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**ANALYSIS OF THE IMPACT OF ADOPTING
INTERNATIONAL ACCOUNTING STANDARDS IN
PREDICTING THE INSOLVENCY OF BUSINESSES LISTED
ON THE BM&FBOVESPA BRAZILIAN STOCK EXCHANGE**

*Análise do impacto da adoção das normas internacionais de contabilidade na previsão de
insolvência de empresas listadas na BM&FBovespa*

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Abstract

The financial statements of Brazilian companies have been transformed with the adoption of international accounting standards, and it was expected that this would offer more reliable information for decision-making. This study aims to analyze the influence of the adoption of international accounting standards in predicting corporate insolvency. The sample comprises 94 Brazilian companies listed on BM&FBovespa, divided into two groups: the first group has companies considered insolvent and the second group has solvent companies. For each insolvent company we selected another enterprise of the same segment, based on the nearest value of the total assets. The collected data comprised the period of 31 December 2004 to 31 December 2013. The explanatory variables include 29 financial indicators and the methodological procedure was the statistical method called Discriminant Analysis. The application of statistical tests on separate samples in periods before and after the adoption of IFRS, led to the conclusion that there was a considerable improvement in predicting insolvency after the adoption of international accounting standards, because the average accuracy increased from 73.5% to 82.1%.

Keywords: Insolvency forecast. Financial indicators. International accounting standards.

Resumo

As demonstrações contábeis das empresas brasileiras foram revolucionadas com a adoção das normas internacionais de contabilidade e espera-se que tragam informações mais confiáveis para a tomada de decisão. O objetivo com este trabalho foi analisar a influência da adoção das normas internacionais de contabilidade na previsão de insolvência empresarial. A amostra compreende 94 empresas brasileiras listadas na BM&FBovespa, divididas em dois grupos: um com empresas consideradas insolventes e outro com as empresas solventes. Para cada empresa insolvente foi selecionada outra do mesmo segmento, com o valor do ativo mais próximo. Os dados coletados abrangem o período de 31 de dezembro de 2004 a 31 de dezembro de 2013. As variáveis explicativas compreendem 29 indicadores contábeis e o método aplicado baseia-se no método estatístico de Análise Discriminante. A aplicação de testes estatísticos em amostras separadas em períodos anteriores e posteriores à adoção das IFRS permitiu verificar que houve uma melhoria considerável na previsão de insolvência após a adoção das normas internacionais de contabilidade, pois a média de acerto aumentou de 73,5% para 82,1%.

Palavras-chave: Previsão de insolvência. Indicadores contábeis. Normas internacionais de contabilidade.

1 INTRODUCTION

Insolvency forecasting can be used by investors to do a company risk analysis. It makes it possible to predict financial conditions in a way that can help avoid or

reduce financial losses. These losses may give rise to costs that directly affect employees, managers, stockholders, and suppliers. They can even affect society in general, as taxes collected from these companies can be used for the general well-being of society.

From the perspective of senior management, managers have become cautious about the risks involving corporate responsibility. After the closing of organizations such as Enron and WorldCom, one of the main objectives of the regulations in Basel II became to minimize the risk of credit. Many models have been used to predict corporate bankruptcy. All of these methods have their strengths and weaknesses, and choosing among these for an empirical application is not a simple task (AZIZ; DAR, 2006).

The scientific literature does not present insolvency prediction models unanimously accepted by the researchers, but there are several studies carried out with the objective of knowing in advance if a company incurs the risk of entering into insolvency proceedings. The methods developed seek to minimize the geographical, sectoral and dimensional limitations that present the predictive models of insolvency (CHARITOU; NEOPHYTOU; CHARALAMBOUS, 2004; AZIZ; DAR, 2006; PINHEIRO et al., 2009).

Studies done on insolvency prediction models have mostly been supported by the use of historical data split into two groups of failed or heavily indebted companies, and creditworthy or healthy companies. According to Pinheiro et al. (2009), a model that better represents the combination of variables used, can be estimated from historical data on companies through a dichotomous classification of the data. This makes it possible to predict institutional bankruptcy.

Accounting aims to provide its users useful information for the economic and financial evaluation of the entity. Iudícibus (2010) points out that one of the purposes of accounting is the performance evaluation of past periods, as well as providing skillful information for management decision-making about the future.

The use of accounting data is used in the preparation of models for forecasting insolvency. For Guimarães and Moreira (2008), the accounting records reflect the actions of the managers of the firms and these actions must be guided by the economic rationality that, according to the firm's theory, is the maximization of investor profit or wealth. Maximizing investor wealth means allocating resources to assets whose risks are compatible with their returns or choosing the optimal capital structure or even minimizing costs. All these actions can be extracted from accounting indicators.

Brazilian accounting was revolutionized with the adoption of international accounting standards and with the creation of Statute 11.638 in 2007. Before the adoption of international standards, companies adhered to certain practices permitted by

tax laws, which sometimes distorted the economic reality of the company in its financial statements. In this regard, the objective of this study is to analyze the influence the adoption of international accounting standards has had on bankruptcy prediction.

