

INSEAD GEMBA Implementation Essay

MANAGING CREDIT RISK

Field: Rethinking Risk Management

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INTRODUCTION

As a lawyer advising banks and investors in relation to the drafting and negotiation of loan agreements and related security packages, I am interested in understanding how banks, bondholders and other financial institutions (hereafter “**lenders**” or “**lending businesses**”) define the level of credit risk they are willing to take and manage when contracting, acquiring, or transferring loans, bonds, and other financial instruments (hereafter “**loans**”) exposed to the credit risk of a given borrower, issuer, or other counterparty (hereafter a “**borrower**”).

In order to understand (3) how a lender manages credit risk, we must first examine (1) what credit risk entails and (2) what determines a lender’s appetite for financial - including credit - risk.

1 DEFINITION OF CREDIT RISK

- (a) Credit risk corresponds to the **risk of default** or (to the extent that a lender wants to dispose of a loan before its maturity or uses it as collateral) the risk of reduction in market value caused by the change in the credit quality of the relevant borrowers in one’s portfolio of loans.
- (b) Credit risk depends of the following **variables**:
 - (i) the **loss** of each loan in a considered time period, which corresponds to the multiplication of these three variables:
 - (A) the **exposure at default** (“EAD”) of each loan in a considered time period (i.e., the outstanding amount for a regular loan),
 - (B) the **probability of default** (“PD”) of the relevant loan;
 - (C) the **loss given default** (“LGD”) of the relevant loan, expressed as a percentage of EAD,
 - (ii) given a lender’s portfolio of loans, the **correlations** of the loss variables of each combination of two loans.
- (c) Credit risk must be **distinguished from** other types of risk (although credit risk and liquidity risks can be viewed as components of market risk):
 - (i) **Market (price) risk**, including:
 - (A) the risk of an increase in interest rates (in absolute terms or relative to the interest rate under the relevant loan) and
 - (B) the risk of lower (higher) volatility in the assets underlying options over which the lender has a long (short) position (greater volatility of the value of a borrower’s assets also increases credit risk given that equity holders are akin to holders of a call option on a company’s assets);
 - (ii) **liquidity risk**, namely the risk of loss for not being able to dispose of a loan before its maturity at a fair market value (revealing a widening bid-ask spread for traded securities); the materialization of this risk led to the demise of LCTM, which was forced to sell large positions in a market with few willing buyers following the shutdown of the Salomon Brothers Treasury bond arbitrage desk and the flight to liquidity induced by the financial crises in Asia and Russia;
 - (iii) **operational risk and other non-financial risks**, including regulatory and legal risks, inappropriate counterparty relations, management errors;
 - (iv) some authors¹ would add to this list **systemic risk**, being the risk of collapse or dysfunctionality of financial markets through either
 - (A) a cascade of defaults and ultimately the default of one’s counterparty or
 - (B) widespread illiquidity,as typically caused by massive withdrawals of deposits from banks by panicked investors. It is a special kind of non-diversifiable risk that cannot be appropriately measured and controlled as other market risks – in other words, it is a “black swan” as this term is used by Nassim Nicholas Taleb (or a Quadrant IV risk in Claudia

¹ Including D. Duffie and K. Singleton, *Credit Risk: Pricing, Measurement, and Management*, Princeton University Press, Princeton NJ, 2003.

Zeisberger's terminology) –, although one must draw a line between a true systemic risk and increased default risk or illiquidity risk that could be modeled.

