises not considering the interest rate too high are not the ones financed by venture
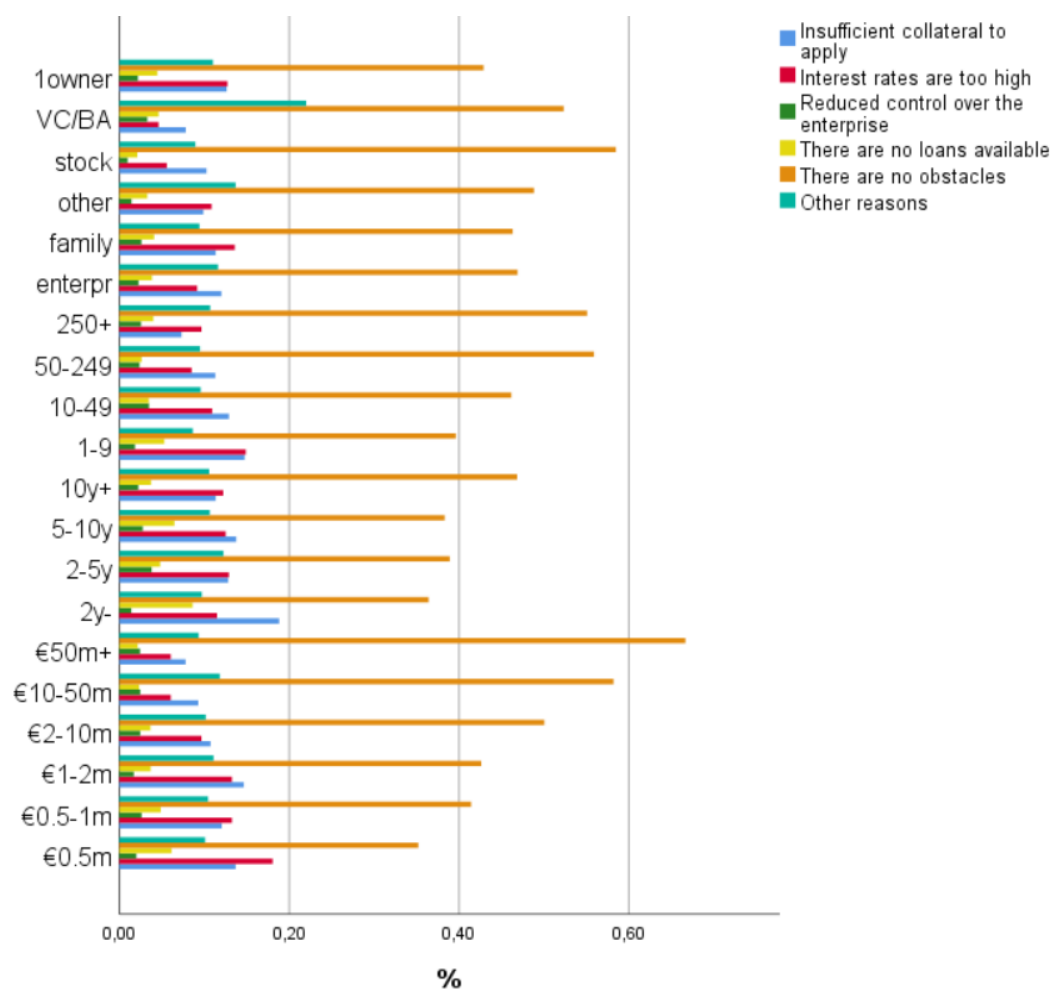
Figure 3.15: Most important limiting factor to receive a bank loan

capitalists or business angels and the ones already quoted on the stock market. In the past graphs it was also observed that this kind of firms seems to be the ones applying more for bank loans and also the ones whose financial gap is higher, but at the same time it was also observed that their rate of rejection is quite high.

Conclusions

In this subsection have been analyzed the results of the SAFE survey in 2019 by business characteristics. The variables taken into considerations are:

- The % of firms considering having access to finance as their main problem;

- The relevance of bank loans;

- Why SMEs do not consider bank loans a relevant source of financing;

- The financial gap;

- The % of firms that applied for a loan;

- The outcome of the application;

- The main obstacles in receiving a bank loan.

From this analysis it does not emerge a clear and unequivocal trend among the variables, even if the more significant one seems to be the turnover of the enterprise. For the respondent enterprises with a low turnover bank loans are less relevant because they found more difficulties in having access to them. Moreover a lower turnover seems to be linked to an higher rate of rejection and self-rationing, while it is not possible to find a correlation with size-rationing. At the same time the financial gap is decreasing for enterprises with an higher turnover, contradicting the other results. An higher fear of rejection brings to self-rationing also for enterprises with a low number of employees.

3.2.4   Credit rationing in some countries of the European Union

The analysis conducted in the past section can also be applied focusing on the differences among countries in the European Union. The countries in the scope of this analysis are France, Germany, Greece, Netherlands, Italy, Portugal and Spain and their results are compared with the average results for the EU. As previously done the analysis begins by considering where the access to finance is considered the main problem for the respondent enterprises. This variable is shown in the graph 3.16. From the figure it emerges that in Greece the % of enterprises considering the access to finance a central problem is much higher compared to the other countries (21% of the respondents against an average of 7% of respondent enterprises in EU). Italy, Spain and Netherlands are slightly over the EU average while Germany is the country where this issue is less relevant for the enterprises.

The relevance of bank loans for the enterprises of the different countries is compared in the figure 3.17. From this figure it is observable that there are no striking differences among the countries and the only remark that can be made is that in France bank loans on average seems to be more relevant compared to the other European countries.