Prediction of insolvency can be used by investors as a tool for risk analysis of companies, where it will be possible to predict a difficult financial situation in advance, so that financial losses are avoided or reduced. These losses can generate costs that directly affect employees, managers, shareholders, suppliers and even society in general, because the collection of taxes generated by companies can be applied for the common good of society.

Zhou (2013) states that when a company asks for a loan from a lender, the lender must respond if it is possible for the borrower to go bankrupt and not repay the loan? Before an investor makes an investment in a company's stock, the investor always cares about the bankruptcy of the company, which can cause a loss of the entire investment. Therefore, the study is important for lenders and investors to be able to predict bankruptcy of the company.

The work is justified by professional interest, where the prediction of insolvency can be a tool for business managers to make better credit decisions, thus reducing the financial risks caused by default of customers and suppliers.

Premachandra, Bhabra and Sueyoshi (2009) argue that predicting bankruptcies is important because bankruptcy imposes significant direct and indirect costs on the company's stakeholders. Evidence suggests that direct costs (court costs, lawyers, and experts) can be between 5% and 28% when both direct and indirect costs (loss of sales, lost profits, higher cost of credit, lost investment opportunities) are considered. In this way the need for early detection of the potential for insolvency is very important.

A great revolution in Brazilian accounting came by the adoption of international accounting standards and by the Law 11638/2007. Before the international standards, Brazilian companies had some practices allowed by the tax authorities, and sometimes distorted the company's economic reality in the statements (IUDÍCIBUS, 2010). Based on this argument, this research aims to analyze the influence of the adoption of international accounting standards in predicting corporate insolvency. Thus, this research bring some new insights and conclusions about evidences that the financial statements have brought more information that is reliable for decision-making.

2 THEORETICAL FOUNDATION

Initially, the review of literature will cover the importance of accounting information, in order to offer a theoretical basis for the usage of accounting indicators as explanatory variables. International accounting standards, their history, their objectives, and their adoption in Brazil are also reviewed here. In order to understand the procedures and methods used in this subject area, a review of similar studies recently published in national and international journals was also completed.

2.1 RELEVANCE OF ACCOUNTING INFORMATION

Accounting literature considers the work of Ball and Brown (1968) to be the start of the investigation of the relationship between accounting variables and the securities market. The authors' work made it possible to note that accounting information presents informative content capable of altering the expectations of investors and identifying variations in the market values of a company. This led to the conclusion that revenue statements contain information relevant to the securities market. Thus, various studies emerged that attempted to find the relation between stock prices and company revenue statements.

Francis and Schipper (1999) presented four possible interpretations and definitions of the relevance of accounting information. The first interpretation considers the importance of accounting information to be inferred from the returns obtained through strategies based on accounting information. The premise is that the accounting numbers directly reflect the intrinsic value of the company and not the stock price on the securities market. The second approach distinguishes that financial information is relevant when it contains variables used in an analysis model or helps predict them. The third interpretation is one in which accounting information can be considered relevant when it is used by investors to make decisions in relation to stock price variations. Finally, the fourth definition of relevance represents the idea that the main role of accounting information is to summarize the transactions of the company. In other words, accounting information is relevant according to the way it captures and summarizes the company's information.

The relevance of accounting information encompasses the relation between the market value (dependent variable) and the accounting variables (independent variables) (BEAVER, 2002). In this way, an accounting variable can be considered relevant if it is directly related to the dependent variable. The author also highlights that

the theoretical foundation for the studies on the relevance of accounting information for the securities market envisages the combination of analysis theory and the accounting information reporting context.

2.2 INTERNATIONAL ACCOUNTING STANDARDS

Since the 1960s, according to the growth of globalized markets, it was noted that accounting should be evaluated based on its ability to provide information to its users. Given this context and the strong expansion of the capital market, international accounting began to become more prominent in order to unify accounting standards and facilitate the understanding of information in all parts of the world (ANTUNES; ANTUNES; PENTEADO, 2007).

According to Carvalho and Lemes (2002), the lack of a single language of communication in the world becomes a hindrance to the companies, because when they are faced with the difficulties in presenting their financial accounting statements under other norms, they feel discouraged to resort to other markets.

At the end of the 1990s, the International Accounting Standards Board (IASB) was created to substitute the International Accounting Standards Committee (IASC) from 1973, and published what would later become the international accounting standards. These standards are called the International Financial Reporting Standards (IFRS).

Over the years, companies adapted slowly to the IFRS, and in 2005, more than ninety countries had already adopted these standards, as well as all of the companies listed on the stock exchange of the 25 countries in the European Union. The New York Stock Exchange (NYSE) also approved a similar measure, in which foreign companies interested in trading their stocks at the NYSE were required begin reporting their revenue statements based on the IASB standards.

