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CREDIT RISK MEASURES — A CASE OF RENEWABLE ENERGY COMPANIES

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Abstract: The Basel III will have a significant impact on the European banking sector. In September 2010, supervisors of several countries adopted the new rules proposed by the prudential Committee on Banking Supervision to be applied to the business of credit institutions (hereinafter called CIs) in a phased starting in 2013 and assuming to its full implementation by 2019. The purpose of this new regulation is to limit the excessive risk that these institutions took on the period preceding the global financial crisis of 2008. This new regulation is known in slang by Basel III.

Depending on the requirement of Basel II for banks and their supervisors to assess the adequacy of internal risk measurement and credit management systems, the development of methodologies for the validation of internal and external evaluation systems

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is clearly an important issue. More specifically, there is a need to develop tools to validate the systems used to generate the parameters (such as PD, LGD, EAD and ratings of perceived risk) that serve as starting points for the IRB approach for credit risk. In this context, the work is composed by an approach and tool used to evaluate the credit risk in a IRB system, applied to the renewable energy sector in Portugal.

■■■ INTRODUCTION

The Basel Committee, proposed the method of Internal Ratings Based Approach or IRB, which is based largely on an internal valuation of assets and exposures of a bank, aimed to secure two essential objectives consistent with those supporting the wider review of the New Agreement capital:

1. The use of risk assessment models more sensitive to credit risk, allowing the determination of capital requirements more closely aligned with the potential economic loss that may occur in the bank's assets;
2. Encouraging the use of more advanced models, something that an IRB appropriately structured methodology can provide, motivating banks to continue to improve their internal risk management practices.

One of the most innovative aspects of the New Accord is called the approach or method of internal ratings (or IRB) approach to credit risk and provides two variants, with different degree of complexity: a simplified / basic version or *Foundation* and an advanced version or *Advanced*. The first (*Foundation*) is only determined internally PD (default probability)¹. In the second (*Advanced*) are determined four parameters: PD, LGD (loss given default), EAD (exposure at default) and M (mature).

THE RESEARCH METHODOLOGY AND THE COURSE OF THE RESEARCH PROCESS

The main difference between the two variants is related to the entity responsible for establishing and determining the parameters in question, as we see in the following figure.

¹ For retail segment is permitted only variant *Advanced*, that means it is, necessary to be determined internally the four parameter.

Table 1. Risk Parameters

Risk Parameters	IRB Foundation	IRB Advanced
Probability of default (PD)	Estimated by the Credit Institution	Estimated by the Credit Institution
Loss Given Default (LGD)	Amounts to be provided by the supervisory authority	Estimated by the Credit Institution
Exposure at default (EAD)	Amounts to be provided by the supervisory authority	Estimated by the Credit Institution
Maturity (M)	Amounts made available by the supervisory authority or by the Credit Institution	Estimated by the Credit Institution

Source: Elaboration of the author.

In Portugal, *Banco Espírito Santo (BES)* became the first Portuguese financial institution to obtain IRB accreditation of the Portugal Central Bank, for the calculation of capital requirements to cover credit risk.²

The design of a valid methodology of rating analysis depends on the type of classification system, made by the bank. This can vary in several ways, depending on the type of borrower risk, the relevance of exposure, the dynamic properties of the classification methodology, and the availability of standard data and quality ratings of external credit. As a consequence, validation is a relatively complex issue and requires a good understanding of the rating system and its properties.

Most of the validation process focuses on a static point of view, in which the features of an IRB system (calibration, performance) are evaluated for a given set of criteria. This discussion about the design emphasized the need to infer the stochastic behavior of rating transitions within an IRB system. In contrast, the discussion on benchmarking, stresses the need to change from an approach that is completely exogenous, in many aspects incomplete for a more complete approach in its ideal form would cover a model of equivalence.

Broadly the variables to be analyzed can be defined as follows:

- **Probability of Default (PD)** – Probability of default of a given borrower, calculated for a time horizon of one year.
- **Loss Given Default (LGD)** – Measure of expected loss in case of default may be seen up to 100% of the loan amount, depending on the risk mitigation instruments used in their coverage.

² <http://Noticias.sapo.pt/lusa/artigo/9628372.html> 2013112.

- **Exposure at Default (EAD)** – Measure that represents the total exposure value in euro at the time to declare default. Exposure at default is determined for each loan individually considered.
- **Maturity (M)** – Measure of effective maturity of the credit. Maturity is a weighted measure of the life of the loan, that means the percentage of equity paid in each year weighted by year to which it relates.

In the analysis and estimation of the parameters of PD, LGD and EAD, the model can distinguish two approaches, backtesting and benchmarking.

- Backtesting means using statistical methods to compare the estimations of the three components mentioned above. Whereas, for the risk models, backtesting market model involves the whole process, by which internal rating systems of risk components (model inputs) are tested, but the system and procedures of the model are provided by the supervisor, regarding the form of the functions risk weighting.
- Benchmarking refers to a comparison of internal estimates between banks and / or external benchmarks (external ratings or models developed by supervisors).