In this case it will not be reported why bank loans are considered not relevant for the respondents because it was not detected a difference among the countries and the graph would not be explanatory. It is possible to carry on the analysis considering the application rate for bank loans in the different countries and then
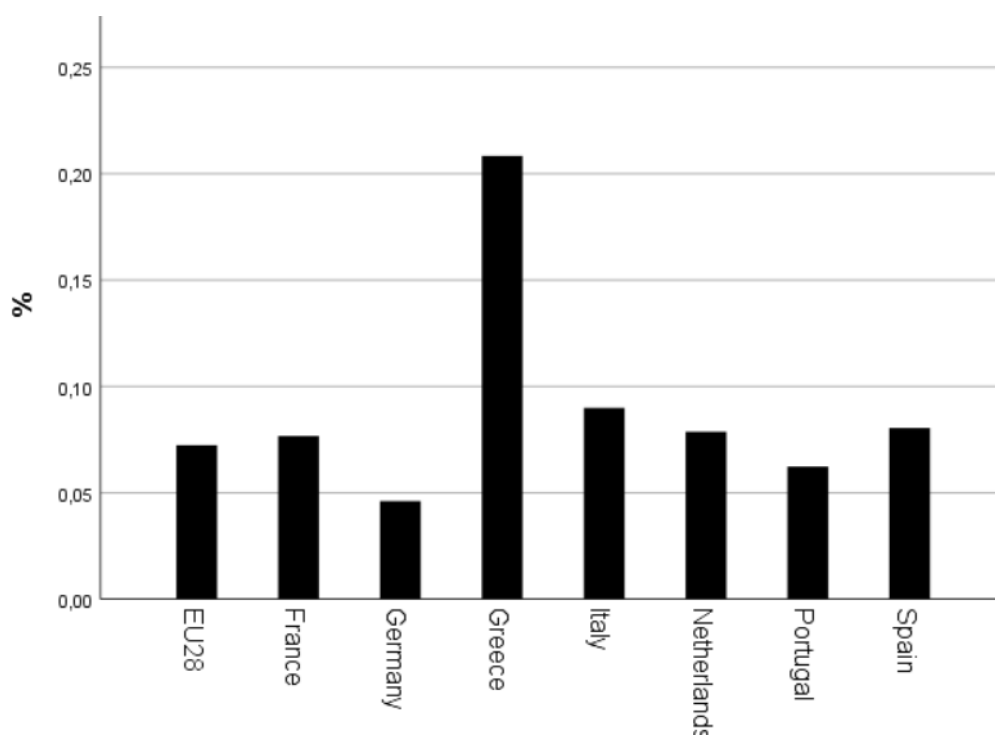
Figure 3.16: % of enterprises whose main problem is the access to finance

compare this results with the outcomes of the application. In the graph 3.18 it is emerges that there are some differences among the countries. The first element that can be observed is that on average the 25% of the respondent enterprises applied for a loan in the European Union. The results in the different countries do not deviate from this average with the exception of Netherlands, in which the % is lower than the 15%. The reason can be found in the % of enterprises that did not apply because of sufficient internal funds, which in Netherlands is much higher compared to the other countries. Surprisingly it can also be observed that the % of firms in Netherlands that did not apply because of the fear of a possible rejection is slightly above the EU average. It is also possible to underline how this same % in Greece is much higher compared to the other countries indicating that self-rationing in Greece is a more severe problem compared to the EU average.

To complement the investigation made so far it is possible to look at the outcomes of the applications of the firms.

These results are shown in graph 3.19. From the graph it emerges that around the 65% of the respondent enterprises in the EU countries applied and received the whole amount requested. All the countries considered in the analysis have an average of respondent enterprises receiving the amount requested comprised
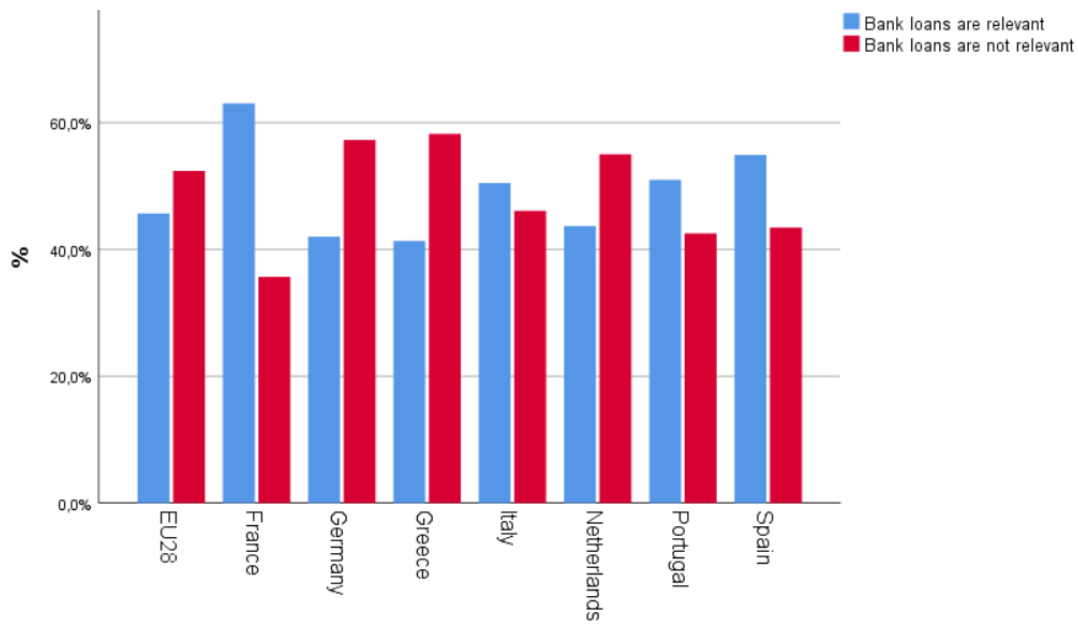
Figure 3.17: Relevance of bank loans

between the 60% and the 70%, the only two exceptions are Netherlands and Greece. In Netherlands it is possible to observe that the amount of application still pending is much higher compared to the other countries, but above all that the rate of rejection is almost the triple compared to the average in EU. On the other side the % of respondents considerable size-rationed is almost null. In Greece the % of rejected enterprises is twice the EU average, and also the number of firms not receiving the whole amount requested is considerably high compared to the other countries in scope.

