

Maria Manuela Martins Cunha

Determinants for convertible bonds valuation

Determinants for convertible bonds valuation

Maria Manuela Martins Cunha



Instituto Politécnico de Coimbra
Instituto Superior de Contabilidade
e Administração de Coimbra

Maria Manuela Martins Cunha

Determinants for convertible bonds valuation

Dissertação / Trabalho de projeto / Relatório de estágio [selecionar a opção correta]
submetida(o) ao Instituto Superior de Contabilidade e Administração de Coimbra para
cumprimento dos requisitos necessários à obtenção do grau de **Mestre em Análise
Financeira**, realizada(o) sob a orientação do(a) Professor(a) Doutora Ana Paula Quelhas.

Coimbra, Outubro de 2018

TERMO DE RESPONSABILIDADE

Declaro ser o(a) autor(a) desta dissertação / projeto / relatório de estágio, que constitui um trabalho original e inédito, que nunca foi submetido a outra Instituição de ensino superior para obtenção de um grau acadêmico ou outra habilitação. Atesto ainda que todas as citações estão devidamente identificadas e que tenho consciência de que o plágio constitui uma grave falta de ética, que poderá resultar na anulação da(o) presente dissertação / projeto / relatório de estágio.

PENSAMENTO

“Simple pricing models value a convertible bond as being equivalent to a straight bond with an embedded option that enables the bond holder to convert to a specific amount of common stock”

Batten, Khaw and Young

DEDICATÓRIA

À minha “mã”, ao meu pai e ao meu marido: sem vocês, a minha existência era impossível!

AGRADECIMENTOS

Em primeiro lugar quero agradecer ao meu marido, Paulo, por me ter desafiado a testar novamente as minhas fronteiras e a permitir-me estes 2 anos que foram um crescendo brutal! À minha professora e orientadora, Doutora Ana Paula Quelhas, pela força, estima, partilha e paciência em se redimir aos meus intentos e a ajudar no possível e no impossível que se tornou este texto. Ao meu co-orientador que, acima disso, foi também meu mentor na manutenção desta resiliência permanente e na perseverança em fazer mais e melhor! Aos meus colegas de trabalho que tanta paciência tiveram para comigo nos (muitos) maus dias, quando não sabia como continuar... Aos meus amigos, dos quais me afastei ao longo destes 2 anos para estudar novamente e numa nova cidade. Aos meus novos colegas, conhecidos e amigos que conheci no ISCAC e que me receberam de braços abertos. Um agradecimento especial ao meu colega de grupo, João Vilas (...estás no meu coração!...) E, finalmente, a todos os Professores do Mestrado, que nos foram acompanhando de perto ao longo destes 2 anos, especialmente à Professora Doutora Elizabete Neves.

RESUMO

O objectivo deste trabalho é o de apresentar várias determinantes que se consideram importantes na valorização de uma obrigação convertível. Seguindo o artigo de Batten, Khaw e Young (2014), pretende-se recriar as características específicas da emissão de uma obrigação convertível e construir um modelo que relacione factores externos (neste caso, do emitente) com liquidez de mercado (preço).

A metodologia utilizada centrou-se no método dos mínimos quadrados e na construção de um modelo de regressão linear múltiplo. Foi extraída uma amostra de obrigações convertíveis e dos respectivos emitentes para duas geografias: a Europa e o Norte da América no período de 2006-2016. Para o estudo do modelo foi utilizado o software GRETL e para a extracção de dados recorreu-se essencialmente ao software Eikon e Datastream.

Com este estudo conseguiu-se determinar as variáveis mais significativas no estudo da valorização da obrigação convertível para ambas as geografias estudadas (Europa e Norte da América). No entanto, o modelo apresenta algumas limitações no que concerne às determinantes em estudo e na respectiva aplicação na valorização da obrigação convertível.

Palavras-chave: Obrigações convertíveis, Call, preço, dívida

ABSTRACT

The goal of this work is to present several determinants considered important to evaluate a convertible bond. Following the work of Batten, Khaw e Young (2014), we intend to recreate the specific features of a convertible bond issuance and build a model that associates external factors (from the issuer, in this case) with market liquidity (price).

The methodology used was based in Ordinary Least Squares to shape a Multiple Linear Regression Model. The data for convertible bonds and their issuers were extracted to two geographies (Europe and North America) in the period 2006-2016. To study the model, we used the software GRETL and downloaded the data essentially from Thomson Reuters Eikon and Datastream.

With this study we could determine the most significant variables to evaluate the convertible bonds to both geographies studied (Europe and North America). Nevertheless, the model presents some limitations in terms of the determinants used in this work and in its application to value the convertible bonds.

Keywords: Convertible Bonds, Call, price , debt

ÍNDICE GERAL

INTRODUCTION AND BACKGROUND	1
1. LITERATURE REVIEW	5
1.1 Risk	5
1.2 Information.....	6
1.3 Capital structure	6
1.4 Hybridization.....	8
1.5 Contingent Convertible Bonds.....	9
1.6 Reasons for issuing convertible bonds.....	9
1.7 Types of Convertible Bonds.....	10
1.8 Different Theories on Information Asymmetry, Financial distress, Agency Costs, backdoor financing and non-signaling.....	12
1.8.1 Information Asymmetry	12
1.8.2 Financial distress.....	13
1.8.3 Agency costs	13
1.8.4 Backdoor financing.....	14
1.8.5 Non-signaling.....	16
2 EMPYRICAL ANALYSIS.....	17
2.1 Hypothesis development	17
2.2 Data	18
2.3 Methodology and Model.....	19
2.4 Results	21
2.5 Discussion of the results.....	32
CONCLUSÃO	36
REFERENCES	38

APPENDICES	44
APPENDIX 1 - Table 1: Corporate Bond Market size: 2006 to 2016	45
APPENDIX 2 - Table 3 – Number of convertible bonds issued between 2006 and 2016 by sector and by country.....	61
APPENDIX 3 - Table 8 – Call anticipation on convertible bonds between 2007 and 2016 in Europe and North America	66

ÍNDICE DE TABELAS E FIGURAS

Graph 1	15
Graph 2	16
Table 4	24
Graph 3	25
Graph 4	27
Table 6	27
Table 7	28

Lista de abreviaturas, acrónimos e siglas

BvD - Bureau Van Dijk

CAPEX – Capital Expenditure

GRETLM – Gnu Regression Econometrics and Time-series Library

ISIN – Identification Standard Identification Number

OLS - Ordinary Least Squares

RESET Ramsey TEST – Ramsey Regression Equation Specification Error Test

RIC – Reuters Identification Code

ROA – Return on Assets

R^2 - R-Squared

VIF - Variance Inflation Factors

INTRODUCTION AND BACKGROUND

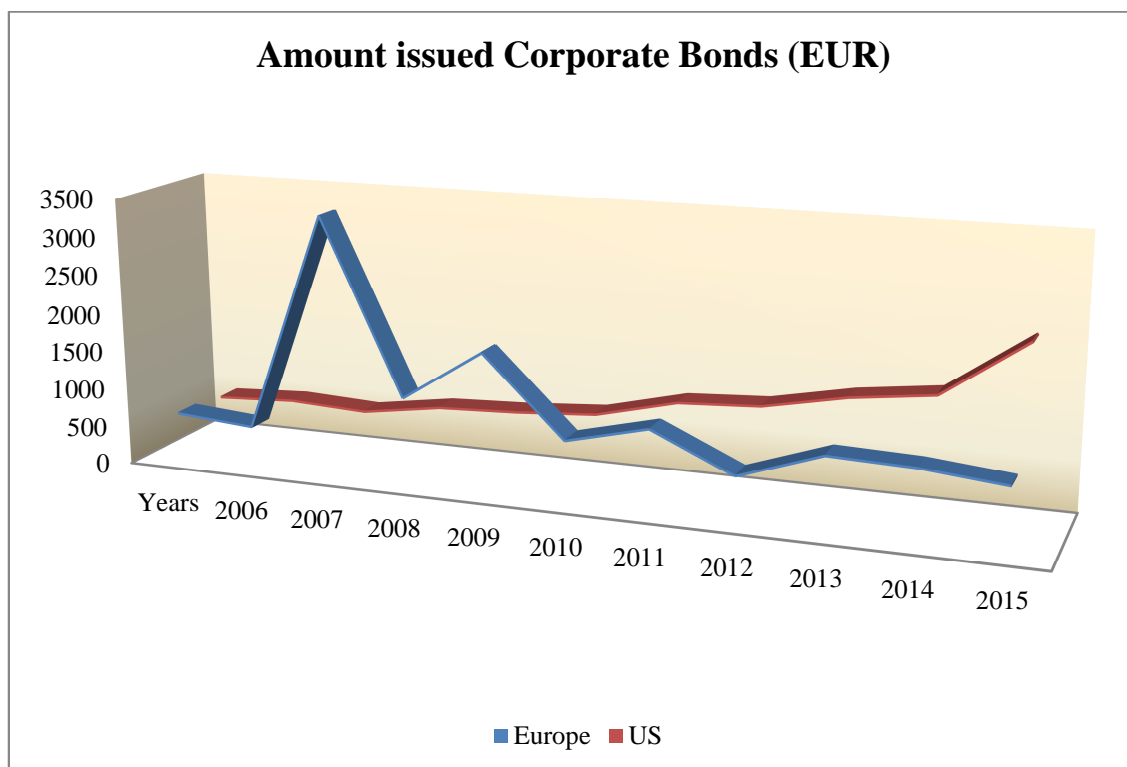
The goal of this study is to connect several variables related with the issuers' capital structure and the influence that the market price of convertible bonds might have in their capital structure as well as in its market pricing. This mean that we will follow the work of Batten, Khaw and Young (2014) in order to fill a gap that exists in these kind of studies to consider issuance-specific factors with market liquidity on the pricing of convertible bonds.

The objective of their survey was to emphasize the key theoretical and empirical features of convertible bonds and also to identify areas of research that may be improved around valuation and application of these securities.

Nonetheless, there is no possibility to speak on convertible bonds without referring to corporate bonds as they are a type included in this kind of securities. The size of the convertible bond market compared with a much larger corporate market is registered in Table 1 (see Appendix section). As it can be observed this table provides the number of corporate bonds (straight bonds) and the convertible bonds issued between 2006 and 2016 as well as its amount outstanding and a comparison in terms of volume between both "markets" within Europe and North America. Through all the years studied it may also be observed that both markets have been increasing until 2012 where Europe reached in corporate bonds the amount of 1.075,52 Thousand Million Euros and then decreasing the issuance both in convertibles and corporate bonds through the next following years opposing the steady increase in both segments in North America that can be shown in the columns dedicated to this part of the Continent.

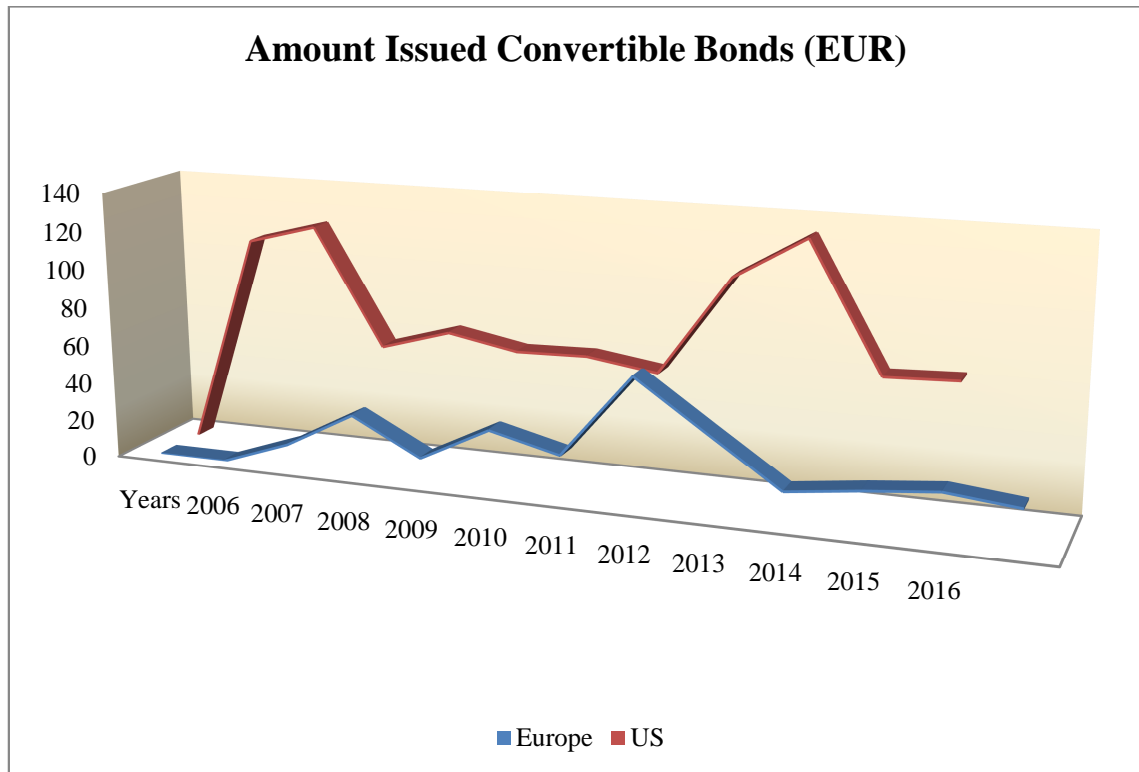
As we can witness in the two graphs below, there are also some differences looking to both segments and where there is an obvious different path comparing Europe to North America. Like indicated in the previous paragraph, the amount issued (and numbers) for Corporate Bonds (Graph 1 below) had a big increase around 2008 in Europe and then it tends to decrease slowly with a few picks from 2010 onwards. In North America we can see a slight and slow increase from 2006 onwards.

