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Insolvency and Corporate Governance:

A Forecasting Model for Brazilian Firms

Dissertação de Mestrado

Dissertation presented to the Programa de Pós-graduação em Administração de Empresas of the Departamento de Administração de Empresas, PUC-Rio as partial fulfillment of the requirements for the degree of Mestre em Administração de Empresas.

Advisor: Prof. Luiz Felipe Jacques da Motta

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Abstract

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This research aims to answer if the usage of corporate governance mechanisms by companies in the Brazilian market can help them avoid insolvency. To achieve such goal, this paper proposes an insolvency prediction model, which is based on a logistic regression that uses a dummy variable pointing whether the firm belongs or not to the categories Novo Mercado (New Market) or Nível 2 (Level 2). Besides the aforementioned variable, accounting ratios previously considered relevant in the prediction of insolvency by other researches regarding the Brazilian market are included in the model as well. The sample used in this paper includes the companies listed at BM&FBOVESPA in the period 2001-2013. However, it does not include financial institutions, companies with unavailable information, and firms whose shares were not traded in BM&FBOVESPA during the period. The model estimations presented statistically significant evidences that firms with better corporate governance practices have a lower probability of being in an insolvency situation. This research also used financial ratios as control variables to the model and found evidences, regarding their relation with insolvency, similar to other previous studies present in the literature.

Keywords

Insolvency prediction; corporate governance; accounting ratios; logistic regression.

Resumo

Meireles, Bruno Lessa; Motta, Luiz Felipe Jacques Da. Insolvência e Governança Corporativa: Um Modelo de Previsão para Empresas Brasileiras. Rio de Janeiro, 2016. 47p. Dissertação de Mestrado - Departamento de Administração de Empresas, Pontifícia Universidade Católica do Rio de Janeiro.

O presente estudo tem como objetivo responder se o uso de mecanismos de governança corporativa nas empresas é capaz de ajudar a evitar situações de insolvência em empresas do mercado brasileiro. Para tanto, esta dissertação propõe um modelo de previsão de insolvência por meio de uma regressão logística, utilizando uma variável dummy que indica se a empresa faz parte ou não dos segmentos Novo Mercado ou Nível 2. Além desta variável, são utilizados também indicadores contábeis já estimados como relevantes em modelos de previsão de solvência anteriores que abrangeram o mercado brasileiro. A amostra utilizada contempla todas empresas listadas na BM&FBOVESPA entre 2001 e 2013. Entretanto, não foram consideradas na amostra instituições financeiras, empresas com informações indisponíveis e empresas que não tiveram ações negociadas na bolsa no período. O modelo apresentou evidências estatisticamente significantes de que empresas com melhores práticas de governança corporativa têm menor probabilidade de estar em situação de insolvência. O presente trabalho também utilizou indicadores financeiros como variáveis de controle para o modelo. Foram encontradas evidências semelhantes a estudos anteriores no que diz respeito a relação de cada uma dessas variáveis com insolvência.

Palavras-chave

Previsão de insolvência; governança corporativa; indicadores contábeis; regressão logística.

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1 Introduction

Since early 2000s, prominent companies – such as Enron, WorldCom and Lehman Brothers – were revealed as involved in huge accounting scandals that shocked investors. This increased the sense of necessity for further research and improvement in both ethics and governance issues.

As stated by Daily *et al.* (2003), governance deals with the many uses to which organizational resources are deployed and with the answer to the divergences of the many stakeholders of an organization. In accordance with the aforementioned, this dissertation intends to go further on governance issues, as it aims to answer if the usage of corporate governance mechanisms by companies in the Brazilian market can help them avoid insolvency. To assist in solving this issue, an insolvency prediction model based on corporate governance measures will be used in this dissertation. According to Ross *et al.* (2013), an insolvency situation could indicate an even more serious scenario is yet to come, since insolvency could work as the first step on a firm's path to a formal process of bankruptcy.

In the last decade, Brazil had an important economic growth and became a target for international investors. According to the World Bank database, from 2011 to 2014 the increase of foreign direct investment was 35.4%. However, things seem to be changing lately. A good example of it is that, last June, the World Bank forecasted a decrease of 1.3% for the Brazilian GDP in 2015. The actual, and official, number for the country's GDP was even worst, according to the national institute that measures the country's GDP officially, the variation for the Brazilian GDP in 2015 was -3.8%.

Recently, Standard & Poor's and Fitch rating agencies lowered Brazil's credit rating to BB+ with negative outlook. Moody's rating agency also lowered the country's credit rating to Ba2 (as they have different rating scales) with a negative outlook. That is to say, the agencies have real chances of a new downward revision in the future. Because of the credit rating decrease, Brazil lost its investment-grade rating, which is granted to countries considered good payers and safe to invest. Moreover, the country has seen corruption scandals involving big Brazilian companies – including Petrobras – lately. Those scandals even lead to the arrest of some companies' top managers.

Due to Brazil's current situation, it might be a very suitable time to study the combination of corporate governance and corporate insolvency. The country's situation and the literature's gap contribute to show the importance of a bankruptcy prediction model for the Brazilian market.

1.1. Research Context and Relevance

The former Bolsa de Valores de São Paulo (BOVESPA) aimed to create an environment that incites both the investors' interest and the companies' value. With that in mind, BOVESPA created, in 2000, four different categories in which its listed companies were classified according to their corporate governance practices. The new categories were Novo Mercado (New Market), Nível 2 (Level 2), Nível 1 (Level 1) and Tradicional (Traditional). Each of these categories demands a different level of commitment on information disclosure and ownership structure rules. The former's objective was to facilitate following up and auditing the companies, whereas ownership structure rules target a better balance between shareholders' rights, regardless of whether they have the companies' control or not.

As stated by BM&FBOVESPA (2009), the higher information quality provided by the companies and the increase of shareholder's rights enable a lower level of uncertainties in the investment's process of valuation. According to the same publication, less uncertainty represents a lower risk in the investment and therefore a lower cost of capital. Consequently, it would trigger a better pricing of the shares and stimulate more companies going public as another way to finance themselves.

Using a Brazilian sample from the period 2001-2005 of 178 firms (81 percent of the stock market capitalization at the time), Braga-Alves and Shastri (2011) analyzed if corporate governance practices are significantly related to firm value and operating performance. Their study used an index created by themselves as a proxy of six governance practices common to all firms listed on BOVESPA's top level of corporate governance (Novo Mercado). A higher value in the index would represent a higher commitment to those practices. Using the aforementioned sample, they found a robust positive relation between their index and Tobin's q, a measure of firm value.

Revaluations of fixed assets can also be seen as a poor governance practice. Lopes and Walker (2012) found evidence that they are negatively correlated to future firm performance, prices and returns. The authors also observed that revaluations of fixed assets are positively associated with indebtedness and illiquidity.

The results of these researches could lead one to think this market seems to favor companies that are more concerned with their corporate governance practices and they seem to perform better. However, can good corporate governance practices help avoid corporate insolvency?

1.2. Research Question and Objective

Prediction models of financial distress and its possible consequences (such as insolvency or bankruptcy) have been in the literature for at least half a century (ALTMAN, 1968; BAUER & AGARWAL, 2014; BEAVER, 1966; CHARITOU *et. al*, 2004; COATS & FANT, 1993; OHLSON, 1980; REISZ & PERLICH, 2007). Corporate governance has been studied as an important aspect to understand the risk of bankruptcy or insolvency. Yet, financial ratios or market-based measures have been dominant in most of the researches regarding bankruptcy and financial distress prediction models (AZIZ & DAR, 2006).

Studies that analyze the effect of corporate governance attributes on bankruptcy prediction often do not use simultaneously accounting ratios and market-based variables. Nevertheless, Darrat *et al.* (2014) published a notable exception in which they use data referring to American firms.

Even though many studies – including Daily and Dalton (1994), Darrat *et al.* (2014); Elloumi and Gueyié (2001), Lee and Yeh (2004), Platt and Platt (2012) and Wilson and Altanlar (2009) – have considered corporate governance structures while studying bankruptcy, insolvency and financial distress, few use Brazilian data. The findings of those researches cannot be simply generalized to other nations,

as they have different economic and regulatory environments, distinct size of capital markets, cultural differences and unequal efficiency of governance mechanisms. Thus, a model for the effect of corporate governance on situations of financial distress should be separately examined in each country, and the important factors investigated.