The graph 3.20 depicts the main limiting factor indicated by the enterprises in receiving a bank loan. A first comparison can be made considering the % rates of respondent enterprises considering that there are no obstacles. This % is around the 45% in EU countries, but it is quite lower in Spain, Portugal and especially in Greece, and it is much higher in Germany. In Spain the main problems seems to be linked to the high interest rate and the request for collateral, which is higher compared to the average. These elements seems to be decisive also in Portugal, where the high interest rate are selected by almost the triple of the respondents compared to the other countries analyzed. Much more severe are the results of the enterprises located in Greece. In this case the number of enterprises considering the insufficient collateral as a main obstacle is in line with the European average, but what is striking is the % of respondent enterprises considering the high interest rate as a main limiting factor. This number in 2019 corresponds to the 39% of the
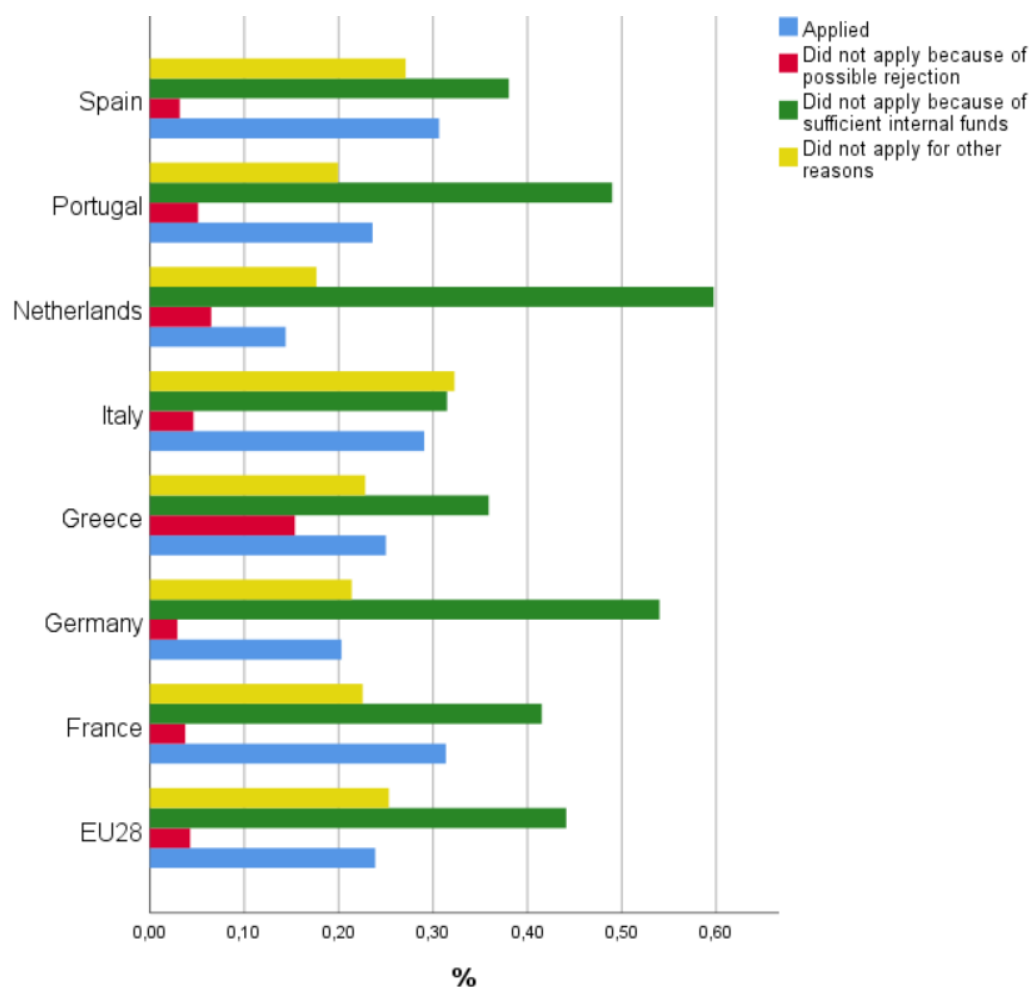
Figure 3.18: % of enterprises that applied for a loan

respondent firms, far higher comparing the result with the other countries.

A last element that can be analyzed is the confidence of enterprises on talking about financial needs with banks and obtain the desired results. It is quite striking from the graph 3.21 that in Italy and in Greece the % of respondent enterprises not feeling confident talking about their financial needs with banks is much higher compared to the average in Europe. While in EU countries the average of these firms in 2019 was the 19.2%, in Italy they represent the 36.7% of the respondents while in Greece the 40.5%.
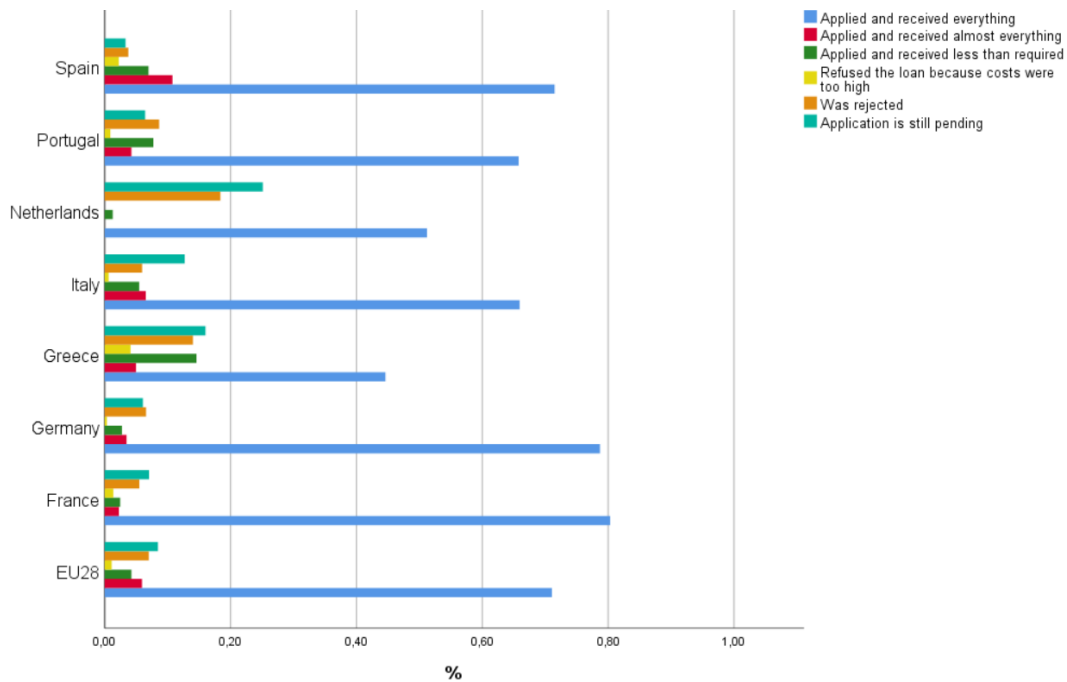
Figure 3.19: Outcome of the application