Graph 1 – Represents the amount in thousand million Euros of corporate bonds issued between 2006 and 2016



As for the Convertible Bonds segment (Graph 2 below), North America met always the largest amounts issued and there is no possible comparison with the amounts issued in Europe, which may infer that convertibles are more commonly used in North American markets than Europe (and which are also bigger). In spite of the decrease observed in 2015, it still issues 268% more in terms of amount. Also, starting 2016, Europe started issuing fewer convertibles probably meaning the end of the financial crisis covenants and the readdress to others type of instruments.

Graph 2 – Represents the amount in thousand million Euros of convertible bonds issued between 2006 and 2016



The methodology for this work was a multiple linear regression model based in the model Ordinary Least Squares (OLS) and using the software GRETL. The data was extracted using Thomson Reuters software Eikon and Datastream as well as Bloomberg and Amadeus from Bureau Van Dijk (BvD) getting information from capital structure from issuers and convertible bond issues from 2006 and 2016 in Europe and North America.

We will try to conclude that the model chosen for both geographies can demonstrate that the bond price as dependent variable is influenced by the independent variables selected (CAPEX, SIZE, Financial Leverage, Long Term Debt, the Equity Price and the Book Value). The objective is to get the most profit of these two models and to determine the best significant determinants that may influence bond price until this one is matured or called.

The text is organized as follows:

- Literature Review.

- Empirical Analysis with the Hypothesis development, Data, Methodology and Model, Results and the discussion of those results.
- Conclusion.

In the end, this is clearly a study that pleases investors, companies, analysts, investigators and students that want to know more about this issue.

1. LITERATURE REVIEW

Convertible bonds are considered a hybrid security with debt and equity like features. Like a straight bond, a convertible bond is entitled to receive regular fixed coupon payments but also the investor has the option to waive the fixed-income component and convert the bond into the stock of the issuing firm. They are also presented as debt securities that enable companies to finance any project they might have in plan. As per Dutodoir, Lewis, Sward and Veld (2013), there are many explanations or motives provided to explain this kind of financing. Some of those explanations rely mainly on issuance costs and on a way to achieve a rapid financing. However there are other valid motives such as reducing agency costs (Green, 1984), asymmetric information (Brennan & Schwartz, 1988) or a non-signalling model (Nyborg, 1995) that may explain the issuance of these kind of bonds.

1.1 Risk

Jensen and Meckling (1976) argued that, unlike shareholders, bondholders anticipate the risk of some projects and thereby demand a higher yield as a compensation for the risk and therefore imposing a contracting cost to the shareholders. Myers and Majuf (1984) claimed that in terms of information asymmetry, the companies rely more on debt than in equity as debt is less associated with lack of information and, as so, less associated with adverse selection costs. Stein (1992) followed the lead of Myers and Majuf (1984) and developed a model that trades off the adverse cost of equity against the financial distress cost of debt. He concluded that firms would prefer to issue debt over equity, especially if it is in the form of convertible bonds, because it lowers the fixed component for those firms. Additionally, Stein (1992) argued that the absence of internal funds for a growing company makes it more probable to issue convertibles instead of equity or straight debt because it is cheaper in terms of transactional costs. Also the fact of having a call feature allows the company to force conversion whenever the market conditions support this decision as far as the firms' circumstances do not change and the stock prices rise above the price conversion. He went further when assuming that a call to force conversion to equity reduces leverage while allowing the firm to get equity into its capital structure through a "backdoor" enabling financing at a lower cost. Mayers (1998) extends this idea telling that convertible debt may help to finance current and future investments because it is easy to decide whether the market

conditions are in favour or not to proceed with the financing. According to Lewis, Rogalski and Seward (1999) and Loncarski, Horst and Velt (2009), the decision to issue convertible bonds as being more equity or debt alike are decided at their issuance depending on the conditions of the investment to be done.

Likewise all other theories, Brennan and Kraus (1987) and Brennan and Schwartz (1988) demonstrated that convertible bonds are indifferent to risk perceptions and they are less likely to be undervalued comparing to equity or straight debt. So they are considered to be subject to higher information asymmetry especially because of their riskness.

1.2 Information

Harris and Raviv (1985) and Nyborg (1995) argued on information signalling. Harris and Raviv (1985) proposed an explanation for this theory and questioned on the reason why firms delay calling convertible bonds. On delaying the call, the manager can influence the market and increase the value of the firm. Or, as Nyborg (1995) studied, the issuance of convertible bonds may allow the companies to redeem bonds before their maturity.

1.3 Capital structure

Other theories studied the effect of debt within capital structure and gave in to more pecking order studies such as the one of Frank and Goyal (2003) where they tried to find the best corporate determinants that best justify the decision-making for corporate leverage. Others like John and Litov (2010) tried to identify what are the drivers that managers follow to decide on when debt is the best way to finance the company and play along with the agency costs.

There are many recent studies that corroborate all these theories and in the overall, Krishnaswamia and Yaman (2008), King and Mauer (2014), Batten, Khaw and Young (2014) and Kazmierczak (2017) provided their own investigations on all their premises seeking the update of those same theories.

Krishnaswamia and Yaman (2008) examined the impact of firm specific features (such as the company size and free cash flow) and macroeconomic factors (such as interest rates, industry performance or economic growth) to the likelihood of issuance and the structure of convertible bonds. They also studied how important are the determinants

such as moral hazard costs, adverse selection and financial distress costs to the probability of issuing convertible bonds instead of straight bonds. Specifically for adverse selection they meant the assumption that stock price movements are not explained by market movements. They concluded that the possibility of issuing convertibles is greater for firms with higher moral hazard, adverse selection, and expected financial distress costs, such as high growth firms, smaller firms and firms with high levels of information asymmetry. They also found that firms are more likely to issue convertibles during periods of high interest rates, and during industry and economic downturns, periods when expected financial distress costs are higher. Their evidence also show that convertibles are designed to mitigate financial distress costs and that these instruments are more equity-like during periods of high interest rates and economic decline.

King and Mauer (2014) investigated the determinants of call policy with a sample of convertible bonds issued in the United States between 1980 and 2002. Their evidence showed that the call policy is influenced by the cash flow considerations and to mitigate agency costs. Also the decision to issue and call a convertible bond is strongly influenced by the need to obtain backdoor equity financing and to finance growth options.

Batten, Khaw and Young (2014) started by exploring a large sample of convertible bonds issued in the American, European and Japanese market between 2000 and 2011. They intended to discuss the “risk-shifting” hypothesis (Green, 1984) and the “backdoor-equity” hypothesis (Stein, 1992). After analysing these studies and many others, they ended their article concluding that the value of a convertible bond is a function of certain factors and depend in underlying risk factors like the interest rate and the boundary conditions such as call and conversion provisions. They also call the attention to the fact that there is a lack of comparative studies of convertible bonds issued in developed and developing countries.

Kazmierczak (2017) chose a sample of several convertible bonds from the United States, Europe and Asia issued between 2004 and 2014. His research came up with 3 different perspectives that show that these 3 global areas have different strategies towards the role of callable convertibles in terms of investment purposes. In the end, he determined that American companies use callable convertibles for investment processes

but European invest much less than American companies. Asian companies tend to consider convertible bonds as “delayed equity” or as a form to avoid external financing.

1.4 Hybridization

It is known in the market that convertibles are considered as a hybrid instrument where there is a combination of both bond and equity characters. This relationship has been analysed since the 50’s and many studied these instruments namely Ingersoll (1977a and 1977b), with the call notice and its contingent claims. As Mayers (1998) stated, convertibles with a call option may enable companies to finance investment opportunities and reducing costs of raising additional capital. Korkeamaki and Moore (2004) also demonstrated that companies with higher levels of capital expenditures use convertibles with or without soft call protection in order to force an immediate conversion when they become “in the money” to get profitable investment options. They also reported that soft call provisions shifted to hard call provisions in the late 1990’s. This change probably means that there was a first need to get the attention to this kind of investment. With this hard call provision, the investor would maintain the same conditions along a certain time-period without having the issuer calling the bond whenever there was a change in interest rates or in the underlying’s pricing. Also, soft call provisions, protected the investor giving him a call premium whenever the issuer thought in any gain. Likewise, it was also observed that companies with lower capital investment are able to issue “hard call protection” which turns this instrument non-callable, at least, for a certain period of time (Kazmierczak, 2017).

Korkeamaki and Michael (2013) studied the life cycle of convertible bonds searching for determinants that affect the end of life for these kind of bonds and focused on the time that these bonds remain active after a call announcement. Their sample is intended to seek features like coupon rate, maturity, call protection, rating or the capital expenditure vs the total assets with a dependent variable measuring the length of time before “death” after call notice. Along with other interesting findings, the study confirms that companies tend to use shorter life span bonds when they must follow a heavy investment schedule.

King and Mauer (2014) searched factors that may explain why companies may call the convertible bonds in a certain period of time. They were particularly interested in the “call delay”. Their findings explain that a call is only done when a safety premium of

conversion value above call price is obtained or only when there is a clear cash flow advantage for doing so.

1.5 Contingent Convertible Bonds

There are further studies that also should be included in this study because of its most significance and which indicate other perspectives upon the convertible bonds issue, such as the capital structure pre-balancing (Rastad, 2016), the ratings information (Hundt, Sprungk and Horsh, 2016) or the contingent capital claims based in Contingent Convertible Bonds used to prevent the banking bailout (De Spiegeleer and Schoutens, 2011; Tan and Yang, 2017).

The study of contingent convertible bonds (usually named as “CoCo” bonds) has been largely the latest theme to investigate as they have become attractive to both issuer and bondholder (investor) as a way to depend not only in conversion into equity but also in a certain credit event that might signal financial distress (Batten, Khaw and Young., 2014). Besides being an investment safer for the investor itself, these type of bonds have been very useful to the issuer because it gives a perspective of accessing a market for its lowest interest rate comparing with the “straight bond”. Also it added flexibility to an issuer that has trouble in entering the corporate bond market due to the credit rating requirement costs. Moreover, it provides the ability to improve the capital resources in adverse conditions (Zahres, 2011). However, it offers some disadvantages as clearly defended by De Spiegeleer and Schoutens (2011.), As per this last analyst, it may become a death spiral convertible bond because it is so dependent on certain covenants and reset clauses in terms of interest rate and credit risk along with equity (market) risk. Companies such as Banks that issue these kind of bonds need a quick way to finance themselves but the coupon rates of these bonds, the investment thresholds, the default thresholds as well as the conversion ratios and their own thresholds are so many to be constant, independent in time (Tan and Yang, 2017), that is very difficult to comply in the future.

1.6 Reasons for issuing convertible bonds

Before trying to explain some of the theories around convertible bonds, it is important to focus in what exactly are the intentions and what is really the idea when a company and/or its management issues one type or other of these type of bonds.

Of course, it is important to know the theories around information asymmetry, financial distress, agency costs or backdoor financing as well as the famous pecking order theory but let us have a small look to some concepts

1.7 Types of Convertible Bonds

In a few tables that you will see in Appendix attached to this work and also in other tables and graphs that we will be shown below, you will examine several statistical numbers on different types of convertibles issued in Europe and North America between 2006 and 2016.

