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Credit risk and pricing in credit sales of commercial enterprises

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Abstract
As in credit institutions, companies when making credit sales, they are implicitly grant credit to their customers.
Commercial enterprises such as credit institutions, must have databases that provide information about the behavior of their customers. About small consumers generally individuals and small businesses can be harvested by the company's own means (within the limits allowed by the General Data Protection Regulation) or by external sources.
According to the *Expresso* newspaper, May 26, 2018, in the Economy section, the situation is very worrying in Europe. In Europe only "39.1% of companies pay on time, but in Portugal, according to data collected in April 2018, only 15.2% of companies meet the deadlines that are 30 days in the public sector and 60 days for the rest. In fact, Portugal is in the top 5 countries in the world whose businesses are less compliant. "It is a less than desirable position.
This leads to that the cost of funding is higher, because when companies ask for money, credit institutions include payment delays in the cost of capital. This means that when a customer is late, the supplier must finance it with the credit risk inherent
A credit risk rating system should include all methods, processes, controls, data collection and technology of information systems (IT) to support the measurement of risk. The main structure of this system is the classification of exposures similar risk classes, which is associated with a given probability of failure which must be monitored over time. One of the models used for individuals and small businesses is the designated statistical scoring models. In the case of larger companies should also come into consideration the opinion of experts? Also, from the classification system should be estimated loss that is closely linked to the type of operation and the side that is obtained.
In this paper we study several approaches to the impact of credit risk. We will see that the must important source of information is financial statements.

Keywords: credit risk, pricing, default, rating

Introduction

1. Credit Risk

Exposure to credit risk arises from a default situation. Consumption is considered a key element for expanded and realized business organizations as their business opportunities. Credit risk is evidenced throughout the business as one of the most historical risks. Thus, there is an organization that is against the capital when there is a likelihood that no consideration will be paid for the capital or due in whole or in part.

2. The determination of pricing

An important element in the credit management process is its pricing (price). This should include adjustments to reflect credit risk and / or risk of debtor default, as well as commissions and collateral that are used to secure credit.
In general, the components that must be implicit in their pricing are as follows:

- The credit interest rate;
- commissions;
- credit risk premium;
- collateral;
- Other components such as deposits or compensatory reserve requirement

For the calculation process can be done using an average obtained from all sources or, if possible, by allocating specific funds to a particular credit (optical marginalist). This rate is called the framework ahead by "BR"
This rate should be added to the credit risk premium. Traditionally this award relates to add that those who extend credit to take advantage relative to the base for obtaining funds. It is connected to low-risk customers who usually have little or no risk of default. This award is particularly important in long-term credits and is referred to in the table by "m". The risk of failure is given by the specific default probability (PD) which will be dealt with below.
The sum of these two components is meant by "total return interest (j)"
The total return this interest must be added one component relative to the processing services (administrative and other services) for credit origination and monitoring and control. This processing fee is designated by the letter "p".
Finally, the last component has to do with cash margin of safety (t) refers to the percentage of the amount obtained is not implemented in the client. It can happen, for contractual reasons, that part of the funds raised are applied or retained in other types of operations that often do not generate return. The

paradigmatic case is cash reserves, where a percentage of deposits that banks get are retained at the Bank of Portugal.
It is thus the formula for determining the pricing no specific credit risk (k)

$$K = \frac{(BR+m)+p}{1-t}$$

Application case

Table 1: formation of pricing without specific risk

Base rate - funding (BR)	**4.00%**
General credit risk premium (m)	1.50%
Total return interest (j)	5.50%
Processing fees (p)	0.50%
Total	6.00%
Treasury safety margin (T)	3.00%
Pricing without credit risk	
specific credit (k)	6.19%

On what:

$$K = 6.19\% \frac{(4{,}00\% + 1{,}50\%) + 0{,}50\%}{1-3{,}00\%}$$

The meaning of 6.19% is that it comes to pricing to provide the best customers, what means, without or with a probability of default (PD) very low. It is a promised rate, the lender and the borrower agreed.
Thus, the relationship that is established between a-promised rate and the expected rate is as follows:

$$1 + E(r) = S(1+k) + (1-S)\,G(k+1)\ 1)$$

On what:
E (r): expected rate having considered the specific risk a specific debtor
S: probability that the customer will pay the entire debt (principal plus interest), which corresponds to survival rate
K: the promised rate according to the contractual terms, to the best customers
1 - S: probability that the customer will not pay the entire debt, that is, the probability of default (PD)
G: recoverable component of the debt that was unfulfilled.
Assuming that L = 0, will be taken: E (r) = S (1 + k) - 1
And considering that for a specific client was estimated a PD of 5% will be had to:

$$E(r) = 95\%\,(1\% + 6.19) - 1 = 0.88\%$$

This represents a drop of 5.31% = 6.19% - 0.88%
Clearly this break can be lower, since there are collateral that minimize the loss given default. Collateral (real or personal guarantees) a means to control the risk of default. They are a direct replacement for the risk premium when extending credit.
So what's the specific credit risk premium to be taken for a client with a probability of default (PD) of 5% and a loss given default (LGD) of 10%, assuming that you want to keep the objective of maintenance fee promised according to the contractual terms, to the best customers, what means in this case 6.19%?
Returning to equation 1) above would be:

$$K = S(1 + k^*) + (1\text{-}S)\,G(1 + K^*) - 1\ 2)$$

Or by using the PD and LGD

$$K = (1\text{-}PD)(1+k^*) + PD\,(1\text{-}LGD)(1 + K^*) - 1\ 3)$$

On what:
K * - rate to be negotiated with the client, considering a specific credit risk
6.19% x 95% = (1 + k *) + 90% x 5% x (1 + K *) - 1 = 6.72%
What leads to a specific risk premium of credit: 0.53% = 6.72% - 6.19%
The following table shows several possible hypotheses, ranging LGD and fixing PD at 5%.

Table 1: Several hypotheses

		H1	**H2**	**H3**	**H4**	**H5**
Promised rate (no specific risk)	k	6,19%	6,19%	6,19%	6,19%	6,19%
Default rate (non-compliance)	1-S = PD	5,00%	5,00%	5,00%	5,00%	5,00%
Survival rate	S	95,00%	95,00%	95,00%	95,00%	95,00%
Loss rate	1-G = LGD	0,00%	10,00%	50,00%	75,00%	100,00%
Recovery rate	G	100,00%	90,00%	50,00%	25,00%	0,00%

***Source*:** Own elaboration

A concept that has links with the risk premium is EL the expected loss ("Expected Loss"). Is obtained by multiplying the following three factors: PD (cited above), LGD (cited above) and DL (exposure time of failure), that is, EL = PD x LGD x EAD (BIS, 2006) [6]. This is the fraction of the exposure that expectedly will not be received or recovered.
The estimate of PD must represent a conservative view for a time horizon of one year. Thus, the estimation must be based on historical experience and empirical evidence.
According to the Notice of Banco de Portugal N. º 5/2007,
There must be failure when one of the following:

- The institution assign a low probability to the possibility of the debtor fully respect its obligations, if not to resort to measures such as the execution of any guarantees;
- The institution considers likely to have to cope with the responsibilities of the counterparty, and the respective recovery is doubtful in the case of off-balance sheet;
- The debtor register an overdue more than 90 days on any significant payment obligation to the institution, its mother company or any of its subsidiaries

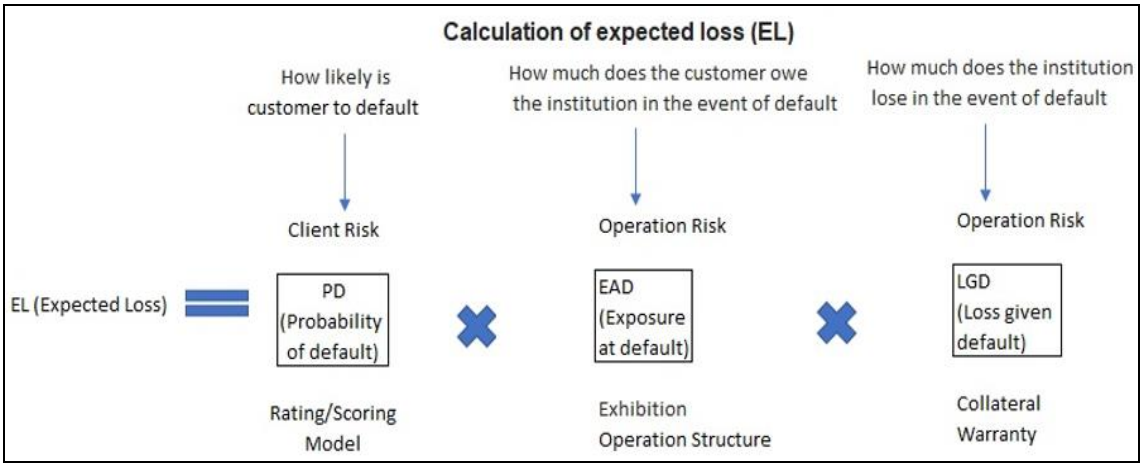
The PD shall be estimated by degree of debtor from the long-term average annual failure rates. By degree of debtor means a risk category within a range of ratings, for example, scoring models and rating

2.1 Placing a calculation component

While the PD is associated with a given borrower, the potential loss in the event of default (LGD) is specific to each transaction. It should be noted that often, the magnitude of loss is associated with features of the obligation and how it may or may not be guaranteed.