Conclusion

This analysis depicted the differences between some countries in the European Union and compared the results with the average of the Eu countries. In this section have been analyzed the following variables:

- The % of enterprises whose main problem is access to finance

- The relevance of bank loans in the different countries

- The % of enterprises that applied for a loan

- The outcome of the application

- The most important limiting factor to receive a bank loan

- The confidence of the respondent enterprises in talking about their financial needs with banks

From the analysis it emerged that access to finance is considered a more severe problem in Greece compared to the other countries, and Greece is also the country with the highest rate of self-rationing since the 15% of the respondent enterprises did not apply to loans because of a possible rejection. Among the firms that
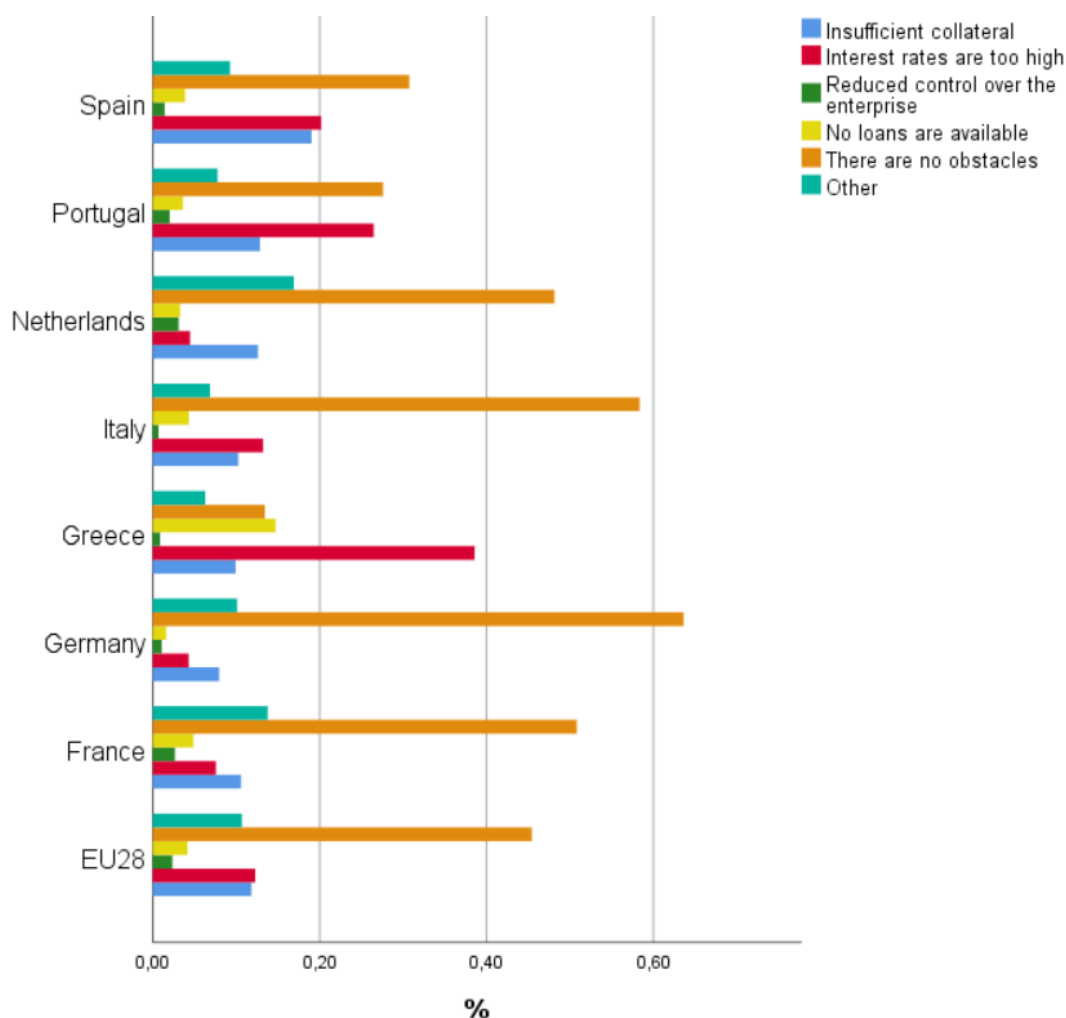
Figure 3.20: Most important limiting factor to receive a bank loan