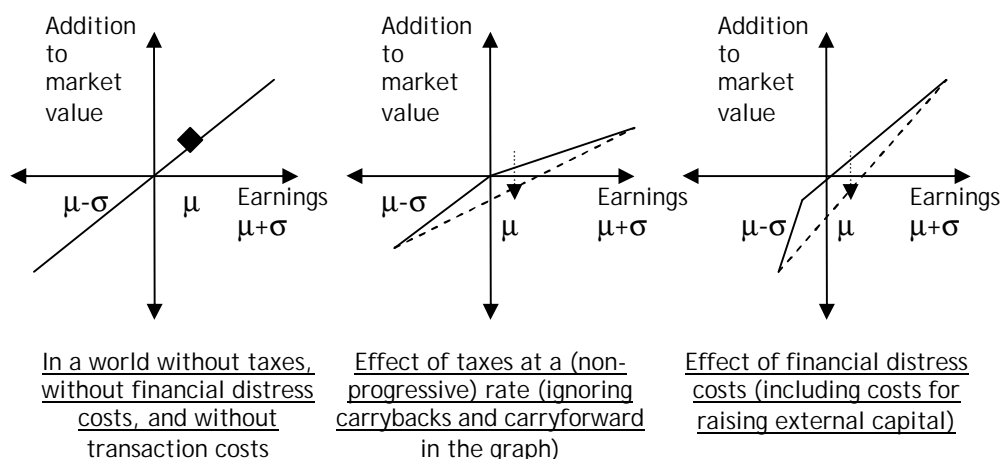
2 DETERMINING A LENDER'S APPETITE FOR FINANCIAL - INCLUDING CREDIT - RISK

A lender's appetite for financial risk, including credit risk, is mainly determined by (2.1) its own value creation drivers. One should however be aware of the possible influence of (2.2) of a lender's equity holders and debt holders and of (2.2) its officers and employees.

2.1 Main determinants of the appetite for risk: value creation drivers

- (a) Inasmuch as capital markets are not perfect as a result of asymmetries of information and transaction costs, lenders will want to **create value by bearing financial risk**:
- (i) Given their knowledge of the market and (through economies of scale) the lower cost for them of maintaining this knowledge of the market, lenders are able to better assess and cost-effectively control **market risk** than borrowers.
 - (ii) Even if asymmetries of information are generally in favor of the borrowers and against the lenders when it comes to assessing the **credit risk** associated with a given counterparty, banks and financial institutions are nevertheless better (because of their skills in credit assessment and their lower cost, through economies of scale, for maintaining these skills) than other capital providers (more specifically all individuals and corporate entities that hold deposits with banks) at assessing that credit risk and limiting it with protective covenants, a security package, and the ongoing management of the lending relationship.
- (b) If profits and losses simply added or reduced market value in a linear function, a lending business exposed to financial risk would happily engage into riskier projects with a greater expected return (as may be calculated using the capital asset pricing model and a beta corresponding to the riskiness of such project), notwithstanding the potential extreme losses associated with it. In reality, this curve is however **nonlinear – it is concave** - in at least the following ways, as illustrated in **figure 1**, so that it is not in the best interests of a lending business to take more than a certain amount of risk, which is determined notably by its tax rate and possible carryforwards and carrybacks, and by its current capital structure as well as its potential financial distress costs including costs for raising external capital:

Figure 1: Concavity effect of taxes and financial distress costs



- (i) Given that **only profits are taxed** whereas losses are not State-subsidized (save to the extent that they can be carried backward or – but this give rise to a contingent tax asset depreciating with time given the time value of money – forward), the expected addition to the lending business's market value may be inferior to the expected gross profit resulting from a given loan project (μ). Indeed, suppose that the gross return for that loan project is normally distributed so that $\mu - \sigma$ corresponds to a gross loss and $\mu + \sigma$ corresponds to a gross profit; if you take the average of the corresponding market value added for each of these two gross profit/loss values, you might come up

with a negative number. This is even more accentuated in jurisdictions applying a progressive tax schedule.