As differentiated later in this paper, business failure, financial distress, insolvency and bankruptcy are not equal and their consequences reach different levels for stakeholders. However, a notable amount of authors use those terms interchangeably when describing their models. For example, even though they use "insolvency prediction model" in the title of their paper, Chung *et al.* (2008) use failure as the dependent variable for their model. Moreover, they define "failure" in the page 20 of their paper as "a registered company which is insolvent, under receivership or has been liquidated". That is to say, they do use a single exact outlining within their study. The concepts used in this dissertation shall follow the description included in the literature review chapter.

This research aims to answer if the usage of corporate governance mechanisms in the Brazilian market can help avoid firms' insolvency. To support that, this research will use an insolvency prediction model, which will more detailed in a forthcoming chapter of this dissertation. Others researches have shown that financial ratios and capital market data can be used to forecast corporate insolvency in this market – including Gimenes and Uribe-Opazo (2001), Martins and Galli (2007), Minussi *et al.* (2002) and Teixeira (2014). Yet, there is a gap of examination showing the effects of also considering corporate governance attributes to insolvency prediction models as using Brazilian evidence.

In order to examine the relationship between corporate governance attributes and insolvency prediction, this study the following goals:

- Produce a literature review that is able to explain the main concepts and theories on corporate distress and governance and present corporate insolvency prediction models;
- gather corporate governance, financial and market based data from Brazilian listed companies from 2001 to 2013 in order to apply to the model;
- develop an analysis of the results and compare to similar studies that use both domestic and international data;
- evaluate the created model based on the effect of the added corporate governance measures.

1.3. Contribution and delimitation

This dissertation can be used to form a basis for financial studies on topics such as corporate governance, insolvency, investment selection and firms' market value. The impact of corporate governance on corporate insolvency might be addressed in slightly different ways based on the results found here. However, it is important to emphasize that the results here obtained possibly will not be useful to firms in other countries. Brazil has a distinctive set of characteristics that probably is not reproduced in any other nation.

Moreover, the present research may be relevant to managers and investors. The results from the companies in the insolvency prediction model can be used as a first sign to managers to take action, as bad times may be coming. Investors might use firms' insolvency prediction as a first parameter in their investment valuation.

This dissertation will study the effects of corporate governance attributes on insolvency. Yet, a dummy variable for good governance will be used to capture the positive corporate governance attributes by assembling many different perspectives of corporate governance in one number. It shall be better explained later in this dissertation.

2 Literature Review

The first chapter described the purpose and objectives of this dissertation. This chapter's goal is to review the existing scholarly literature regarding the topics discussed in this dissertation. This is then used to make clear what the perspectives of the concepts used in this dissertation are. This chapter begins presenting the difference among the terms used for firms that are not financially healthy, eventually leading to bankruptcy. This shall also include diverse aspects of those situations. Then, this chapter describes corporate governance concepts and their consequences for firm value and performance. Last, but not least, it discusses existing insolvency prediction models.

2.1. Corporate Distress

Some of the key aspects of corporate distress will be described below. Because bankruptcy can be a consequence of a significant number of different reasons, this paper does not intend to approach all those possibilities, but rather consider some main points.

Not rarely, we can see these concepts misused and, therefore, it is important to make them well-defined aiming the progress of this dissertation.

2.1.1. Risk

Present in most of financial or investment decisions, uncertainty is what makes us doubtful about exactly what is going to happen in the future. Although many people use the terms "risk" and "uncertainty" as having the exact same meaning, they are indeed different. Risk is how we depict the amount of uncertainty that exists. It can be defined, therefore, as the existing degree of uncertainty (FABOZZI & PETERSON, 2003).

Taking a different perspective, Blach (2010) states that risk can be seem from two different angles. The first would define risk as a potential for loss (negative view), while the second would see it as a threat, but also as an opportunity to reach unexpected outcomes (neutral view).

Ross *et al.* (2013) divide risk in two classes: systematic risk and unsystematic risk. The authors define the former as any risk that influences a large number of assets, in a greater or lesser level. As to the latter, they define it as a risk that affects a single asset or a small group of assets. Even though they use this distinction, they assert that those kinds of risk cannot be always as exact as they make it out to be, since any small piece of new information about a specific company could engender consequences through the economy.

As for the financial risk itself, Jorion (2007) states that it embraces more specific components: market risk, credit risk and operational risk. We might want to take a deeper look into them in order to understand financial risk. He defines market risk as the potential losses that might occur because of movements in financial market prices or volatilities. Next, the author describes credit risk as the possibility of losses because of counterparties being reluctant or unable to accomplish their contractual obligations. Lastly, he defines operational risk as the potential losses due to system or people's failures, inefficient processes in the organization or even external events.

Similarly to Ross *et al.*'s (2013) observation described above, Jorion (2007) argues that often those categories described by him interact with each other. Hence, an effort to classify risk might be arbitrary.

2.1.2. Financial Distress

A financial distress situation may lead a firm to take actions that it would not have taken if its financial conditions were better. Although hard to delineate, Ross *et al.* (2013) define it as a condition where the firm's current obligations (including interest expenses and trade credits) cannot be fulfilled by its operating cash flow.

Fabozzi and Peterson (2003, p. 584) adopt a simpler definition in their book. According to them, financial distress "is the condition where a firm makes decisions under pressure to satisfy its legal obligations to its creditors". Indeed, it does not opposes the previous stated definition, but it is a broader explanation.

Although a financial distress situation could sign that the firm will be facing problems with its cash flow, the firm can actually benefit from this period. For example, the firm might be forced to restructure its assets and this new arrangement might truly generate gain to the company.

Taking a leveraged recapitalization is not rare for companies in financial distress. Such a choice would lead to an accumulation of debt, which the firm's cash flow might not be sufficient to cover the required payments. Therefore, the company would have to sell its noncore business. Such a change in the firm's assets could lead to new organizational forms and operating strategies for the company (ROSS *et al.*, 2013).

2.1.3. Financial Constraints

Theories on whether firms are facing a financial constraint situation or not have been arising since Fazzari *et al.* (1988).

In this paper, the authors associate firms' financial constraints with their investments sensitivity to fluctuations in their internal funds. They define firms as constrained when external financing is exceedingly expensive. In this scenario, firms would have to use their internal fund to finance investments instead of using it to pay dividends. Hence, most constrained firms would have investments more sensitive to cash flow than least constrained firms would.

Using a different point of view, Kaplan & Zingales (1997) state the most precise, but also the broadest, definition for financial constraints categorizes it as a situation where firms meet a difference among internal and external costs of funds. However, a notable issue of this definition is that virtually any firm could be considered as constrained, when applying their definition. Yet, Kaplan & Zingales (1997) disagree on Fazzari et al.'s (1988) understanding of the result, since, using their definition and regression, firms in the category "Likely constrained" had shown less sensitivity to cash flow in their investments.

We can see in the literature some papers suggesting indexes to measure the firm's level of constraint. Lamont *et al.* (2001), for example, use Kaplan and

Zingales' (1997) work to build an index using five accounting ratios, which was named *KZ index*. The higher the index, the higher the constraint the firm has.

As previously suggested, this is not the only index created. Whited and Wu (2006) used the generalized method of moments (GMM) estimation and a structural investment model to build a new index of financial constraints. Differently from the more often used KZ index, this index is consistent with firm characteristics associated with external finance constraints (e.g. low investment level in spite of good opportunities and high debt to capital ratios).

2.1.4. Insolvency

Insolvency may be mistook by financial distress due to some similarities in their definitions. Altman and Hotchkiss (2005) state that technical insolvency, for example, exists when the firm's is unable to meet its current obligations, which would mean a lack of liquidity. Indeed this would be a very similar definition to Ross *et al*'s. (2013) definition of financial distress (as specified above). Nevertheless, those authors use less conflicting classifications as they go deeper on the theme. Altman and Hotchkiss (2005) claim that insolvency in a bankruptcy sense is a more definitive situation, rather than a temporary condition. In this scenario, a firm's total liabilities exceed a fair valuation of its total assets, making the firm's real net worth negative. Ross *et al.* (2013) use two classifications of insolvency: stock-based insolvency and flow-based insolvency. The latter was already described in this paper, whereas the former is claimed by the authors to occur when the firm has a negative net worth in a way that its assets' value is less than the value of its debts.