In Brazil, there was a delay in the adoption of the international standards, as federal laws governed accounting practices for publicly traded companies. It was necessary to alter legislation and to have the approval of regulatory agencies, such as the Federal Accounting Committee (CFC), the Securities and Exchange Commission of Brazil (CVM), the Central Bank of Brazil (BACEN), and the Brazilian Institute of Independent Auditors (IBRACON). These bodies have a fundamental role in the study of international standards and promote changes due to their application.

According to Iudícibus (2010), the most important changes that result from the process of internationalization of accounting standards are: the primacy of the

essence over the form, principles-based accounting standards and the need for the exercise of judgment by accounting professionals.

2.3 SIMILAR RECENT STUDIES

An annotated bibliography was composed on the topic of the study, with the objective of individually analyzing the articles contained, in order to identify the objective, the statistical method, the period analyzed, the variables, the data sample used and the conclusions. This procedure was used to align the study with other studies done in this area.

The study done by Charitou, Neophytou and Charalambous (2004) had the objective of analyzing the incremental information content of the operating cash flow and the possibility of predicting financial difficulties. The authors developed insolvency prediction models for public industrial companies in the United Kingdom. 102 companies were analyzed in the period from 1988 to 1997, using logistical regression and neural networks. The results indicated that a model containing three financial variables, working capital, profitability, and financial leverage, attained an accuracy of 83% for one year before bankruptcy. These models can be used to help investors, creditors, managers, auditors and regulatory agencies in the United Kingdom to predict the probability of business failure.

In the study done by Chen (2006), four prediction models were compared to examine the utility of financial indicators in predicting business failure in China. The study looked at 1029 companies, with data collected during a period from 1999 to 2003. The statistical methods used were linear discriminant analysis, logistical regression, decision trees and neural networks. The results indicated that the logistical regression and neural network models are optimal prediction models, and attained the lowest total error cost in classification. According to the authors, the five most important predictors of financial indicators are Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA), profit per share, debt ratio, book value and current ratio. The selected variables indicate that companies with low liquidity, low operational efficiency and high leverage have a high probability of failure.

Sandin and Porporato (2008) tested the utility of predicting failure in a stable period in an emerging economy, such as was the case with Argentina in the 1990s. Twenty-two companies were analyzed between 1990 and 2000, using the multiple discriminant analysis technique. It was shown that the information available in the financial statements of the companies listed on the Buenos Aires Stock Exchange is

useful to predict companies that are approaching bankruptcy. Altman's model (1993) also proved to have the capability of prediction. However, only insolvency indicators were used, while in the model developed for the study, profitability indices were also used.

Appiah and Abor (2009) completed a study with 62 companies from the United Kingdom, in order to determine if the failure of companies could be predicted using the development of a model using the multiple discriminant analysis technique. The authors used relevant financial information from medium-sized privately held companies, from the period of 1994-2004. The results indicate that the altered model proved to be extremely accurate in correctly predicting failure in 97.3% of cases, while the original model had an accuracy of 79%.

The objective of Das, Hanouna and Sarin (2009) was to provide convincing evidence that accounting indicators are important in predicting insolvency, in addition to information available in the financial markets. The statistical method used was logistical regression, with data from 2001 to 2005, with information from 230 companies. The study provides evidence that accounting data is important in predicting insolvency. Two models were proposed: one uses accounting information and the other uses data from the stock market. The results showed that the two models created in this study suggest that accounting data is a better at predicting than the structural models that use data from the stock market.

In order to develop a model to predict bankruptcy in Iranian companies, Etemadi, Rostamy and Dehkordi (2009) utilized genetic programming and compared the accuracy of genetic programming models and multiple discriminant analysis, using data from 144 companies between 1998 and 2005. The results show that the genetic programming model produced a very accurate failure prediction model.

The objective of Müller, Steyn-Bruwer and Hamman (2009) was to test if some modeling techniques produce better prediction accuracies than others. The statistical techniques used were multiple discriminant analysis, decision trees, logit analysis and neural networks. The population consisted of South African industrial companies listed on the JSE Securities Exchange and the period analyzed was from 1997 to 2002. Their conclusions were that each different modeling technique produced different prediction accuracies. The multiple discriminant analysis and neural network techniques correctly predicted greater numbers of bankrupted companies. This study shows that there is the possibility to attain better accuracy using data from the year before failure as a subdivision, instead of the economic period as a subdivision.

Lin (2009) examined the predictive capacity of the four most used insolvency prediction models (multiple discriminant analysis, logit, probit, and artificial neural

networks), and constructed models for industrial companies in Taiwan. The sampled data included information on 96 companies that failed and 158 companies that did not fail, collected between 1998 and 2005. The results indicated that the probit, logit and artificial neural network models achieved the highest predictive accuracy. The models utilized in Lin (2009) study can be used to help investors, creditors, managers, auditors, and regulatory agencies in Taiwan to predict the probability of business failure.

Premachandra, Bhabra and Sueyoshi (2009) utilized the data development analysis method in the area of failure analysis. The study compares the capacity to analyze failure by the data development analysis with that of logistical regression. The collection of large failures in the United States was obtained from an Altman database at New York University. This data contained failures in the period from 1991 to 2004, representing the complete spectrum of industries. A random sample of 100 companies was selected out of 130. The results show that in 84-89% of cases, the data development analysis is capable of correctly identifying failed companies, in comparison with the logistical regression model, where the corresponding values ranged much more, from 16-64%.