- (ii) Another nonlinearity results from the fact that losses may cause the firm, in order to meet its liabilities, to incur **financial distress costs** insofar as it would have to either raise external capital at significant cost or sell its assets at a loss, and may in the process lose its competitive advantage:
 - (A) Raising **external capital** (as opposed to using retained earnings as a source of funding) results in transaction costs and, because of asymmetry of information, often in a “lemon’s premium” (a term first used by Akerlof) being charged by the new capital providers to the lending business in case of debt financing with an increased interest rate (or to the existing equity holders in case of the issue of new shares at discount and resulting dilution of existing shareholders).
 - (B) Instead of raising external capital at an exorbitant cost, a financial institution may want to **sell assets** at a price below their market value because they are illiquid (as happened to LCTM and, in 2008 and 2009, to many Icelandic banks) or sell a whole division for a price not reflecting the value of the synergies that such division created for the firm.
 - (C) In the process, the lender may **lose its competitive advantage**, such as the ability of refinance itself at a low cost or the ability to attract business relying on the creditworthiness of the lender (issuance of bank guarantees, facility agreements calling for a drawdown at a future date...).
- (c) **Regulatory requirements regarding capital adequacy and liquidity**, designated to protect the financial community at large (and one could say the whole human community) from a systemic risk, also draw a limit to the risks a financial institution is authorized to bear. In this respect, the new standard proposed by the Basel Committee on Banking Supervision, called Basel III, will require banks to hold 4.5% of common equity (up from 2% in Basel II) and 6% of Tier I capital (up from 4% in Basel II) of risk-weighted assets (Basel II’s Tier 3 capital will be eliminated).

2.2 Influence of equity holders and debt holders

(a) Stockholders

Stockholders of a lending business may push policies that incite employees to take on more risk than what would be in the best interests of the lending business if it were all-equity financed. Indeed, many lenders are organized in highly-levered limited-liability entities whose stockholders’ interests are similar to the interests that would have the holder of long call option on the assets of the lending business as a going concern, with a strike price equal to the debt outstanding. Consequently, as the volatility of these assets’ values increases, more value is transferred from the debt holders (and holders of preferred shares) to the common stockholders, especially when the value of the assets of the lending business as a going concern is inferior to² or only slightly superior the amount of debt (plus the liquidation value of preferred shares). In order to align the interests of equity holders with those of the lending business, a lending business’ capital structure should not be too leveraged.

(b) Bondholders

Bondholders (and holders of preferred shares) are well aware of this hence may want debt and preferred shares instruments to contain protective covenants limiting the scope of activities that the lending business may undertake, so as to reduce the volatility of its returns, sometimes at the detriment of the lending business. If the capital structure of the lending business is not too much leveraged, bondholders will however less fear excessive risk taking by stockholders hence will less of an incentive to require such protective covenants.

2.3 Influence of officers and employees

On one hand, officers and employees who are remunerated largely based on the returns of the lending business that employs them may have an incentive to take on more risk than what would be in the best

² This may be a bankruptcy trigger in the jurisdiction of incorporation of the relevant lender.

interests of the lending business; if the returns are big, they win, if the returns are low or negative, they do not lose (except maybe their job, but they can always find another one or live out of the money they amassed).

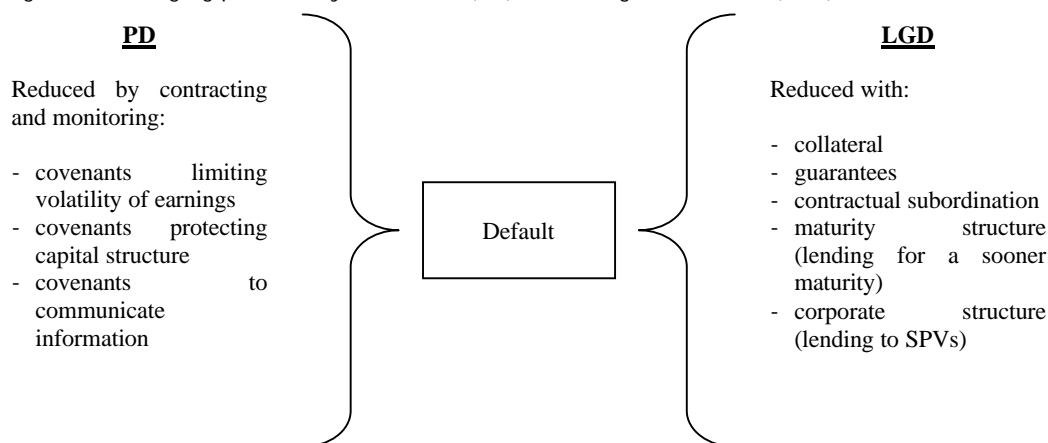
On the other hand, if their remuneration is largely fixed, they will not be incentivized to take value-creating risks for their lending business, given the associated risk of losing their job if the lending business goes bankrupt after certain financial risks materialized.

