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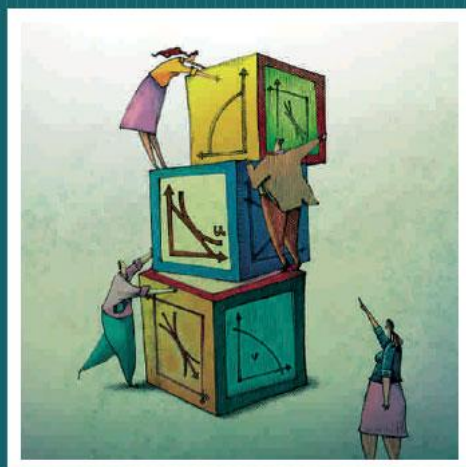## Serie Economía

Investment Opportunities and Corporate Credit Risk

Eugenia Andreasen, Patricio Valenzuela*

ABSTRACT

Using a panel dataset for international corporate bonds, this paper explores the relationship between investment opportunities and corporate credit risk. Consistent with theoretical arguments that investment opportunities reduce a firm's likelihood of bankruptcy, this study shows that corporate credit spreads are negatively related to proxies for investment opportunities, even after controlling for the standard determinants of credit risk. This result is stronger for bonds maturing in the short and medium term. This paper also presents evidence that credit spreads and investment opportunities are linked through a credit-rating channel.

KEY WORDS: Bankruptcy; Credit ratings; Credit spreads; Default risk; Investment opportunities

JEL CODE: F3, F4, G1, G2, G3

1. Introduction

A large body of research has documented that investment opportunities play a crucial role in the theory of corporate finance by affecting firms' capital structure, dividend policies and compensation contracts (e.g., Smith and Watts, 1992; Goyal, Lehn, and Racic, 2002; Billett, King and Mauer, 2007). However, their role as a significant factor in the pricing of corporate debt remains largely unexplored. To fill in this gap, this study investigates the relationship between investment opportunities and corporate credit spreads using a panel dataset of international corporate bonds issued by advanced and emerging-market borrowers.

We build on Lyandres and Zhdanov's (2013) analysis of the relationship between investment opportunities and corporate bankruptcies. From both a theoretical and an empirical perspective, Lyandres and Zhdanov (2013) argue that the mix of investment opportunities and assets in place is an important determinant of a firm's likelihood of default. First, default is more costly for shareholders of a firm with considerable investment opportunities since shareholders forfeit the right to exercise the investment option in the future. Second, the more valuable the firm's investment opportunities, the higher the value of the residual claims on the firm's assets that do not accrue to current debtholders, and the easier it is to obtain external financing. As a result, investment opportunities increase shareholders' willingness to serve their debt obligations while, at the same time, improving their ability to raise external financing to keep servicing debt. Given that corporate bond spreads reflect the market perception of an obligor's overall capacity and willingness to meet its financial obligations, investment opportunities should also reduce corporate bond spreads.

This paper shows that corporate bond spreads are negatively related to proxies for investment opportunities—i.e., the market-to-book ratio and the R&D-to-sales ratio—even after controlling for the standard determinants of credit risk. This relationship is stronger for bonds maturing in the short and medium term. The paper also explores whether investment opportunities and credit spreads are linked through a corporate credit-rating channel. We find that better credit ratings are positively related to the market-to-book ratio, while they are negatively related to the R&D-to-sales ratio. This latter result is consistent with recent empirical evidence showing that firms respond to the incentives of credit-rating agencies to improve their appearance on certain financial dimensions by reducing investment in innovation in order to receive higher ratings (Begley, 2015).

This paper contributes to different strands of the corporate credit risk literature. First, it contributes to the literature on the determinants of corporate credit risk initiated by Merton (1974). Second, it contributes to the literature that shows that firms' financial decisions are consistent with credit-rating "targeting" (Hovakimian, Kayhan, and Titman, 2009; Kisgen, 2009). Finally, it contributes to the flourishing literature on the relationship between investment opportunities and credit risk (Lyandres and Zhdanov, 2013).

2. Data

Our dataset contains information on corporate bonds placed in international markets by developed- and emerging-market borrowers. It builds on Valenzuela's (2016) dataset, which includes all fixed-rate bonds denominated in U.S. dollars, available in Bloomberg as of June 2009, with the exception of bonds issued by firms located in the U.S. or England. After cleaning the data, we obtain a final sample—including all of our control variables—that contains 17,803

bond-month observations for the period from January 2005 to June 2009. These observations correspond to 496 different bonds issued by firms located in 26 countries.[1] Due to data availability, we employ quarterly data in our models using the R&D-to-sales ratio.

