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Intrinsic Value vs. Market Value:

An Empirical Mean-Reversion-Based Study

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Abstract

The market very often overestimates financial assets because of speculation. This makes it difficult to determine the proper value of a company. We believe that intrinsic value should be used to make an accurate assessment. Hence, financial statements data should be used to determine the value of a company. The main purpose of this paper is to measure the performance of a mean reversion structural model in pricing shares. The model was developed by El Ibrami and Naciri (2012). The market is used as a benchmark to determine the performance of the model analyzed. The results of the study show that the market overestimated mean reversion companies by about 10% and remain consistent throughout the industries.

Keywords: Mean reversion, Equity, EBIT, Volatility

1. Introduction

Very few researchers have evaluated the contingent claims of company stakeholders empirically, using models based on capital structure. The main purpose of this paper is to determine the intrinsic value of public companies by using a mean reverting EBIT model that is suitable for the evaluation of contingent claims. The model is the one developed by El Ibrami and Naciri(2012).To achieve our analysis, we use the quarterly EBIT data of the 300 largest Canadian companies, sorted by revenue, listed on the Toronto Stock Exchange from 2006 to 2010.We will perform a mean reversion test to determine our evaluation sample and maintain companies with statistically significant mean reversion parameters. Then, we will compare the theoretical value of these companies with their market value. A robustness test will be conducted to confirm the results obtained. We then will perform a yearly comparison between the theoretical values and the market values to measure the market collapse mainly in 2008. Finally, we will conduct a performance evaluation by industry and try to corroborate our assertions using a robustness test. We feel that the market underestimated the companies in 2008 because it collapsed that year and overestimated the same companies for the other four years. The rest of the paper is organized as follows: Section II investigates the literature review. Section III is reserved for the methodology. Section IV states the results of our analysis and Section V focuses on conclusions.

2. Literature Review

Empirically, very few authors focus on the stakeholders contingent claims evaluation. Among these authors, some use models based on capital structure while others focus on arbitrage models. Hence, Eom, Helwedge and Huang (2004) empirically compare the performance of five structural models in the evaluation of bond debt. The three authors examine the Merton (1974), Geske (1979), Longstaff and Shwartz (1995), Leland and Toft (1996) and Collin-Dufresne and Goldstein (2001)[1] models.

To make such a comparison, the three authors initially use a sample of 8700 bond prices; however, their final sample is only composed of 182 prices[2].Their analysis shows that low-risk bonds involve little spreads because of the little leverage used by the issuer of these bonds and its low asset volatility. On the other hand, riskier bonds involve high spread levels. The authors notice that the Merton (1974) and Geske (1979) models overestimate bond value although this overestimation is less pronounced in the Geske model because of endogenous volatility assumption, which helps to improve credit spreads. The authors also find that Longstaff and Schwartz (1995) and Collin Dufresne and Goldstein (2001) over estimate bond value because of the correlation between the dynamic equations of the firm's value and the stochastic interest rate.

According to the authors' analysis, the Leland and Toft (1996) model underestimates the bond value because of an assumed continuous coupon and finite underlying debt. The authors conclude that not one of the five models analyzed correctly estimates the credit spread

[1]) The evaluation period chosen by the authors runs from 1986 to 1997.

[2]) They use non-redeemable bonds and bonds not issued by financial institutions nor by oil or electrical energy distribution companies because of the stringent regulations they involve. Furthermore, the authors chose bonds that have at least a one-year expiry and hold coupons. The authors also exclude subordinated bonds from their sample formed of companies that issue one or two types of marketable bonds.

associated to high-risk bonds and then these models are irrelevant for a company's evaluation.

Other analyses emphasized bond debt evaluation by using models based on capital structure. Hence, Ericsson and Reneby (2005) use a Monte-Carlo simulation to compare the performance of three structural models in the evaluation of bonds with spreads ranging from 104 to over 604 basis points, for a period of 90, 250, 500 and 750 days respectively.