applied for loans, Greece is also the country with the higher number of size-rationed and rejected enterprises. From the analysis on the applications outcomes it also emerged that Netherlands is the country with the higher rate of rejections. For what concerns the most important limiting factors to receive a bank loans, it was striking the number of Greek enterprises considering the interest rates too high, while there was no big difference in the request for collateral. Also in Portugal the problem of high interest rates was underlined by a conspicuous number of firms. In Greece and in Italy then then is the higher rate of firms not feeling confident in discussing their financial needs with banks. On the other side Germany presents the higher % of respondent firms who do not see obstacles in receiving a bank loan and the lower % of respondent firms whose main problem is having access to
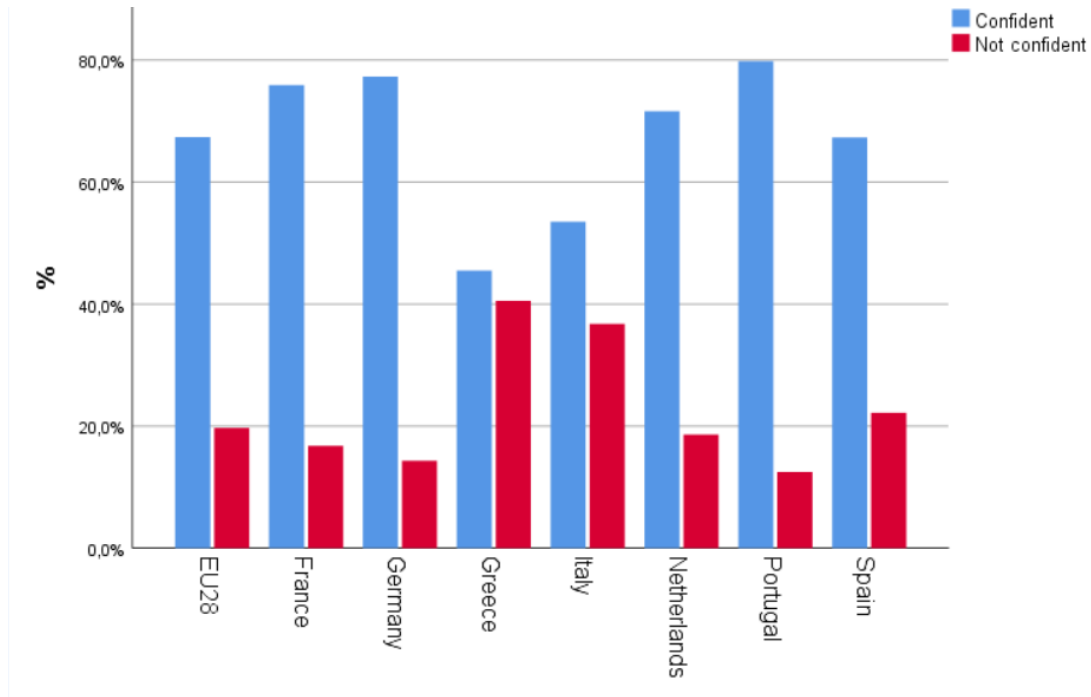
Figure 3.21: Confidence of the respondent enterprises in talking about their financial needs with banks

finance.

3.2.5 The comparison with the SAFE analytical report

Every year the European Commission and the European Central Bank prepare a report on the SAFE survey [23]. The report follows a fixed structure composed by 4 chapters. The first chapter is focused on the use of external sources of financing, describing their relevance for the enterprises, the last obtained amounts and the interest rates charged. The second chapter is related to the access to external sources of financing and it is focused on the changes in the availability of financing sources, in the needs and in the terms and conditions of financing. The third chapter is more forward-looking, and it is focused on the expected growth of the SMEs, their confidence in being able to get future financing and the expected availability of internal funds. Finally the last chapter gives an overview of the characteristics and current status of the enterprises, their financial state, the most important problems they are facing, their innovativeness and their exports. The report is based on the complete survey, taking into consideration all the different sources shown in table 3.1. Moreover the report gives an overview for some of the business types and all the EU countries (28 countries in 2019, 27 countries in 2021).

The analysis conducted in this work is more similar to the results described in the first chapter of the report, but it is also raised one point contained in the second and one point of the fourth chapter. The report produced in 2019 by the joint effort of the European Commission and the European Central Bank, is mostly reporting the results of the surveys from 2015 to 2019. The report is mainly descriptive and the results of the questions are reported in graphs and then described in the text below. In general the authors do not make assumptions or comment on the percentages depicted. In the original report some variables are not aggregated as in this analysis. A first difference is that the proportion of applicants to the sources of financing is considered among the respondent enterprises which considered the source to be relevant for them. A criticism that could be moved to this approach is that in the analysis presented so far it emerged that a large number of firms considered bank loans not a relevant source of financing because of their difficulties in having access to them. In general the report is not particularly focusing on the number of enterprises considering the sources of financing not relevant, neither on the why. The % of applicants and the outcome of the application are reported sequentially both in the report and in this analysis. Another difference that can be found is in the analysis of the rejection rate. The report staggers the rejection rate, grouping the percentages in four different categories. Linking this categories to colours (that indicate the severity of the problem) it provides easier comparisons among the countries. Due to the low number of countries in scope of this analysis, this methodology was less necessary but it would have been still valid and could have underlined more differences among the countries. The main difference between the analysis and the report nevertheless is that the latter does not report the variables considered relevant for in this analysis. Looking at the results it is never reported a breakdown by firms' age, turnover or the main shareholders and the only common point is on the number of employees. For this reason it is not possible to compare the results of this work with the ones of the analytical report prepared by the ECB.

3.3   The perspective of the Bank Lending Survey

The euro area bank lending survey (BLS) [22] was firstly launched in 2003 and it is conducted four times a year. A representative sample of euro area banks is selected, comprising around 150 institutions from all euro area countries. Its main objective is to enhance the knowledge of bank lending conditions in the euro area. It provides information on the lending policies of euro area banks and supplements existing statistics on loans and bank lending rates with information on the supply of and demand for loans to enterprises and households. The BLS provides input to the assessment of monetary and economic developments carried out by the ECB Governing Council in the process of making its monetary policy decisions. The BLS questionnaire is addressed to senior loan officers at the banks and covers supply and demand aspects of bank lending conditions. It contains 22 standard questions on past and expected developments: 18 backward-looking questions and four forward-looking questions. In addition, it contains one open-ended question. The questions are referred three loan categories:

- Loans or credit lines to enterprises;

- Loans to households for house purchase;

- Consumer credit and other lending to households.