In order to use a more feasible measure to identify insolvency, some authors consider those firms with negative equity as insolvent (BRAGA *et al.*, 2006; BREWER & MONDSCHEAN, 1992). In accordance with the stock-based perspective of insolvency, Ross *et al.* (2013) argue this situation would represent that the value of the firm's debt is bigger than the value of its assets.

This dissertation will use negative equity as a proxy for insolvency, following the aforementioned authors.

2.1.5. Bankruptcy

One of the most recognized authors when the subject is bankruptcy, Edward Altman published a book along with Edith Hotchkiss entitled *Corporate financial distress and bankruptcy: predict and avoid bankruptcy, analyze and invest in distressed debt* (2005).

In this book, they classify bankruptcy in two types. The first denotes a firm's net worth position, whereas the second uses a more observable connotation by considering an enterprises' formal (and legal) declaration of bankruptcy, associated with a petition either to liquidate its assets or to endeavor a recovery program (ALTMAN & HOTCHKISS, 2005).

Another term sometimes used for bankruptcy interchangeably, even though it has a different meaning, is failure. According to Altman and Hotchkiss (2005), failure means the market has comparable investments that have a higher realized rate of return on invested capital (including allowance for risk consideration), both significantly and continually. As stated by the authors, this definition meets the economic criteria and does not necessarily denotes the existence or discontinuity of the entity. Hence, a firm could be considered an economic failure, even if it keeps up with its current obligations thanks to the lack of legally enforceable debt.

Ross *et al.* (2013) write about the next stage of bankruptcy. They define bankruptcy as a legal proceeding originated either willingly, by the firm filling the petition, or involuntarily, by the creditors filling the petition themselves. Those firms that choose not to honor or cannot afford the previously agreed payments to their creditors would have, then, two options: liquidation or reorganization.

Liquidation is the termination of the organization, as it does not have the resources needed to continue operating indefinitely. This operation includes selling the company's assets for salvage value. The second option, reorganization, means to maintain the firm operating and includes issuing new securities to substitute the old ones (ROSS *et al.*, 2013).

2.2. Corporate Governance

Because this dissertation intends to use a dummy variable based on BM&FBOVESPA's classification of the firm's level of corporate governance, this section shall discuss some governance notions used by them while doing the company's assessment.

In a broader sense, corporate governance itself can be described as the mechanisms or principles that rule the decision process within a firm. It is the set of rules established in order to minimize the agency problems (CARVALHO, 2002).

2.2.1. Agency theory and separation of ownership and control

The agency theory has been applied to a diversity of organizational issues. Fama (1980) was one of the first and main papers published at the time to deal with it as taking the financial point of view. He takes an approach on firms' separation of ownership and control to try to explain how it can be an efficient form of economic organization.

In her paper, Eisenhardt (1989) take a broader view to do a review on the subject and states the theory is based on the conflict among the principal and the agent. As per the theory presented in this paper, they (principal and agent) are engaged in corporative behavior, but have partly different goals and risk preferences.

Although the separation of ownership and control is common in public companies around the world, it may be witnessed very differently depending on the country. Taking into account many characteristics, they can be divided into systems of concentrated or dispersed ownership, as suggested by Coffee (1999). In the United States' case, dispersed ownership is the dominant structure in its economy with a high proportion of large, publicly quoted companies managed by professionals and owned by widely dispersed shareholders that are able to buy and sell equity in highly liquid and developed securities markets (CHEFFINS, 2001).

As for the Brazilian scenario, Leal *et al.* (2002) found, at the end of 1998, evidence of a high degree of ownership concentration, while analyzing 225 public companies. According to them, even in instances which there is not a singular controlling shareholder, usually its three largest shareholders control the firm.

This formal separation of ownership and control in big public companies make the agency problem even clearer through the unnecessary costs – both direct and indirect – that may arise from that relationship. Brealey *et al.* (2010) describe two situations where those costs (agency costs) would incur. The first would be when managers do not try to maximize the firm value and the second would be when shareholders have to spend money to monitor and constrain manager's actions.

Ross *et al.* (2013) define agency costs as those costs that arise from the conflict of interest between management and stockholders. According to them, an example of indirect cost would be a situation in which, managers, fearful of the possibility that things will turn out badly and they could lose their jobs, reject a relative risky opportunity of investment that would increase the share value.

On the other hand, direct agency costs could incur in two ways. The first would be the firm having expenditures due to the need to monitor management actions (e.g. paying outside auditors), whereas the second would be corporate expenditures that benefits managers to the detriment of shareholders. For example, managers choosing to buy luxurious corporate jets or scheduling business meetings at expensive resorts would generate costs that could be avoided.

In the same book, the authors claim it is sometimes argued that managers would be likely to maximize the amount of resources controlled by them as much as they can. This might lead to them overemphasizing organizational survival – through corporate size growth, for example – to protect their job security. Hence, if they are not taking into account just what is best for the company, they might be not benefiting the shareholders.

Ehrhardt and Brigham (2011) write about another case in which the conflict of interest could be disadvantageous to shareholders. They state that bankruptcy risk (due to higher levels of debt) may affect managers' behavior in different ways. According to them, in times of good financial results, managers tend to raise agency costs through perquisites or unnecessary expenditures, therefore wasting cash flow. Nevertheless, when managers realize a greater likelihood of bankruptcy, the opposite effect would take place. Agency costs would diminish and cash flow would increase.

In not favorable circumstances, the agency cost could be manifested via the so-called underinvestment problem. In this situation, managers would reject projects with a positive net present value (NPV) if they find those projects are too risky. Assuming that most shareholders are well diversified, they could afford to take some extra risk in a project that has a positive NPV. The reason behind it is that, even if that specific project comes out as a failure, other companies in their portfolio might also be taking risky, but successful, projects. Hence, their risk would be dispersed. However, managers' wealth and reputation are usually linked to a single company. For this reason, a riskier project would have a higher impact on them and the most reasonable decision would be that they accept only projects with lower risk.

Thus, the conflict of interest would be present again, as the shareholders' risk would be inferior to the managers' risk.

2.2.2. Board of Directors

The literature has an increasing amount of empirical research that aims to analyze the structure and effectiveness of corporate governance system. An essential understanding from that writings is that managers seem to be influenced by executive compensation (COLES *et al.*, 2006; CORE *et al.*, 1999; CORE & GUAY, 1999), takeover threats (COMMENT & SCHWERT, 1995; DEANGELO & RICE, 1983; JARRELL & POULSEN, 1987; WALKLING & LONG, 1984) and other control instruments.

Another important discussion in the literature is whether board size matters or not regarding business' performance and value. Yermack (1996) uses a sample of 452 large U.S. industrial corporations to test the theories relating board size and firm's effectiveness. The author uses Tobin's Q as an estimate to market value and finds an inverse association between board size and firm value.

Conversely, Gondrige *et al.* (2012) published a study that used a set of 208 Brazilian public companies aiming to better understand the relation between firms' governance practices and their value. Although they use a sample that includes only one year, they found a statistically significant positive association between board size and firm value.

Using 799 firms with dominant shareholder in 22 countries, Dahya *et al.* (2008) investigated the association between corporate value and the fraction of independent directors. The result from their investigation was a positive relation, especially in countries that do not hold a strong legal protection for shareholders.

However, Black *et al.* (2012) observed evidence of a negative relation between those variables in Brazil. Their results also found that relation in India as insignificant. Using evidence from New Zealand, Koerniadi and Tourani-Rad (2012) found corroborative evidence that, rather than adding value, board independence negatively affect firm value.

Taking an economic approach on board's size and independence, Boone *et al.* (2007) claim that their variation through time can be partially explained via the specific nature of the firm's competitive environment and managerial team. According to the authors, the board composition would be the endogenous result of a competitive process. Hence, firms would be designed to suit their unique competitive environment and that would make rules of board governance (e.g. limits on board size) unlikely to enhance value for most firms.

Using another point of view, board diversity has been studied considering its effect on shareholder value creation. In their paper, Carter *et al.* (2003) reached a robust result of statistically significant positive relationships between the presence of women or minorities on the board and firm value (measured by Tobin's Q). Their sample consisted in firms from the Fortune 1000 list.

Those differences in the results found around the globe contribute to the idea that conclusions based on non-Brazilian evidences cannot be simply extended to the referred country and, thus, it adds to the relevance of this paper.

2.2.3. Performance and Value

Theoretically, then, corporate governance as a whole would diminishes the agency problem and make managers work in a way that creates more value to the companies' true owners (shareholders). Yet, how much of truth or effectives is there in this proposition?