The **PD** should be calculated taking into account its historical, associated with the credit quality of the borrower information. This quality score is given by (*rating*) assigned by the internal model. The most popular application of this technique is empirical, with the PD relatively to each class of risk to be determined from the historical frequency of defaults recorded by the debtors of this class, using enough data to cover good and bad years of economic performance period. Compiling records of various annual fees, using average historical rates, it can be calculated a long-term rate. A enough period for the IRB *Advanced* is 5 years but the IRB *Foundation* starts with two years, and this period should increase each year until data covering at least 5 years.

Highlight that to exist defaults, it must exist one of the following conditions (Notice of Portugal Central Bank No 5/2007):

- a) The Institution assign a low probability to the possibility that the borrower will comply fully with their obligations to the institution itself, or any of its subsidiaries, if did not access to measures such as the execution of any warranty;
- b) The Institution considers likely to have to meet the obligations of the counterparty, and their recovery is doubtful in the case of off-balance sheet;
- c) The debtor register a delay exceeding **90** days (this is the most common situation) for a significant obligation to the institution or its subsidiaries.

The 90 day period may be extended to 180 days in the case of exposures to public sector entities (such as regional and local authorities). On the other hand, in the case of significant debt account, the delay should be counted at the time the obligor has breached an advised limit, has been advised of the set a lower threshold current outstandings, or has drawn, in an unauthorized manner, credit amounts. In the case of credit cards, the delay should start being counted from the date of the minimum payment.

LGD configures the severity of the failure, this means, the expected loss of a credit transaction, if the counterparty will default. The complement is the recovery rate. LGD is usually calculated as a percentage of the EAD, this percentage may be obtained at time of failure for cases already in default or correspond to an estimated loss conditional upon default, for cases where there is no default, which is the majority.

In calculating the estimated LGD beyond the level of recovery, there is a need to consider the amount and type of operation when it exists. The recoveries may materialize in cash or through the appropriation of property, the latter type of recovery but generating an exposure to market risk (discount or *haircuts*), when it is attempted to convert them into monetary values.

LGD is calculated, taking into consideration the amount of recovery (R), the direct and indirect administrative cost recovery (C) and appropriate discount rate (i) to discount to present the expected flows of receipts and payments that should incorporate the risk-free rate (associated with government bonds) plus a *spread* showing the risk of default and (t) corresponding to the timeframe in which there are monetary flows. The formula is as follows:

$$LGD = 1 - \frac{\sum_{t=1}^n \frac{R_t}{(1+i)^t} - \sum_{t=1}^n \frac{C_t}{(1+i)^t}}{EAD}$$

Source: Elaboration of the author.

The EAD is a measure that represents the total exposure value, in euro at the time to declare default. Exposure at default is determined for each loan individually considered. It should be in mind that this exhibition enter the off-balance sheet items (in case of unused credit lines – potential liabilities recorded off balance sheet) for which should be used conversion factors TLC (*credit conversion factors*). For example for a line of credit with a maturity more than 1 year,

a factor of 50% should be used. Thus, the current EAD = Exposure x + CCF (part unused credit limit).

The Maturity (M) is a measure of the effective maturity of the credit. The maturity is a weighted average life of the loan, that means, the percentage of equity paid in each year weighted by year to which it relates. For example, a loan to two years of 200, 100 payable in each year, the maturity will equal: $M = (1 \times (100/200)) + (2 \times (100/200)) = 1.5$ years. In the IRB approach *Foundation* in credit to companies (*corporate*) it will be used a mature standard, set in New Agreement of 2.5 years.

RATING PROCESS

Banks must document its evaluation criteria and provide appropriate follow-up when given class differs from the assessment indicated by test to be applied. The requirements are defined for (BIS 2010a):

- promote consistent application of the criteria *rating*;
- assess credit conservatively when there is greater uncertainty;
- understand the financial condition of the borrower over the coming period;
- use of models *rating* and comprehensive statistical power of all significant variables.

The bank or the CI must demonstrate that their criterion covers all the factors that are relevant to risk analysis of the borrower. Factors must demonstrate the ability to differentiate risk, anticipate events, have discriminative power, be relevant and intuitive to ensure that the *ratings* are designed to distinguish the risk, and not to minimize capital requirements.

The first *input* for the IRB approach is the calculation of the bank for each of its internal rating grades. From borrowers without risk to defaulting borrowers, the **PD** calculate for each level can vary by many orders of magnitude, thus making this a highly sensitive measure of risk.

For each level of its internal rating, the bank calculates a probability of default for one year.

Banks should consider all available information to calculate **PD** using the following three techniques for calculation:

- experience of internal failure;
- association of external data;
- statistical models of default.