In addition to the standard questions, the BLS questionnaire may contain ad hoc questions on specific topics of interest. As in the SAFE survey, also in the BLS the analysis of the aggregate results focuses on the "net percentage", which is the difference between the share of banks reporting that credit standards applied to loan approval have been tightened and the share of banks reporting that they have been eased. A positive net percentage indicates that a larger proportion of banks have tightened credit standards ("net tightening"), whereas a negative net percentage indicates that a larger proportion of banks have eased credit standards ("net easing"). The responses to the standard and ad hoc questions in the BLS questionnaire are analysed in the online BLS report, which is published four times a year. In this section it is provided a brief review of some points of the report on the BLS published by the European Central Bank. For this analysis will be taken into consideration the results of the two of the nine questions of the BLS related to loans to enterprises. In the 3.3 it is possible to find the complete list of the questions of the BLS. Also in this case the row data have been imported to SPSS to perform descriptive statistics and the graphs presented are fruit of an authors' original work. The first question is related to credit standards (i.e. banks' internal guidelines or loan approval criteria). From the graph 3.22 it is possible to see how the internal guidelines applied to the approval of loans or credit lines to enterprises evolved from 2012 to 2019. This result is coherent with the trend of

the SAFE survey confirming that the credit standards were tighter in 2012 and then eased until 2016. From 2016 to 2019 there was a slight tightening of credit standards for loan to enterprises until 2019.
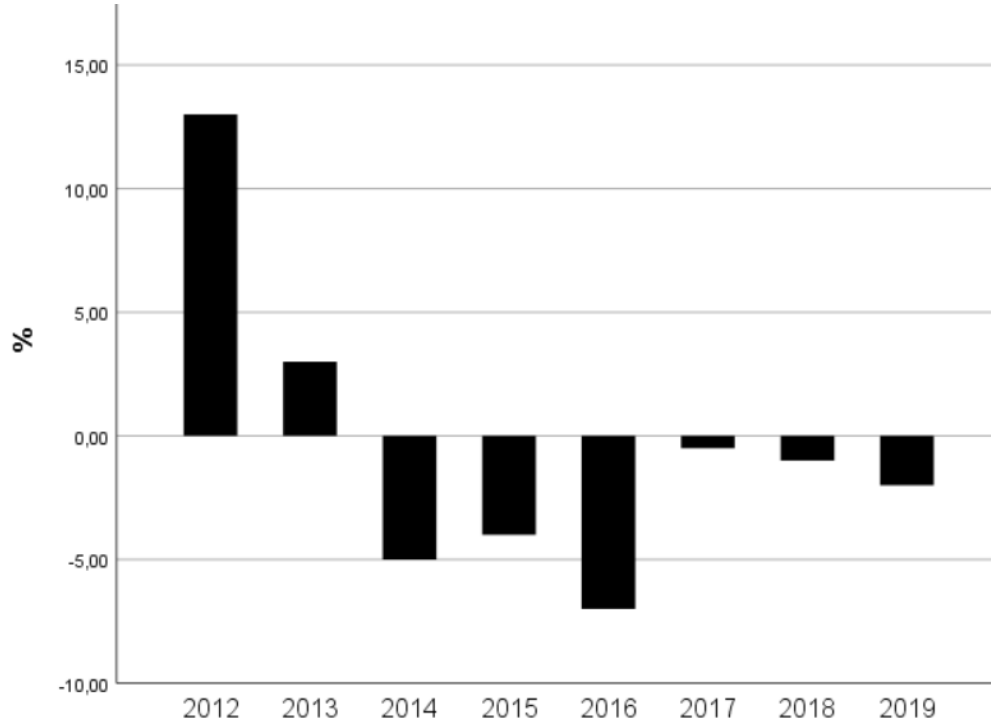

Figure 3.22: Variation in credit standards

Unquestionably, the variable of major interest in the BLS is the rejection rate for loans to enterprises, depicted in graph 3.23. This question was only added to the survey in 2015.

The net percentage share of rejected loan applications (i.e. the difference between the sum of the percentages of banks reporting an increase and that of banks reporting a decline in the share of loan rejections) is not totally in line with the results found so far. Looking at the graph it emerges that the rejection rate increased consistently from 2015 to 2019, while the graph 3.5 depicted how % of rejected enterprises was almost constant or even decreased. One consideration that can be made is that the BLS differently from the SAFE survey considers all the enterprises and not only the SMEs and for this reason the results could be slightly misaligned. Anyway, the most important result is that also the BLS confirms the existence of a significant percentage of firms that apply for loans and are rejected and consequently the existence of credit rationing.
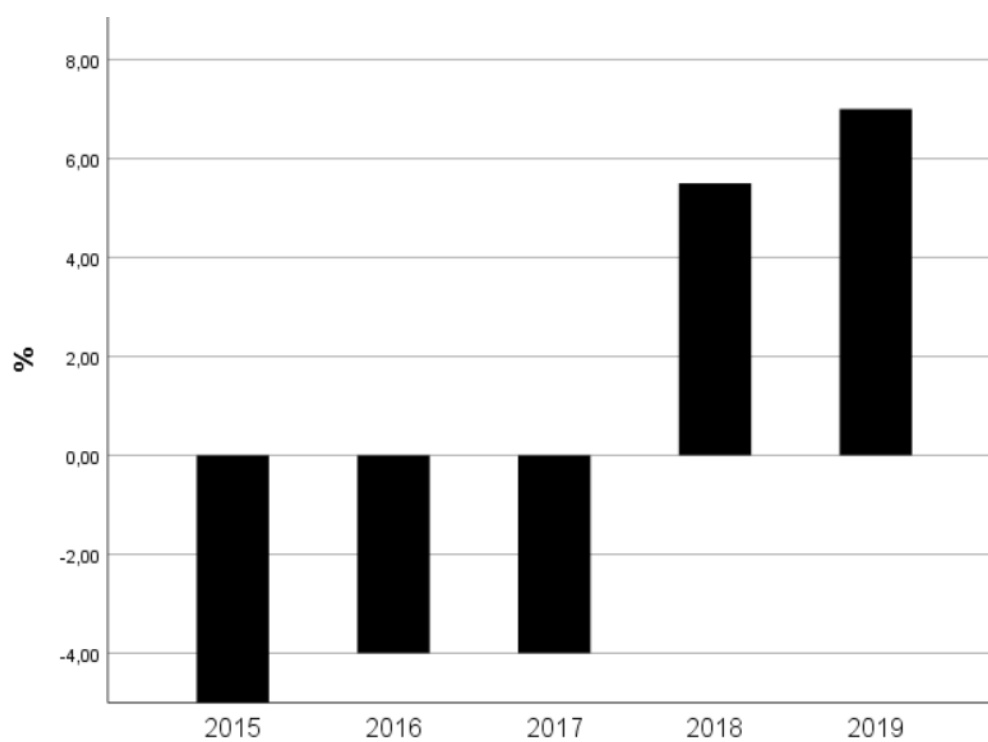
Figure 3.23: Rejection rate