To start, in Table 3 (see Appendix Section) we could configure the number of convertible bonds issued between 2006 and 2016 by sector and by country. There, you may watch that there are countries in Europe such as France, Germany, Italy, Norway and Switzerland that issue the most of convertibles for about every sector that you may find (Banking, Financial, IT, Pharmaceuticals, Machinery, Metals, etc.)

Then in the table 4 below, you will detect some less known designations like Contingent Convertible, Reverse convertible or Synthetic Exchangeable. These concepts and others serve a different purpose and depend on the issuer goal.

As per Batten, Khaw and Young (2014), Contingent convertible bonds (or “CoCo”) are long-term subordinated bonds that are automatically converted into equity when the issuing bank reaches a certain level of financial distress or there is a certain type of predetermined credit event that signals that financial distress. This feature appears to be attractive to the regulator because it fits a more stable financial system but it may not become efficient to the economy because of the several covenants that sometimes are difficult to comply. As per the same authors, a Reverse convertible is issued with an embedded put option, which is held by the issuer. The issuer has the right to convert the bond into shares of another firm that is possessed by the issuer. Normally the issuer has to provide an additional compensation as the investor assumes a higher level of risk.

A Synthetic Exchangeable is similar to an exchangeable bond where the payoff depends on the underlying stock of a different firm. The Synthetic bond is normally combined with warrants resembling a convertible bond giving a call or put option over the shares of another company.

The other types of convertibles being Convertible into Debt, Convertible into Fixed Value of Shares, Convertible into Non-Listed Securities and Convertible into Listed Securities are straightforward in its designation.

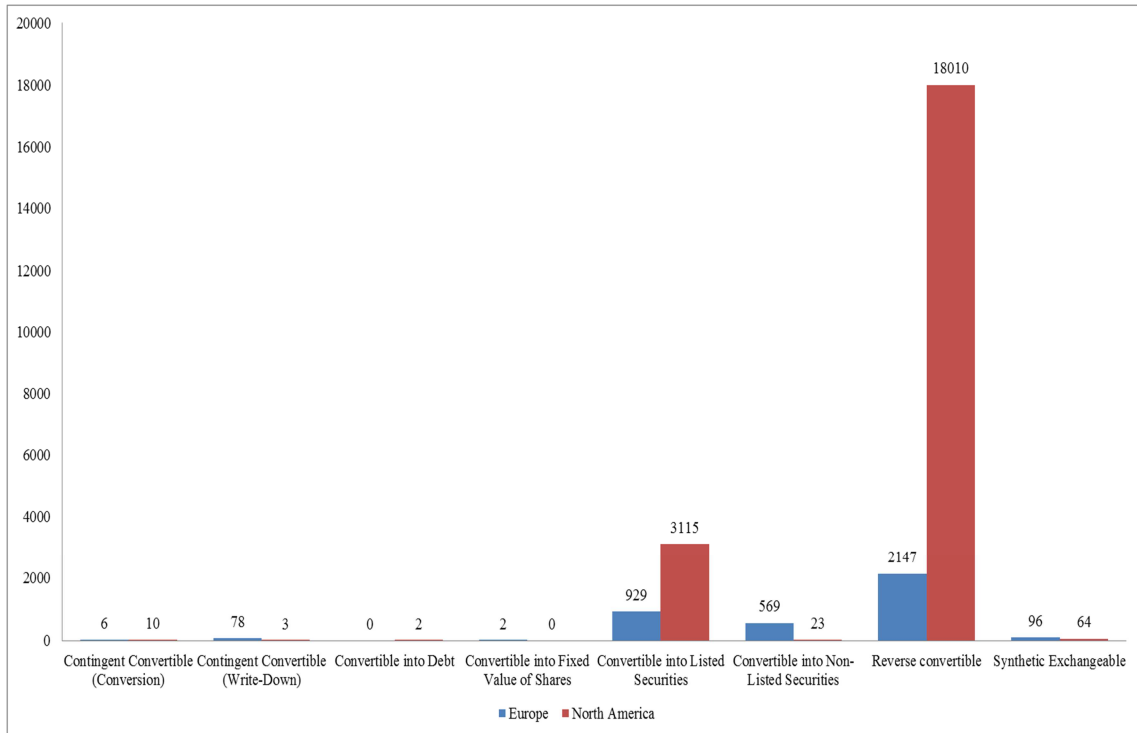
There are other type of convertible bonds which will not be focused in this work like Eurobonds convertible and Foreign currency convertible bonds (“FCCB”) that you may find in some working papers done in this area. The first one is a type of bond issued outside the domestic market which enables nonresident issues to gain an equity stake in the domestic firm. They may be issued in the currency of the issuer’s or in any other foreign currency. The second one is a hybrid instrument in a currency other than the issuer’s domestic currency and all the money raised as well as the principal and periodic coupons are payable in foreign currency. Issuer is exposed to exchange risk but when domestic issues are too expensive and restricted by regulatory constraints, firms tend to issue these type od bonds

Table 4 – Number of convertible bonds issued between 2006 and 2016 in Europe and North America by type of convertibility

Convertible Bond Type	Europe	North America	Grand Total
Contingent Convertible (Conversion)	6	10	16
Contingent Convertible (Write-Down)	78	3	81
Convertible into Debt		2	2
Convertible into Fixed Value of Shares	2		2
Convertible into Listed Securities	929	3115	4044
Convertible into Non-Listed Securities	569	23	592
Reverse convertible	2147	18010	20157
Synthetic Exchangeable	96	64	160
Grand Total	3827	21227	25054

In Graph 3 below you may find the graphical representation of the above-mentioned table:

Graph 3 – Graphical representation of the number of convertible bonds issued between 2006 and 2016 in Europe and North America by type of convertibility



1.8 Different Theories on Information Asymmetry, Financial distress, Agency Costs, backdoor financing and non-signaling

As previously exposed, there are many theories that may explain the issuance and different covenants to prepare the type of convertible to issue and also the terms of the call itself.

1.8.1 Information Asymmetry

The information asymmetry happens when there is a different opinion on risk assumption between the firm insider and the outsider (the investor). Issuing straight bonds implies that the firm has to pay a higher interest rate and it is perceived to have a higher level of risk. The way to solve this is to issue convertible bonds because the higher level of risk is transformed in a higher value of the conversion option (Brennan & Schwartz, 1988).

1.8.2 Financial distress

The financial distress is found when there the company finds itself with the possibility to invest but has to mitigate the expected costs of issuance. In these terms some convertibles are designed to mitigate these kind of distress because it is more equity-like which is preferred by smaller companies or high growth companies (Krishnaswamia & Yaman, 2008).

1.8.3 Agency costs

The agency problems are probably one of the most peculiar problems that can be solved by issuing the convertible bonds. While Green (1984) considers agency problems between bondholders and shareholders, Mayers (1998) considers convertibles as a way to reduce these agency problems because there is a sequence of investment of opportunities. It is better to invest in a long term straight bond than in this “short-term” debt because in the sequence of the investment opportunity, if it turns out to be valuable, the debt may be converted into equity and depending in its design it may be called when met a certain number of pre-specified provisions. Also the convertible bonds issuance can be cheaper in terms of cost comparing to equity or straight debt/bond.

As you can see in Table 5 (see Appendix Section), in the timeframe studied (2006-2016) there are many types of exercise (American, European, Bermudan or Event Linked) and many convertible bonds in Europe and North America may be callable or puttable, i.e., the issuer may call the bond or the bondholder may exercise the put option and demand an early repayment.

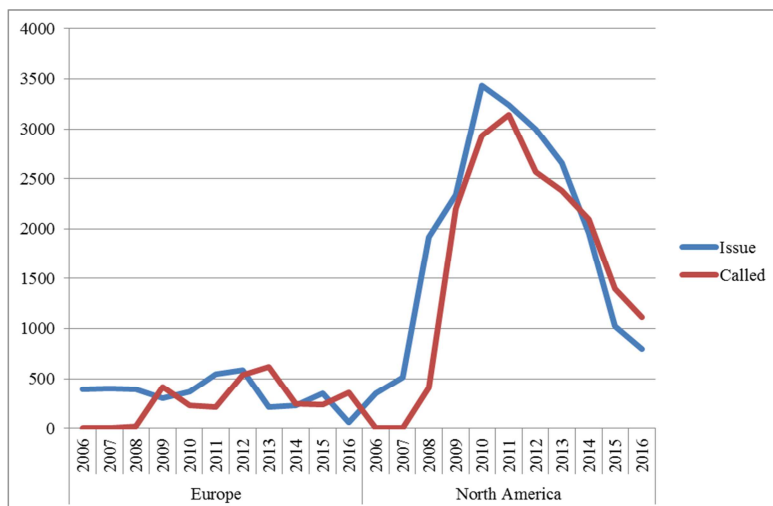
If you look also to the Table 6 and Graph 4 you may interpret the number of issues and calls that convertible bonds had in Europe and North America in the period 2006-2016.

Once again, as you could see in Table 1 and Graphs 1 and 2 done for this work, North America has a substantial number of convertibles comparing with Europe

This Table is an adjustment from Table 1 presented in the article of King and Mauer (2014).

Table 6 and Graph 4 – Number of convertible bonds issued and called between 2006 and 2016 in Europe and North America

Globe Region	Year	Issue	Called
Europe	2006	389	0
	2007	395	2
	2008	392	18
	2009	305	414
	2010	370	225
	2011	542	208
	2012	582	539
	2013	212	614
	2014	232	244
	2015	348	234
	2016	60	357
North America	2006	347	0
	2007	516	2
	2008	1918	407
	2009	2343	2203
	2010	3432	2928
	2011	3243	3139
	2012	2993	2570
	2013	2659	2379
	2014	1954	2096
	2015	1025	1397
	2016	797	1111



1.8.4 Backdoor financing

Stein (1992) argued that the absence of internal funds increased the probability to issue convertible bonds instead of equity or straight debt because it is cheaper but also because the call feature made even more possible the possibility to convert into equity reducing the leverage allowing the firm to get both financing and equity into its capital structure. This is the so-called backdoor financing.

As you can see by table 7 below, the equity trigger exists even in low values, and it is one of the “call” policies used:

Table 7 – Number of convertible bonds called on equity trigger basis between 2007 and 2016 in Europe and North America

Globe Region	Equity Trigger Basis	Year end	Total
Europe	No	2007	2
		2008	18
		2009	414
		2010	225
		2011	208
		2012	539
		2013	614
		2014	244
		2015	234
		2016	357
Europe Total			2855
North America	% of Conversion price	2011	28
		2012	24
		2013	9
		2015	9
		2016	11
	No	2007	2
		2008	407
		2009	2203
		2010	2928
		2011	3111
2012	2546		
2013	2370		
2014	2096		
2015	1388		
2016	1100		
North America Total			18232

1.8.5 Non-signaling

Harris and Raviv (1985) and Nyborg (1995) defended the theory of the signaling which basically exists when a company sends a signal positive or negative when issuing debt or equity. Nyborg (1995) even states that calling a convertible bond may send a negative signal to the market and it is only positive when the conversion is voluntary. Harris and Raviv (1985) argued on the possibility to delay a call. On delaying the call, the manager can have time to influence the market.

As you can see by table 8 (see Appendix Section), there are several call anticipations amongst the sample studied which may perceive that the market accepts the provisions in which the bond is issued.

2 EMPIRICAL ANALYSIS

In order to continue this work we did an analysis of the convertible bonds issued between 2006 and 2016 in Europe and North America. This analysis will be divided into five parts: the first dedicated to the hypothesis to be answered by the model; the second one will be to indicate the data used; in the third part we will show the model chosen for the two different geographies; the fourth will be to demonstrate the results of the data analysis and, finally, the fifth part will be the discussion of these results.

2.1 Hypothesis development

Let us now present the different hypothesis we want to verify through this work.

- Hypothesis 1a: As the investment in assets (CAPEX) becomes larger so does the bond pricing?

This hypothesis is based on Stein (1992) findings when he argues that convertible issuers have a higher rate of investment ratio such as CAPEX and Mayers (1998) theory on sequential financing and which is based in convertible bonds.

- Hypothesis 1b: Does the investment increase when a bond is issued?

This hypothesis is grounded again on (1992) Stein theory and on King and Mauer work (2014). Stein (1992), in his backdoor financing defends that a growing firm prefers a convertible bond and that the values of financing deficit increase immediately after the issuance of a convertible bond.

- Hypothesis 2: Does the Return on Assets (ROA) decrease with the issuance of a bond?

As the Return on Assets is the ratio between the Net Income and the Total Assets it is assumed that there is decrease in the results when issuing a bond.

