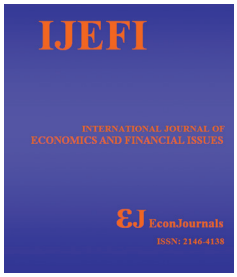

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Loan Guarantees: An Option Pricing Theory Perspective

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ABSTRACT

In this paper we analyze security loan guarantees in the light of the option pricing theory. We interpret them as put options on the cash flows of a secured debt. We highlight that the value of the guarantee is always positive before a loan's maturity and it depends on the same factors that determine the value of a financial option. We also analyze their value in the condition of market efficiency and we conclude that the inefficiencies of the financial markets justify their existence. Finally, we focus our attention on public agencies' intervention by offering credit guarantees to private firms.

Keywords: Loan Guarantee, Option Pricing Theory, Public Guarantee, Guarantee Value
JEL Classifications: H81

1. INTRODUCTION

The aim of this paper is to propose an alternative way of interpreting loan guarantees from a financial perspective. This will allow us to highlight the key elements for their valuation, to contextualize the reasons for public agencies' intervention by offering credit guarantees to private firms, to assess the potential benefits of the public intervention and to identify some related critical issues.

A credit guarantee is a form of protection of the creditor against debtor defaults. Without going into too much detail, we consider it "public" when it is provided by the government or another public body. To the lender, the warranty represents the option to recoup the collateral or the assets from the guarantor in the case of default by the guaranteed. Our intention in this study is to examine and interpret credit guarantees in the light of the option theory.

In his seminal work, Merton (1977) developed a systematic theory for determining the cost of a loan guarantee that makes use of the tools and the techniques of the option pricing theory. Sosin (1980) was among the very first to employ option pricing techniques to examine the properties of loan guarantees to corporations and obtain estimates of their purely pecuniary value. He concluded that for firms with variances and capital structures approximating to those of the market as a whole, the cost of a loan guarantee is relatively small for 5- and 10-year terms, but it is not negligible. He also argued that for firms that move away from the market mould the cost of the guarantee and the saving in interest increases dramatically, especially for riskier firms. Selby et al. (1988) discussed the financial economics of loan guarantees. They used a contingent claims valuation model to value loan guarantees and the wealth transfers to the security holders of the firm. Moreover, they concluded that the value of a guarantee depends very much on the maturity structure of the existing loans, and they suggested that the use of a compound option-based model is preferable to a single period option model. Finally, they argued that wealth transfers can be large and, therefore, could affect the shareholders' incentives to invest. Lai (1992) used option pricing theory in a discrete time setting to derive a closed formula for evaluating private loan guarantees. He found that the structure of the loan subordination greatly affects the valuation of the guarantee. Lai and Gendron (1994) incorporated the stochasticity of interest rates into the valuation of both public and private guarantees. Their model makes use of the continuous time option-pricing methodology, and also takes into account potential default by the guarantor. They measured the impact of incorporating the term structure of interest rates in the guarantee valuation and argued that guarantee valuations computed under non-stochastic interest rate assumptions are biased estimates of the fair values. Mody and Patro (1996) applied option-based methods for valuing guarantees, reporting estimates of the value of guarantees

in different settings, and also summarizing the accounting methods utilized for anticipating losses, creating reserves, and ensuring that the costs of guarantees are evident to decision makers and guarantor stakeholders. Chang et al. (2002) used contingent claims analysis in a discrete time setting and the risk-neutral option valuation technique to study the impact of private guarantees on the default risk premiums of new junior loans. Their results indicate that a substantial reduction of the default risk premium is brought about by private guarantees. Billings et al. (2009) proposed a methodology to determine the loan fees of international loan guarantees where the guarantee fee is treated as additional interest that cannot exceed the present value of interest savings from an unguaranteed loan. Their model conveniently applied to consolidated financial statements' valuation of parent loan guarantees. Using a different perspective, Kuo et al. (2011) attempted to establish a reasonable model for estimating guarantee fees that reflect the applicant's credit status as well as the guarantor's financial health. To this end, they referred to the actuarial pricing theory and treated guarantee fees as insurance premiums.

