



Moral Hazard Index for Credit Risk to SMEs

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Agenda

1. Introduction

2. Literature Review:

Credit risk and Moral Hazard evaluation

3. Methodology and Empirical Evidence

3.1 Data

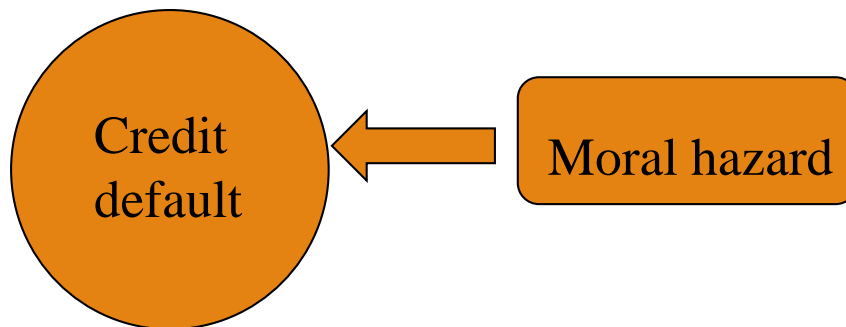
3.2 Moral Hazard Index for Credit Risk

4. Conclusions

1. Introduction

Objectives

- Analyze the impact of moral hazard on default probability of Colombian SMEs in the presence of a collateral
- Propose a moral hazard index for credit risk (MHICR)



(Berger, Scott Frame, & Ioannidou, 2011).

No index to assess moral hazard (Jeanne & Zettelmeyer, 2005).

2. Literature Overview: Credit Risk and Moral Hazard evaluation

Credit Risk Evaluation

- Econometric Models

Linear discriminant analysis, logit, and probit models

- KMV or Moody's model

- Machine learning techniques

2. Literature Overview: Credit Risk and Moral Hazard evaluation

Econometric Models

- *Definition of the cause of the financial difficulty*

- Bankruptcy

Zhao et al. (2016), Blanco-Olivero et al. (2014), Altman et al. (2010), and Liou and Smith (2007).

- Insolvency

Altman and Sabato (2007) and Grunert et al. (2005).

- *Explanatory variables*

- Financial ratios

Brédart (2014), Liou and Smith (2007), Altman (1968), and Beaver (1966).

- Cash flows

Sharma and Iselin (2003), and Gentry et al. (1987),

- Macro variables

Filipe et al. (2016) and Liou and Smith (2007).

2. Literature Overview: Credit Risk and Moral Hazard evaluation

Econometric Models

- Methodology

- Logit

Zhao et al. (2016), Filipe et al. (2016), Becchetti and Sierra (2003), Keasey and Watson (1987) and Ohlson (1980).

2. Literature Overview: Credit Risk and Moral Hazard evaluation

Moral Hazard Evaluation

- Existence of distortions in the price of credit to emerging economies
▶Martinez-Vazquez & Mina (2003).
- Determination of the extent to which financial bailouts by IMF stimulate moral hazard
▶Dell'Ariccia et al. (2002), Lee and Shin (2008), and Dam and Koetter (2012).
- Effects of the collateral on some credit channels
▶Honig and Jain-Chandra (2006), Uesugi et al. (2010), Berger et al. (2011), Ono et al. (2012), and Ono et al. (2013) – or mortgage credit – Agarwal et al. (2016).
- Few attempts for a moral hazard measure
▶Bryan et al. (2013), Zinman (2014).
- Recently, Castillo et al. (2018) introduced the financial ratios for moral hazard of credit risk models for SMEs.

3. Methodology and Empirical Evidence

Model

$$\ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \sum_{i=1}^m \beta_i X_i$$

$$LOR = \beta_0 + \sum_{j=1}^n MHFR_j \beta_j + \sum_{k=n+1}^m CFR_k \beta_k$$

CFR: traditional (common) financial ratios

MHFR: other ratios accounting for moral hazard financial ratios

3. Methodology and Empirical Evidence

Model

Financial ratios	Moral hazard characteristic
$\frac{\text{Short-term investments} + \text{Long-term investments}}{\text{Total Assets}}$	Asset substitution Captures the influence of investments to obtain a higher return and meet debt obligations promptly.
$\frac{\text{Operating Costs and Expenses}}{\text{Total Assets}}$	Low effort The higher the ratio, the higher the effort of a firm with credit in the presence of collateral.
$\frac{\text{Non-Operating Expenses}}{\text{Total Assets}}$	Underinvestment Higher levels of non-operating expenses indicate a decrease in investments that are the <i>raison d'être</i> of the company with collateralized loans.
$\frac{\text{CapEx}}{\text{Total Assets}}$	Different use of invested capital The lower the ratio, the higher the default probability.