In order to align the interests of officers and employees with those of the lending business, a large portion of their remuneration should be correlated to the risk-adjusted returns they generated.

3 MANAGING CREDIT RISK

Management of credit risk involves assessing and controlling (3.1) the probability of default and (3.2) the extent of loss given default of each borrower, as illustrated in **figure 2**, as well as (3.3) diversifying loans by limiting exposures to certain categories of borrowers.

Figure 2: Managing probability of default (PD) and loss given default (LGD)



3.1 **Assessing and controlling probability of default (PD) at the borrower level**

(a) **Assessing PD**

Managing credit risk starts with assessing the probability of default. Edward I. Altman built a linear regression model in 1968 – “Z-score” model – predicting the likelihood of bankruptcy of firm based on certain key financial ratios as input variables, with different regression coefficients. The financial ratios with the highest regression coefficients turned out to be sales/total assets (0.999) followed by Earnings Before Interest and Taxes / Total Assets (0.033) whereas the Market Value of Equity / Book Value of Total Liabilities financial ratio received a regression coefficient of only 0.006.

Nowadays models are categorised between (i) structural and (ii) reduced-form models:

- (i) **Structural (or firm value) models of default probability** focus on the value of the borrower’s assets and its liabilities.
 - (A) The **classic model** of Black and Scholes (1973) and Merton (1974) – which is the root of the estimated default frequency model developed by KMV Corporation - estimates the probability of default at a time T corresponding to the maturity of the debt, looking at the expected rate of return on assets (net of debt service and distributions), asset volatility, and time to maturity. The probability of default can be expressed as a percentage or in terms of number of standard deviations by which assets are expected to exceed liabilities at time T (distance to default).
 - (B) **First-passage models** assume default occurring whenever the assets’ value drops below a certain level (with reference to a LTV or DSCR covenant the breach of which entitles the lender to accelerate the loan). Probability of default is expressed as a default intensity, for a given time horizon.
- (ii) **Reduced-form models of default probability** determine credit events in terms of

some exogenously specified jump process. These may be used to estimate default time (intensity-based models) or migrations between credit rating classes (credit migration models).

(b) Controlling PD

Assessing the probability of default requires one to make a series of assumptions about the business of the borrower, but a borrower could end up running its business otherwise than a lender was led to believe. Merely increasing the interest rate to offset that risk would not be an adequate solution because of **adverse selection**: borrowers who really intend to run their business in a prudent way (from the perspective of a lender) would turn down the loan offer for being too expensive; such loan offer would attract many borrowers who intend to run their business in a more risky way than the expected risk that was priced by the lender.

The solution rather lies in setting **protective covenants** and monitoring their compliance, threatening actions in case of breach. Protective covenants include:

- (i) **covenants limiting the volatility of the returns of the borrower's assets** (more specifically the free cash flows, namely EBITDA minus taxes and minus net capital expenditures), such as covenants:
 - (A) not to change the nature of the business;
 - (B) not to sell the business, and not to acquire new businesses (at least of different types);
 - (C) to insure assets and hedge against interest-rate changes, currency risks;
- (ii) **covenants in respect of the capital structure**, such as covenants:
 - (A) to refrain from making distributions (dividends, repayment of subordinate debt, management fees), at least as long as certain LTV, DSCR or other ratios are not complied with;
 - (B) to refrain from borrowing more funds at the borrower's level or at the level of a subsidiary of the latter (other than loans from shareholders bound by a subordination deed);

it being noted that these covenants, insofar as they insure that the value of the equity remains significantly positive, also indirectly limit the volatility of the returns of the borrower's assets by preventing moral hazard, namely the situation where equity holders cause the borrowing company to manage its business in a riskier way than they it would if it were all-equity financed;

- (iii) **covenants to communicate information** (e.g., quarterly financial statements...).