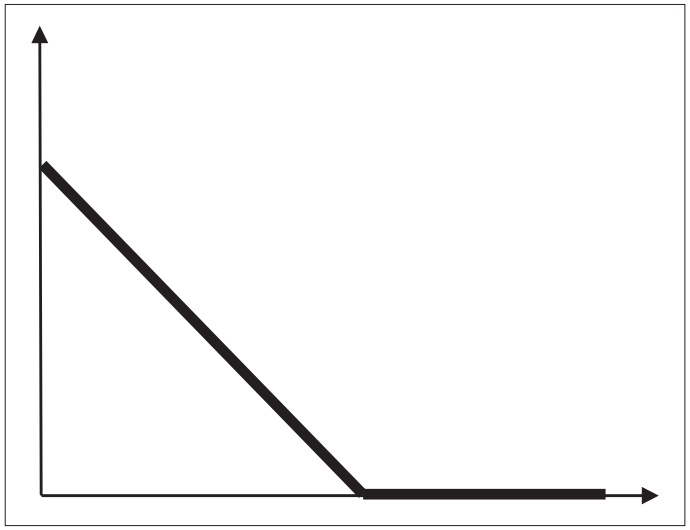
This paper is organized as follows: The next section frames the guarantees on loans from the perspective of the option theory; the third section focuses on the value of a loan guarantee in the conditions of efficient and inefficient financial markets; the fourth section examines how public agencies can support firms' lending through the issue of guarantees; and, the final section presents the conclusions.

2. TO INTERPRET LOAN GUARANTEES IN THE LIGHT OF THE OPTION THEORY

By acquiring the guarantee, the creditor acquires the right to overcome the debtor's insolvency by recouping his residual credit on the collateral or on the guarantor's properties. Interpreting everything in terms of options, the creditor acquires a put option on the cash flows of the outstanding debt. It is a European option because it can be executed at the maturity of the loan, with a strike price equal to the amount of debt to be repaid. The underlying of this option is represented by the cash flows of the guaranteed loan. In the case of a loan repayable by installments, the financial framework can be similarly replicated by a number of options that are a function of the repayment structure of the loan. These complications are beyond the scope of this work. We focus on the case of a secured loan of amount X (including interest) that has to be repaid in a lump sum at a maturity date. In the event of default by the debtor, the creditor can recoup the sum by asking the guarantor for the portion of the loan not paid by the debtor (the insolvency may be total or it can refer to a part of the debt only), leaving to the guarantor with the encumbrance of claiming from the debtor the payment of the defaulted debt.

Assuming that the value of the collateral is adequate to the debt value, the financial framework for such a payout is shown in Figure 1. It is easy to verify that it coincides with the framework for a put option. If the loan is backed by a warranty, then it can be assumed that from a financial perspective the lender has acquired the option to sell the default to the guarantor (that is, the cash flows to be received from the loan) in exchange for the refund of the unpaid debt.

Figure 1: Guarantee's payout at maturity date



We believe that interpreting credit guarantees from the perspective of the option theory allows them to be better contextualized and enables their financial features to be better investigated.

First of all, it allows the conclusion to be reached that the guarantee has a positive value before the expiration of the loan. This is true even at the moment at which it is issued. It justifies the claims of the guarantor for the payment of a fee for the issuance of the guarantee or, in the case of a public guarantee, for a benefit to the community. By recalling the principles of the option pricing theory (Black and Scholes, 1973; Merton, 1973; Cox and Ross 1976; Smith, 1976) we can also understand the factors on which the value of a credit guarantee depends:

a. Value of the secured debt (that is, the option strike price). The higher the secured debt the higher the value of the guarantee
b. Expected value of the repayment of the loan (that is, the value of the underlying). The lower the expectations about the repayment capacity of the borrower the greater the value of the guarantee
c. Volatility of the expected value of reimbursement (that is, the riskiness of the underlying). The more the guarantee is worth, the more risky the loan
d. Maturity of the debt. The more distant the expiration date of the loan is temporally, the greater the chance of encountering insolvency, therefore the higher the value of the collateral
e. Risk-free interest rate. All other conditions being equal, a change in the risk-free interest rate produces the effect of the opposite sign on the market value of a put option. Therefore, it is to be expected that an increase in the risk-free rate results in a reduction of the value of the collateral, and the converse applies to its decrease. The effect is partly explained by the fact that an increase in the risk-free rate results in a reduction of the present value of the proceeds that will follow the possible exercise of the option.
f. Any cash flows paid by the underlying during the lifetime of the warranty (as the payment of installments). If there are

no automatic adjustment mechanisms of the guarantee to the lower debt amount, a lower debt consequence of the payment of installments will be guaranteed by the same stock warranty. The market value of the guarantee can therefore only be greater. This can also be understood to mean that the reimbursement of a portion of the loan determines a reduction of its expected value of reimbursement, leaving unchanged the amount of the guarantee. As for points (a) and (b), the value of the warranty (put option) increases.

g. Risk of double default (that is, the risk that in the event of default by the guaranteed, the guarantor also defaults). Since these are not options traded on regulated markets, there are no clearing systems or margins for the obligations assumed by the parties. Therefore, the possible breach by the guarantor must also be taken into account if required to repay the loan. The higher the risk of double default the less the value of the warranty.