Firstly, to answer that question one must consider that the legal system's strength does matter. Firms can choose to adopt better governance practices on their own, but if a legal requirement is made in some level, a generalized benefit in that market should be observed. The laws that protect investors are not the same around the world. According to La Porta *et al.* (1998), the origin of each country's legal system explains great part of the logic behind their governance requirements. Different enforcement levels will influence, in their own way, market valuations, dividend yields and ownership structure (LOMBARDO & PAGANO, 2000; LA PORTA *et al.*, 1999a; LA PORTA *et al.*, 1999b).

In corroboration with it, Klapper and Love (2003) considered a sample of firms from 14 emerging markets and found evidence that the average firm-level governance is lower in countries where legal systems are weaker.

Back to answer our question, we can refer to Klapper and Love's (2003) results, which suggest a high correlation between corporate governance and operating performance. In addition, Morey *et al.* (2009) used a different data set that included firms from 21 emerging market countries and found evidence that developments in corporate governance result in significantly higher valuations.

Taking a look into the American scenario, Core *et al.*'s (1999) research results propose that weak governance structures imply in greater agency problems. Next, they claim those agency problems would lead to worse firm performance.

Silva and Leal (2005) conducted a study aiming to understand the connection between firm's levels of corporate governance and its valuation and performance. As an alternative to use a single control mechanism, they created a corporate governance index that works as a broad measure of firm-specific level of corporate governance – considering disclosure, board composition and function, ownership and control structure and shareholder rights. Their research utilized a data from the period 1998-2002 and resulted in a sample with 131 Brazilian firms. In accordance with previously mentioned studies, their results suggest companies with better corporate governance are also associated with higher performance (return on assets) in Brazil. Although not statistically significant, a positive relationship between firm's value (based on Tobin's Q) and better corporate governance practices was observed.

2.3. Corporate distress prediction models

Appiah *et al.* (2015) highlight in their systematic literature review that authors used bankruptcy, liquidation, insolvency, financial distress and dissolution as synonyms for corporate failure. This was reinforced by Bellovary *et al.*'s (2007) literature review on bankruptcy, in which they include and compare studies that used words such as failure, financial distress and bankruptcy interchangeably, as if they had the same purpose of research. The confusion can also happen within a single paper and is noted in Chung *et al.* (2008), as described in the introduction of this dissertation. In this light, this section describes existing prediction models for companies in distress situations, which include insolvency, financial distress, failure or bankruptcy. Moreover, it is important to emphasize that Appiah *et al.*'s (2015) literature review, for example, includes studies that use these many definitions for corporate distress, including, then, corporate distress prediction models that use other concepts than insolvency.

If companies could take a glance into the future, they probably could take a big advantage against their competitors and ensure their own survival. Even though we cannot be certain of everything happening in the future, an effort has been made to, at least, understand the odds of one's business continuity.

According to Bellovary *et al.* (2007), the initial studies using ratio analysis for bankruptcy prediction focused on individual ratios (univariate). The authors defined those as important groundwork for multivariate studies. For instance, Altman (1968) used that foundation to propose a five-factor multivariate discriminant model, which became very popular, as literature suggests.

Since then, many models for bankruptcy prediction have been created and they mainly use the following methods: multivariate discriminant analysis (MDA), logit analysis, probit analysis and neural networks. As stated by Aziz and Dar (2006), a MDA model is a linear combination of specific discriminatory variables that will result in a score. This bankruptcy score is then used to classify firms into non-bankrupt and bankrupt, as per their individual characteristic. Logit analysis and probit analysis consider the probability that the firm will go bankrupt as a dichotomous dependent variable. The latter requires non-linear estimation, which the former does not (BELLOVARY *et al.*, 2007). Neural networks use an approach

similar to brain process to perform classification tasks. Each "neuron" is a node with weighted interconnections, which are structured in layers. Each node in the input layer will receive input signals – information about firms, in the bankruptcy prediction context – from different source objects that will be transformed into a single output signal. This output signal will either be accepted as a classification decision or re-transmitted as an input signal to other nodes (it might include itself). This procedure continues until a classification decision is attained and it satisfies the pre-specific criteria (AZIZ & DAR, 2006).

Along with the method, an important aspect to take notice is the number of factors. Bellovary *et al.*'s (2007) findings suggest that having a larger number of factors in the model does not ensure its accuracy is higher. They observe that models with only two factors could be as precise as a 21 factor model.

Besides the number of factors, other elements should also be taken into account when considering a corporate distress prediction model. After analyzing 83 selected studies on bankruptcy prediction based on a systematic literature review, Appiah *et al.* (2015) laud the results in studies using one-year financial data prior to failure. Yet, the results from these models were not as good as when utilizing data 2-5 years prior to failure, according to them.

Concluding their study, the authors agreed they could repeat the inference of Charitou *et al.* (2004), which criticize that many bankruptcy prediction researches were not based on an economic theory in choosing the variables for distinguishing between failing and non-failing firms. Appiah *et al.* (2015) continue their conclusion suggesting the link between corporate failure and theoretical arguments should be considered in future studies. Next, they propose that using corporate governance lens to theoretical arguments may contribute for a better understanding in the corporate failure process.

Although some studies targeted to clarify the impact of corporate governance elements on bankruptcy (Daily and Dalton (1994) and Fich and Slezak (2008), among others), few of them used data from the Brazilian market. For instance, Appiah *et al.*'s (2015) systematic literature review had its final selected studies originated from 11 countries, with 53% of the studies utilizing dataset from US and only 1% from Brazil.

Most of the insolvency prediction researches based on the Brazilian market do not use any corporate governance variables. On the other hand, the literature offers many studies based on Brazilian evidence relating corporate governance attributes with performance and firm's value. This could be the closest to bankruptcy, since one thing can lead to the other.

In 1979, one of the first Brazilian papers on the theme was published by Altman *et al.*. They utilized a sample of 58 firms and the MDA in order to identify companies that would be in financial distress or not. Only financial measures were used in this study – all of them were calculated from firms' balance sheet. The authors posited their predictions would be 88% precise for the data regarding 1-year prior to the distress recognition and 78% correct for the data that would forfeit three years ahead.

In 2003, Castro Júnior used Brazilian companies in insolvency prediction models that were based on three different statistics techniques: discriminant analysis, logistic regression and neural networks. His goal was to compare them in terms of predictive capabilities. The author's results confirmed a considerable advantage for the neural network models, since its accuracy reached at least 90% among the three built models in his research. In order to estimate those models, Castro Júnior used different mixes of variables of distinct types. Those types could be classified in capital structure, liquidity indicators, profitability variables and inventory related variables. None of the variables used in Castro Junior's study was related to corporate governance either.

3 Methodology

This chapter describes the methodology used in this dissertation, including the data gathering process, its treatment and application to the model. A short review on the logit function and regression are done as well, since they are used to produce the insolvency prediction model.

3.1. Logit function and regression

The methodology used in this dissertation is quantitative. The proposed research uses a logit model to express the probability of failure of a firm as a dichotomous dependent variable that is a function of a vector of explanatory variables. However, the dichotomous dependent variable, as a logit model assumes, is the logarithm of the odds (probability) that an event (fail or not) will occur. Hence, we can see a logistic regression as a mathematical approach usually employed to explain the relationship of several independent variables to a dichotomous dependent variable (KLEINBAUM & KLEIN, 2010).

The logit model is based on the logistic function, which is defined as the function of any random variable (z, e.g.) by the formula below (BROOKS, 2014).

$$F(Z_i) = \frac{1}{1 + e^{-z_i}}$$

In the formula above, *e* would be the exponential under the logit approach. This can be interpreted as the probability that $y_i = 1$ and is given by the formula below, where x_k would represent explanatory variables (analogous to z in the previous formula).

$$P_i = \frac{1}{1 + e^{-(\alpha + \beta_1 x_1 + \dots + \beta_k x_k + \mu_i)}}$$



The model's characteristic to vary from 0 to 1 is represented by Figure 1.

Figure 1: Logistic Function. Source: (KLEINBAUM & KLEIN, 2010)

This logistic model presumes the value 0 and 1 as asymptotes to the function and, as a result, the estimated probabilities will never really be precisely 0 or 1, even though they might come infinitesimally close. Noticeably then, the model is not linear and cannot be estimated using the ordinary least squares method. Conversely, the maximum likelihood is employed for this model (BROOKS, 2014).