3.2 Assessing and controlling loss given default (LGD) at the borrower level

Structural and reduced-form models can also be used to determine not only the probability of default but also the expected recovery rate in case of default.

Loss given default may be controlled by using the following tools, in addition to the ongoing management of the lending relationship (e.g., in case of default, agreeing to modify the terms of the loan or accelerating the loan and enforcing all security interests and guarantees, as may be adequate):

(a) Collateral

Collateral consists in *in rem* security interests ("security interests in the asset") given over the borrower's assets³, enabling a lender to be paid out of the proceeds of the sale of such assets in priority to other creditors, save those creditors which the law gives some priority (in essence, depending on the jurisdiction, the type of proceedings, and the type of collateral: wages, taxes, and post-petition claims).

³ *In rem* security interests may take the form of either "fixed" charges that attach only to existing collateral (not future collateral) and generally remain attached even after the collateral is sold to a third party in breach of a covenant, or "floating" charges that attach to not only existing but also future collateral but which does not remain attached to collateral that is disposed of before "crystallization" of the charge (following default).

(b) External credit enhancers

External credit enhancers include:

- (i) parent guarantees, which may themselves be secured by collateral belonging to the parent⁴: their value depends on the PD and LGD in relation to that parent;
- (ii) parents' undertaking to make capital contributions to the borrower so that the latter may satisfy its investment, operating, and/or financing cash flow needs;
- (iii) credit insurance, including any insurance purchased in the form of a credit default swap.

External credit enhancers are particularly helpful in periods during which information asymmetry is high, such as during the pre-completion period of a project when no positive free cash flows are generated.

(c) Contractual subordination

Contractual subordination has the same effect of collateral: it allows a lender to be paid in priority to another creditor who agreed to be subordinated.

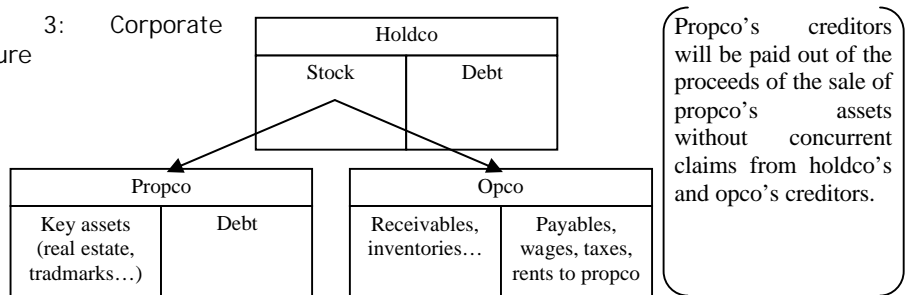
(d) Maturity structure

Maturity structure allows creditors whose debt matures first to be paid in priority to creditors whose debt matures later, the latter being used as credit support for the former.

(e) Corporate structure

Corporate structure allows creditors who lent to a subsidiary owning the key assets of the business ("propco") to be paid in priority to the creditors who lent to a holding company ("holdco") or to an operating company ("opco") which does not own but rents or licenses the key assets of its business from the propco, as illustrated in figure 3.

Figure 3: Corporate structure



3.3 Diversifying credit risk by limiting exposures per category of loans

(a) Diversification of credit risk

Credit risk may be diversified to some extent by lending to different borrowers, in different industries, in different geographies, for different purposes. It is true that some credit risk will remain non diversifiable; for instance, a global recession may likely cause all borrowers of all industries and geographies (except perhaps turnaround consultants, but this is not a capital intensive industry!) to have less free cash flows to service their debt obligations.