Conclusions

This work provided a summary of the main theoretical and empirical frameworks for the study of credit rationing. Formerly the subject was analyzed from a theoretical point of view, with a review of the main models proposed from the '50s on. The concept of credit rationing was firstly treated by the availability doctrine, whose main contribution was to introduce the concept of availability of credit. At the time it was still not possible to formulate a theoretical explanation of the existence of the phenomenon in a long-term equilibrium. An important step ahead was done with the paper of D.R. Hodgman, in which it is included the borrowers' risk of default. This variable explains for the first time how credit rationing could persist in an equilibrium framework. The most important important contribution in the literature before the '70s was made by the model proposed by D.W. Jaffee and A. Modigliani. The authors formulated the first definition of credit rationing describing it as a situation in which the demand for commercial loans exceeds the supply of these loans at the commercial loan rate quoted by banks. Moreover, they propose what will later become a canonical distinction between *equilibrium rationing*, which occurs when the loan rate is set at its long-run equilibrium level and *dynamic rationing*, which may occur in the short-run, when the loan rate has not been adjusted to the optimal level. The main criticism moved to these models is their inability to endogenize the phenomenon, looking for its cause in external constraints. The real turning point was represented by the definition of adverse selection in the paper published by Akerlof. The description of the mechanisms for "peaches" and "lemons" in the car market, paved the way for a broader application of the model. Relying on this paper Jaffee and Russel formulated a first important framework, based on a distinction between honest and dishonest borrowers. In this context the existence of dishonest borrowers pushes the lender not to charge the interest rate that would clear the demand and the offer but a lower one, and for this reason the lender is not able to grant to the borrowers the entire amount desired. Honest borrowers, in order to avoid to pay an higher interest rate to compensate for the default costs of dishonest borrowers, prefer to be rationed. This kind of rationing will be in the subsequent literature recognized as size-rationing, identifying a situation in which all the borrowers receive an amount lower than the

one requested. The model of Stiglitz and Weiss incorporated many elements of the models previously presented. In this context credit rationing is defined as a situation in which some individuals are cut off from the market even if they would accept to pay an higher interest rate. Borrowers are observationally identical and the lender must charge the same interest rate to all the borrowers. If the interest rate that maximizes the profit of the lender is lower than the one clearing the demand and the supply, some individuals are not able to receive a loan and the lender has no interest in increasing the interest rate. An increase in the interest rate could have two effects: the former is that risk adverse borrowers will withdrawn, leaving only riskier borrowers in the pool, the latter is that an higher interest rate incentivize borrowers to undertake riskier projects. A criticism to the model of Stiglitz and Weiss was proposed by Bester, who gives a central role to the presence of collateral. Bester argued that if the lender is able to choose simultaneously collateral and interest rate, it can use the different contracts as a self selection mechanism. In this context borrowers with a low probability of default prefer to accept an increase in the collateral required, if it implies a decrease in the interest rate charged by the lender. A new variable was introduced in 1986 and 1987 by Stephen Williamson who introduced the idea of monitoring. The model have been classified as a model with *ex-post* asymmetric information, since in this case credit rationing does not arise due to adverse selection but due to the asymmetric information on the return on the borrowers' investment project, which is not known to the lender. In this framework the borrowers that are not able to repay back the loan and go on default, have an even higher impact on the lender who have to sustain a cost to monitor the outcomes of the project. Another variable examined is the one introduced by D.W. Diamond and is the reputation of the borrower and its evolution over time, discussing how this variable can mitigate conflicts of interest between the borrower and the lender. The main result of the paper is that when borrowers manage to acquire a good reputation, it is easier for them to obtain a loan. A more recent model reviewed is the one of Levenson and Willard, which considers for the first time the idea that firms do not even apply for loans because they are anticipating a deny. This concept is known in the literature as self-rationing. Finally, to provide a different perspective, it is described the model by De Meza and Webb. The authors considered that, despite the presence of imperfections in the credit market, the use of subsidies can bring to the opposite result of overlending, decreasing the overall level of efficiency of the economic system. The second chapter contains a review of the main tools used to analyze the issue of credit rationing in the empirical literature. The main instruments mentioned are surveys, proxy variables and econometric analysis. Despite the rationality behind the choice of rationing the credit to some individuals have been widely demonstrated, measuring credit rationing has always been considered a non-obvious issue. This can be easily explained considering that, while the relationship between borrower and lender is