The simulation of 2000 paths they use allows them to estimate the stock price and then the company's asset price. By subtracting the stock value from the asset value, they obtain the bond value. Ericsson and Reneby analyze the Black-Scholes-Merton (1974), Leland and Toft (1996) and Briys and Varenne (1997) models. The authors assume that the bias observed in the past bond evaluations stems from the wrong processes estimation method. So, they show that the non-biased maximum likelihood estimator, compared to the one given by the mean-variance method, offers coherent results for credit spread, leverage, asset volatility and asset value.

On the other hand, the authors prove that the Leland and Toft (1996) model is irrelevant for bond evaluation because the instantaneous volatility becomes extreme when the asset value reaches the company's bankruptcy threshold. According to them, this pronounced volatility contributes to an overestimated stock value and an underestimated bond value.

According to the authors, the Briys and Varenne model offers more relevant results than those given by the other models analyzed regardless of the method used (mean-variance or maximum likelihood). That being said, the maximum likelihood method gives more consistent results compared to those given by the mean-variance method in the Briys and Varenne model. According to the authors, the maximum likelihood method is more consistent because of the stochastic interest rate and exogenous bankruptcy assumptions.

The authors also show that the Black-Scholes-Merton model offers lower credit spreads compared to those obtained with the Briys and Varenne model because of a constant interest rate in the case of the former model, which contributes to overestimating bond value.

In this sub-section, we emphasized empirical studies that focused on contingent claims evaluation. These analyses sometimes used models based on capital structure and sometimes arbitrage models; however, they only stressed on debt evaluation.

That being said, others authors emphasized EBIT-based models. Hence, Modigliani and Miller (1958) consider that, in equilibrium, the market value of any company represents the perpetual present value of its expected profit before deductions of debt interest. According to the two authors, in the absence of equilibrium, the exchange of securities continues to be beneficial to the investors independently of their attitude toward risk. So, they will continue exploiting the arbitrage opportunities offered to them until these arbitrage opportunities disappear. As a consequence, the cost of capital of a company and then its market value should not be correlated with its capital structure; however, in their original paper, the two authors didn't take into account tax deductibility when defining the market value of a company.

In their second paper, Modigliani and Miller (1963) argue that, in equilibrium, the unlevered value of a company represents the lowest boundary of its levered value and that tax deductibility helps enhancing this value. Hence, investors looking for additional gains, due to the extra after tax-earnings, have an incentive to sell shares in unlevered companies and purchase the shares and bonds of levered companies. The two authors note, however, that tax shields do not necessarily achieve their perpetual level because the company often uses combined sources of financing and not only debt financing. That being said, the two authors don't take into consideration the arbitrage between tax shields and bankruptcy and agency costs when measuring a company value.

For his part, Miller (1977) agrees that stockholders must suffer increasing risks of bankruptcy to deserve the gains due to deductibility so that the balancing of bankruptcy costs against tax shields allows raising optimal capital structure; however, the author finds that even if tax shields are fully deductible, the value of the firm, in equilibrium, continues being independent of its capital structure and that the level of bankruptcy and agency costs seems to be relatively low compared to the tax savings they are assumed to balance.

On the other hand, Goldstein, Ju and Leland (2001) propose an EBIT-based model that takes into account the arbitrage between bankruptcy costs and tax shields in the evaluation of the company. According to GJL, contingent claims all have to satisfy the PDE of their model and the separation of investment and financial policy assumption makes the EBIT-generating machine, which is the source of firm value, run independently of how the EBIT flow is distributed among its claimants. Hence, the EBIT is invariant to changes in capital structure.

Sarkar and Zapatero (2003) also propose an EBIT-based model but consider that earnings should revert to their mean value. Like GJL, SZ use the arbitrage between tax shields and bankruptcy cost to determine the optimal capital structure of the company and then its proper value. According to the two authors, the mean reverting earnings assumption reconciles traditional trade-off theory of capital structure with the empirical evidence by obtaining a negative earnings-leverage relationship. In addition, the two authors show that the mean reverting process, followed by the EBIT, allows keeping the coupon level unchanged. So, the company can choose this coupon level to shield the mean earnings level optimally.