For instance, say you have two profit centers originating two types of loans with an assumed zero correlation, say a profit center granting and managing residential real estate loans in the U.S. and a profit center granting and managing corporate loans in Botswana. Say the standard deviation of the returns of each profit center (i.e., the square root of the variance of returns, being the expected squared difference between actual earnings and expected earnings) is 400 million dollars for the U.S. profit center and 300 million dollars for the Botswana profit center. Assuming zero correlation, the standard deviation of the returns of both profit centers should be not 700 million U.S. dollars (that would assume perfect positive correlation) but rather 500 million U.S. dollars (i.e., the square root of the sum of $400,000,000^2$ and $300,000,000^2$).

⁴ Parent guarantees can also take the form of *in rem* security interests granted by a parent over that parent's assets as security directly for the borrower's loan.

(b) Limiting exposures per category of loans

Without exposure limits per category of loans, such diversification would however not be easily achieved to the extent that the bank could be struck by a **winner's curse**: it would find itself with many loans in those categories where it underestimated the most the credit risk priced in the loan's interest rate.

The maximum exposure allocated to each profit center (assuming each profit center issues only one category of loans, and that a loan originated by a profit center can be transferred to another profit center once it is impaired or further to a change in the credit quality of the borrower) should be calculated with reference to:

- (i) the overall credit, market and liquidity risk exposure associated to the relevant category of loans,
- (ii) the expected returns of that category of loans, more specifically the risk-adjusted returns obtained by dividing the expected return (or its portion that exceeds the interest-free rate) by a risk coefficient which would increase (proportionally or exponentially) with a beta variable corresponding to the covariance between the returns of that profit center and the returns of all profit centers combined, divided by the variance of the returns of all profit centers combined⁵.
- (iii) the maximum value at risk (VaR) or expected shortfall the lending business is willing to take given its appetite for financial risk, these concepts being defined hereafter:
 - (A) value at risk corresponds to the amount of the loss for which there is a probability α of a loss of at least such amount materialising in a given period (a day, two weeks, a month – the relevant time period corresponding generally to the time necessary to dispose of the relevant investments), based on a sample of results (expressed as percentages) for similar periods over a certain historical period with a sample mean \bar{x} and sample standard deviation s ; VaR corresponds to the value of a position (i.e., the present value of the loans in our case) multiplied by $\bar{x} - z_{\alpha} \cdot s$;
 - (B) expected shortfall (i.e., the expected result considering only results below VaR) happens to be equal, assuming a normal distribution, to the value of the position multiplied by $\bar{x} - z'_{\alpha} \cdot s$ where z'_{α} is a certain function of z_{α} it is beyond the scope of this essay to formulate (e.g., for $\alpha = 1\%$, $z_{\alpha} = 2.326$ and $z'_{\alpha} = 2.667$).

CONCLUSION

We have seen that credit risk corresponds to the risk of default or (to the extent that a lender wants to sell a loan before its maturity) of reduction in market value caused by the change in the credit quality of the borrowers in respect of one's portfolio of loans.

A bank's appetite for credit risk and other risks will be determined by loans' greater expected returns associated with greater risks but also the concavity effect of taxes and financial distress costs. Stockholders and bondholders as well as officers and employees may also unduly influence the risk-taking policy of a lending business.

Managing credit risk requires, at the individual loan level, assessing and controlling both the probability of default and the extent of loss given default at the borrower level; protective covenants can be used to limit probability of default whereas collateral, credit enhancers, contractual subordination, maturity structure, and capital structure can be used to limit loss given default. It also involves diversifying categories of loans by limiting credit exposures using tools such as VaR and expected shortfall.

⁵ The limited capacity of certain profit centers to originate and manage loans – because of the current number of its employees or saturation of the market – should however be reckoned with when weighing the returns of all profit centers for the purpose of constructing the beta for each profit center following a proposed allocation of exposure limits.

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