

The determinants of bankruptcy and default of real sector companies in Colombia for a differentiated government policy **-since the economy has been officially declared to be in recession-**

Juan Sergio Cruz M¹, main researcher and Enrique Vargas García²
July 10th 2009³

Abstract

Colombia is experiencing a new economic recession. Its depth and duration will affect the stability of Colombian companies. The IMF has already projected a negative economic growth of 0.3 percent for the GDP in 2009. Regarding these expectations, the *dominant interpretations* for analyzing the fragility of companies follow analytic models that are essentially of *closed economies*,⁴ which have inspired the *analytical instruments*. Through binomial Logit regression techniques, several general econometric models have been developed *to establish the probability of bankruptcy and the probability of default for companies, as well as specific models to determine these probabilities in sectors and subsectors*. Beginning with more than 21,000 companies that turned their financial statements in to the Superintendence of Corporations in the 1995-2008 period, this paper demonstrates that the determinants of the probabilities transcend the financial structure of companies and concludes that the national and international economic crises of certain sectors or subsectors **take place in a differentiated manner**⁵. The results confirm the importance of a model that includes variables that are external to a company in open economies. One of the additional contributions of this paper is the identification of the *risk asymmetry of the different subsectors* which are part of each *sector*.

1. Introduction

General purpose of the research.

The general objective of this study is to define the default and bankruptcy probability as well as the determinant variables of companies in subsectors and economic sectors. This paper will also determine how these issues impact companies and to how far the destruction of Colombian businesses can go. A general Logit model as well as other models will be constructed with an inferior aggregation level by sector, subsector and single companies for this purpose; from a systematic analysis -endogenous and

¹ Professor and Investigator at CESA Business School. Master in International Policies. Specialist in Finance. Former advisor of the Superintendence of Corporations, former advisor of the Presidency of the Republic of Colombia and the Ministry of Justice, author of several books and research papers. Financial Consultant-jcruz@cesa.edu.co

² Undergraduate Student at CESA Business School. Aspiring candidate to the undergraduate Diploma of Business Administration at CESA Business School.

³ Thanks to Carlos Andres Perez from Andes University, Luis Fernando Melo from Bank of the Republic

⁴ ANIF-Fedesarrollo. Colombia. Diagnosis of the structure of financing and funding. (2004)

⁵ ANIF-Fedesarrollo. Colombia. Diagnosis of the structure of financing and funding. (2004)

exogenous to a company- , according to the concepts enshrined in Colombian legislation. To achieve this, financial variables of companies will be specified, as well as the size of the productive and economic structure of each sector, the macroeconomic variables referred to in financial literature and most important, the introduction of variables of open economies will be specified.

Specific goals:

In 2005 and 2006 the main researcher for this paper worked as a financial advisor⁶ for the Superintendence of Corporations and even though a system of early alert was being used at the time –IDI-, said system was not able to indicate issues for several sectors and companies were going bankrupt. Something was not working properly. Due to this, it is of the utmost importance to face the fragility of Colombian companies from a different perspective.

1.1 Usually the studies presented in Colombia focus on determining the probability of bankruptcy starting from seven macro sectors. The latest research has focused on economic sectors. This study will be developed starting from this level, but it is believed that the sectors (65)⁷ encompass a risk asymmetry among the subsectors as a hypothesis, due to which, this issue will be studied in more depth.

It is quite usual to ask about the probability of liquidation, and in most cases, there is no rigorous treatment of its legal or financial definition. Furthermore, there is no clear difference between a restructuring process and a liquidation⁸ process. Thus, on a data base level, the companies covered by Act of Congress 550 and 222⁹ have been treated in an undifferentiated manner. Consequently, the question we seek to answer is: **how to determine the probability of bankruptcy and default of companies, subsector and mayor economic sectors in Colombia in the 1995-2008 period?**

1.2. The usual framework for analysis of the fragility of enterprises and their aggregates are interpretative models of closed economies and endogenous models of companies that follow the seminal studies Altman's. Colombia has changed notably since the constitution of 1991, but the subject under discussion is still being analyzed with models that were used 40 years ago. Our analytic framework of firm vulnerability pertains eminently to open economies, and the effects of the economic model of Uribe's government in the structure of the productive sectors are recognized. Therefore, our aim is to answer the following: **which variables would determine that a company and its aggregates would fall into a liquidation process and which would determine default?** The variables that will be considered are: size of the company¹⁰

⁶ Assessor of the bureau of the Superintendence of Societies in the design and functionality of the information system of Enterprise Risk –SIREM-; received a recognition as one of the best government information systems in 2008.

⁷ For further information read attachment #1. The number of companies by sector since 1995 to 2005 is presented. This allows explaining a group of sectors which are not going to be considered in the investigation due to lack of information.

⁸ This difference is presented clearly by Jack Glen in his document "Debt and Vulnerability".

⁹ These laws give a different treatment to bankruptcy and restructuring.