- Hypothesis 3: Is the company size affected by the bond price increase?

Again Stein (1992) and King and Mauer (2014) indicate a strong increase in company size.

- Hypothesis 4: Does Debt increase along with the increase in bond pricing?

Krishnaswamia & Yaman, 2008 studied the Debt as a variable that is influenced by the bond issuance and pricing.

- Hypothesis 5: Does the equity price decrease when the bond price increases?

Loncarski, Horst and Velt (2009) defended that in short-term the equity price is affected by convertible arbitrage activities in terms of downward movements.

- Hypothesis 6: Is book value influenced positively by the increase in bond pricing?

Like equity pricing, it is probable that the book value of a company may be influenced negatively by the issuance of bonds or fluctuations of its price.

2.2 Data

The data was collected in Thomson Reuters (now Refinitiv) from their software Eikon and Datastream. The idea was to get information on issuers and convertible bonds issuance in Europe and North America (United States and Canada)

The variables searched for convertible issuers were CAPEX, Earnings before interest and taxes, Long Term Debt, Total Debt, Total Capital and Total Liabilities. Then we calculated the Debt Equity Ratio, Total Assets, Total Equity, the Leverage Ratio (based on Long Term Debt and Return on Assets (ROA)). We looked also for issuers' names, RIC (Reuters Identification Code), Country and Sector and also their equity price at each end of year (close price) and its book value (last business day).

For convertible bonds issue there was a large research in issues done from 2006 until 2016 in terms of Identification Standard Identification Number (ISIN), Exchange Market, country of incorporation, asset status, instrument type, issue type, issue date, end date, maturity date, amount issued, type of option exercise, conversion price, conversion ratio, bond price at each year end (close price on last business day) and also some provisions such as call type, multi-step, etc.

To cross information, some data was searched also in Bloomberg Terminals and in Amadeus from Bureau Van D'Jyck (now Moodys Analytics).

Then all this data was aggregated to find outliers. In the end, from 28970 issues for North America and 9113 for Europe, we selected 3885 issues for North America and 470 for Europe with 339 North American issuers and 212 European issuers.

2.3 Methodology and Model

We estimated two models (one for North America and the other for Europe) using the methodology of Ordinary Least Squares and used GRETTL to help with the model observance.

The dependent variable is Bond Price and the Independent variables are the logarithms of CAPEX, SIZE (Total Assets), Financial Leverage (Debt Equity Ratio), Leverage Ratio Long Term Debt, the Equity Price and the Book Value.

The basic model is:

$$\begin{aligned} \text{BondPrice}_{i,t} = & \beta_0 + \beta_1 \log \text{Capex}_{i,t} + \beta_2 \log \text{ROA}_{i,t} + \beta_3 \log \text{FirmSize}_{i,t} \\ & + \beta_4 \log \text{FinancialLeverage}_{i,t} + \beta_5 \log \text{LeverageRatioLongDebt}_{i,t} \\ & + \beta_6 \log \text{EquityPrice}_{i,t} + \beta_7 \log \text{BV}_{i,t} + \varepsilon_{i,t} \end{aligned}$$

North America

Multiple Linear Regression Model

```

gretl: model 3
File Edit Tests Save Graphs Analysis LaTeX
Model 3: OLS, using observations 1-42737 (T = 12777)
Missing or incomplete observations dropped: 29960
Dependent variable: l_BondPrice

-----
                coefficient  std. error  t-ratio  p-value
-----
const              4.09031      0.0613198   66.70   0.0000   ***
l_DebtRatioFinan~ -0.0981628    0.0174699   -5.619  1.96e-08   ***
l_LeverageratioL~  0.0258104    0.00517240   4.990  6.12e-07   ***
l_PriceClose       0.135672     0.0142252    9.537  1.73e-021  ***
l_BookValuePerSh~ -0.169873    0.0126293  -13.45  5.79e-041  ***
logTotalAssetssi~  0.0781215    0.00814521   9.591  1.03e-021  ***
l_CAPEXTOTALASSE~ 0.0500981    0.00582183   8.605  8.50e-018  ***
l_ROA              -0.0693628    0.00720762  -9.624  7.54e-022  ***

Mean dependent var  4.389385  S.D. dependent var  0.587537
Sum squared resid  4188.835  S.E. of regression  0.572754
R-squared           0.050210  Adjusted R-squared  0.049689
F(7, 12769)        96.43150  P-value(F)          8.1e-138
Log-likelihood      -11005.17 Akaike criterion    22026.34
Schwarz criterion   22085.98  Hannan-Quinn       22046.28

Log-likelihood for BondPrice = -67088.3
    
```

We encountered 42737 observations which include 29960 that were dropped by lack of information. Data observed=12777

We got the following model:

$$\text{BondPrice} = 4,09031 + 0,0781215 \text{ size} + 0,135672 \text{ equityprice} + 0,0500981 \text{ CAPEX} - 0,0693628 \text{ ROA} - 0,981628 \text{ Debt} + 0,0258104 \text{ LTDebt} - 0,169873 \text{ BV}$$

Europe

Multiple Linear Regression Model

File Edit Tests Save Graphs Analysis LaTeX					
Model 16: OLS, using observations 1-5170 (T = 1595)					
Missing or incomplete observations dropped: 3575					
Dependent variable: l_Bond_Price					
	coefficient	std. error	t-ratio	p-value	
-----	-----	-----	-----	-----	-----
const	1.89905	0.173528	10.94	6.35e-027	***
logTotalAssetssi~	0.301317	0.0326973	9.215	9.54e-020	***
l_PriceClose	0.0718560	0.0274709	2.616	0.0090	***
l_CAPEXTOTALASSE~	0.0232721	0.0173115	1.344	0.1790	
l_ROA	0.0496483	0.0309559	1.604	0.1089	
l_DebtRatioFinan~	-0.673428	0.0873853	-7.706	2.27e-014	***
l_LeverageratioL~	0.0363880	0.0367614	0.9898	0.3224	
l_BookValuePerSh~	0.0786543	0.0322291	2.440	0.0148	**
Mean dependent var	4.294104	S.D. dependent var	1.069657		
Sum squared resid	1505.846	S.E. of regression	0.974096		
R-squared	0.174336	Adjusted R-squared	0.170694		
F(7, 1587)	47.86991	P-value(F)	6.65e-62		
Log-likelihood	-2217.335	Akaike criterion	4450.671		
Schwarz criterion	4493.668	Hannan-Quinn	4466.640		
Log-likelihood for Bond_Price = -9066.43					
Excluding the constant, p-value was highest for variable 13 (l_LeverageratioLongtermdebt)					

We encountered 5170 observations which include 3575 that were dropped by lack of information. Data observed=1595

We got the following model:

$$\text{BondPrice} = 1,89905 + 0,301317 \text{ size} + 0,0718560 \text{ equityprice} + 0,0232721 \text{ CAPEX} + 0,0496483 \text{ ROA} - 0,673428 \text{ Debt} + 0,0363880 \text{ LTDebt} + 0,0786543 \text{ BV}$$

2.4 Results

North America

In terms of Economic Theory we can observe that the bond price is 4,09031 with a positive sign which may imply that this is a well specified model. Furthermore we can verify that there is:

- a positive impact in the size of the company.
- a positive impact in the equity price.
- a positive impact in CAPEX (investment).
- a negative impact in the return of assets.
- a negative impact in the short term debt.
- a positive impact in the long term debt.
- a negative impact in the book value.

We can deduct from the R^2 that approximately 5% of the model is explained by the independent variables. We have a $-p$ value very small which infers a satisfactory estimation.

The variables are all significant to the model at a significance value of 5%.

The test of global significance done through the restriction of variables demonstrates that the model is significant in its overall.

```

Restriction set
1: b[l_CAPEXTOTALASSETS] = 0
2: b[l_ROA] = 0
3: b[l_DebtRatioFinancialLeverage] = 0
4: b[l_LeverageratioLongtermdebt] = 0
5: b[l_PriceClose] = 0
6: b[l_BookValuePerShare] = 0
7: b[logTotalAssetssize] = 0

Test statistic: F(7, 12769) = 96.4315, with p-value = 8.14547e-138

Restricted estimates:

                coefficient  std. error  t-ratio  p-value
-----
const                4.38938    0.00519782   844.5    0.0000 ***
l_CAPEXTOTALASSETS    0.00000    0.00000         NA     NA
l_ROA                 0.00000    0.00000         NA     NA
l_DebtRatioFinancialLeverage 0.00000    0.00000         NA     NA
l_LeverageratioLongtermdebt 0.00000    0.00000         NA     NA
l_PriceClose         0.00000    0.00000         NA     NA
l_BookValuePerShare  0.00000    0.00000         NA     NA
logTotalAssetssize   0.00000    0.00000         NA     NA

Standard error of the regression = 0.587537

```

In terms of diagnostic tests, we did:

- The Collinearity by Variance Inflation Factors (VIF):

```

Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

      l_CAPEXTOTALASSETS  1.185
      l_ROA                1.843
l_DebtRatioFinancialLeverage 1.185
l_LeverageratioLongtermdebt 1.762
      l_PriceClose        3.290
      l_BookValuePerShare 3.345
      logTotalAssetssize  1.250

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:

      --- variance proportions ---
lambda  cond  const l_CAPEXT~  l_ROA l_DebtRa~  l_Levera~  l_PriceC~  l_BookVa~  logTotal~
6.932   1.000  0.000  0.001  0.005  0.003  0.004  0.000  0.000  0.000
0.514   3.671  0.000  0.002  0.729  0.003  0.008  0.001  0.001  0.000
0.260   5.165  0.000  0.015  0.002  0.013  0.798  0.001  0.002  0.001
0.201   5.878  0.000  0.009  0.074  0.779  0.081  0.000  0.000  0.002
0.050  11.828  0.003  0.218  0.070  0.085  0.001  0.029  0.144  0.033
0.032  14.830  0.038  0.733  0.053  0.020  0.092  0.003  0.016  0.111
0.008  29.798  0.091  0.021  0.057  0.028  0.000  0.447  0.628  0.333
0.004  40.779  0.868  0.000  0.009  0.068  0.016  0.519  0.208  0.519

lambda = eigenvalues of X'X, largest to smallest
cond   = condition index
note: variance proportions columns sum to 1.0

```

If $VIF > 10$ we might have problems of collinearity, but as you may observe there are none.

- The Heteroscedasticity using White's test:

```

White's test for heteroskedasticity
OLS, using observations 1-42737 (n = 12777)
Missing or incomplete observations dropped: 29960
Dependent variable: uhat^2

      coefficient   std. error   t-ratio   p-value
-----
const                5.54077      1.72524     3.212    0.0013 ***
l_CAPEXTOTALASSE~  -0.255511     0.190135    -1.344    0.1790
l_ROA                -0.124323     0.208711    -0.5957   0.5514
l_DebtRatioFinan~  -0.282828     0.842435    -0.3357   0.7371
l_LeverageratioL~  -0.398172     0.247295    -1.610    0.1074
l_PriceClose        -0.708435     0.354433    -1.999    0.0457 **
l_BookValuePerSh~   0.304314     0.381204     0.7983    0.4247
logTotalAssetssi~  -1.74801      0.487909    -3.583    0.0003 ***
sq_l_CAPEXTOTALA~   0.00569824    0.00631393   0.9025    0.3668
X2_X3                0.00986325    0.0158021    0.6242    0.5325
X2_X4               -0.0208902    0.0346194    -0.6034    0.5462
X2_X5               -0.000907465  0.0162134    -0.05597   0.9554
X2_X6                0.0360445     0.0265993    1.355     0.1754
X2_X7               -0.0405774    0.0284812    -1.425     0.1543
X2_X8                0.0437102     0.0291100    1.502     0.1332
sq_l_ROA            -0.00244635    0.00999595   -0.2447    0.8067
X3_X4                0.0302644     0.0533080    0.5677    0.5702
X3_X5                0.0223075     0.0289299    0.7711    0.4407
X3_X6                0.0518374     0.0327470    1.583     0.1135
X3_X7               -0.0147015    0.0288792    -0.5091    0.6107
X3_X8                0.0147854     0.0326238    0.4532    0.6504
sq_l_DebtRatioFi~   0.0113008     0.0342964    0.3295    0.7418
X4_X5               -0.0221037    0.0449496    -0.4917    0.6229
X4_X6               -0.0639362    0.0538393    -1.188     0.2350
X4_X7                0.0518916     0.0521867    0.9943    0.3201
X4_X8                0.0843121     0.129525     0.6509    0.5151
sq_l_Leveragerat~  -0.00345646    0.00743608   -0.4648    0.6421
X5_X6                0.0405159     0.0390405    1.038     0.2994
X5_X7               -0.000963067  0.0344371    -0.02797   0.9777
X5_X8                0.0397066     0.0350509    1.133     0.2573
sq_l_PriceClose     0.0506723     0.0326939    1.550     0.1212
X6_X7               -0.0557862    0.0505324    -1.104     0.2696
X6_X8                0.125440      0.0590600    2.124     0.0337 **
sq_l_BookValuePe~   0.0247863     0.0205010    1.209     0.2267
X7_X8               -0.0604035    0.0601207    -1.005     0.3151
sq_logTotalAsset~   0.138228      0.0388315    3.560     0.0004 ***

-----

Unadjusted R-squared = 0.009654

Test statistic: TR^2 = 123.352153,
with p-value = P(Chi-square(35) > 123.352153) = 0.000000
    
```

Here we have two hypothesis:

H0 – constant variance – Homoscedasticity

H1 – not constant variance – Heteroscedasticity

It is obtained a $-p$ value equal to 0 and therefore inferior to the usual significance values. We reject the null hypothesis and the model is confirmed to present Heteroskedasticity.