3 RESEARCH METHOD

The procedure was divided into four parts. The first involves the methodological framework of the study. Next, the variables utilized are identified and in the third part, the companies included in the data sample for this study are described. Finally, the statistical method utilized is explained.

3.1 METHODOLOGICAL FRAMEWORK

In regards to the objectives, this is a descriptive study, with the objective of describing the characteristics of a set population or phenomenon and establishing the relationships between variables.

This is an empirical study, as it is investigative and based on observations (ALAVI; CARLSON, 1992). In relation to the approach to the problem, this is a quantitative study. The data collected for this study is secondary and was already available in report form.

In regards to the technical procedure, this study is classified as bibliographic and ex-post-facto. This study is bibliographic, as it involves searching for literature

available on the subject. This is an ex-post-facto study, because the researcher does not have control over the independent variables.

3.2 DEFINING THE VARIABLES

We collected the data in the financial statements from the Economática database and BM&FBovespa website. After collecting the data, it was compiled in a digital spreadsheet on Microsoft Excel. In order to carry out all of the statistical tests, the software package SPSS Statistics was utilized.

The liquidity indices are utilized to analyze the company's payment capacity. That is, they make it possible to identify if the company has the ability to pay off its balance. The liquidity variables are shown by the indices X1, X2, and X3. The indebtedness variables show the company's policies on obtaining revenue and the capital structure variables analyze the passive revenue sources structure of the company. Both are represented by the indices X4, X5, X6, X7, X8, X9, X10 and X11.

The variables X12, X13, X14, X15 and X16 represent the average term indices. The average term indices, also known as activity ratios, show the turnover rates for their respective activities. The profitability variables are represented by the X17, X18, X19, X20, X21, X22, X23, X24, X25, X26, X27, X28 and X29 indices. The profitability indicators serve to identify capability to create returns on invested capital or earnings created by the company.

Board 1 shows 29 economic-financial indicators and Board 2 shows the legend for groups of accounting calculations used in each formula.

Board 1 – Economic-Financial Indicators

Acronym	Indicator	Formula
X1	General Liquidity	$(AC + RLP) / (PC + ELP)$
X2	Current Liquidity	AC / PC
X3	Non-current Liquidity	$(AC - E) / PC$
X4	Level of Indebtedness	$(PC + PNC) / PL$
X5	Debt Composition	$PC / (PC + PNC)$
X6	Fixed Asset Ratio	ANC / PL
X7	Gross Debt divided by Assets	DB / A
X8	Gross Debt divided by Net Assets	DB / PL
X9	Net Debt divided by Net Assets	DL / PL
X10	Receivables divided by Assets	EX / A
X11	Receivables divided by Net Assets	EX / PL

Acronym	Indicator	Formula
X12	Average Storage Term	$(E / CPV) \times 360$
X13	Accounts Payable Turnover	$(VMCP / C) \times 360$
X14	Accounts Receivable Turnover	$(VMCR / V) \times 360$
X15	Operational Cycle	PME + PMR
X16	Financial Cycle	PME + PMR – PMP
X17	Gross Margin	LB / ROL
X18	Net Margin	LL / ROL
X19	EBIT	LAJIR / ROL
X20	EBITDA	$(LAJIR + D) / ROL$
X21	EBIT divided by Gross Debt	LAJIR / DB
X22	EBIT divided by Net Debt	LAJIR / DL
X23	EBIT divided by Financial Costs	EBIT / DF
X24	Asset Turnover	ROL / A
X25	Net Assets Turnover	ROL / PL
X26	Returns on Assets	LL / A
X27	Returns on Net Assets	LL / PL
X28	Operating Leverage	$(ROL - CPV) / (ROL - CPV - DV - DA)$
X29	Financial Leverage	$(LL \times A) / PL / (LL - RF)$

Source: the authors.

Board 2 – Legend for accounting calculations used in the indicator formulas

Acronym	Name	Acronym	Name
A	Assets	LB	Gross Profit
AC	Current Assets	LL	Net Profit
ANC	Non-current Assets	PC	Current Liabilities
C	Purchases	PL	Net Equity
CPV	Cost of Goods Sold	PME	Average Storage Term
D	Depreciation	PMP	Average Payment Term
DA	Administrative Costs	PMR	Average Receivables Term
DB	Total Debt	PNC	Non-current liabilities
DF	Financial Costs	RF	Financial Profit
DL	Net Debt	RLP	Long-term Assets
DV	Cost of Sales	ROL	Net Operating Revenues
E	Stock	V	Sales
ELP	Long-term Accounts Payable	VMCP	Average Accounts Payable
EX	Receivables	VMCR	Average Accounts Receivable
EBIT	Earnings Before Income and Taxes		

Source: the authors.