not difficult to understand in theory, it becomes much more difficult if the aim is to quantify some variables related to this relationship. Surveys have been widely used to confirm the existence of credit rationing and to evaluate its effect and this tool can reveal to be valid (if the survey is correctly prepared and analysed) and economic, despite presenting some defects. The main variables considered are the age of the firm, its number of employees, its management and the average riskiness of its project. In the literature there is not a wide agreement on which are the main determinants of the phenomenon but many empirical studies tried to verify the hypothesis according to which small and medium-sized enterprises are mostly interested by the phenomenon of credit rationing. Many rational theories and empirical evidences have been provided to support this thesis, mainly linked to the instability of SMEs, their higher rate of default and the objective difficulties in collecting information on their projects and their credit history. In the last chapter were analyzed the results of SAFE survey, launched by the European Central Bank and the European Commission in 2009. From this survey three data-set were extracted. The first one contains all the aggregated results for the past iterations at EU level from 2012 to 2019, the second contains the aggregated answers of 2019 by business type and the third the aggregated answers of 2019 by countries. Among the different variables, the one considered were the age of the firm, the number of employees, the annual turnover and the main shareholders. This choice has been done considering the main determinants of credit rationing individuated in the second chapter. The three data-sets have been downloaded, cleaned and some variables have been aggregated. The results have been imported to SPSS to perform descriptive statistics. The results of the analysis and the relative graphs are an authors' original work. From the first data-set it appeared that the issue was much more severe in 2012 compared to 2019, but it is also shown that still today SMEs are facing more issues in having access to credit compared to large firms. Moreover, the existence of size-rationing and self-rationing appears to be evident in the survey. It appears clearly that smaller firms are more frequently rationed compared to larger firms and this is particularly true for self-rationing. Breaking down the results bu business type, it is not possible to demonstrate that rationing increases linearly with one variable. Among the variables considered, the turnover resulted to be the more significant one. Firms with low turnover are more often rejected and are the ones suffering more self-rationing. On the other side these firms did not report to have higher request for collateral or to be charged higher interest rates. Moreover it emerged that the financial gap is even decreasing with an increase in the turnover of the SME. A higher rate of rejection seems also to be correlated with low number of employees, as well as high collateral requirements. For what concerns the main shareholders the results that emerged are conflicting. The only clear element in the analysis is that firms with a single owner/entrepreneur and in business run by one family complained

to have higher interest rate an a higher request for collateral. Finally, there are no striking results related to the age of the firms. For what concerns the analysis made on the different countries, it emerged that in Greece the problem of access to finance is much more severe compared to the other countries, and there are also the higher rates of self-rationing and rejection. Despite the majority of the enterprises stated not to have problems in accessing to external sources of finance, a higher rejection rate was also registered in Netherlands. Finally, in Italy and in Greece a high number of enterprises do not feel confident in talking about their financial needs with banks. These results underline how rationing occurs more frequently in countries that faced a severe economic crisis. The work was then compared with the official report produced by the European Commission and the European Central Bank and the main difference is related to the results presented in the report. The annual turnover, the main shareholders and the age of the firms are not presented in the ECB report, leading to the impossibility to perform a deep comparison. Eventually, it was presented a brief analysis on two questions of the Bank Lending Survey. The results reported are not totally coherent with the ones of the SAFE survey, but confirm the existence of credit rationing. Nevertheless, it should be made a distinction between this kinds of rationing and the one described in the theoretical frameworks. In the literature rationing happens among observationally identical firms and it is known as *pure credit rationing*. This kind of phenomenon would be almost impossible to verify from a survey, since in this case respondent firms would never be identical. In conclusion, the phenomenon of credit rationing is widely reflected in the results of the SAFE survey. This issue may take the form of rejection from banks, size-rationing or self-rationing. Among the three forms the last two are more frequent. Despite the difficulties in finding a total coherence in the analysis, it is evident that the phenomenon is more relevant for small enterprises compared to large ones and this is particularly true for self-rationing. Despite it was not found a variable indisputably and closely related to the phenomenon, the annual turnover and the number of employees were the most impacting variables for the analysis. Finally, among the EU countries, in Greece the phenomenon seems to be more severe.

Appendix

The questions of the SAFE survey

- d1. How many people does your enterprise currently employ either full or part time in at all its locations?

- d2 What is the main activity of your enterprise?

- d3 Who owns the largest stake in your enterprise?

- d4 What was the annual turnover of your enterprise in 2019?

- d5 In which year was your enterprise first registered? (recoded to age of the enterprise)

- q0a How important have the following problems been for your enterprise in the past six months? Please answer on a scale of 1-10, where 1 means not it is not at all important and 10 means it is extremely important.

- q0b What is currently the most important problem your firm is facing?

- q1a. Bank loan (excluding subsidised bank loans, overdrafts and credit lines) - Are the following sources of financing relevant to your firm, that is, have you used them in the past or considered using them in the future?

- q1b. Other loan - Are the following sources of financing relevant to your firm, that is, have you used them in the past or considered using them in the future?

- q1c. Other sources of financing - Are the following sources of financing relevant to your firm, that is, have you used them in the past or considered using them in the future?

- q2a. Bank loan - Have you taken out a new loan or renewed such a loan in the past 6 months?

- q2b. Other loan - Have you taken out or renewed such a loan in the past 6 months?

- q2c. Other sources of financing - Have you obtained such source of financing in the past six months

- q3 You mentioned that bank loans are not relevant for your enterprise. What is the most important reason for this?

- q4a. Bank loans (excluding overdraft and credit lines) - For each of the following types of external financing, please indicate if your needs increased, remained unchanged or decreased over the past 6 months?

- q5a. Bank loan (excluding overdraft and credit lines) - Have you applied for the following types of financing in the past 6 months?

- q5c Other external financing - Have you applied for the following types of financing in the past 6 months?

- q6a. Bank loan (excluding overdraft and credit lines) - If you applied and tried to negotiate for this type of financing over the past 6 months, what was the outcome?

- q6c Other external financing - If you applied and tried to negotiate for this type of financing over the past 6 months, what was the outcome?

- q8 Willingness of banks to provide credit to your enterprise - For each of the following factors, would you say that they have improved, remained unchanged or deteriorated over the past 6 months?

- q8a Bank loans (excluding overdraft and credit lines) - For each of the following types of financing, would you say that their availability has improved, remained unchanged or deteriorated for your enterprise over the past 6 months?

- q8b Other loan - For each of the following types of financing, would you say that their availability has improved, remained unchanged or deteriorated for your enterprise over the past 6 months?

- q9 Do you feel confident talking about financing with banks and that you will obtain the desired results?

- q10 What do you see as the most important limiting factor to get this financing?

The questions of the BLS

- Over the past three months, how have your bank's credit standards as applied to the approval of loans or credit lines to enterprises changed? Please note that we are asking about the change in credit standards, rather than about their level.

- Over the past three months (apart from normal seasonal fluctuations), has the share of enterprise loan applications that were completely rejected by your bank increased, remained unchanged or decreased (loan volume, relative to the total volume of loan applications in that loan category)?

List of Figures

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