The dependent variables used in this study are the corporate *option-adjusted spread* (OAS) from Bloomberg and the foreign-currency long-term corporate credit rating issued by Standard and Poor's (S&P). The OAS measures the yield on a corporate bond in excess of a comparable U.S. Treasury security, after accounting for the value of any embedded option. The OAS of a bond with no embedded option (i.e., a non-callable bond) is computed as the constant spread that must be added to the spot interest rate to make the price of the risk-free bond identical to the observed market price of the corporate bond.[2] According to S&P, a foreign-currency credit rating is the rating agency opinion of an obligor's overall capacity to meet its foreign-currency-denominated financial obligations. We follow the existing literature and map the credit-rating categories into 21 numerical values, with the values 21 and 1 corresponding to the highest and lowest ratings, respectively.

We consider two proxies for firms' investment opportunities: the market-to-book ratio and the R&D-to-sales ratio. The information to calculate both ratios is also obtained from Bloomberg. While a firm's market-to-book ratio is frequently used as a proxy for investment opportunities, it can also proxy for the (mis)valuation of its stock by the market or by the erosion of book value due to accumulated losses. The R&D-to-sales ratio has the advantage of not being affected by

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[1] Argentina, Austria, Australia, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, Norway, Panama, Peru, Philippines, Singapore, Spain, Sweden, Switzerland and Thailand.

[2] For details on the OAS computation, see Cavallo and Valenzuela (2010) and Valenzuela (2016).

the (mis)valuation problem. However, it has data availability issues, as information on R&D expenditures is missing for a substantial fraction of firms.

To control for other variables that could directly affect corporate bond spreads and credit ratings, we consider the standard determinants of corporate credit risk according to structural credit-risk models and the empirical literature on the determinants of corporate bond spreads (see, Merton, 1974; Collin-Dufresne et al., 2001; Campbell and Taksler, 2003; Borensztein, Cowan and Valenzuela, 2013; Valenzuela, 2016). The control variables considered in this study are: years to maturity; equity volatility; operating income to sales; short-term debt to total debt; total debt to assets; cash holdings to total debt; total assets; and the sovereign credit rating. Table I presents the definitions, units, and sources of the variables used in this paper. Table II reports the descriptive statistics of the variables.

3. Empirical analysis

The primary objective of this study is to explore the relationship between corporate credit spreads and investment opportunities. Thus, we estimate the following econometric model:

$$\text{Spread}_{bfct} = \alpha + A_b + B_t + \gamma \text{INV\_OPP}_{ft} + \beta X_{bfct} + \varphi Y_{fct} + \delta Z_{ct-1} + \varepsilon_{bfct}, \quad (1)$$

where the subscript 'bfct' refers to bond b, firm f, country c, and time t. Spread_{bfct} is the corporate bond option-adjusted spread. INV_OPP_{ft} corresponds to one of our two proxies for investment opportunities: Market-to-book or R&D-to-sales. A_b and B_t are vectors of bond and time fixed effects, respectively. X_{bfct} is a set of bond characteristics; Y_{fct} is a set of firm-level performance indicators; and Z_{ct-1} is a set of lagged macroeconomic variables. ε_{bfct} is the error term.

3.1. Investment opportunities and credit spreads

Table III presents the results from the estimation of our fixed effect panel regressions by ordinary least squares (OLS) with errors clustered at the bond level. Columns 1 and 2 report the results for our baseline specification for the two proxies of investment opportunities. Consistent with the theoretical arguments of Lyandres and Zhdanov (2013), the results of our empirical analysis show that corporate bond spreads are negatively related to proxies for investment opportunities, even after controlling for the main determinants of credit risk. This relationship is statistically significant and economically meaningful. That is, a one-standard-deviation increase in investment opportunities reduces corporate bond spreads by between 21 and 35 basis points.

It is noteworthy that, according to the predictions of structural credit-risk models, most of the estimated coefficients of our control variables are statistically significant in the expected direction. On the one hand, years to maturity, equity volatility, short-term debt to total debt, and total debt to assets are positively related to credit spreads. On the other hand, cash holdings to total debt, firm size, and sovereign credit ratings are negatively related to spreads.