3.3 DEFINITION OF THE SAMPLE

The population in this study consists of non-financial publicly held companies that were listed on the BM&FBovespa during the period from December 31, 2004 to December 31, 2013.

The companies considered in this study were those listed on the BM&FBovespa, and in various stages of insolvency. In other words, these are companies that presented an insufficient balance, or companies that had gone into court-ordered restructuring. Healthy companies are part of the same sectors as unhealthy companies.

Table 1 lists 22 companies considered insolvent and traded on the Brazilian Securities, Commodities and Futures Stock Exchange in São Paulo (BM&FBovespa), from all sectors except finance. Insolvent companies are those that have filed for extrajudicial restructuring, bankruptcy or court-ordered restructuring. For each insolvent company selected, another of the same sector was chosen, solvent and with a similar assets value.

The list of insolvent companies was obtained from the site of BM&FBovespa, at the link 'PlantãoEmpresas' which showed a list of companies in special circumstances on the 21/10/2014.

Table 1 – Companies in Judicial Restructuring Procedures

Insolvent Company	Sector	Filing Date	Assets Value (R\$)	Solvent Company	Assets Value
BUETTNER	Textile	18/05/2011	207,645.00	ENCORPAR	218,062.00
CELPA	Electrical Power	28/02/2012	5,024,910.00	GER PARA-NAP	5,085,278.00
CHIARELLI	Construction Materials	09/01/2009	46,974.00	POR-TOBELLO	611,063.00
CLARION	Food and Beverages	07/06/2013	1,360,263.00	JOSAPAR	1,188,854.00
CONST BETER	Construction	15/09/2008	86,209.00	AZEVEDO	138,799.00
GPC PART	Others	17/05/2013	765,193.00	PAR AL BAHIA	759,978.00
INEPAR	Others	15/09/2014	3,363,345.00	ANHANGUE-RA	3,682,604.00
INEPAR TEL	Telecommunications	15/09/2014	554.00	LA FONTE TEL	986,770.00
LUPATECH	Industrial Goods	10/10/2014	1,471,121.00	FERBASA	1,421,313.00
MANGELS INDL	Steel and Metallurgy	01/11/2013	737,520.00	KEPLER WEBER	640,457.00

Insolvent Company	Sector	Filing Date	Assets Value (R\$)	Solvent Company	Assets Value
MET DUQUE	Steel and Metallurgy	06/02/2014	221,467.00	ALIPERTI	442,209.00
MMX MINER	Mining	15/10/2014	7,453,203.00	LITEL	33,198,401.00
OGX PETRO-LEO	Petroleum and Gas	19/11/2013	18,646,493.00	COMGAS	4,966,752.00
OSX BRASIL	Vehicles and Spare Parts	26/11/2013	10,675,780.00	IOCHP-MA-XION	6,302,794.00
PET MANGUI-NH	Petroleum and Gas	28/01/2013	347,618.00	CEG	2,240,987.00
REDE ENER-GIA	Electrical Power	26/11/2012	14,915,036.00	TRACTEBEL	14,264,041.00
SANSUY	Others	22/12/2005	452,686.00	EVORA	716,880.00
SCHLOSSER	Textile	01/07/2011	148,882.00	PETTENATI	362,665.00
TECEL S JOSE	Textile	10/08/2010	45,966.00	IND CATA-GUAS	270,370.00
TECNOSOLO	Others	06/08/2012	213,616.00	SONDOTEC-NICA	107,430.00
TEKA	Textile	26/10/2012	586,085.00	DOHLER	600,162.00
TEX RENAUX	Textile	05/05/2010	138,901.00	CAMBUCCI	212,769.00

Source: the authors.

Companies that were insolvent because of an insufficient balance did not start court-ordered restructuring and presented at least one annual financial statement with negative net worth. As there are companies that went through this situation more than once during this time period, the date of occurrence was considered to be the first time that the company presented a negative net capital.

Companies on the BM&FBovespa found to be with a negative net capital are shown in Table 2. The selection of solvent companies followed the same criteria as before, to be of the same sector and have a similar assets value.

Table 2 – List of Companies with a Negative Net Capital

Insolvent Company	Sector	Year of Occurrence	Value of Assets (R\$)	Solvent Company	Assets Value
AGRENCO	Agriculture and Fishing	2008	1,225,574.00	SLC AGRICOLA	1,541,853.00
ALL ORE	Mining	2009	24.00	CENT AÇU	48,606.00
ARTHUR LANGE	Others	2006	53,439.00	IDEIASNET	65,618.00
BATTISTELLA	Commerce	2011	564,993.00	WLM IND COM	561,606.00