Option pricing theory leads indirectly to another very important conclusion: The value of a loan guarantee cannot depend on other factors.

Table 1 summarizes the factors that influence the value of a credit guarantee.

3. DISCUSSION

What does the value of a loan guarantee correspond to? As seen in the previous section, it varies as a function of the time (maturity); thus, it is preferable "to stop" time and perform the analysis with reference to a specific moment. Consider, for the sake of simplicity and clarity, the time at which the guarantee was granted.

For the guaranteed, the value of the warranty is the present value of the lower interest that, given the guarantee, that person will pay with respect to what he or she would have expected to have paid in the absence of collateral. That is:

$$Gb = PV(Iu) - PV(Is) \quad (1)$$

Where,
Gb is the value of the guarantee for the borrower;
Iu is the interest the borrower expects would have been paid on the unsecured debt;
Is is the actual interest the debtor pays on the secured debt;
PV is the present value.

Table 1: Guarantee's value determinants

Determinant	Sign
Guaranted loan value	+
Expected cash flows from the guaranteed loan	−
Volatility of the expected loan's cash flows	+
Loan's maturity	+
Free risk rate	+
Payments made by the debtor during the life of the loan	−
Double default risk	−

The "+" and "−" indicate the sign of the correlation between the factor and the option (guarantee) value: "+" indicates that when the factor increases, the value of the guarantee increases, and *viz*.; "—" signifies that when the factor increases the value of the guarantee decreases, and *viz*.

For the lender, the value of the guarantee is given by the reduction of the risk of the loan, which in monetary terms can be estimated as the present value of the difference between the interest that would have been applied to the guaranteed party in the absence of warranty and the interest that is actually applied according to the guarantee that assists the loan. That is:

$$Gl = PV(Il) - PV(Is) \quad (2)$$

Where,
Gl is the value of the guarantee to the lender;
Il is the interest that the lender would have asked for on the unsecured debt;
PV and Is are as above.

For the guarantor (obviously assuming the guarantor exists, that is, if the guarantee is not directly provided by the guaranteed) the value of the collateral is represented by the risk that he or she believes is being assumed by granting the guarantee. For a uniform yardstick, we estimate this value as the difference between the present value of the interest that the guarantor would have applied on such an unsecured loan and the present value of the interest that would have applied to the debt secured by an analogous guarantee. That is:

$$Gg = PV(Igu) - PV(Igs) \quad (3)$$

Where,
Gg is the value of the guarantee for the guarantor;
Igu is the interest that the guarantor would have asked for on the unsecured debt;
Igs is the interest that the guarantor would have asked for on the secured debt;
PV is as above.

Obviously, the guarantor will require a fee of at least Gg to grant the guarantee.

If the efficient market hypothesis (EMH) is verified (Fama, 1970), the three values coincide because there will be no differences in the assessment of the riskiness of the borrower by the two/three parties to the transaction. That is:

$$Gb = Gl = Gg \text{ or } PV(Iu) - PV(Is) = PV(Il) - PV(Is) = PV(Igu) - PV(Igs) \quad (4)$$

This means that:

- The guarantor will get compensation equal to the present value of the savings in terms of interest that the guaranteed will get thanks to the guarantee (in the condition of efficient markets the guarantor could not get more, nor would the guarantor grant the guarantee for a lower fee).
- The guaranteed pays a fee for the warranty equal to the present value of the lower interest on debt (or, in the event that the warranty is provided directly by the guaranteed, pledges a patrimonial value equal to the benefit in terms of lower interest).
- For the lender the risk reduction will be offset by a fair reduction in the remuneration for the operation.

In practice, no advantage would have been given by a guarantee either to the guaranteed (who would pay in total what would have been paid on an unsecured loan) or to the lender (as the risk reduction is offset by a corresponding fair reduction of the profits). The only one to derive some benefit would be the potential third guarantor who collects a fair compensation for an operation where his or her presence is neither necessary nor useful to the other parties (that is, the net present value of granting the guarantee would be null, but the guarantor would have earned the fair price of the transaction anyway). Therefore, if the EMH is verified, the presence of guarantees that assist loans is considered to be fortuitous and not useful.

Then, the existence and the proliferation of loan guarantees is justified by the presence of market imperfections.