How many more are the techniques and data sources used by a bank, the greater the confidence in their own calculations **PD**.

Accordingly the BIS (Bank of International Settlements) (BIS 2010b), it follows that also a system *Rating* will also have the following additional functions:

- Authorities approved credit limits;
- Review of lending rates;
- Give information of the risk profile of the Bank's portfolio and the Directors of the Bank;
- Analysis of the adequacy of the Bank's capital reserves and profitability;
- Performance under pressure tests to assess capital adequacy.

ELECTRICITY FROM RENEWABLE ENERGIES IN PORTUGAL

Portugal in gross electricity consumption in 2008 was recognized as the fifth country in the European Union with greater integration of renewable energy, however it is also the fifth country with energy dependence in the European Union. This dependence led to the development of ways to minimized, yielding strong investment in the sector. Recent statistics published by the General Directorate of Energy and Geology, reveal that in October 2010 Portugal enjoyed 9405 MW of capacity to generate electricity (Pereira, Saete 2011).

The strategy implemented in this sector is a growth strategy or development. Defined based on various constraints, involves intervention of other entities, influences before the final consumer, eliminating bureaucracy and the development of specific competencies (Pereira 1998). To implement quality and accreditation in order to guarantee and ensure the viability of the system, the existence of professional skills and the promotion of research and development are required. The expected result is the implementation of sustainable economic growth (Velasco 2009), contributing to the elimination of harmful effects to the environment, preserving the reserve of energy in the world, create jobs (Perez 2001) and can generate a surplus of energy reserves allowing exports and will not need to import so many features and consequently contribute to the equilibrium of the balance of payments.

STUDY OF PORTUGUESE RENEWABLE ENERGY COMPANIES – RESULTS

On this part of the article we tried to study the credit risk of a group of 30 portuguese companies in the renewable sector. We use a quantitative methodol-

ogy in each we try to determine the main variables that can explain a credit risk measure. For this propose we use a linear regression model with multiple variables.

We considered a dependent variable that is the amount of money that the companies must pay to the State divided by the total assets from the company. Note that we consider this variable as a proxy to the credit risk. We should use a variable related to the credit banking incidents but this type of information is not available. So we use a proxy variable working the amount of money that should be payable to the fiscal administration. We consider if the company does not fill its obligation to the fiscal administration it also fail to the bank.

As independent variables we use financial autonomy, solvability, Debt to Equity ratio, Liquidity, Cash Flow, Sales evolution, ROE (return on Equity), Receivable time, payable time, debt long term.

This model has a coefficient of adjustment of almost 46% as below.

Table 2. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin- Watson
1	0,675	0,456	0,196	0,034075	1,995

a. Predictors

b. Dependent Variables

Source: SPSS.

About the variables we get the following results after applying a linear regression model (table 3).

Table 3. Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (constant)	0,009	0,017	0	0,547	0,59
Financial autonomy	0,003	0,022	0,53	0,13	0,898
solvability	-0,028	0,012	-0,766	-2,276	0,033
Debt to Equity ratio	0	0	-0,228	-1,272	0,217
Liquidity	0,01	0,006	4,76	1,708	0,102
Cash Flow	3,822 E - 008	0	1,031	2,027	0,506
Sales evolution	0,3	0,011	0,64	2,8	0,011
ROE	-0,001	0,011	-0,161	-0,495	0,626
Receivable time/ payable time	-0,002	0,002	-4,698	-1,714	0,101
debt long term	9,341 E -007	0	0,046	0,272	0,788
	-1E+111	0	-1,469	-2,727	0,013

a. Dependent Variable

Source: SPSS.

From this results we conclude that only solvability, cash flow, sales evolution and debt on long term are statistical relevant, considering a p value of 5%.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin- Watson
1	0,562	0,316	0,215	0,0336762	2,123

a. Predictors (constant)

b. Dependent Variable

Source: SPSS.

We repeated the first step for the model but we get R square lower than the first one, so we are losing capacity of explanation of the model.

■■■ CONCLUSION

A bank must demonstrate to its supervisor capabilities before adopting the IRB approach on a continuous basis. The data collection requirements are closely aligned with the capacity of banks to validate their calculations **PD** and models *rating*.

The Committee recognizes that the fundamental choice of a model approach under the IRB capital requirements should be based on the nature of their holdings and the adequacy of the same underlying methodologies. As an example, when bank profits are materially affected by market volatility of their equity positions, the approach should try to capture this risk.

Relatively to the work methodologies, benchmarking is an important part of the validation process and, in many cases, appears as an important empirical complement to the more rigorous and formal approach. However, benchmarking remains in many cases as subjective and need to be more formal.

From the study of the Portuguese companies in the renewable sector, we get problems on getting a good pack of variables that could explain the risk from the companies. Although this we get a model with four variables statistical relevant. One alternative work to continue this paper was to divide the companies in company insolvent and solvent and try to determine de Z-Altman score.

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