- To try and improve the model we use the Heteroskedasticity corrected:

```

File Edit Tests Save Graphs Analysis LaTeX

Model 3: Heteroskedasticity-corrected, using observations 1-42737 (n = 12777)
Missing or incomplete observations dropped: 29960
Dependent variable: l_BondPrice

-----
                coefficient    std. error    t-ratio    p-value
-----
const                3.34751      0.0598500    55.93     0.0000    ***
l_CAPEXTOTALASSE~    0.0576405    0.00509672   11.31     1.63e-029 ***
l_ROA                -0.0227432    0.00553072   -4.112    3.94e-05   ***
l_DebtRatioFinan~   -0.141930     0.0176165    -8.057    8.53e-016 ***
l_LeverageratioL~    0.0164076     0.00459752    3.569     0.0004    ***
l_PriceClose         0.122795      0.0106821    11.50     1.96e-030 ***
l_BookValuePerSh~   -0.132721     0.00948895   -13.99    3.96e-044 ***
logTotalAssetssi~    0.207407      0.00800841    25.90     3.52e-144 ***

Statistics based on the weighted data:

Sum squared resid    72334.21    S.E. of regression    2.380090
R-squared            0.136482    Adjusted R-squared    0.136009
F(7, 12769)         288.3128    P-value(F)            0.000000
Log-likelihood       -29205.20    Akaike criterion      58426.41
Schwarz criterion    58486.05    Hannan-Quinn          58446.35

Statistics based on the original data:

Mean dependent var   4.389385    S.D. dependent var    0.587537
Sum squared resid    4285.011    S.E. of regression    0.579292
    
```

In spite of improving the R^2 to 13% the $-p$ value is still 0. So the Heteroscedasticity maintains.

- RESET Ramsey TEST – which identifies a bad specification in the model

Here we have two hypothesis:

H0 - well specified model

H1 – not well specified model

```

gretl: RESET test

Auxiliary regression for RESET specification test
OLS, using observations 1-42737 (n = 12777)
Missing or incomplete observations dropped: 29960
Dependent variable: l_BondPrice

-----
                coefficient  std. error  t-ratio  p-value
-----
const                -433.795    30.9697   -14.01   3.00e-044 ***
l_CAPEXTOTALASSE~    -8.51907    0.604253  -14.10   8.41e-045 ***
l_ROA                 11.7806    0.835811   14.09   8.86e-045 ***
l_DebtRatioFinan~    16.6743    1.18172   14.11   7.14e-045 ***
l_LeverageratioL~   -4.39318    0.311616  -14.10   8.46e-045 ***
l_PriceClose        -23.0102    1.63197   -14.10   8.27e-045 ***
l_BookValuePerSh~   28.8190    2.04369   14.10   8.06e-045 ***
logTotalAssetssi~  -13.2968    0.942866  -14.10   7.95e-045 ***
yhat^2               37.1923    2.63772   14.10   8.21e-045 ***
yhat^3              -2.69048    0.192461  -13.98   4.40e-044 ***

Test statistic: F = 101.485546,
with p-value = P(F(2,12767) > 101.486) = 1.87e-044
    
```

The result is superior to the significance level of 5%. So the null hypothesis is rejected.

- Residuals Test

We will try two hypothesis:

H0 – variables with residual errors

H1 – variables without residual errors

```

gretl: summary stats: uhat2

Summary statistics, using the observations 1 - 42737
for the variable 'uhat2' (12777 valid observations)

Mean                -4.6595e-016
Median              0.21432
Minimum             -5.3841
Maximum             2.5463
Standard deviation   0.57260
C.V.                1.2289e+015
Skewness            -3.6475
Ex. kurtosis        22.545
5% percentile       -0.98576
95% percentile      0.38056
Interquartile range 0.35299
Missing obs.        29960
    
```

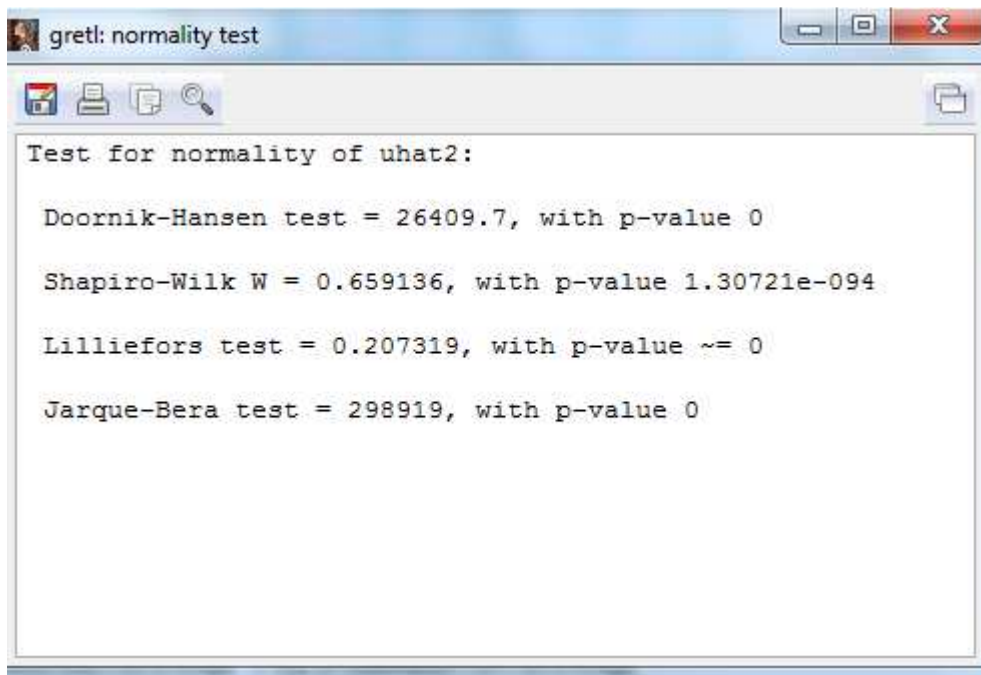
The mean value is inferior to the usual significance level, so the null hypothesis is not rejected.

- Last test done was the Normality Test with Jarque Bera

For the two hypothesis:

H0 – follow the normality

H1 – does not follow the normality



```
gretl: normality test

Test for normality of uhat2:

Doornik-Hansen test = 26409.7, with p-value 0
Shapiro-Wilk W = 0.659136, with p-value 1.30721e-094
Lilliefors test = 0.207319, with p-value ~ = 0
Jarque-Bera test = 298919, with p-value 0
```

Being –p equal to 0 and then inferior to the usual significance level, the null hypothesis is rejected.

Europe

In terms of Economic Theory we can observe that the bond price is 1,89905 with a positive sign which may imply that this is a well specified model. Furthermore we can verify that there is:

- a positive impact in the size of the company.
- a positive impact in the equity price.
- a positive impact in CAPEX (investment).
- a positive impact in the return of assets.
- a negative impact in the short term debt.

- a positive impact in the long term debt.
- a positive impact in the book value.

We can deduct from the R^2 that approximately 17% of the model is explained by the independent variables. We have a $-p$ value very small which infers a satisfactory estimation.

The variables more significant to the model at a significance value of 5% are size, equity price, short term debt (debt ratio) and the book value, the latter in 10%.

The test of global significance done through the restriction of variables demonstrates that the model is significant in its overall.

```
Restriction set
1: b[l_CAPEXTOTALASSETS] = 0
2: b[l_ROA] = 0
3: b[l_DebtRatioFinancialLeverage] = 0
4: b[l_LeverageratioLongtermdebt] = 0
5: b[l_PriceClose] = 0
6: b[l_BookValuePerShare] = 0
7: b[logTotalAssetssize] = 0

Test statistic: F(7, 1587) = 47.8699, with p-value = 6.65403e-062

Restricted estimates:

-----
                coefficient  std. error  t-ratio  p-value
-----
const                4.29410    0.0267833    160.3    0.0000 ***
l_CAPEXTOTALASSETS    0.00000    0.00000         NA     NA
l_ROA                 0.00000    0.00000         NA     NA
l_DebtRatioFinancialLeverage 0.00000    0.00000         NA     NA
l_LeverageratioLongtermdebt 0.00000    0.00000         NA     NA
l_PriceClose         0.00000    0.00000         NA     NA
l_BookValuePerShare  0.00000    0.00000         NA     NA
logTotalAssetssize   0.00000    0.00000         NA     NA

Standard error of the regression = 1.06966
```

In terms of diagnostic tests, we did:

- The Collinearity by Variance Inflation Factors (VIF):

```

Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

      1_CAPEXTOTALASSETS    2.394
              1_ROA        2.698
1_DebtRatioFinancialLeverage 1.798
1_LeverageratioLongtermdebt  1.190
              1_PriceClose  2.867
      1_BookValuePerShare   3.518
      logTotalAssetssize    4.108

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:

--- variance proportions ---
lambda   cond      const 1_CAPEXT~   1_ROA 1_DebtRa~ 1_Levera~ 1_PriceC~ 1_BookVa~ logTotal~
6.512    1.000    0.000  0.001   0.001  0.001  0.002  0.002  0.001  0.000
0.978    2.581    0.000  0.002   0.000  0.437  0.000  0.000  0.000  0.000
0.296    4.689    0.001  0.014   0.008  0.006  0.043  0.134  0.036  0.000
0.090    8.520    0.009  0.044   0.029  0.053  0.945  0.019  0.000  0.003
0.054   11.033    0.124  0.223   0.002  0.255  0.004  0.092  0.270  0.014
0.038   13.132    0.002  0.709   0.228  0.001  0.002  0.202  0.219  0.003
0.026   15.860    0.155  0.001   0.501  0.046  0.000  0.536  0.426  0.006
0.007   30.952    0.709  0.006   0.232  0.201  0.004  0.015  0.048  0.973

lambda = eigenvalues of X'X, largest to smallest
cond   = condition index
note: variance proportions columns sum to 1.0
    
```

If $VIF > 10$ we might have problems of collinearity, but as you may observe there are none.