According to Kleinbaum and Klein (2010), the logit of P_i would be given by the natural log of the quantity P_i divided by one minus P_i , where P_i represents the logistic model. Therefore:

$$logit P_i = \ln\left(\frac{P_i}{1 - P_i}\right)$$

Using the probability formula to substitute P_i in the previous formula leads us to the conclusion that:

$$logit P_i = \ln \left[e^{\alpha + \beta_1 x_1 + \dots + \beta_k x_k + \mu_i} \right] = \alpha + \beta_1 x_1 + \dots + \beta_k x_k + \mu_i$$

Thus, the distribution used shall be a logistic cumulative distribution function. An application of it would represent that a result of 0.5 would mean equals chances of the company being insolvent or not. This research suggests an insolvency prediction model based on a dummy variable for the firm's level of corporate governance, as well as financial and accounting ratios.

3.2. Choice of variables

Using Brazilian market (BM&FBOVESPA) data, Stüpp (2015) compared the insolvency prediction power of 29 of the main financial and accounting ratios used in the literature. It included measures of liquidity, indebtedness, capital structure, average periods and profitability. One of his paper's goals, according to the author, was to identify the most relevant independent variables for the insolvency prediction process. After taking into account MDA and logistic analysis, the writer claims the most significant variables, in decreasing order, were:

- Total liabilities/total assets;
- return on equity;
- current ratio;
- EBIT/net debt;
- non-current assets/equity;
- debt-equity ratio;
- debt composition;
- cash conversion cycle;
- acid-test ratio;
- asset turnover.

To reach this conclusion, the author used two different approaches: first, he used all of the 29 variables and afterwards he used the stepwise method (selecting the variables with the greatest classification capacity).

Table 1, presented below, shows the formulas that were used to calculate each one of those ten ratios.

Name	Description
Total Liabilities / Total Assets	Total Liabilities Total Assets
Return on Equity	Net Income Shareholder's Equity
Current Ratio	Current Assets Current Liabilities
EBIT / Net Debt	EBIT Net Debt
Non-current assets / Equity	Non-current Assets Shareholder's Equity
Debt-Equity Ratio	(Current Liabilities + Non-current Liabilities) Shareholders' Equity
Debt Composition	Current Liabilities (Current Liabilities + Noncurrent Liabilities)
Cash Conversion Cycle	Days Inventory Outstanding + Days Sales Outstanding – Days Payable Outstanding
Acid-test Ratio	(Current Assets + Long-term Assets) (Current Liabilities + Long-term Liabilities)
Asset Turnover	Revenue Total Assets

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Table 1: Explanatory variables' formulas Source: Created by the author

As this dissertation is based on companies listed on the BM&FBOVESPA exchange, it uses the categories of corporate governance created by this stock exchange. Those categories take into account information disclosure and ownership structure rules, as well as other board composition requirements that go beyond the Brazilian law demands. The four main categories – Novo Mercado (New Market), Nível 2 (Level 2), Nível 1 (Level 1) and Tradicional (Traditional) – were explained in the introduction of this paper. This research uses a dummy independent variable marking 1 if the company is either classified as Novo Mercado or Nível 2, or 0 if the firm is not in either one of these two categories. As companies in these two categories are theoretically the ones with the best governance practices, this could be an interesting criterion to represent the effect of corporate governance practices. Accordingly, the corporate governance level dummy and those ten variables from Stüpp (2015) – used as control variables – are the variables to be used in the model. A similar one testing the insolvency prediction power of governance mechanisms has not been described for the Brazilian market in the literature.

As for the dependent variable, this paper considers firms as insolvent when they present a negative equity, following Braga et al. (2006) and Brewer and Mondschean (1992). This definition of insolvency should be a more feasible measure to identify insolvency in the data set. Hence, as a logistic regression demands for its dependent variable, a dummy will be set as 1 for companies with negative equity, whereas it will be set as 0 in any distinct scenario.

3.3. Data Gathering

In order to have a more detailed access to information, this dissertation includes only data from companies that have been listed in BM&FBOVESPA from 2001 to 2013. Economática's database was the chosen source of financial and accounting information. Moreover, firms' classification of corporate governance was obtained through BM&FBOVESPA's website. Since the exchange started structuring its process of classifying companies in governance levels only in the year 2000, data collection starts in the following year, 2001.

Moreover, the sample used in this paper does not include financial institutions, companies with unavailable information, and firms whose shares were not traded in BM&FBOVESPA during the period. This resulted in an observation of 527 firms through 13 years, that is to say, 6,851 firm-year observations per variable. However, because the database had some missing information and those observations had to be disregarded; those data shall compose an unbalanced panel with a final number of 3,934 firm-year observations per variable.

3.4. Sample assessment

The software used to generate the logistic model, as well all the other statistical calculations was Eviews. The software presented that three independent variables of the logistic model (Total liabilities/total assets, Non-current assets/Equity and Debt-Equity Ratio) had their capacity to explain firms' insolvency restricted due to lack of variance within the employed context of maximum likelihood. This is suggested by the fact that those three regressors had each a separating value from which all their other observations, above or below it, were linked to the same result in the dependent variable (insolvent or solvent). Thus, those variables were excluded from the model because of this lack of variance.

3.4.1. Correlation coefficient

The Pearson's product moment correlation, also kwon as correlation coefficient, standardizes or normalizes the covariance in a way that it is set as unit free. The direct effect of it is that it becomes bounded to lie on the (-1,1) interval, meaning that a correlation of 1, or its negative opposite (-1), suggests a perfect positive (or negative, for its counterpart) association between the analyzed series (Brooks, 2014). Moreover, according to the author, the correlation coefficient is represented by the general following formula:

$$\rho_{x,y} = \frac{\sum (x_i - \bar{x}) (y_i - \bar{y})}{(N-1)\sigma_x \sigma_y} = \frac{\sigma_{x,y}}{\sigma_x \sigma_y}$$

According to Brooks (2014), when two explanatory variables are presented as having a very high correlation, we are facing a multicollinearity situation and it should be avoided. Hence, in order to check the presence of multicollinearity in the proposed model, the correlation between the eight explanatory variables (first round) are tested using the software Eviews. The results shown in Table 2 exhibit a high correlation between the ROE and Asset Turnover explanatory variables. Thus, the ROE variable is excluded and the correlation between the remaining variables in the model is retested (second round). The results are presented in Table 3 show the model is now set free from multicollinearity problems.

	CG Dummy	Return on Equity	Current Ratio	EBIT/Net Debt	Debt Composition	Cash Conversion Cycle	Acid-test Ratio	Asset Turnover
Corporate Governance	1.000							
Return on Equity	-0.006	1.000						
Current Ratio	0.094	0.430	1.000					
EBIT/Net Debt	0.001	-0.146	-0.059	1.000				
Debt Composition	-0.054	0.036	-0.002	0.000	1.000			
Cash Conversion Cycle	-0.008	0.000	0.000	0.102	-0.035	1.000		
Acid-test Ratio	0.053	0.568	0.775	-0.085	0.294	-0.004	1.000	
Asset Turnover	-0.010	0.984	0.434	-0.150	0.042	-0.001	0.574	1.000

Table 2: Correlation coefficients (first round) Source: Created by the author

	CG Dummy	Current Ratio	EBIT/Net Debt	Debt Composition	Cash Conversion Cycle	Acid-test Ratio	Asset Turnover
Corporate Governance	1.000						
Current Ratio	0.094	1.000					
EBIT/Net Debt	0.001	-0.059	1.000				
Debt Composition	-0.054	-0.002	0.000	1.000			
Cash Conversion Cycle	-0.008	0.000	0.102	-0.035	1.000		
Acid-test Ratio	0.053	0.775	-0.085	0.294	-0.004	1.000	
Asset Turnover	-0.010	0.434	-0.150	0.042	-0.001	0.574	1.000

Table 3: Correlation coefficients (second round) Source: Created by the author

3.4.2. Model Development

In order to avoid problems with the heteroscedasticity of the standard error estimates, the Huber/White estimator (HUBER, 1967; WHITE, 1982) was employed during the regression estimation.