To explore whether the relationship between credit spreads and investment opportunities is heterogeneous across bonds with different time to maturity, we divide the sample into short- to medium-maturity bonds (time to maturity under or equal to six years) and long-maturity bonds (time to maturity greater than six years). The coefficients show that the relationship between credit spreads and investment opportunities is stronger for bonds maturing in the short and medium term (columns 3 and 4) than in the long term (columns 5 and 6). This is expected, as time might dilute the effect of present investment opportunities.

3.2. Investment opportunities, credit spreads and credit ratings

Since investment opportunities are likely to affect both corporate credit spreads and credit ratings, we expand our analysis to evaluate whether corporate credit spreads and investment opportunities are linked through a credit-rating channel.

In columns 1 and 2 of Table IV, we augment our baseline regressions to control for credit-rating fixed-effects.[3] On the one hand, column 1 shows that the relationship between credit spreads and the market-to-book ratio weakens, but it remains highly statistically significant once we control for credit ratings. This result suggests that investment opportunities affect credit spreads both directly and indirectly through a credit-rating channel. On the other hand, the coefficient on the R&D-to-sales ratio becomes larger once we control for credit-rating fixed-effects (column 2). This result suggests a positive direct relationship between the R&D-to-sales ratio and credit spreads, but a negative one with credit ratings.

To further explore a potential credit-rating channel, we estimate the following model:

$$\text{Rating}_{fct} = \alpha + A_f + B_t + \gamma \text{INV\_OPP}_{ft} + \varphi Y_{fct} + \delta Z_{ct-1} + \varepsilon_{bfct}, \quad (2)$$

where Rating_{fct} is the corporate credit rating granted by S&P, and A_f is a vector of firm (or industry) fixed effects.

The results of column 3 corroborates that the market-to-book ratio is positively related to corporate credit ratings, even after controlling for the main determinants of corporate credit risk, as well as for firm and time fixed effects. By contrast, column 4 shows a negative and statistically

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[3] By controlling for credit-rating fixed effects instead of a credit-rating control variable, our model accounts for the nonlinear relationship between corporate credit spreads and ratings.

significant relationship between credit ratings and the R&D-to-sales ratio. The latter result is in line with recent empirical evidence showing that firms respond to the incentives of credit-rating agencies to improve their appearance on certain financial dimensions by distorting real investment activities and reducing innovation in order to receive higher ratings (Begley, 2015).

4. Conclusions

Despite a rich body of literature examining the determinants of corporate bond spreads, empirical research on the role of investment opportunities as a significant factor in the pricing of corporate debt remains in its infancy. This article presents empirical evidence that corporate bond spreads are negatively related to investment opportunities, even after controlling for the standard determinants of credit risk. Additionally, we find evidence that our proxies for investment opportunities are directly and indirectly (through a credit-rating channel) associated with credit spreads.

We view the findings in this paper as additional preliminary evidence supporting the argument that investment opportunities affect borrowers' overall capacity and willingness to meet their financial obligations. However, more research is needed to explore the causal effect of investment opportunities on corporate credit risk. Exploring exogenous measures of firms' investment opportunities could be a fruitful avenue for estimating the impact of investment opportunities on corporate credit spreads and ratings.

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Table I
Description of Variables

Name	Description	Unit	Source
Bond characteristics			
OAS spread	Option-adjusted spread.	Basis points	Bloomberg
Years to maturity	Years to maturity.	Years	Bloomberg
Firm characteristics			
Equity volatility 180	Standard deviation of the day to day logarithmic price changes.	Percent	Bloomberg
Credit rating	S&P's firm rating, long term debt, foreign currency.	(1=D, …, 21=AAA)	S&P's
Operating income to net sales	Operating income divided by net sales.	Ratio	Bloomberg
ST debt to assets	Short term debt divided by total debt.	Ratio	Bloomberg
Debt to assets	Total debt divided by total assets.	Ratio	Bloomberg
Cash holdings to total debt	Cash holding divided by total debt.	Ratio	Bloomberg
Total assets	Total firm assets.	Millions of US$ (log)	Bloomberg
Country characteristics			
Sovereign credit rating	S&P's sovereign rating, long term debt, foreign currency.	(1=D, …, 21=AAA)	S&P's
Measures of investment opportunities			
Market-to-book	Market capitalization divided by book.	Ratio	Bloomberg
R&D-to-sales	R&D expenditures divided by net sales.	Ratio	Bloomberg

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Table II
Descriptive Statistics