- The Heteroscedasticity using White's test:

```

White's test for heteroskedasticity
OLS, using observations 1-5170 (n = 1595)
Missing or incomplete observations dropped: 3575
Dependent variable: uhat^2

      coefficient   std. error   t-ratio   p-value
-----
const                7.88579    4.66352    1.691    0.0910   *
l_CAPEXTOTALASSE~   -1.46538    0.569806  -2.572    0.0102   **
l_ROA                -2.69734    0.859115  -3.140    0.0017   ***
l_DebtRatioFinan~    3.91894    3.24158    1.209    0.2269
l_LeverageratioL~    1.42189    1.12845    1.260    0.2078
l_PriceClose        -3.88903    0.777114  -5.004    6.24e-07 ***
l_BookValuePerSh~    4.40797    0.921543    4.783    1.89e-06 ***
logTotalAssetssi~   -3.46676    1.66734    -2.079    0.0378   **
sq_l_CAPEXTOTALA~    0.0122193  0.0194459    0.6284    0.5299
X2_X3                0.172514    0.0769228    2.243    0.0251   **
X2_X4               -0.686906    0.264288    -2.599    0.0094   ***
X2_X5                0.413279    0.110210    3.750    0.0002   ***
X2_X6                0.361506    0.0742848    4.866    1.25e-06 ***
X2_X7               -0.358859    0.0804723    -4.459    8.81e-06 ***
X2_X8                0.350276    0.0964226    3.633    0.0003   ***
sq_l_ROA             0.326696    0.0946572    3.451    0.0006   ***
X3_X4                0.244665    0.347354    0.7044    0.4813
X3_X5                0.704482    0.211149    3.336    0.0009   ***
X3_X6               -0.0165307  0.153929    -0.1074    0.9145
X3_X7               -0.500166    0.158155    -3.162    0.0016   ***
X3_X8                1.20296    0.206560    5.824    6.97e-09 ***
sq_l_DebtRatioFi~   -0.265670    0.351869    -0.7550    0.4503
X4_X5                1.94085    0.499611    3.885    0.0001   ***
X4_X6               -0.661807    0.478564    -1.383    0.1669
X4_X7                0.540733    0.526051    1.028    0.3042
X4_X8               -0.155439    0.543523    -0.2860    0.7749
sq_l_Leveragerat~   -0.112743    0.132741    -0.8493    0.3958
X5_X6               -0.477671    0.195649    -2.441    0.0147   **
X5_X7                0.309462    0.223980    1.382    0.1673
X5_X8                0.545226    0.191842    2.842    0.0045   ***
sq_l_PriceClose     -0.213722    0.0622098    -3.435    0.0006   ***
X6_X7               -0.444112    0.123835    -3.586    0.0003   ***
X6_X8                0.983921    0.163925    6.002    2.42e-09 ***
sq_l_BookValuePe~    0.710868    0.100508    7.073    2.28e-012 ***
X7_X8               -1.48702    0.179538    -8.282    2.57e-016 ***
sq_logTotalAsset~    0.792948    0.174183    4.552    5.72e-06 ***

X7_X8               -1.48702    0.179538    -8.282    2.57e-016 ***
sq_logTotalAsset~    0.792948    0.174183    4.552    5.72e-06 ***

Unadjusted R-squared = 0.347673

Test statistic: TR^2 = 554.538042,
with p-value = P(Chi-square(35) > 554.538042) = 0.000000

```

Here we have two hypothesis:

H0 – constant variance – Homoscedasticity

H1 – not constant variance – Heteroscedasticity

It is obtained a $-p$ value equal to 0 and therefore inferior to the usual significance values. We reject the null hypothesis and the model is confirmed to present Heteroscedasticity.

- To try and improve the model we use the Heteroskedasticity corrected:

```

File Edit Tests Save Graphs Analysis LaTeX
-----
Model 2: Heteroskedasticity-corrected, using observations 1-5170 (n = 1595)
Missing or incomplete observations dropped: 3575
Dependent variable: l_Bond_Price

      coefficient  std. error  t-ratio  p-value
-----
const          2.30142    0.147365   15.62    2.96e-051 ***
l_CAPEXTOTALASSE~  0.0113844  0.00562407   2.024    0.0431 **
l_ROA           0.0393550  0.00851973   4.619    4.16e-06 ***
l_DebtRatioFinan~ -0.816380   0.0467108  -17.48    1.08e-062 ***
l_LeverageratioL~  0.0110466  0.0169851   0.6504    0.5155
l_PriceClose     0.0624579  0.00898899   6.948    5.38e-012 ***
l_BookValuePerSh~  0.0550565  0.0126498   4.352    1.43e-05 ***
logTotalAssetssi~  0.245804   0.0166153   14.79    1.73e-046 ***

Statistics based on the weighted data:

Sum squared resid  9762.899  S.E. of regression  2.480281
R-squared          0.258666  Adjusted R-squared  0.255396
F(7, 1587)        79.10494  P-value(F)          1.32e-98
Log-likelihood     -3708.050  Akaike criterion    7432.100
Schwarz criterion  7475.097  Hannan-Quinn        7448.069

Statistics based on the original data:

Mean dependent var  4.294104  S.D. dependent var  1.069657
Sum squared resid  1538.209  S.E. of regression  0.984508

Excluding the constant, p-value was highest for variable 13 (l_LeverageratioLongtermdebt)
    
```

In spite of improving the R^2 to 26%, the $-p$ value has a negative value of $1.32e-98$. So the Heteroscedasticity maintains.

- RESET Ramsey TEST – which identifies a bad specification in the model

Here we have two hypothesis:

H0 - well specified model

H1 – not well specified model

```

gretl: RESET test
Auxiliary regression for RESET specification test
OLS, using observations 1-5170 (n = 1595)
Missing or incomplete observations dropped: 3575
Dependent variable: l_Bond_Price

-----
                coefficient    std. error    t-ratio    p-value
-----
const                4.65570         1.68054         2.770     0.0057 ***
l_CAPEXTOTALASSE~    0.161595         0.0621448       2.600     0.0094 ***
l_ROA                 0.366043         0.133588        2.740     0.0062 ***
l_DebtRatioFinan~   -4.88314         1.64944        -2.960     0.0031 ***
l_LeverageratioL~    0.267215         0.0937756       2.850     0.0044 ***
l_PriceClose         0.527088         0.181822        2.899     0.0038 ***
l_BookValuePerSh~    0.584694         0.206020        2.838     0.0046 ***
logTotalAssetssi~    2.18814         0.757270        2.890     0.0039 ***
yhat^2              -1.37693         0.650640       -2.116     0.0345 **
yhat^3               0.0960849        0.0554651       1.732     0.0834 *

Test statistic: F = 8.622676,
with p-value = P(F(2,1585) > 8.62268) = 0.000189
    
```

The result is superior to the significance level of 5%. So the null hypothesis is rejected.

- Residuals Test

We will try two hypothesis:

H0 – variables with residual errors

H1 – variables without residual errors

```

gretl: summary stats: usq1
Summary statistics, using the observations 1 - 5170
for the variable 'usq1' (1595 valid observations)

Mean                0.94410
Median              0.068932
Minimum             2.0541e-008
Maximum             73.111
Standard deviation   4.5792
C.V.                4.8504
Skewness            10.359
Ex. kurtosis        128.37
5% percentile       0.00022522
95% percentile      2.8665
Interquartile range 0.36135
Missing obs.        3575
    
```

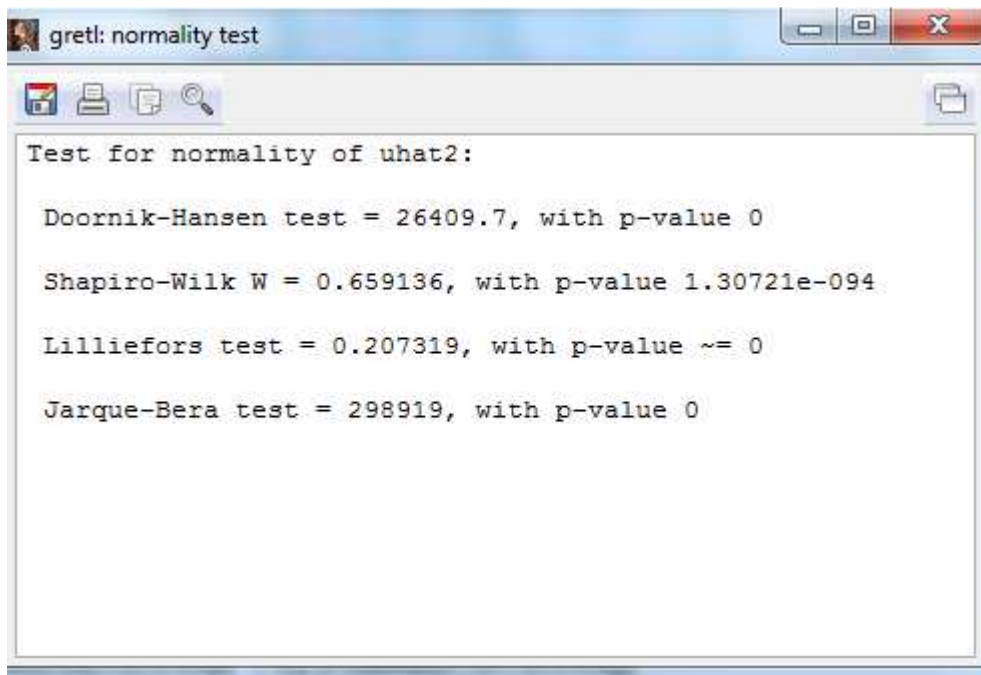
The mean value is superior to the usual significance level, so the null hypothesis is rejected.

- Last test done was the Normality Test with Jarque Bera

For the two hypothesis:

H0 – follow the normality

H1 – does not follow the normality



```
gretl: normality test

Test for normality of uhat2:

Doornik-Hansen test = 26409.7, with p-value 0
Shapiro-Wilk W = 0.659136, with p-value 1.30721e-094
Lilliefors test = 0.207319, with p-value ~ = 0
Jarque-Bera test = 298919, with p-value 0
```

Being –p equal to 0 and then inferior to the usual significance level, the null hypothesis is rejected.

2.5 Discussion of the results

Both models are equally important to understand the bond pricing feature.

Both models provide a R^2 and adjusted R^2 are positive, in spite of being low, which might infer problems with the sample used or with the type of variables used.

In terms of North America and passing through the Hypothesis in analysis remembering the model:

$$\text{BondPrice} = 4,09031 + 0,0781215 \text{ size} + 0,135672 \text{ equityprice} + 0,0500981 \text{ CAPEX} - 0,0693628 \text{ ROA} - 0,981628 \text{ Debt} + 0,0258104 \text{ LTDebt} - 0,169873 \text{ BV}$$

- Hypothesis 1a: As the investment in assets (CAPEX) becomes larger so does the bond pricing?

Indeed the answer is positive to this question because a unit of 4,09031 implies an increase in CAPEX of 0,0500981. So once again Stein (1992) findings and Mayers (1998) are correct.

- Hypothesis 1b: Does the investment increase when a bond is issued?

By the positive reply to the hypothesis above, (1992) Stein theory and King and Mauer (2014) have done their work well.

- Hypothesis 2: Does the Return on Assets (ROA) decrease with the issuance of a bond?

As probably noticed there is no clear theory on this variable but obviously the result is correct with the hypothesis perhaps because the Net Income also decreases when the company issues a bond. The value is analysis is -0,0693628 in one unit of bond price.

- Hypothesis 3: Is the company size affected by the bond price increase?

Again Stein (1992) and King and Mauer (2014) indicate a strong increase in company size and it is a correct theory if we see the positive impact in the model.

- Hypothesis 4: Does Debt increase along with the increase in bond pricing?

It depends on the timeframe of the debt. If short it has a negative impact of 0,981628, if long term it has a positive impact of 0,0258104.

- Hypothesis 5: Does the equity price decrease when the bond price increases?

Loncarski, Horst and Velt (2009) defended that in short-term the equity price is affected by convertible arbitrage activities in terms of downward movements. In North America price does increase opposing the theory of Loncarski, Horst and Velt (2009).

- Hypothesis 6: Is book value influenced positively by the increase in bond pricing?

As initially previewed the book value of a company is influenced negatively by the issuance of bonds or fluctuations of its price. We could not find any proves for this assumption.

Now for Europe and passing through the Hypothesis in analysis remembering the model:

$$\text{BondPrice} = 1,89905 + 0,301317 \text{ size} + 0,0718560 \text{ equityprice} + 0,0232721 \text{ CAPEX} + 0,0496483 \text{ ROA} - 0,673428 \text{ Debt} + 0,0363880 \text{ LTDebt} + 0,0786543 \text{ BV}$$

- Hypothesis 1a: As the investment in assets (CAPEX) becomes larger so does the bond pricing?

Likewise for North America data, the answer is also positive to this question because a unit of 4,09031 implies an increase in CAPEX of 0,0232721. So once again Stein (1992) findings and Mayers (1998) are correct.

- Hypothesis 1b: Does the investment increase when a bond is issued?

By the positive reply to the hypothesis above, (1992) Stein theory and King and Mauer (2014) have done their work well.

- Hypothesis 2: Does the Return on Assets (ROA) decrease with the issuance of a bond?

As probably noticed there is no clear theory on this variable but in Europe, unlike North America, the result is incorrect with the hypothesis. The value in analysis is positive in 0,0496483 in one unit of bond price.

- Hypothesis 3: Is the company size affected by the bond price increase?

Again Stein (1992) and King and Mauer (2014) indicate a strong increase in company size and it is a correct theory if we see the positive impact in the model

- Hypothesis 4: Does Debt increase along with the increase in bond pricing?

Similarly to North America, it depends on the timeframe of the debt. If short it has a negative impact of 0,673428, if long term it has a positive impact of 0,0363880.

- Hypothesis 5: Does the equity price decrease when the bond price increases?