The logistic regression achieved its maximum likelihood, through quadratic hill climbing, after 10 iterations for the binary logit as using the remaining explanatory variables, which were:

- corporate governance dummy (*X*₁);
- current ratio (X_2) ;
- EBIT/Net Debt (X_3) ;
- debt Composition (X_4) ;
- cash conversion cycle (X_5) ;
- acid-test ratio (X_6) ;
- asset turnover (X_7) .

As mentioned before, this was obtained through the usage of Eviews software using an unbalanced panel, since not all information were available in every analyzed period. The logistic regression to the probability that the firm is insolvent is then given by the equation:

$$logit P_{i} = \alpha + \beta_{1}X_{1} + \beta_{2}X_{2} + \beta_{3}X_{3} + \beta_{4}X_{4} + \beta_{5}X_{5} + \beta_{6}X_{6} + \beta_{7}X_{7} + \mu_{i}$$

For the equation above, P_i is given by its exact formula mentioned earlier in this chapter.

Brooks (2014) reminds us that we cannot simply assume that, in a logit model, a 1-unit increase in one x_{4i} (variable chosen arbitrary just for the sake of the example) causes a β_{4i} % increase in the probability that the firm is insolvent. This would be incorrect because the form of the function in a logit model is $P_i =$ $F(\alpha + \beta_1 x_1 + \dots + \beta_k x_k + \mu_i)$. Therefore, to get hold of the exact relationship between changes in x_{4i} and P_i , the required proceeding would be to differentiate Fwith respecto to x_{4i} .

4 Results

This chapter exhibits the descriptive statistics of the sample, the results from the logistic regression and an expectation-prediction evaluation for the model.

4.1. Analysis

Table 4 shows the descriptive statistics for the seven explanatory variables of the model.

	Corporate Governance	Current Ratio	EBIT/Net Debt	Debt Composition	Cash Conversion Cycle	Acid-Test Ratio	Asset Turnover
Mean	0.204626	1.735446	-20.89182	0.511340	5456813.	1.159037	1.301807
Median	0.000000	1.338973	20.70824	0.491337	54.86478	0.859695	0.656240
Maximum	1.000000	57.60000	287153.9	1.000000	2.15E+10	57.60000	2023.705
Minimum	0.000000	0.000604	-262500.0	0.000988	-517541.8	0.000372	-0.008181
Std. Dev.	0.403480	2.045319	9236.815	0.227872	3.42E+08	1.566326	32.25913
Skewness	1.464318	10.37732	5.017424	0.224753	62.69769	15.30904	62.65797
Kurtosis	3.144227	200.3809	665.5486	2.322797	3932.000	458.7697	3928.678
Jarque-Bera	1409.308	6456673.	71971114	108.2931	2.53E+09	34203422	2.53E+09
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	805.0000	6827.243	-82188.41	2011.612	2.15E+10	4559.652	5121.310
Sum Sq. Dev.	640.2758	16453.03	3.36E+11	204.2231	4.61E+20	9649.129	4092883.
Observations	3934	3934	3934	3934	3934	3934	3934

Table 4: Descriptive StatisticsSource: Created by the author

With the explanatory variables more detailed in the table above, we can now proceed to the logistic regression with the insolvency dummy as the dependent variable. The sample contained 413 observations of insolvency (negative equity) from a total of 3,934 firm-year examinations. Table 5 shows the results from the

logistic regression to the probability that the firm is insolvent and each explanatory variables' coefficient. It is worth noticing that the corporate governance variable is presented with a negative sign, associating firms with better governance practices with a lower chance of becoming insolvent. The variable's p-value is low enough to found statistical significance at even a 1% level.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C Corporate Governance Dummy Current Ratio EBIT/Net Debt Debt Composition Cash Conversion Cycle Acid-Test Ratio	1.187482 -2.260787 -0.459637 -3.50E-06 2.884938 -9.12E-06 -7 681342	0.280719 0.369970 0.304522 3.00E-06 0.563004 1.95E-06 0.591481	4.230141 -6.110738 -1.509374 -1.163673 5.124189 -4.685706 -12.98664	0.0000* 0.0000* 0.1312 0.2446 0.0000* 0.0000*
Asset Turnover	0.227760	0.011437	19.91432	0.0000*
McFadden R-squared S.D. dependent var Akaike info criterion Schwarz criterion Hannan-Quinn criter. Restr. deviance LR statistic Prob(LR statistic)	0.533160 0.306569 0.317685 0.330450 0.322214 2642.815 1409.043 0.000000	Mean deper S.E. of regre Sum square Log likelihoo Deviance Restr. log like Avg. log like	ndent var ession d resid od kelihood lihood	0.104982 0.218961 188.2273 -616.8858 1233.772 -1321.407 -0.156809
Obs with Dep=0 Obs with Dep=1	3521 413	Total obs		3934

logit $P_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 x_5 + \beta_6 X_6 + \beta_7 X_7 + \mu_i$

* Indicates statistical significance at the 1% level

Table 5: Logistic Regression to the Probability the Firm is Insolvent Source: Created by the author

The variables Current Ratio and Acid-Test Ratio are measures of liquity. Theorericaly then, the higher their numbers, the better for firms' financial and operacional health. Considered as return measaures, the ratios EBIT/Net Debt and Asset Turnover would have higher values in better scenarios. As the Debt Composition ratio considers how much of the firm's libiabilities is on the short-tem, it would be reasonable to assume that lower values would mean less obligations for the firm's cash flow in the short-term and, therefore, less chances to become insolvent in the short-term. Following the definition of the Cash Conversion Cycle, it would be expected lower numbers (less days) for the solvent firms, but the model estimation found an inverse relationship between insolvency and the aforementioned variable. However, the same result was found in Stüpp

(2015), in which he analyzes public Brazilian firms as well. As a return measure, one could expect the variable Asset Turnover to have a negative sign on the estimated logistic regression shown above. This would mean that, the higher the revenue a company can generate from its total assets, the lower would be the firm's chance to be in an insolvency situation. However, the opposite relation is presented in the estimated regression. Also using a Brazilian sample, Sanvicente and Minardi (1998) found a similar association between insolvency and Asset Turnover. They suggest that firms would face financial distress due to their growth without a relevant amount of equity or long-term debt to finance it. According to them, if this continues to go on, the firm would then become dependent on expensive shot-term credits, increasing its risk of insolvency.

This insolvency prediction model seems to corroborate with evidences that the use of corporate governance mechanisms can bring benefits to the companies.

In order to test the prediction efficiency of the model, Table 6 is exhibited containing the percentage of correct classifications using the estimated equation. This in-sample prediction used a cutoff of 0.5 to designate the classification of the firm as insolvent or not, according with the probability that comes out from the equation in each case. The model based on the estimated equation obtained a precision of 93.39% when predicting firm's insolvency.

Success cutoff: $C = 0.5$

	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	3438	177	3615	3521	413	3934
P(Dep=1)>C	83	236	319	0	0	0
Total	3521	413	3934	3521	413	3934
Correct	3438	236	3674	3521	0	3521
% Correct	97.64	57.14	93.39	100.00	0.00	89.50
% Incorrect	2.36	42.86	6.61	0.00	100.00	10.50
Total Gain*	-2.36	57.14	3.89			
Percent Gain**	NA	57.14	37.05			

*Change in "% Correct" from default (constant probability) specification **Percent of incorrect (default) prediction corrected by equation

Table 6: Expectation-Prediction Evaluation for Binary Specification Source: Created by the author

Similar, but not equal to insolvency, the literature presents studies showing the effects of corporate governance mechanisms in the prediction of bankruptcy, financial distress, default and corporate failure as using data from other countries than Brazil – including Daily and Dalton (1994), Darrat *et al.* (2014); Elloumi and Gueyié (2001), Lee and Yeh (2004), Platt and Platt (2012) and Wilson and Altanlar (2009). Still, none of those use an index or any measure that assembles exactly the same corporate governance carachteristics in one number. Therefore, those results are not exactly comparable with the ones found in this paper.

Nevertheless, we have an example that associates firms' financial health with good governance practices. Lee and Yeh (2004) used the percentage of directors occupied by controlling shareholder, the percentage the controlling shareholders pledged for bank loans and the deviation in control away from the cash flow rights. They used Taiwanese listed firms in their sample and state that, on the whole, those firms associated with weak corporate governance measures are vulnerable to economic downturns and more susceptible to falling into financial distress.