EAD also is specific to each operation. In most cases, the DL is equal to the nominal value of the transaction, but for certain operations that represent potential commitments (for example, lines of credit to use), the calculation is determined from the allocation of a conversion factor for component potential liability.

Thus, the calculation of expected losses (EL) follows the following scheme:



***Source*:** Own Elaboration

Fig 1: calculating the expected loss (EL)

The expected loss is a cost activity (reflecting the risk premium) and should be conveniently passed on in the price of operations. The expected loss is the risk premium adjusted the rate factor, that is:

$$(K + 1) = (1\text{-}EL)\ (k + 1\ *) \qquad (4)$$

$$EL = \frac{k^{*} - k}{1 + k^{*}}$$

On what:

K* - k = risk premium

To H2:

$$= 0.5\% \frac{6{,}72\% - 6{,}19\%}{1 + 6{,}72\%} \frac{0{,}53\%}{1 + 6{,}72\%}$$

The next table shows the various hypotheses

Table 2: Expected loss versus risk premium

		H1	H2	H3	H4	HS
Explanation	Survival Rate	95,00%	95,00%	95,00%	95,00%	95,00%
	(1+1(*)	106,19%	106,72%	108,91%	110,32%	111,77%
Component from the						
1	specific risk-free credit (survival rate x (1+ks)-1)	0,88%	1,38%	3,46%	4,81%	6,19%
	Default Rate 1-S=PD	5,00%	5,00%	5,00%	5,00%	5,00%
	(1+1(*)	106,19%	106,72%	108,91%	110,32%	111,77%
2	Component Arising from Non-Compliance	5,31%	5,34%	5,45%	5,52%	5,59%
	Specific Risk Negotiated Rate	6,19%	6,72%	8,91%	10,32%	11,77°%
	Default Rate 1-S=PD	5,00%	5,00%	5,00%	5,00%	5,00%
	Loss Rate 1-G=LGD	0,00%	10,00%	50,00%	75,00%	100,00%
	Expected Loss (PD x LGD)	0,00%	0,50%	2,50%	3,75%	5,00%
	(1+1e)	106,19%	106,72%	108,91%	110,32%	111,77°%
3	Product (Risk Premium)=Expected Loss x (1+k')	0,00%	0,53%	2,72%	4,14%	5,59%
4=1+2+3	Promised Rate (No specific risk)	6,19%	6,19%	6,19%	6,19%	6,19%

***Source*:** Own elaboration

In general, the EL is not constant over time. However, you can express it in terms of spot rates (spot) and forward rates (forward) [1].
Consider the following example from the above data:
For the expected rates:

$$(1+ks^{*2}_0)^2 = (1+ks^{*1}_0)(1+kf^{*1}_1) \quad (5)$$

ks^{*2}_0: Spot rate for the period beginning today to run for two years, which in this case is 8.00%;
ks^{*1}_0: Spot rate for the period starting today to be maintained for a year, which in this case is 6.72% (referred to H2 above);
kf^{*1}_1: Forward rate fixed today to force in a year for a period of one year, which is calculated as follows:
$(1 + 8, 00\%)^2 = (1 + 6, 72\%)(1 + kf^{*1}_1)$ -> $kf^{*1}_1 = 9, 30\%$
To the promised rates (better credit risk premium) one proceeds likewise:

$$(1+ks^{2}_0)^2 = (1+ks^{1}_0)(1+kf^{1}_1) \quad (6)$$

Assuming that = ks^{2}_0 7.40%
$(1 + 7, 40\%)^2 = (1 + 6, 19\%)(1 + kf^{1}_1)$ -> $kf^{1}_1 = 8, 63\%$
The calculation of EL2 (second period) is calculated by the following formula

$$(1+kf^{*1}_1) = (1-EL2)(1+kf^{1}_1) \quad (7)$$

That is:
(1 + 8.63%) = (1 - EL2) (1 + 9.30%) -> 0.61%
EL this way for the first period is 0.5%, which is now called the EL1, and the second period of 0.61%, which is now called the EL2. The cumulative expected loss is given by the following formula:

$$EL\ accumulated = 1-(1-EL1)(1-EL2) \quad (8)$$

That is: EL accumulated = 1 - (1 - 0.5%) (1 - 0.61%) =1.11%
That is, an operation with the described features, has a probability of 1.11% expected loss in the next two years
So far, we used the expected loss: EL = PD x LGD. However, various literature uses only the PD, which implies that LGD = 100% [2]. The values established in this case would be much more burdensome.