Insolvent Company	Sector	Year of Occurrence	Value of Assets (R\$)	Solvent Company	Assets Value
BIOMM	Others	2007	9,707.00	RET PART	10,598.00
BOMBRIIL	Chemical Products	2004	346,473.00	PRONOR	477,571.00
BOTUCATU TEX	Textile	2008	62,175.00	LE LIS BLANC	211,934.00
CELGPAR	Electrical Power	2010	6,266,517.00	ENEVA	6,279,555.00
CONST A LIND	Construction	2007	52,693.00	CIMOB PARTIC	93,887.00
DOCAS	Others	2007	374,971.00	KROTON	503,402.00
DOC IMBI-TUBA	Transportation and Services	2004	164,689.00	INVEPAR	183,142.00
ESTRELA	Others	2004	162,535.00	SPTURIS	184,844.00
FAB C RE-NAUX	Textile	2006	136,595.00	CREMER	220,869.00
GAZOLA	Steel and Metallurgy	2004	23,807.00	MICHELE-TTO	32,950.00
HOTEIS OTHON	Others	2006	402,871.00	SARAIVA LIVR	415,920.00
IGB S/A	Electronics	2007	305,558.00	BEMATECH	455,919.00
IGUACU CAFÉ	Food and Beverages	2011	588,677.00	CACIQUE	532,590.00
KARSTEN	Textile	2013	364,033.00	SANTANENSE	416,906.00
LAEP	Food and Beverages	2009	753,153.00	USIN C PIN-TO	1,744,047.00
PQ HOPI HARI	Others	2013	304,933.00	HARPIA PART	341,774.00
RECRUSUL	Vehicles and Spare Parts	2004	38,366.00	WIEST	127,839.00
RIOSULENSE	Vehicles and Spare Parts	2008	123,162.00	DHB	198,769.00
TEC BLUME-NAU	Textile	2008	8,301.00	CEDRO	352,030.00
TELEBRAS	Telecommunications	2006	235,027.00	NEWTEL PART	404,356.00
WETZEL S/A	Vehicles and Spare Parts	2004	96,177.00	BIC MO-NARK	215,423.00

Source: the authors.

3.4 DISCRIMINANT ANALYSIS

Discriminant Analysis consists of creating a linear combination of two or more independent variables that best distinguish between objects (people, companies, etc.) in groups defined a priori. The process of discriminating is done by establishing the weights of the statistical variable for each independent variable, so as to maximize the differences between groups (HAIR JUNIOR et al., 2009). Nevertheless, discriminant analysis is considered to be a prediction and classification technique. This is a multivariable statistical analysis method utilized when the dependent variable is categorical. In other words, the dependent variable is not continuous, but rather qualitative, and the independent variables are quantitative, or continuous.

4 RESULTS OF THE STUDY

In order to analyze the data, information was collected from 94 companies, half of which were insolvent, while the other half were solvent. The insolvent companies were each paired with a solvent company, based on the year previous to the occurrence of insolvency. This section envisages the comparison of the predictive capability of each model for separate samples, for periods before and after the adoption of international standards.

The adoption of more transparent management practices and the use of internationally accepted accounting standards tends to reflect in improved credit evaluations by credit rating agencies and in the increase of market liquidity (BUCHANAN, 2003; LEHMAN, 2005). In light of this assumption, this study sought evidence of alterations in corporate insolvency prediction after the adoption of the IFRS standards.

The adoption of IFRS occurred in two phases for Brazilian companies: initially, a partial adaptation in the accounting reports starting in January of 2008; and starting in January of 2010, a complete adoption of the new standards. Although the adoption of the international accounting standards took place in two stages, due to the sample size being relatively small, the companies were split into two groups.

In Board 3, the insolvent companies are separated into two groups, with the separation criteria being the year in which the company entered the insolvency stage. The companies that entered insolvency between 2004 and 2009 were categorized as “before the IFRS adoption”. The companies that entered insolvency between 2010 and 2014 were categorized as “after the IFRS adoption”.

Board 3 – Separation of companies into groups, before and after the adoption of IFRS

COMPANY	INSOLVENCY START YEAR	COMPANY	INSOLVENCY START YEAR
Bombril	2004	Celgpar	2010
Doc Imbituba	2004	Tecel S Jose	2010
Estrela	2004	TexRenaux	2010
Gazola	2004	Battistella	2011
Recrusul	2004	Buettner	2011
Wetzel S/A	2004	IguacuCafe	2011
Sansuy	2005	Schlosser	2011
Arthur Lange	2006	Celpa	2012
Fab C Renaux	2006	RedeEnergia	2012
HoteisOthon	2006	Tecnosolo	2012
Telebras	2006	Teka	2012
Biommm	2007	Clarion	2013
Const A Lind	2007	GPC Part	2013
Docas	2007	Karsten	2013
IGB S/A	2007	MangelsIndl	2013
Agrenco	2008	OGX Petroleo	2013
BotucatuTex	2008	OSX Brasil	2013
ConstBeter	2008	Pet Manguinh	2013
Riosulense	2008	PqHopiHari	2013
Tec Blumenau	2008	Inepar	2014
All Ore	2009	Inepar Tel	2014
Chiarelli	2009	Lupatech	2014
Laep	2009	Met Duque	2014
		MMX Miner	2014

Source: the authors.