5 Conclusion

This research aimed to answer if the usage of corporate governance mechanisms in the Brazilian market can help avoid firms' insolvency. A logit model measuring the probability of insolvency for Brazilian firms was used in order to try to answer that question. The model estimations presented statistically significant evidences that firms with better corporate governance practices have a lower probability of being in a insolvency situation. Those evidences arise from a logistic regression that used data from companies listed in BM&FBOVESPA from 2001 to 2013. This dissertation also used financial ratios as control variables to the model and found evidences, regarding their relation with insolvency, similar to other previous studies present in the literature.

The original idea for this paper was to study the relation of firms' bankruptcy with corporate governance measures. However, this idea was abandoned due to the difficulty of getting precise information regarding the bankruptcy of Brazilian firms. Insolvency, on the other hand, could be interpreted from an accounting perspective and it was, therefore, more feasible to obtain data and study it. Hence the choice for insolvency.

In addition, an important point to take notice is the amount of authors using interchangeably the terms business failure, financial distress, insolvency and bankruptcy. As described in the literature review chapter of this dissertation, they are not precisely the same and their consequences reach different levels for all the stakeholders. This dissertation employed caution on the usage of each one of those terms. In this context, the present literature describes no similar model testing the insolvency prediction power of governance mechanisms for the Brazilian market in the literature. This dissertation could then represent a relevant contribution to the literature regarding corporate governance and corporate insolvency, as weel as to all stakeholders of the firms listed on BM&FBOVESPA.

A study limitation that could be noticed in this dissertation is the usage of the dummy variable that considers the two top levels of B&MFBOVESPA's

classification of corporate governance as representing a whole package of governance carachteristics. It was, indeed, interesting and useful in order to understand the relation between insolvency and corporate governance as whole. Yet, it could be appealing to analyze the realation between specific measures of corporate governance – such as board size, proportion of inside directors and board diversity – and insolvency (or failure) in the Brazilian market. The literature currently shows a gap of evidences picturing that relation, even though this could be interesting to scholars and firms' stakeholders. Nevertheless, this could represent a tremendous challenge considering the availability of data concerning Brazilian firms.

ALTMAN, E. I. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. **The Journal of Finance**, v. XXIII, n. 4, p. 589–609, 1968.

ALTMAN, E. I.; BAIDYA, T. K. N.; DIAS, L. M. R. Previsão de problemas financeiros em empresas. **Revista de Administração de Empresas**, v. 19, n. 1, p. 17–28, 1979.

ALTMAN, E. I.; HOTCHKISS, E. Corporate financial distress and bankruptcy: predict and avoid bankruptcy, analyze and invest in distressed debt. 3 ed. New Jersey: John Wiley & Sons, Inc., 2005.

APPIAH, K. O.; CHIZEMA, A.; ARTHUR, J. Predicting corporate failure: a systematic literature review of methodological issues. **International Journal of Law and Management**, v. 57, n. 5, p. 461 – 485, 2015.

AZIZ, A.; DAR, H. A. Predicting corporate bankruptcy: where we stand? **Corporate Governance: The international journal of business in society**, v. 6, n. 1, p. 18–33, 2006.

BAUER, J.; AGARWAL, V. Are hazard models superior to traditional bankruptcy prediction approaches? A comprehensive test. **Journal of Banking and Finance**, v. 40, n. 1, p. 432–442, 2014.

BEAVER, W. H. Financial Ratios As Predictors of Failure. **Journal of Accounting Research**, v. 4, n. 1966, p. 71–111, 1966.

BELLOVARY, J. L.; GIACOMINO, D. E.; AKERS, M. D. A Review of Bankruptcy Prediction Studies: 1930-Present. **Journal of Financial Education**, v. 33, n. Winter, p. 1–42, 2007.

BLACH, J. Financial Risk Identification based on the Balance Sheet Information Managing and Modelling of Financial Risks. Ostrava Anais...2010.

BLACK, B. S.; CARVALHO, A. G. DE; GORGA, É. What matters and for which firms for corporate governance in emerging markets? Evidence from Brazil (and other BRIK countries). **Journal of Corporate Finance**, v. 18, n. 4, p. 934–952, set. 2012.

BM&FBOVESPA. **Novo Mercado - Governança Corporativa**. Disponível em: http://www.bmfbovespa.com.br/pt-br/a-bmfbovespa/download/folder_novomercado.pdf Acesso em 28 nov. 2015. BOONE, A. L. *et al.* The determinants of corporate board size and composition: An empirical analysis. **Journal of Financial Economics**, v. 85, n. 1, p. 66–101, 2007.

BRAGA, M. J. *et al.* Investigating the Solvency of Brazilian Credit Unions Using a Proportional Hazard Model. **Annals of Public and Cooperative Economics**, v. 77, n. 1, p. 83–106, 2006.

BRAGA-ALVES, M. V.; SHASTRI, K. Corporate Governance, Valuation, and Performance: Evidence from a Voluntary Market Reform in Brazil. **Financial Management**, v. 40, n. 1, p. 139–157, mar. 2011.

BREALEY, R. A.; MYERS, S. C.; ALLEN, F. **Principles of Corporate Finance**. 10th. ed. New York: McGraw-Hill/Irwin, 2010.

BREWER, E.; MONDSCHEAN, T. H. Ex ante risk and ex post collapse of S&Ls in the 1980s. **Economic Perspectives**, n. Jul, p. 2–12, 1992.

BROOKS, C. Introductory Econometrics for Finance. Third ed. New York, NY: Cambridge University Press, 2014.

CARTER, D. A.; SIMKINS, B. J.; SIMPSON, W. G. Corporate Governance, Board Diversity, and Firm Value. **The Financial Review**, v. 38, n. 1, p. 33– 53, 2003.

CARVALHO, A. G. DE. Governança corporativa no Brasil em perspectiva. **Revista de Administração**, v. 37, n. 3, p. 19–32, 2002.

CASTRO JÚNIOR, F. H. F. D. Previsão de insolvência de empresas brasileiras usando análise discriminante, regressão logística e redes neurais. São Paulo. Dissertação (Mestrado em Administração), [s.l.], Universidade de São Paulo, 2003.

CHARITOU, A.; NEOPHYTOU, E.; CHARALAMBOUS, C. Predicting corporate failure: empirical evidence for the UK. **European Accounting Review**, v. 13, n. 3, p. 465–497, set. 2004.

CHEFFINS, B. R. Does Law Matter? The Separation of Ownership and Control in the United Kingdom. **Journal of Legal Studies**, v. 30, n. 2, p. 459–484, 2001.

CHUNG, K.; TAN, S.; HOLDSWORTH, D. Insolvency prediction model using multivariate discriminant analysis and artificial neural network for the finance industry in New ZealandInternational Journal of Business and Management, 2008. Disponível em: <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1080430> Acesso em 28 nov. 2015.

COATS, P. K.; FANT, L. F. Recognizing Financial Distress Patterns Using a Neural Network Tool. **Financial Management**, v. 22, n. 3, p. 142–155, 1993.

COFFEE, J. C. Privatization and Corporate Governanvce: The lesson from security market failure. **Journal of Corporation Law**, v. 25, n. 1, p. 6–39, 1999.

COLES, J.; DANIEL, N.; NAVEEN, L. Managerial incentives and risk-taking . **Journal of Financial Economics**, v. 79, n. 2, p. 431–468, fev. 2006.

COMMENT, R.; SCHWERT, G. W. Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures. **Journal of Financial Economics**, v. 39, n. 1, p. 3–43, 1995.

CORE, J. E.; HOLTHAUSEN, R. W.; LARCKER, D. F. Corporate governance, chief executive officer compensation, and firm performance. **Journal of Financial Economics**, v. 51, n. 3, p. 371–406, mar. 1999.

CORE, J.; GUAY, W. The use of equity grants to manage optimal equity incentive levels. **Journal of Accounting and Economics**, v. 28, n. 2, p. 151–184, dez. 1999.

DAHYA, J.; DIMITROV, O.; MCCONNELL, J. J. Dominant shareholders, corporate boards, and corporate value: A cross-country analysis. **Journal of Financial Economics**, v. 87, n. 1, p. 73–100, jan. 2008.

DAILY, C. M.; DALTON, D. R. Bankruptcy and Corporate Governance: the Impact of Board Composition and Structure. **Academy of Management Journal**, v. 37, n. 6, p. 1603–1617, 1994.

DAILY, C. M.; DALTON, D. R.; CANNELLA JR, A. A. J. Corporate governance: Decades of dialogue and data. **Academy of Management Review**, v. 28, n. 3, p. 371–382, 2003.