According to Sarkar(2003), the main advantage of using the Geometric Brownian Motion process (GBM) is that it leads to closed-form solutions that can be easily analyzed; however, this process is inappropriate to model cash-flows. Rather, under equilibrium conditions, the mean-reverting process should be used to model such cash-flows. The author argues that the mean reversion produces a variance effect that reduces the long-run variance and then brings closer the trigger level needed for investment or real option exercise. As a result, it triggers a realized-price effect meaning a lower variance that impacts negatively the investment. The two effects offset one another. The author adds that the mean reversion also affects negatively systematic risk which should result in a lower discount rate. Hence, it should affect the investment decision. The author concludes that mean reversion, in general, has a significant effect on investment and that using a GBM process to approximate a mean-reverting process cannot be justified except under restrictive conditions such as risk neutrality and negligibility.

In the same vein, El Ibrami and Naciri (2012) show that lognormal processes are just special cases of mean-reverting ones and that the EBIT should be used to compute the proper value of a firm. The two authorspropose an EBIT-based technique for equity evaluation by considering that the EBIT follows a mean reverting process, but unlike SZ and Sarkar whose contingent claims all contain a confluent hyper geometric function; El Ibrami and Naciri (2012)present expressions that are easy to compute. We will use this last model to determine the intrinsic value of equity.

3. Methodology

Our initial sample consists of the 300 largest Canadian companies listed on the Toronto Stock Exchange from 2006 to 2010. The size of a company is measured by its revenue[3]. We will eliminate companies with insufficient data. In fact, companies that were not listed on the Toronto Stock Exchange since 2008 will be excluded from the evaluation sample to make sure to have a representative EBIT volatility. The companies used for the evaluation should have statistically significant levels for the mean reverting EBIT, called "θ" and the speed of mean reversion called "k". Like Sarkar and Zapatero (2003), we will start by conducting a mean reversion parameter test. To do so, we will perform the following linear regression:

$$\frac{\Delta x_{it}}{x_{it}} = \beta_0 + \beta_1 \frac{1}{x_{it}} + \varepsilon_{it}; \; t = 1,\ldots,T$$

Where:

x_{it} represents the EBIT value of a company at time t;

$\beta_0 = -k$;

$\beta_1 = k\theta$.

In fact, the regression measures the significance level of "$ß_0$" and "$ß_1$".Their values both have to be statistically significant for the companies included in our evaluation sample. To conduct this regression, we will take into account the quarterly financial statements to make sure that we have enough data to calculate volatility. The volatility value is given by the following formula:

$$\sigma = \sqrt{\frac{\text{SSE}}{n-2}}$$

Where:

SSE represents the sum squared error due to estimation;

n represents the number of EBIT variations.

Given that we will use quarterly data for the regression, we will annualize the volatility output by considering its value times 2.After determining our evaluation sample, we will apply the El Ibrami and Naciri model (2012)[4] to measure the market efficiency. To be able to

[3]Arnott, Hsu and Moore (2005) show that, because of the investors risk-return relationship perception, the size of a company should be measured by its revenue rather than its market capitalization. They conclude that the revenue represents the right indicator of company fundamental characteristics.
[4]The equation of equity as established by El Ibrami and Naciri (2012) is presented as follows:

compare the market and theoretical data, we will use five annual financial statements (from 2006 to 2010). Data are collected from Stock Guide, Bloomberg, Sedar, Compustat, TSE and Yahoo finance Databases. Some variables, like debt and asset value, are cumulative, so the model is useful for annual data only. We will evaluate shareholders value for the companies included in our evaluation sample, at the financial statements date, and compare it to the market capitalization of these companies by calculating the mean of geometric spreads between theoretical and market values. We will use the mean geometric spreads rather than the arithmetic ones to consider inter-periodical returns because the investor is assumed to invest his capital for the long term .As a robustness test, we will perform a regression of the market data on the theoretical ones. As a second step, we will perform a year-by-year comparison to intercept the market fluctuations during the selected evaluation period. Like the evaluation performed for the five years jointly, robustness tests will be conducted annually to confirm the results obtained while using the mean spreads. As a final step, we will compare the market results with the model's results using mean spreads and conduct robustness tests as we would have done during the first two analysis stages.