Loncarski, Horst and Velt (2009) defended that in short-term the equity price is affected by convertible arbitrage activities in terms of downward movements. In North America and also in Europe, the price does increase opposing the theory of Loncarski, Horst and Velt (2009).

- Hypothesis 6: Is book value influenced positively by the increase in bond pricing?

Unlike the initially predicted, the book value of a company in Europe is influenced positively by the issuance of bonds or fluctuations of its price. We could not find any proves for this assumption neither for the positive nor for the negative influence.

CONCLUSIONS AND PERSPECTIVES

Across several studies, we can find several interesting conclusions in how convertible bonds may help (or not so much) the company and the investor as the main stakeholders in the capital markets.

The different issues that all these stakeholders may encounter such as the debt-alike or equity-alike, or problems of asymmetry, agency and signaling, limits the access or damages the convertibles as a “safe” security. The probability of default or some soft or hard call provisions happening tend to distance the investor from these kind of corporate bonds.

Nonetheless it is proven that the issuance of convertible bonds may help the company to finance itself whenever there is an investment opportunity with the advantage of not having its leverage increased. The probability of actually stop being a bondholder and start being a shareholder is also something that pleases the investor.

However not all the features are positive, because the convertible bond functions well when there is a low interest rate, but when it starts climbing, the bondholder does not want to receive a low interest rate or to have its investment involved with a bond that does not compensate him as a straight bond does, for example.

Throughout this work, we studied several theories, clarified some topics and came out with a model that tries to get the best variables that affect both the security and its issuer. This model was a start to comply with a gap existent in the market which cannot manage the valuation in its overall.

The “basic” model is based in severable variables that refer both capital structure (debt, capex, assets) and market price (equity and bond). Moreover this model is divided by the two geographies studied (Europe and North America) with a large sample of issues and issuers. This maybe a reason for the entropy found in the model that could not be explained or achieve its main role of understanding several determinants to evaluate a convertible bond.

This was an essay to what should be done in the future and that we found as a limitation. To improve this model, it is necessary to study other variables such as time on issuance or other capital structure variables such as free cash flow. Also, we suggest a thorough study of other markets such as Japan. From the several reading we did, the

Japanese tend to have an even different approach to convertibles and treat this security as an important part of their long term investment.

REFERENCES

Asquith, P. (1995). Convertible bonds are not called late. *The Journal of Finance*, 50(4), 1275-1289. Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1995.tb04058.x>

Batten, J. A., Khaw, K. L. H. & Young, M. R. (2014). Convertible bond pricing models. *Journal of Economic Surveys*, 28(5), 775-803. Available at <https://onlinelibrary.wiley.com/doi/full/10.1111/joes.12016>

Batten, J. A., Khaw, K. L. H., & Young, M. R. (2018). Pricing convertible bonds. *Journal of Banking & Finance*, 92, 216-236. Available at <https://www.sciencedirect.com/science/article/pii/S0378426618301006> doi: [10.1016/j.jbankfin.2018.05.006](https://doi.org/10.1016/j.jbankfin.2018.05.006)

Brennan, M. J. & Schwartz, E. S. (1980). Analyzing convertible bonds. *Journal of Financial and Quantitative analysis*, 15(4), 907-929. Available at <https://www.cambridge.org/core/journals/journal-of-financial-and-quantitative-analysis/article/analyzing-convertible-bonds/A77A3855FFAE7F932FFA38579CF77598> doi: [10.2307/2330567](https://doi.org/10.2307/2330567)

Brennan, M. & Kraus, A. (1987). Efficient financing under asymmetric information. *The Journal of Finance*, 42(5), 1225-1243. Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1987.tb04363.x>

Brennan, M. J. & Schwartz, E. S. (1988). The case for convertibles. *Journal of Applied Corporate Finance*, 1(2), 55-64. Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1745-6622.1988.tb00166.x>

De Spiegeleer, J. & Schoutens, W. (2011). Pricing contingent convertibles: A derivatives approach. Working paper. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1795092

Downs, J. & Goodman, J. E. (2018). *Dictionary of Finance and Investment Terms*. Barrows.

Dutordoir, M., Lewis, C., Seward, J. & Veld, C. (2014). What we do and do not know about convertible bond financing. *Journal of Corporate Finance*, 24, 3-20. Available at <https://www.sciencedirect.com/science/article/pii/S0929119913001089> doi: [10.1016/j.jcorpfin.2013.10.009](https://doi.org/10.1016/j.jcorpfin.2013.10.009)

Fernandes, A. L. C.; Mota, P. R.; Alves, C. F. & Rocha, M. D. (2018). *Mercados, Produtos e Valorimetria de Ativos Financeiros*. Coimbra: Almedina

Frank, M. Z. & Goyal, V. K. (2003). Testing the pecking order theory of capital structure. *Journal of financial economics*, 67(2), 217-248. Available at <https://www.sciencedirect.com/science/article/pii/S0304405X02002520> doi: [10.1016/S0304-405X\(02\)00252-0](https://doi.org/10.1016/S0304-405X(02)00252-0)

Green, R.C. (1984). Investment incentives, debt, and warrants. *Journal of Financial Economics*, 13(1), 115–136. Available at <https://www.sciencedirect.com/science/article/pii/0304405X84900345> doi: [10.1016/0304-405X\(84\)90034-5](https://doi.org/10.1016/0304-405X(84)90034-5)

Harris, M., & Raviv, A. (1985). A sequential signalling model of convertible debt call policy. *The Journal of Finance*, 40(5), 1263-1281. Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1985.tb02382.x>

Henderson, B. J., & Zhao, B. (2014). More than meets the eye: Convertible bond issuers' concurrent transactions. *Journal of Corporate Finance*, 24, 57-79. Available at

<https://www.sciencedirect.com/science/article/pii/S0929119913000916> doi:
[10.1016/j.jcorpfin.2013.10.001](https://doi.org/10.1016/j.jcorpfin.2013.10.001)

Hundt, S., Sprungk, B. & Horsch, A. (2017). The information content of credit ratings: evidence from European convertible bond markets. *The European Journal of Finance*, 23(14), 1414-1445. Available at <https://www.tandfonline.com/doi/abs/10.1080/1351847X.2016.1204333> doi: [10.1080/1351847X.2016.1204333](https://doi.org/10.1080/1351847X.2016.1204333)

Ingersoll, J. E. (1977a) A contingent-claims valuation of convertible securities. *Journal of Financial Economics*, 4(3), 289–321. Available at <https://www.sciencedirect.com/science/article/pii/0304405X77900046> doi: [10.1016/0304-405X\(77\)90004-6](https://doi.org/10.1016/0304-405X(77)90004-6)

Ingersoll, J. (1977b). An examination of corporate call policies on convertible securities. *The Journal of Finance*, 32(2), 463-478. Available at <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.1977.tb03285.x>

Jensen, M. C. & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, 3(4), 305-360. Available at <https://www.sciencedirect.com/science/article/pii/0304405X7690026X> doi: [10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X)

John, K. & Litov, L. P. (2010). Corporate governance and financing policy: New evidence.

Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=637341

Kaźmierczak, D. (2017). Do Callable Convertibles Support The Investment Process Of A Company? An Analysis Of The World Market Of Hybrid Debt. *Comparative Economic Research*, 20(2), 5-19. Available at

<https://content.sciendo.com/view/journals/cer/20/2/article-p5.xml> doi: 10.1515/cer-2017-0009

King, T. H. D. & Mauer, D. C. (2014). Determinants of corporate call policy for convertible bonds. *Journal of Corporate Finance*, 24, 112-134. Available at <https://www.sciencedirect.com/science/article/pii/S0929119912000624> doi: [/10.1016/j.jcorpfin.2012.06.011](https://doi.org/10.1016/j.jcorpfin.2012.06.011)

Korkeamaki, T. & Moore, W. T. (2004). Capital investment timing and convertible debt financing. *International Review of Economics & Finance*, 13(1), 75-85. Available at <https://www.sciencedirect.com/science/article/pii/S1059056003000340> doi: [10.1016/S1059-0560\(03\)00034-0](https://doi.org/10.1016/S1059-0560(03)00034-0)

Korkeamaki, T. & Michael, T. B. (2013). Where are they now? An analysis of the life cycle of convertible bonds. *Financial Review*, 48(3), 489-509. Available at <https://onlinelibrary.wiley.com/doi/full/10.1111/fire.12012>

Krishnaswami, S. & Yaman, D. (2008). The role of convertible bonds in alleviating contracting costs. *The Quarterly Review of Economics and Finance*, 48(4), 792-816. Available at <https://www.sciencedirect.com/science/article/pii/S1062976907000488> doi: [10.1016/j.qref.2007.03.005](https://doi.org/10.1016/j.qref.2007.03.005)

Lewis, C. M., Rogalski, R. J. & Seward, J. K. (1999). Is convertible debt a substitute for straight debt or for common equity?. *Financial management*, 5-27. Available at https://www.jstor.org/stable/3666180?seq=1#page_scan_tab_contents doi: 10.2307/3666180

Loncarski, I., Ter Horst, J. & Veld, C. (2009). The rise and demise of the convertible arbitrage strategy. Available at

https://www.jstor.org/stable/40390205?seq=1#page_scan_tab_contents or at
<https://www.jstor.org/stable/40390205>

Mayers, D. (1998). Why firms issue convertible bonds: the matching of financial and real investment options. *Journal of financial economics*, 47(1), 83-102. Available at <https://www.sciencedirect.com/science/article/pii/S0304405X9700038X> doi: [10.1016/S0304-405X\(97\)00038-X](https://doi.org/10.1016/S0304-405X(97)00038-X)

Murteira J. & Castro, V. (2016), *Introdução à Econometria*. Coimbra: Almedina

Myers, S. C. & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of financial economics*, 13(2), 187-221. Available at <https://www.sciencedirect.com/science/article/pii/0304405X84900230> doi: [doi.org/10.1016/0304-405X\(84\)90023-0](https://doi.org/10.1016/0304-405X(84)90023-0)

Nyborg, K. G. (1995). Convertible debt as delayed equity: forced versus voluntary conversion and the information role of call policy. *Journal of Financial Intermediation*, 4(4), 358-395. Available at <https://www.sciencedirect.com/science/article/pii/S1042957385710157> doi: [10.1006/jfin.1995.1015](https://doi.org/10.1006/jfin.1995.1015)

Olivier, A., Florence, A., & Jean-Laurent, V. (2018). Callable convertible bonds in sequential financing: Evidence on the Western European market. *Journal of Multinational Financial Management*. Available at <https://www.sciencedirect.com/science/article/pii/S1042444X17302724> doi: [10.1016/j.mulfin.2018.04.001](https://doi.org/10.1016/j.mulfin.2018.04.001)

Rastad, M. (2016). Capital structure pre-balancing: Evidence from convertible bonds. *Journal of Corporate Finance*, 41, 43-65. Available at

<https://www.sciencedirect.com/science/article/pii/S0929119916301122>
[/10.1016/j.jcorpfin.2016.08.015](https://doi.org/10.1016/j.jcorpfin.2016.08.015)

doi:

Stein, J. C. (1992). Convertible bonds as backdoor equity financing. *Journal of Financial Economics*, 32(1), 3–21. Available at <https://www.nber.org/papers/w4028>
doi: 10.3386/w4028

Steiner, B. (2017). *Os Principais Conceitos do Mercado Financeiro*. Actual Editora.

Tan, Y. & Yang, Z. (2016). Contingent capital, capital structure and investment. *The North American Journal of Economics and Finance*, 35, 56-73. Available at Doi: [10.1016/j.najef.2015.10.016](https://doi.org/10.1016/j.najef.2015.10.016)

Zähres, M. (2011). Contingent Convertibles: Bank bonds take on a new look. *Deutsche Bank Research, Financial Market Special, EU Monitor*, 79.