DARRAT, A. F. *et al.* Corporate Governance and Bankruptcy Risk. **Journal** of Accounting, Auditing & Finance, v. 31, n. 2, p. 163-202, 2014.

DEANGELO, H.; RICE, E. M. Antitakeover charter amendments and stockholder wealth. **Journal of Financial Economics**, v. 11, p. 329–359, 1983.

EHRHARDT, M. C.; BRIGHAM, E. F. **Financial Management: Theory and Practice**. 13 ed. [s.l.] Cengage Learning, 2011.

EISENHARDT, K. M. Agency Theory: An Assessment and Review. Academy of Management Review, v. 14, n. 1, p. 57–74, 1989.

ELLOUMI, F.; GUEYIÉ, J.-P. Financial distress and corporate governance: an empirical analysis. **Corporate Governance: The international journal of business in society**, v. 1, n. 1, p. 15–23, 2001.

FABOZZI, F. J.; PETERSON, P. P. **Financial Management and Analysis**. 2 ed. New Jersey: John Wiley & Sons, Inc., 2003.

FAMA, E. F. Agency Problems and the Theory of the Firm. v. 88, n. 2, p. 288–307, 1980.

FAZZARI, M. S.; HUBBARD, R. G.; PETERSEN, B. C. Financing Constraints and Corporate Investment. **Brookings papers on Economic Activity**, v. 1988, n. 1, p. 141–206, 1988.

FICH, E. M.; SLEZAK, S. L. Can corporate governance save distressed firms from bankruptcy? An empirical analysis. **Review of Quantitative Finance and Accounting**, v. 30, n. 2, p. 225–251, 2008.

GIMENES, R. M. T.; URIBE-OPAZO, M. A. Previsão de Insolvência de Cooperativas Agropecuárias por Meio de Modelos Multivariados. **Revista FAE**, v. 4, n. 3, p. 65–78, 2001.

GONDRIGE, E. D. O.; CLEMENTE, A.; ESPEJO, M. M. DOS S. B. Estrutura do conselho de administração e valor das companhias brasileiras. **Brazilian Business Review**, v. 9, n. 3, p. 72–95, 2012.

HUBER, P. The behavior of maximum likelihood estimates under nonstandard conditions. **Proceedings of the fifth Berkeley symposium on mathematical statistics and probability**, p. 221–233, 1967.

JARRELL, G. A.; POULSEN, A. B. Shark repellents and stock prices. **Journal of Financial Economics**, v. 19, n. 1, p. 127–168, 1987.

JORION, P. **Financial Risk Manager Handbook**. 4 ed. New Jersey: John Wiley & Sons, Inc., 2007.

KAPLAN, S. N.; ZINGALES, L. Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? **The Quarterly Journal** of Economics, v. 112, n. 1, p. 169–215, 1997.

KLAPPER, L. F.; LOVE, I. Corporate governance, investor protection, and performance in emerging markets. **Journal of Corporate Finance**, v. 10, n. 5, p. 703–728, nov. 2003.

KLEINBAUM, D. G.; KLEIN, M. Logistic Regression: A Self-Learning Text. 3 ed. New York, NY: Springer Science+Business Media, LLC, 2010.

KOERNIADI, H.; TOURANI-RAD, A. Does Board Independence Matter? Evidence from New Zealand. **Australasian Accounting, Business and Finance Journal**, v. 6, n. 2, p. 3–18, 2012.

LA PORTA, R. *et al.* Law and finance. **Journal of Political Economy**, v. 106, n. 6, p. 1113–1155, 1998.

____. Investor protection and corporate governance. **Journal of Financial Economics**, v. 58, n. 1-2, p. 3–27, 1999a.

LA PORTA, R.; LOPEZ-DE-SILANES, F.; SHLEIFER, A. Corporate Ownership Around the World. **The Journal of Finance**, v. 54, n. 2, p. 471–

517, 17 abr. 1999b.

LAMONT, O.; POLK, C.; SAA-REQUEJO, J. Financial Constraints and Stock Returns. **Review of Financial Studies**, v. 14, n. 2, p. 529–554, 2001.

LEAL, R. P. C.; SILVA, A. L. C. Da; VALADARES, S. M. Estrutura de controle das companhias brasileiras de capital aberto. **Revista de Administração Contemporânea**, v. 6, n. 1, p. 7–18, 2002.

LEE, T.; YEH, Y. Corporate Governance and Financial Distress : evidence from Taiwan. v. 12, n. 3, p. 378–388, 2004.

LOMBARDO, D.; PAGANO, M. Legal Determinants of the Return on Equity. Palo Alto, CA: [s.n.]. Disponível em: http://papers.ssrn.com/abstract=209310>. Acesso em 21 jan. 2016.

LOPES, A. B.; WALKER, M. Asset revaluations, future firm performance and firm-level corporate governance arrangements: New evidence from Brazil. **British Accounting Review**, v. 44, n. 2, p. 53–67, 2012.

MARTINS, M. S.; GALLI, O. A Previsão De Insolvência Pelo Modelo Cox: Uma Aplicação Para a Análise De Risco De Companhias Abertas Brasileiras. **Revista Eletrônica de Administração**, v. 13, n. 55, p. 231– 248, 2007.

MINUSSI, J. A.; DAMACENA, C.; NESS Jr., W. L. Um Modelo de Previsão de Solvência Utilizando Regressão Logística. **Revista de Administração Contemporânea**, v. 6, n. 3, p. 109–128, 2002.

MOREY, M. *et al.* Does better corporate governance result in higher valuations in emerging markets? Another examination using a new data set. **Journal of Banking and Finance**, v. 33, n. 2, p. 254–262, 2009.

OHLSON, J. A. Financial Ratios and the Probabilistic Prediction of Bankruptcy. **Journal of Accounting Research**, v. 18, n. 1, p. 109, jan. 1980.

PLATT, H.; PLATT, M. Corporate board attributes and bankruptcy. **Journal** of Business Research, v. 65, n. 8, p. 1139–1143, ago. 2012.

REISZ, A. S.; PERLICH, C. A market-based framework for bankruptcy prediction. **Journal of Financial Stability**, v. 3, n. 2, p. 85–131, 2007.

ROSS, S.; WESTERFIELD, R.; JAFFE, J. **Corporate Finance**. 10 ed. New York: McGraw-Hill/Irwin, 2013.

SANVICENTE, A. Z.; MINARDI, A. M. A. F. Identificação de indicadores contábeis significativos para a previsão de concordata de empresas. **Instituto Brasileiro de Mercado de Capitais,** p. 1–12, Projeto em andamento, 1998.

SILVA, A. L. C. Da; LEAL, R. P. C. Corporate governance index, firm

valuation and performance in Brazil. **RBF - Revista Brasileira de Finanças**, v. 3, n. 1, p. 1–18, 2005.

STÜPP, D. R. **Previsão de insolvência a partir de indicadores contábeis: Evidências de Empresas Listadas na BM&FBOVESPA nos anos 2004-2013**. Florianópolis. 119p. Dissertação (Mestrado em Contabilidade), [s.l.], Universidade Federal de Santa Catarina, 2015.

TEIXEIRA, E. T. M. A. F. **Previsão de Insolvência: Uma Análise das Companhias Abertas com Ações na Bm&Fbovespa de 2005 à 2011**. Natal. Monografia (Graduação em Administração). Universidade Federal do Rio Grande do Norte, 2014.

WALKLING, R. A.; LONG, M. S. Agency theory, managerial welfare, and takeover bid resistance. **The Rand Journal of Economics**, v. 15, n. 1, p. 54–68, 1984.

WHITE, H. Maximum Likelihood Estimation of Misspecified Models. **Econometrica**, v. 50, n. 1, p. 1–25, 1982.

WHITED, T. M.; WU, G. Financial constraints risk. **Review of Financial Studies**, v. 19, n. 2, p. 531–559, 2006.

WILSON, N.; ALTANLAR, A. Director Characteristics, Gender Balance and Insolvency Risk: An Empirical Study: September, 2009. Leeds: [s.n.]. Disponível em: http://dx.doi.org/10.2139/ssrn.1932107> Acesso em 28. nov. 2015.

YERMACK, D. Higher market valuation of companies with a small board of directors. **Journal of Financial Economics**, v. 40, n. 2, p. 185–211, 1996.