The indicators for these companies were also separated into distinct databases. The companies classified as insolvent and their pairs, from the period before the adoption of the international standards, had variables chosen between the years 2004 and 2008. For the companies classified in the group after the adoption of the international accounting standards, the variables were chosen between the years 2009 and 2013.

4.1 INSOLVENCY BEFORE THE ADOPTION OF IFRS

Statistical tests were performed utilizing discriminant analysis under the stepwise method. The first tests were completed with the group before the adoption of international accounting standards. In these tests, the objective is to identify the most relevant variables to classify the companies, in order to find the accuracy of the model.

Table 3, with the usage of discriminant analysis, describes the variables that are best suited for classifying the companies and their coefficients.

Table 3 – Coefficients of the classifying function before IFRS

	SITUATION	
	INSOLVENT	SOLVENT
X5	.034	.019
X13	.011	.005
X14	.008	.002
X16	-.002	.006
X21	-.002	.003
(Constant)	-2.487	-1.341

Source: the authors.

As can be seen in Table 3, the most significant variables for predicting corporate insolvency are Debt Composition (X5), Average Payment Term (X13), Average Receivables Term (X14), Financial Cycle (X16) and EBIT divided by Gross Debt (X21). All of these explanatory variables can be considered newly found by this study, as they were not part of the models studied nor were they encountered in literature.

The discriminant analysis model creates two different functions, one for each group of companies: solvent and insolvent. In order to project whether a company may have financial problems and enter bankruptcy, both equations should be tested, and the one that results in the greater value shall be the group in which the company belongs. If the result indicates a higher value for the insolvent function, there is a high probability that the company is in financial difficulties. The discriminant functions in the period before the adoption of the IFRS standards are as follows:

$$Z \text{ insolvents} = -2.487 + 0.034 X5 + 0.011X13 + 0.008X14 - 0.002 X16 - 0.002 X21$$

$$Z \text{ solvents} = -1.341 + 0.019 X5 + 0.005X13 + 0.002X14 + 0.006 X16 + 0.003 X21$$

Table 4 presents the results of classification through discriminant analysis, solely for the period before the adoption of the IFRS standards.

Table 4 – Results of classification before IFRS

SITUATION		Predicted Group Association		Total	
		INSOLVENT	SOLVENT		
Original	Count	INSOLVENT	76	39	115
		SOLVENT	22	93	115
	%	INSOLVENT	66.1	33,9	100.0
		SOLVENT	19.1	80,9	100.0

Source: the authors.

An average of 73.5% of the original cases were correctly classified. The accuracy in the group of insolvent companies was lower, with 66.1% of insolvent companies associated with the correct group. The accuracy in the group of solvent companies was better, with 80.9% of companies associated with the correct group.

Comparing the results of this research with other studies that also applied the discriminant analysis as statistical method, it is possible to affirm that the statistical results which were below other studies. Beaver (1966) obtained a 87% success for 1 year before the insolvency. Altman (1968) had accuracy in its model of 95% for 1 year before bankruptcy, declining to 36% within a period of up to five years before bankruptcy.

The results of this research were similar to the findings from Charitou, Neophytou and Charalambous (2004). These authors obtained a score of 83% for one year before bankruptcy, analyzing a sample of 102 companies, a number that is similar to this study. Brito and Assaf Neto (2008) applied logistic regression to answer this research question, but their results were higher. They had a 90% accuracy level, and 54 of the 60 companies in the sample were correctly classified.

4.2 INSOLVENCY PREDICTION AFTER THE ADOPTION OF IFRS

From the accounting indicators from 2009 to 2013, and considering the sample companies listed in Board 3, the stepwise method of discriminant analysis was performed. The objective was to identify the most important variables to classify companies as solvent or insolvent. Table 5 shows all of these coefficients.

Table 5 – Coefficients of the classification function after IFRS

	SITUATION	
	INSOLVENT	SOLVENT
X2	1.246	1.598
X6	.004	.009
X7	.057	.034
X10	.034	.019
X12	.005	.011
X19	-.005	-.012
X22	.007	.017
X24	1.271	2.458
X27	-.016	.080
(Constant)	-5.006	-5.357

Source: the authors.

From Table 3 it is possible to verify that all of the variables selected to compose the model are different from those chosen for the period before the adoption of the IFRS standards. Based on this data, it is possible to affirm that there was a significant variation in the accounting reports. The variables that were important before the adoption of IFRS did not show up in the model developed after the adoption of IFRS.

The variable return on equity is the explanatory variable in the studies of Fitzpatrick (1932), Kanitz (1976), Appiah and Abor (2009). The fact that current liquidity was selected as a predictive variable corroborates to the idea of the works from Beaver (1966), Kanitz (1976) and Chen (2006). The variable Indebtedness Level was also used in the models developed by Kanitz (1976), Hensher and Jones (2007), Brito and Assaf Neto (2008), Lin (2009). The study of Kanitz (1976) corroborates with the present work, which has the variable General Liquidity selected to the model.