	Mean	Std. Dev.	Min	Max
Bond characteristics				
OAS Spread	273.4	292.8	26.07	2,696
Years to maturity	6.134	2.648	0.087	14.96
Firm characteristics				
Equity volatility	37.7	22.53	10.45	145.4
Operating income to sales	0.137	0.203	-3.379	0.919
ST debt to total debt	0.258	0.259	0	1
Total debt to asset	0.329	0.167	0.002	0.919
Cash holdings to total debt	0.183	0.258	0	2.331
Total assets	10.35	1.847	6.082	15.1
Credit rating	14.1	3.269	6	21
Country characteristics				
Sovereign credit rating	19.16	3.462	1	21
Measures of investment opportunities				
Market-to-book	2.23	1.436	0.053	14.47
R&D-to-sales	1.69	2.896	0	18.11

Table III
Investment Opportunities and Corporate Bond Spreads

OAS Spread	(1)	(2)	(3)	(4)	(5)	(6)
Years to maturity	16.026***	41.526***	112.940**	8.466	16.070	-7.667
	(2.933)	(10.526)	(52.188)	(21.509)	(12.110)	(9.265)
Equity volatility	0.908***	4.886***	0.954***	5.777***	0.087	3.632***
	(0.223)	(0.609)	(0.324)	(0.936)	(0.251)	(0.728)
Operating income to sales	4.215	-75.163	12.240	-133.392	-73.988***	-86.780
	(23.643)	(61.769)	(28.945)	(102.393)	(27.078)	(61.216)
Short term debt to total debt	132.612***	239.046***	199.089***	212.051**	53.920**	217.783***
	(22.621)	(61.172)	(43.621)	(107.291)	(21.021)	(67.293)
Total debt to assets	75.807*	152.450*	-165.567**	89.688	245.875***	341.596***
	(41.457)	(88.716)	(83.210)	(163.811)	(38.000)	(106.680)
Cash holdings to total debt	-21.971***	-18.096	-36.641***	-1.097	-32.639***	-35.404
	(7.949)	(17.074)	(12.966)	(24.118)	(9.526)	(23.079)
Total assets	-70.550***	-23.334	-97.604***	12.829	-8.881	35.798
	(12.470)	(27.333)	(24.376)	(63.390)	(9.598)	(23.250)
Sovereign credit rating	-16.946***	-42.677***	-12.767**	-34.982*	-31.574***	-61.877***
	(3.485)	(12.820)	(5.702)	(20.079)	(5.215)	(20.456)
Market-to-book	-14.640***		-16.630***		-7.743***	
	(1.701)		(2.801)		(1.884)	
R&D-to-sales		-12.131**		-21.162**		-12.697***
		(5.088)		(10.434)		(4.907)
Observations	17,803	2,654	8,528	1,384	9,275	1,270
R-squared	0.727	0.750	0.696	0.739	0.840	0.852
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond FE	Yes	Yes	Yes	Yes	Yes	Yes

Table IV
Investment Opportunities, Credit Ratings and Corporate Bond Spreads

	OAS Spread		Credit Rating	
	(1)	**(2)**	**(3)**	**(4)**
Years to maturity	12.513***	56.994***		
	(3.103)	(10.301)		
Equity volatility	0.270	2.808***	-0.017***	-0.024***
	(0.188)	(0.573)	(0.001)	(0.003)
Operating income to sales	-21.552	-89.114	0.007	0.278
	(22.872)	(55.905)	(0.057)	(0.245)
Short term debt to total debt	109.289***	223.505***	-0.009	-0.053
	(21.035)	(58.922)	(0.078)	(0.203)
Total debt to assets	-214.645***	-62.113	-2.788***	-3.724***
	(44.071)	(95.870)	(0.171)	(0.500)
Cash holdings to total debt	-26.853***	-22.605	-0.023	-0.026
	(7.565)	(17.725)	(0.028)	(0.076)
Total assets	-26.982**	49.037**	0.471***	0.709***
	(11.309)	(24.361)	(0.046)	(0.106)
Sovereign credit rating	17.671***	-19.629*	0.308***	0.290***
	(5.905)	(11.701)	(0.020)	(0.080)
Market-to-book	-3.402**		0.075***	
	(1.672)		(0.009)	
R&D-to-sales		-18.993***		-0.112***
		(5.295)		(0.024)
Observations	17,803	2,654	8,632	1,325
R-squared	0.755	0.786	0.975	0.971
Time FE	Yes	Yes	Yes	Yes
Bond FE	Yes	Yes	No	No
Rating FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes

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