Let us try to understand what sort of imperfections these are. First all, there are information asymmetries that do not allow the lender to adequately measure the actual risk of the borrower. This means that there is a not negligible possibility that the lender requires interest rates that are not in line with the borrower's actual risk. In the absence of the institution of the guarantees, those whose risk is underestimated would definitely borrow money, while those whose risk is overrated will refuse to indebt (unless it is to accept obtorto collo the detrimental conditions). In the first case there is a classic phenomenon of adverse selection; in the second there is the non-realization of investment projects (presumably with a positive net present value) or the unfair distribution of the value created between those who provide the access to funding sources. In both these cases, it is not possible to speak of the efficient allocation of financial resources at the expense of the overall condition of the economic system. Backing up the loan with a guarantee thus means limiting the negative effects of the adverse selection and achieving a fairer redistribution of the value created between the subjects that provide equity and debt.

Another important market imperfection is the rejection of granting credit. The situation is quite common for newly established firms, for companies operating in innovative and highly risky industries, for loans where the costs the lender would incur in carrying out a proper investigation and monitoring of the position would exceed the profits, and for loans required in times of deep crisis such as the current one. The refusal to grant a loan is also the response of possible lenders to the problem of adverse selection mentioned before. The consequences at the micro level for the development and the very existence of the company and at the macro level for the overall economic system are obvious. The credit can be assisted by a guarantee that can allow this additional market imperfection to be bypassed.

4. PUBLIC GUARANTEES: BENEFITS AND CRITICISMS

It should be noted that if markets are not efficient, those applying for funds could face huge difficulties in offering assets as collateral or in finding third parties to act as guarantors. This is especially true if we consider small and medium enterprises (SMEs) or newly established companies. It is particularly in this context that public agencies can play an important role by providing guarantees for access to the capital market. Generally, public agencies do not require from the guaranteed a fee for the release of the guarantee (or if they do so, they set a significantly discounted price compared to its actual market value). The intent is (or should be) to help firms overcome the market imperfections described above, and to facilitate some economic categories in accessing the capital market. The benefits that the Government expects to receive are therefore not monetary but collective: In a broad sense they can be described as an increase in social welfare.

One of the reasons for public assurance programs being particularly attractive is that they are cheaper, in terms of the cash of the funding agency, in comparison with incentive programs based on direct contributions or co-financing. They also appear to be a form of market-friendly intervention that allows the borrower and the lender to negotiate most of the financial and legal features of a loan (Beck et al., 2010). Moreover, from a theoretical point of view, it is believed that the intervention of a guarantor who has informational advantages compared to the lender may permit problems of asymmetric information to be mitigated and a better quality screening to be conducted. This should be particularly true in the presence of guarantor institutions that are well established in the territory and have access to better information than that normally available to banks, both in the pre-contractual phase and in the subsequent monitoring phase. In these circumstances, the granting of a guarantee can be a sort of certification of creditworthiness that will enable the borrower to spend, even in the context of other financial transactions that are not supported by the guarantor.

Against these arguments in favor of the establishment of public guarantee agencies (or guarantee institutions financed by public funds), there are several critical arguments. The most relevant of these stresses that the public guarantee does not lead, as in the case where the collateral is provided directly by the borrower, to a reduction of the risk that rests on the lender, but to the mere transfer of the risk to the guarantee agency. This risk transfer gives advantages to both the lender and the borrower at the expense of the guarantee agency. On the one hand, the lender is relieved, at least in part, from supporting the costs of screening and monitoring; on the other, the deterrent action against the moral hazard of the borrower induced by collateral directly provided by the debtor will be neutralized. Thus, it follows that there is a double fear that public guarantee agencies, although able to increase through their intervention the number of firms that find access to the capital market, will nevertheless, (a) Bear an excessive level of risk and (b) depress the efforts of both the borrower and the lender to contain the riskiness of the financed investment.

Other impediments to the possibility that the government could provide credit guarantees are based on the consideration that they give to the borrower a collective value (the value of the warranty, which as seen in section 2 is always positive) in order to achieve benefits that will hardly be fairly exploited by the whole community itself. However, this is a matter of economic and industrial policy which, in our opinion, cannot be addressed

in a general way by referring to any type of public guarantee program; instead, it requires a careful analysis of any single facility plan.

5. CONCLUSIONS

This paper proposes a different approach to the analysis and the valuation of loan guarantees based on the option pricing theory. We interpret loan guarantees as put options on the cash flows of the secured debt. This allows us to identify the factors determining their value over time and to highlight the key elements of their proper financial assessment. We also argue that in the condition of efficient markets the presence of guarantees that assist loans is to be considered neither as fortuitous and not useful nor to the borrower or the lender. Market imperfections justify the existence and the proliferation of loan guarantees. We finally focus our attention on the potential benefits and the criticality of the intervention of public agencies in granting guarantees to private companies such as SMEs, to newly established firms or to companies operating in highly innovative sectors that face difficulties in offering collateral or in finding third parties willing to secure their debts.

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