Table 3: Risk premium compared with the expected loss

LGD =100%		
Promised Rate (no specific risk)	k	6,19%
Default Rate	1-S=PD	5,00%
Survival Rate	S	95,00%
Loss Rate	1-G=LGD	100,00%
Recover Rate	G	0,00%
Intermediate Calculations		
l+k		106,19%
Si-G-S*G		95,00%
Expected Rate	k'	11,7r%
Expected Loss	PD x LGD	5,00%
Specific Premium	le-k	5,59%
Difference = (1+1(*)		0,59%

***Source*:** Own elaboration

What applying the above-described formulas would be?
Para akf^{*1}_1, assuming that ks^{*2}_0 = 12% a:

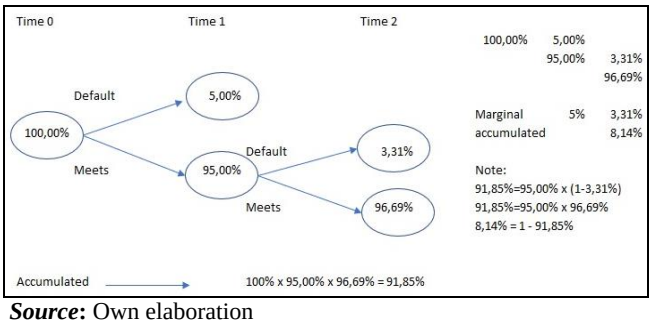
$(1 + 12, 00\%)^2 = (1 + 11, 77\%)(1 + kf^{*1}_1)$ -> $kf^{*1}_1 = 12, 23\%$

And keeping the same calculations for the $kf^{1}_1 = 8.63\%$
Would have the following calculation to the marginal PD2 of the second period:

$$PD2 = (1 + 12, 23\%)/(1 + 8, 63\%) - 1 = 3, 31\%$$

Soon the cumulative probability of default will be:
PD accumulated = 1 - (1 - 5%) (1 - 3.31%) = from 1 to 91.85% = 8.15%

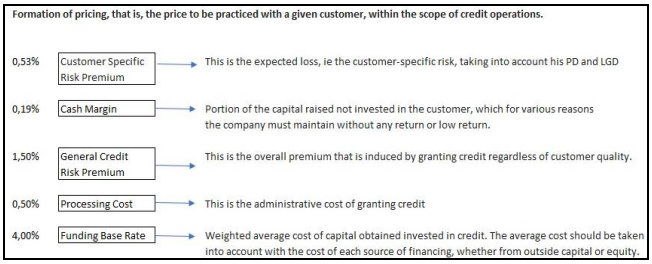
The following diagram clarifies this



***Source*:** Own elaboration

Fig 2: Calculation of cumulative PD

To conclude, one can lay out the various components that make up the rate to be negotiated with the client, that is, its pricing. For example, with H2 (6.72%) would be:



***Source*:** Own elaboration

Fig 3: Formation of pricing

Conclusion

The study of the impact of the credit risk in the organizations

[1]Forward rates - interest rates fixed in this to take effect in time intervals starting at future times. Given the spot rates, you can calculate the implied forward rates
[2] The Basel Committee indicates as default values, in general terms, an LGD of 45% for most applications without a specific, recognized collateral, and greater LGD (75%) applied to subordinated exposures without recognized collateral. This is an issue that has been the subject of controversy and that has not been as studied as PD

is very important and the correct management can make the difference to a successful organization.

Credit risk arises from the potential occurrence of bankruptcy or non-compliance with obligations under terms agreed with a counterparty.

While the PD associated with a given debtor does not depend solely on the characteristics of each specific transaction (eg of each credit), the potential loss in the event of default - LGD is specific to each defaulted transaction, not least because the magnitude of the default. Loss is generally associated with the characteristics of the obligation and how it may or may not be guaranteed (collateral in the case of a claim).

The aim of this paper is present examples of study about credit risk and the pricing of the credit. It is a guide that can be implemented in a economic area, or in a company / organization. This is our limitation and also suggestions for future works.

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