APPENDICES

APPENDIX 1 - Table 1: Corporate Bond Market size: 2006 to 2016

Table 1: Corporate Bond Market size: 2006 to 2016

Year	EUROPE									North America						
	Conv.Bond	C.Bond	Σ C.Bonds	Amount Issued Conv.Bond	Amount Issued C.Bond	Σ Corporate Bonds	%Number Cv.vs C.Bonds	%Volume Cv.vs C.Bonds	Conv.Bond	C.Bond	Σ C.Bonds	Amount Issued Conv.Bond	Amount Issued C.Bond	Σ Corporate Bonds	%Number Cv.vs C.Bonds	%Volume Cv.vs C.Bonds
2006	389	6532	6921	12,689	637,246	650	5,62%	1,95%	347	3358	3705	109,819	571,399	681	9,37%	16,12%
2007	395	6740	7135	31,946	561,310	593	5,54%	5,38%	516	5913	6429	119,578	626,514	746	8,03%	16,03%
2008	392	8130	8522	13,432	3.394,011	3.407	4,60%	0,39%	1918	4294	6212	59,046	579,157	638	30,88%	9,25%
2009	305	9783	10088	31,807	1.148,558	1.180	3,02%	2,69%	2343	1950	4293	69,666	736,299	806	54,58%	8,64%
2010	370	8549	8919	22,927	1.825,599	1.849	4,15%	1,24%	3432	2725	6157	62,952	781,288	844	55,74%	7,46%
2011	542	5923	6465	66,301	817,613	884	8,38%	7,50%	3243	2868	6111	63,866	857,192	921	53,07%	6,93%
2012	582	9238	9820	41,415	1.075,525	1.117	5,93%	3,71%	2993	3443	6436	58,638	1.114,221	1.173	46,50%	5,00%
2013	212	9127	9339	16,859	602,256	619	2,27%	2,72%	2659	3844	6503	109,921	1.174,716	1.285	40,89%	8,56%
2014	232	9431	9663	21,456	971,225	993	2,40%	2,16%	1954	5019	6973	131,774	1.387,829	1.520	28,02%	8,67%
2015	348	8355	8703	25,168	939,131	964	4,00%	2,61%	1025	4536	5561	66,893	1.519,906	1.587	18,43%	4,22%
2016	60	7835	7895	21,536	839,445	861	0,76%	2,50%	797	3928	4725	68,362	2.266,779	2.335	16,87%	2,93%

Following Batten, Khaw & Young (2016), based in the sample used for this work, this table shows the convertible bond market as part of the corporate bond market and its expression in Europe and North America for the period of 2006 to 2016. The columns named “Conv.Bond” refer to Convertible Bonds and “C.Bond” refer to Corporate Bonds “only”. As Convertible Bonds are included in Corporate Bonds Market we did a small sum of amounts issued in numbers as well as in the value issued. The amounts shown are the ones issued in each year converted into thousands of million Euros. All data is sourced from Thomson Reuters Eikon Premium through the Fixed Income Advanced Search.

**APPENDIX 2 - Table 3 – Number of convertible bonds issued between
2006 and 2016 by sector and by country**

Country of Issue	Sector	YEAR										
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Austria	Banking	146	110	97	58	90	124	24	22	5	3	1
	Financial - Other		4		2	2	1	3				
	Mortgage Banking				2							
	Pharmaceuticals						1					
	Real Estate Investment Trust				2		1			2		
	Service - Other											2
Belgium	Financial - Other						1		3	1		4
	Information/Data Technology		2									
Bulgaria	Independent Finance										2	
Croatia	Service - Other							2				
Cyprus	Banking						6					
Czech Republic	Banking									1	1	
Denmark	Banking						1		1		1	1
	Information/Data Technology			2								
Finland	Financial - Other	1	2				2					
	Health Care Supply					1						
	Machinery				2							
	Metals/Mining	2										1
	Retail Stores - Other	2										
France	Aerospace											1
	Automotive Manufacturer				2							
	Banking		1	2	4	3			1	1	4	2
	Beverage/Bottling											2
	Cable/Media	2										
	Chemicals		2									
	Conglomerate/Diversified Mfg		2		2	2						
	Consumer Products				2							
	Containers				2							
	Electronics		4		2	1		1	2			2
	Financial - Other	5	26	10	8	26	4	1	5	6	14	4
	Food Processors	2		2							2	
	Health Care Facilities					2			2			
	Home Builders	2				2	2	1	1			
	Industrials - Other	4			2			3		2		
	Information/Data Technology	2	2	2	8	4	6		1	6	2	
	Leisure				2	2	1		1	2		2
	Machinery				2							
	Metals/Mining											2
	Oil and Gas	2	2				1	1				2
	Oilfield Machinery and Services				2	2				2	2	
	Pharmaceuticals	2										
	Real Estate Investment Trust		1		1	2		1		1	1	
	Retail Stores - Other		4									
	Securities				2							
	Service - Other	2	5	6	7		1	1		3	1	1
	Telecommunications				2				2	4		
	Textiles/Apparel/Shoes	2										
	Utility - Other		2									
	Vehicle Parts					2			2			

Determinants for convertible bonds valuation

Country of Issue	Sector	YEAR										
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Germany	Banking	92	21	43	55	121	254	321	74	44	101	
	Cable/Media									1		
	Conglomerate/Diversified Mfg	2				1	1	1				
	Consumer Products									2		
	Electronics					1	3			2		
	Financial - Other	7	20	14	29	18	60	152	29	68	151	7
	Gas Utility - Pipelines			1								
	Health Care Facilities									4		
	Health Care Supply							2				
	Home Builders										2	
	Industrials - Other			1	2			2	3		2	
	Information/Data Technology			5	3					2		
	Leasing			2				1				
	Leisure			3	2		1	2				
	Machinery								2			
	Metals/Mining							1		2	2	
	Oil and Gas						1					
	Pharmaceuticals	2								2		
	Real Estate Investment Trust			2		2			2		6	
	Securities				2	2	1				7	
Service - Other			1			2	3	1	3			
Telecommunications							2					
Utility - Other			1	2	2	2			3		1	
Greece	Financial - Other					2		2				
	Food Processors			2								
	Service - Other	1										
	Telecommunications										1	
Iceland	Banking			2								
	Financial - Other			1								
Ireland	Banking						2					
Italy	Banking	2	1	4	6	6	2		1			
	Chemicals								1			
	Financial - Other	2	2		2		2		2	6	2	4
	Food Processors									2		
	Health Care Facilities			2				2			2	
	Home Builders						1					
	Life Insurance							1				
	Metals/Mining				2							
	Retail Stores - Other									2		
	Service - Other									1	5	2
	Telecommunications											1
	Utility - Other								2	4		2
	Vehicle Parts									4		
Jersey	Financial - Other										2	
Lithuania	Electronics					1						
Netherlands	Banking		20	26		2						
Norway	Banking				1	1		1		10	10	1
	Building Products						1					
	Electronics	2										
	Financial - Other	6	4	3	2	1	2	3			1	3
	Food Processors			1	2		2		2			
	Industrials - Other	1										
	Leisure			1								
Life Insurance										1		

Determinants for convertible bonds valuation

Country of Issue	Sector	YEAR										
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Norway (cont.)	Machinery		2									
	Metals/Mining				1			2				
	Mortgage Banking									1	1	
	Oil and Gas	8	11	1		1		4	2			2
	Oilfield Machinery and Services		4	1	2	1						
	Service - Other	3			1							
	Transportation - Other		3	1	1	1	1			1		2
Utility - Other					2			1				
Poland	Financial - Other				2	4						
	Real Estate Investment Trust								3			
	Service - Other					2						
	Utility - Other						2					
Portugal	Banking	2			1		1					
Russia	Banking							1	1			
	Chemicals			2								
Spain	Banking		2		4	2	9	12	11			
	Financial - Other				2	2						
	Food Processors											1
	Home Builders				2			1				
	Securities							1				
	Textiles/Apparel/Shoes	2										
Sweden	Airline					2					2	
	Banking										1	
	Electronics							2	2			
	Financial - Other		2		2	3			6	6		1
	Health Care Supply					2		1				
	Machinery				2							
	Metals/Mining					4	1					
	Oil and Gas				2				2			
	Pharmaceuticals				1			1				
	Publishing										2	
	Service - Other					1	2	1	2			1
	Utility - Other								1			
	Switzerland	Banking	57	46	137	30	25	22	10	10	7	9
Building Products											2	
Chemicals					2							
Conglomerate/Diversified Mfg									2	2		1
Consumer Products			1									
Electronics			2									
Financial - Other		19	59	24	20	4	3	8		7	4	1
Food Processors							2					
Home Builders			1									
Industrials - Other		1										
Information/Data Technology												1
Life Insurance										1		
Machinery											2	
Pharmaceuticals				3			2					1
Property and Casualty Insurance									1			
Securities					5			3				
Service - Other		1				4	2					2
Vehicle Parts	1											

Determinants for convertible bonds valuation

Country of Issue	Sector	YEAR										
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
United Kingdom	Financial - Other			2	2	6	3	4	6	5		
	Information/Data Technology					2						
	Metals/Mining		3									
	Oil and Gas	2						1				
	Real Estate Investment Trust					1						
	Retail Stores - Other										1	
	Securities						1					
United States	Service - Other								1			
	Aerospace				3	2		2				2
	Airline	9		11	8				1		1	
	Automotive Manufacturer	1	4		8			4	2	4		
	Banking	7	70	1464	1926	3094	2872	2725	2232	1640	835	580
	Building Products	2	4	1	1	7	8		5		4	2
	Cable/Media	2	7	1	7	4	4	2	8		4	5
	Chemicals		1	4	3	3		1	6	2	3	2
	Conglomerate/Diversified Mfg	2	1	1	7		4			4	1	
	Consumer Products	6	3		3							
	Containers					2						
	Electronics	30	43	14	19	11	29	14	36	11	23	11
	Financial - Other	64	81	256	198	113	131	70	93	77	42	46
	Food Processors	1	8	5	1					2		1
	Health Care Facilities		11	1				6	3	3	4	4
	Health Care Supply	17	21	5		5	7	6	5	18	7	10
	Home Builders		2	1	1	7	4	10	5	2	3	
	Industrials - Other	11	11	3	4	2	4	2	4	8	2	4
	Information/Data Technology	25	23	6	10	28	12	13	49	23	11	6
	Leasing						4					
	Leisure	4			10			2	1	1	3	
	Life Insurance		1		4	8	2		3			1
	Machinery	9	2		3		6		2	1		2
	Metals/Mining	5	20	20	18	13	9	12	19	2	4	5
	Mortgage Banking			2	3			2	3			
	Oil and Gas	6	20	16	9	14	8	15	12	10	14	26
	Oilfield Machinery and Services	3	6	1		3	1	5				1
	Pharmaceuticals	42	25	18	8	16	17	20	46	38	18	17
	Property and Casualty Insurance				1	5	5		2	2		
	Publishing						6	3	4			2
	Real Estate Investment Trust	26	29	5	6	10	10	4	22	14	3	1
	Retail Stores - Other	4	8	1	5			3	1	4		
	Securities		10	36	2	3	2	2	2	4		27
	Service - Other	23	34	9	8	18	29	5	31	37	20	9
	Telecommunications	5	13	8	8	8	4	2	4			
	Textiles/Apparel/Shoes	2	3		1		4		4			
	Transportation - Other	5	10	3	3	3	4	5	1	5	1	
Utility - Other		6	6		2	2		6	7	4	4	
Vehicle Parts	3	3		8	3		3	4	3		1	
Railroads	2					3	2					
Tobacco	2			5			2		2			
Lodging		1	1	3	2							
Restaurants				1								
Gaming	1		2									
Retail Stores - Food/Drug			2							2	1	
Gas Utility - Local Distrib									2			

Determinants for convertible bonds valuation

Globe Region	Call anticipation	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Europe (cont)	1672				1						
	1707		1								
	2008									2	
	4680				2						
	105327										2
	105403										4
	106285						2				
North America	0	406	2194	2915	3055	2461	2258	1912	1203	894	
	1			3	6	49	40	59	64	50	73
	2				2	14	19	21	57	50	42
	3				3	7	20	21	31	16	20
	4			2		6	12	5	13	11	14
	5				2	2	6	4	10	14	2
	6						3		3		3
	7						3		1	1	
	8					1					
	9					2			2		
	10								1		1
	11						1			1	
	13						1				
	15					1	1				
	18							1			
	20						1				
	25									1	
	30					1					
	49									1	2
	62									1	
	94						1				
	213										1
	219									1	
	247									3	1
	294										1
	307										1
	325									1	
	332									1	
	336		1								
	365									1	
368										1	
373										1	
392									1		
395									1		

Determinants for convertible bonds valuation

Globe Region	Call anticipation	Year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
North America (cont)	3616									2	
	3648										2
	3685										2
	3855										2
	3898					1					
	3989										2
	4006										2
	4020									2	
	4256										2
	4392									1	
	4749										2
	5099									2	
	5223									2	
	5384				2						
	5466									2	
	7051		2								
	7669										2
	8342									2	
	8362									2	
	8364									1	
	8384										2
	8397									2	
	9004									3	
9129									2		
9132										1	
9700										1	
10017										1	
10377									2		