In this way, the two discriminant functions of the period after the adoption of the IFRS standards are as follows:

$$Z \text{ insolvents} = -5.006 + 1.246 X2 + 0.004X6 + 0.057X7 + 0.034 X10 + 0.005 X12 - 0.005 X19 + 0.007 X22 + 1.271 X24 - 0.016 X27$$

$$Z \text{ solvents} = -5.357 + 1.598 X2 + 0.009X6 + 0.034X7 + 0.019 X10 + 0.011 X12 - 0.012 X19 + 0.017 X22 + 2.458 X24 + 0.080 X27$$

Table 6 shows the results of the classification of companies utilizing these two discriminant functions.

Table 6 – Classification results after IFRS

SITUATION		Predicted Group Association		Total	
		INSOLVENT	SOLVENT		
Original	Count	INSOLVENT	91	29	120
		SOLVENT	14	106	120
	%	INSOLVENT	75.8	24.2	100.0
		SOLVENT	11.7	88.3	100.0

Source: the authors.

The average accuracy with the data after the adoption of the international accounting standards was 82.1% of companies. The percentages were 75.8% of insolvent companies and 88.3% of solvent companies.

Some studies had similar results in comparison to this research. For example, Appiah and Abor (2009) presented two different results. Initially, the model of the authors presented 79% accuracy. Moreover, in the second test, with the inclusion of new variables and with another sample, the percentage increased to 97.3%. The results of Etemadi, Rostamy and Dehkordi (2009) were slightly lower than those that we found in this study. Using the multivariate statistical method of multiple discriminant analysis, the results showed an accuracy of 77% in the test sample and 75% in the validation sample. Müller, Steyn-Bruwer and Hamman (2009) also had inferior results using the discriminant analysis. The level of accuracy was 70.6% for 1 year and 60.9% for 2 years before bankruptcy.

Sandin and Porpato (2008) consider two types of errors, types I and II. Type I error represents a bankrupt company, classified as healthy, and type II error represents a company, in fact, bankrupt classified as bankrupt. Lin (2009) also classified the errors in Type I and Type II, where the percentage of error ranged from 14.29% to 20% of bankrupt companies classified as healthy and from 7.41% to 29.63% of healthy companies classified as insolvent. This variation in the percentage of error occurred because 3 different sets of explanatory variables were used. Ohlson (1980) variables were the ones with the best predictive power of insolvency prediction.

These accuracy percentages during the period after the adoption of IFRS were better than the period before the adoption of IFRS. The general average rose

8.6%. For insolvent companies there was a classification improvement of 9.7% and for solvent companies the improvement was 7.5%.

Considering the results of the period after the adoption of IFRS, it is possible to affirm that the adoption of IFRS brought improved accounting information and contributed to better decision making by market analysts. This fact supports the studies by Buchanan (2003) and Lehman (2005).

5 FINAL CONSIDERATIONS

To describe the difference between bankruptcy and insolvency, it was considered the concept of Iudícibus and Lopes (2004) that defines insolvency as the state in which the company becomes unable to fulfill certain commitment and bankruptcy as the procedures under the bankruptcy laws when the corporation is unable to pay its commitments without intermediation of justice. Ross, Westerfield and Jaffe (2011, p. 683) mention that insolvency may be due to flow, which is the lack of momentary liquidity or balance, which happens to negative economic value. The companies that made up the sample of this work were considered those that were in judicial recovery, according to a publication available on the BM&FBovespa website and those that presented bankruptcy, considering those that presented short-term liabilities.

The 29 variables selected to be part of the initial model were the accounting indicators used to analyze the financial statements, divided into five groups: liquidity, indebtedness, capital structure, average term and profitability.

This study contributes a new approach to insolvency prediction models, as it was possible to verify the influence of the adoption of international accounting standards on the development of models and on the results of classifying companies. The results indicate that there was a significant change in accounting reports, since the corporate insolvency predicting variables changed the data significantly between the periods before and after the adoption of IFRS. In addition, the adoption of international accounting standards provided more relevant information for decision-making, in the context of insolvency prediction. The accuracy in predicting insolvency increased considerably.

This study also aimed to verify the relationship of accounting information with the risk of insolvency of companies in Brazil. Based on the studies described in the theoretical basis about the relevance of the accounting information and on the results presented in this study, it is possible to affirm that the accounting information has the capacity to predict corporate insolvency. Since, based on the accounting

indicators, it was possible to find a 78% average score for right decision about the classification of companies.

This percentage that we found on our research is among those explained in the theoretical basis. Some of them had better percentages of correctness, such as: Beaver (1966), Altman (1968), Ohlson (1980) and Appiah and Abor (2009). And other studies had similar results, like the results from Etemadi, Rostamy and Dehkordi (2009), Müller, Steyn-Bruwer and Hamman (2009) and Lin (2009).

For future studies, the usage of other insolvency prediction methods is suggested, such as data development analysis, neural networks, and logistical regression. Based on the studies described in the literature review and on the results presented in this study, it is possible to affirm that accounting information has the capacity to predict corporate insolvency. This is because, from the accounting indicators, after the adoption of IFRS, the average accuracy in classifying companies was 82.1%.

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