4. Results and analysis

Our initial sample was formed of the 300 largest Canadian companies listed on the Toronto Stock Exchange from 2006 to 2010. After having eliminated companies with insufficient data, we obtained a sample composed of 285 companies. Then, we performed mean reversion tests to determine our final sample that included 62 companies. Then, we used the El Ibrami and Naciri model (2012)to compare the theoretical and market data by calculating the geometric

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$$E(x) = V - (1-\tau)\frac{c}{r} + \left[(1-\tau)\frac{c}{r} - V_B\right]\left[\exp\left(\frac{2k\theta V_1}{\sigma^2}\right)\left(\frac{1}{V - V_2} - \frac{1}{V_B - V_2}\right)\right]\left(\frac{V - V_2}{V_B - V_2}\right)^{\gamma}$$

Where:

τ represents the tax rate;

c represents the consolidated coupon;

r represents the yield of long-term Canadian bonds;

σ represents the EBIT volatility;

k represents the EBIT mean reversion speed;

θ represents mean reversion value of EBIT

γ is given by the following formula:

$$\gamma = \frac{\left(1 + \frac{2k}{\sigma^2}\right) - \sqrt{\left(1 + \frac{2k}{\sigma^2}\right)^2 + \frac{8r}{\sigma^2}}}{2}$$

V represents the company value and is given by the following formula:

$$V(t) = V_1 x + V_2$$

V_1 and V_2 are given by the following formulas:

$$(1-\tau)\frac{k\theta}{r(k+r)};\ (1-\tau)\frac{x}{(k+r)};$$

x represents the EBIT and V_B represents the company's bankruptcy value.

mean of the spreads[5].

The results show that the market overestimated stocks by about 10%. To validate this assertion, we conducted a robustness test by regressing market values on theoretical ones. The results of this regression are presented in Table1. As shown in Table 1, there is a very strong correlation between theoretical results and market data. In fact, the R-squared value and the adjusted R-squared value are about 91.7%. This means that the model explains market activity very well. In addition, Table 1shows a very significant linear relationship between the dependent and the exogenous variables and an exogenous variable coefficient of 1.093 with a p-value of 0.000. This means that the market overestimated the companies included in our sample during the period of evaluation, which corroborates the results previously obtained. This overestimation should be more pronounced for non-mean-reversion companies[6]. We also tried to evaluate how pronounced the market collapse was in 2008. To do so, we once again compared, but on an annual basis, the theoretical and market values for the period between 2006 and 2010. The results of this comparison are listed in Table 2.

Table 1. Cross-sectional OLS regression using the whole period of evaluation

$$V_M = ß * V_{TH} + \varepsilon$$

V_M represents the market value

V_{TH} represents the theoretical value

Dependent variable	Market value
Exogenous variable	Theoretical value
R-Squared	91.7%
Adjusted R-Squared	91.7%
Regression Coefficient	1.093
T-Statistic	55.732***
F-Statistic	3 106.099***

Table 2. Annual geometric spreads

$$SPREAD = \frac{THEORETICAL\ VALUE - MARKET\ VALUE}{MARKET\ VALUE}$$

Year	Spread
2006	-8.53%
2007	-14.55%
2008	37.42%
2009	-6.91%
2010	-26.46%

[5] $SPREAD = \frac{THEORETICAL\ VALUE - MARKET\ VALUE}{MARKET\ VALUE}$

We calculated the geometric spreads for each company and then the mean of these mean spreads to determine how different the theoretical and market values of our sample were.

[6] Proofs of this allegation are beyond the scope of our paper.

As shown in Table 2, the market overestimated mean reverting companies between 2006 and 2010, except for 2008. In fact, in 2008, the market collapsed, which explains the underestimation observed that year. As a robustness test, we performed a linear regression of the yearly market data on the theoretical values. The results obtained were all very significant with high R-squared values. Also, the results all confirm those presented in Table 2. Table 3summarizes the results of the five regressions we made.

As Table 3 shows, all the results indicate an overestimation of the mean reverting companies' value, except for 2008 where the market collapsed. This corroborates the results obtained earlier. The tests are robust and confirm the market's underestimation of the mean reversion companies in 2008 and their overestimation during the other four years.