Source: Castillo et. al. (2018)

3. Methodology and Empirical Evidence

MHICR definition

The Moral Hazard Index for Credit Risk (MHICR) measure is defined as the (positive) impact of the moral hazard variables over the default probability ratio. For a given year t , MHICR is calculated as

$$MHICR_t = \frac{\sum_{j=1}^n e^{\beta_{j,t}} 1_{\{\beta_{j,t}\}^+}}{\sum_{i=1}^m e^{\beta_{i,t}} 1_{\{\beta_{i,t}\}^+}},$$

where j ($j = 1, \dots, n$) is each of the moral hazard financial ratio variables and i ($i = 1, \dots, m$) are both moral hazard and traditional financial ratio variables. Moreover, $1_{\{\beta_{j,t}\}^+}$ is the indicator function which takes value 1 if $\beta_{j,t}$ is positive, and 0 otherwise.

Thus, the MHICR ranges from 0 to 1.

3. Methodology and Empirical Evidence

3.1 Data (2007-2014)

- Colombian companies (SMEs) short term credit information (working capital loan) is taken for a period less than or equal to 12 months
 - ▶ **National Credit Guarantee Fund of Colombia (FNG)** (*Short time credits warrantied when the financial institutions used or not the guarantee from FNG*).
- Balance sheets and income statements for these same companies with FNG credit guarantees
 - ▶ **Superintendency of Corporations of Colombia** (*financial statements*).

Table 1 : Logit regression 2007-2014 – traditional financial ratios and moral hazard ratios

Model 2		2007	2008•	2009	2010	2011•	2012	2013	2014
No.	Variable	Coeffi.							
1	Cash/total assets	9.356 ***	8.106	8.173 *	-179.958		-43.444 **	3.645	1.294
2	EBITDA/total assets	-2.646		-1.668	-1.138		-0.709	-2.378 **	-3.194 ***
3	EBITDA/financial expenses	-0.001		-0.005	-0.013		-0.005	0.000	-0.002
4	Retained earnings/total assets	1.420		-11.793 ***	-21.575	-4.335	-1.463	-2.782	1.064
5	Short-term debt/capital	0.435	0.209	0.004	0.053 ***		0.033	0.067	0.238
6	D_Number_c	-3.179 **	-2.999 **	-1.199 ***	15.073	-1.234 ***	-2.660 *	-1.321 **	-2.368 *
7	(Short- and long-term investments)/total assets	-3.179 **	0.125	-1.127	-6.891	-40.362	1.764	-681.296	0.702
8	(Operating costs + operating expenses)/total assets	-1.594	-2.098 ***	-0.086	-0.091	-1.359 **	-0.237	-1.161 **	-0.904
9	Non-operating expenses/total assets	8.887 **	5.210	-0.834	4.342 ***	0.958	4.065 *	2.913	0.869
10	Property, plant and equipment/total assets	0.960	2.499	2.352	2.738	-0.744	0.257	-1.638	0.574
11	Constant	-3.763 **	-3.871 *	-4.810 *	-20.531	-3.005 *	-3.420 *	-2.369 *	-3.601 *
Tests									
	-2log likelihood	44.811	55.402	115.459	57.629	113.420	121.909	127.313	120.966
	R ² Nagelkerke	0.360	0.227	0.152	0.233	0.110	0.221	0.174	0.200
	Omnibus: χ^2	24.781	16.025	20.309	17.298	13.828	33.585	25.997	29.193
		(0.006)	(0.025)	(0.026)	(0.068)	(0.032)	(0.000)	(0.004)	(0.001)
	Hosmer and Lemeshow: χ^2	5.144	3.111	5.235	0.533	5.326	2.963	3.778	11.891
		(0.742)	(0.927)	(0.732)	(1.00)	(0.722)	(0.937)	(0.877)	(0.156)

• In the years 2008 and 2011, Model 2 (modified) considers the modification of Model 1 and adds the moral hazard ratios. See also Table 2.

3.2. Moral Hazard Index for Credit Risk

MHICR; range [0,1]; sum of the **positive effect percentages** in the default probability, considering **moral hazard ratios** and the liquidity ratio (because has different sign of the theory, we defined “other category” of moral hazard ratios).

Table 4. Moral Hazard Index for Credit Risk (**MHICR**)

Year	<u>Effect +</u>		MHICR
	Underinvestment	Other category (Liquidity)	
2007	0.38	0.62	1
2008	0	0	0
2009	0	1	1
2010	0.99	0	0.99
2011	0	0	0
2012	1	0	1
2013	0	0	0
2014	0	0	0

Source: By authors

4. Conclusions

- We analyzed the impact of moral hazard on default probability and proposed a moral hazard index for credit risk (MHICR).
- In the sample period (2007-2014), at least three of the moral hazard variables (asset substitution, low effort, and underinvestment) have impact on the default probability on Colombian SMEs.
- The moral hazard index for the data in consideration mainly was established based on underinvestment moral hazard category with a MHICR of 0.38 in 2007, 0.99 in 2010 and 1 in 2012.
- Future studies could be conducted to extend the empirical validation of the moral hazard index for credit offered to other companies and markets.

Thanks for your attention!

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