To complete our analysis, we investigated the market efficiency with regard to the industry. We then divided our evaluation sample into eight categories and measured the spread between their theoretical and market values. The results are presented in Table 4.

Table 3.Annual cross-sectional OLS regressions

Year	Regression Coefficient	T-Statistic	R-Squared	Adjusted R-Squared	F-Statistic
2006	1.09	31.175***	94.9%	94.8%	971.856***
2007	1.095	27.531***	93.5%	93.3%	757.960***
2008	0.924	27.038***	93%	92.9%	731.064***
2009	1.06	17.43***	84.7%	84.4%	303.806***
2010	1.378	16.354***	82.7%	82.4%	267.459***

Table 4.Geometric spreads by industry

Industry	Spread
Utilities	-17.14%
Energy	-27.54%
Financials	4.50%
Consumer staples	-16.90%
Industrials	-15,65%
Materials	-6.57%
Consumer discretionary	9.17%
Information technology	-14.59%

As Table 4 shows, the market overestimated all the industries, except for the financials and consumer discretionary ones, between 2006 and 2010. The underestimation of the two sectors cited may be explained by the fact that the consumer discretionary industry represents nonessential goods and services and that the financials one was forced to stabilize during this turbulent period. As a robustness test, we once again performed a regression of the industries' market value on their theoretical value. The results of these regressions are listed in Table 5.With the exception of the consumer discretionary industry, the results obtained are significant with high R-squared levels and corroborate those obtained earlier. In fact, the

"Yellow Company" data was considered as aberrant observations, which explains the unexpected results obtained earlier for the industry this company belongs to. The results became more reasonable when this company's data was excluded from the industry's sub-sample, indicating an overestimation of this industry, as we logically would have expected.

Table 5. Cross-sectional OLS regressions by Industry

Industry	Regression Coefficient	T-Statistic	R-Squared	Adjusted R-Squared	F-Statistic
Utilities	1.061	9.349***	82.1%	81.2%	87.395***
Energy	1.055	10.777***	73.9%	73.3%	116.143***
Financials	1.007	11.046***	81.9%	81.2%	122.012***
Consumer staples	1.067	28.276***	96.5%	96.4%	799.506***
Industrials	1.485	28.483***	94%	93.9%	811.285***
Materials	1.477	11.853***	89.8%	89.10%	140.483***
Consumer discretionary	1.233	20.917***	88.7%	88.5%	437.511***
Information technology	1.024	39.147***	98.10%	98.10%	1532.457***

5. Conclusion

The main purpose of this paper was to conduct an empirical study using a model susceptible to evaluate companies based on their accounting information. We used the El Ibrami and Naciri model (2012) to perform this evaluation. The model is useful for companies with mean reverting earnings before interest and taxes. We then performed a mean reversion test to determine our evaluation sample. The initial sample consisted of the 300 largest Canadian companies listed on the Toronto Stock Exchange between 2006 and 2010, sorted by revenue. We eliminated the companies with insufficient data before performing the indicated test and obtained a final sample of 62 companies.

We then compared theoretical values with market values and obtained a 10% market overestimation. A robustness test allowed us to confirm this result. We then performed a yearly comparison between theoretical values and market values and obtained an overestimation of the companies analyzed for 2006, 2007, 2009 and 2010. We also obtained an underestimation of the named companies for 2008, which is coherent with the market collapse that year.

To complete our investigation, we performed analyses by industry and most corroborated the overestimation of the market data overall. Robustness tests confirmed this allegation but not for the materials industry, which appeared to have been underestimated by the market before the robustness test contradicted our assertion due to influent data for the "Yellow Company".

Our analysis shows that the El Ibrami and Naciri model (2012) is robust and could be used to measure the proper value of companies listed on the Toronto Stock Exchange. The use of the model could be generalized to other financial assets listed on any other Stock Exchange. The model could also be used to predict the proper value of private companies and derivatives; however, as mentioned by the two authors, it presents some limits. In fact, it is only useful for mean reverting companies and can be operationalized only for companies with a positive EBIT and a debt value lower than the value of the company. Further models with lower restrictions and using accounting information and real options will be operationalized to be able to determine a company's intrinsic value.

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