¹⁰ **Act of congress # 905 of 2004 (august 2) was modified with respect to the promotion of the development of Colombian SME's (small & medium enterprises) and other determinations were specified. Article # 2. Definitions.** For all effects, it is understood that micro, family, small and medium enterprises are units of economic profiteering, undertaken by a natural or juridical person in business, agricultural, industrial, commercial or service activities, whether rural or urban, that respond to two (2) of the following parameters:

1. Medium Enterprise: a) Staff plant between fifty one (51) and two hundred (200) workers, or
- b) Total asset value between five thousand and one (5.001) and thirty thousand (30000) current minimum legal salaries.
2. Small Enterprise: a) Staff plant between eleven (11) and fifty (50) workers, or

(small, medium or large base on the size of its assets), 64 sectors¹¹ base on the legal nature of the company (CIIU code), structure of the sector (monopoly, oligopoly and competition), macroeconomic variables, open economy variables: TRM (exchange rate), balance of trade, flow of foreign investments, GDP of Colombia's main trade partners, variable of technological innovation and finally the default concept according to Act of Congress 550 and bankruptcy according to # 222 and today to act of Congress # 1116 of June 27th2007.

1.3 Colombia has a *high level of imperfection in the capital market*, where a pronounced information asymmetry and a democratic and massive deficit of information are to be found¹².

This is due to the lack of an instrument such as *the market* that allows signals to be sent so that adequate assignment of national and international monetary resources can be done. Only 120 companies are listed in the stock market and barely 23 have good stock market indexes based on international standards. As will be explained further on, the Colombian market is made up of by 1.100.000 companies with diverse legal nature that are not listed on the stock market. Information pertaining to these companies is processed by the Superintendence which takes the financial statements 6 months before closing the official book-keeping year and later on publishes those statements. We consider it relevant to delve deeper into this kind of research because it will allow the regulators and national and international investors to respond more efficiently to the relationship between risk and return in their investments in Colombia. We ask ourselves **is there any difference between the analysis done on a general point of view and an analysis done at sector and subsector levels?**

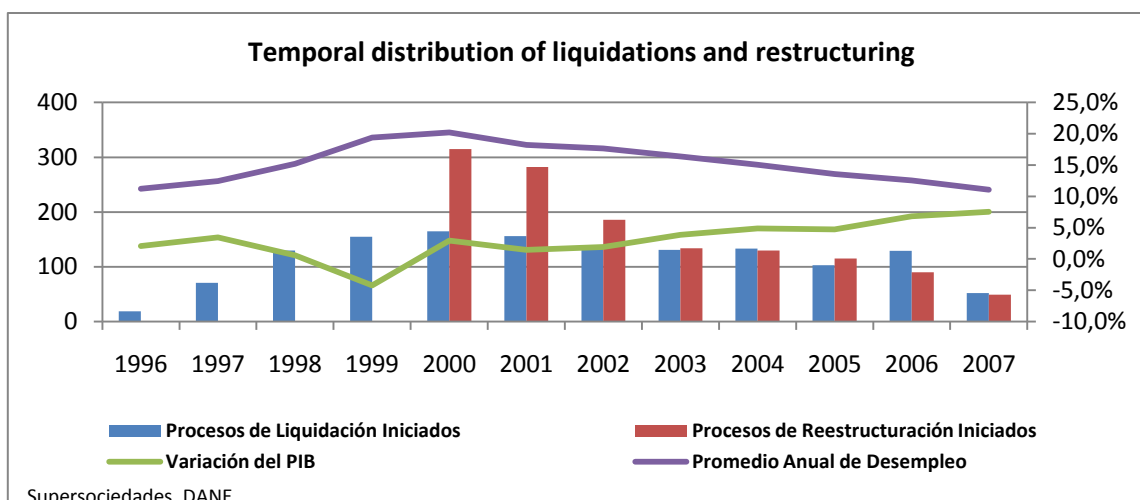
1.4 In the last decade of the past century, Colombia went through a process of opening its economy and later suffered a financial crisis, a situation that gave birth to a deep economic recession that changed the structure of the market. This process obviously changed the number of businesses that defaulted on their payments and also went to bankrupt, a number which increased notably (Figure 1). Figure 1 describes the set of data of the GDP, unemployment, and the set of data of businesses that started a bankruptcy process through the mechanisms foreseen in Act of Congress # 222 and # 550. One of the lessons of the past is that the crisis *impacts businesses with a delay of at least* one to two years and the bankruptcy process of these businesses is distributed over a long period despite later positive economic growth periods. See next table. Consequently, in this study the predictable question is **how will this new crisis impact the future of Colombian businesses and their liquidation?**

b) Total asset value between five hundred and one (501) and less than five thousand (5.000) current minimum legal salaries.

3. Micro-Enterprise:a) Staff plant not superior than ten (10) workers, or b) *Total asset value excluding private household inferior to five hundred (500) current minimum legal salaries.*

¹¹ Refer to attachment # 1

¹² Anif-Fedesarrollo. Colombia. Diagnosis of the financing and funding structure. (2004)



It is irresponsible to state that the Colombian economy is armored against the current crisis. The fact is that **the effects of the crisis have not been felt yet, and these effects could be much stronger if the recession deepens over a longer period of time.** Colombia, its economic agents and national and international regulators must make an intellectual effort to determine the possible outcomes in terms of bankruptcy of businesses and consequently of employment. Starting from that point, it must define differentiated contention policies according to the different sectors and subsectors in order to soften the inevitable effects of national and international recession.

1.5 Finally, as was mentioned previously, the structure of the sectors in Colombia has been significantly modified during President Uribe's government. Currently, the productive structure has focused on large oligopolies. Therefore we ask ourselves **how does this new productive structure affect and how it will affect this new productive structure the fragility of companies and their aggregates and additionally how does this affect and how will it affect the small players (SME's) in the productive system?**

2. Context of the study and dimension of the issue

2.1 Strauss-Kahn made good use of his speech a few months ago when he mocked those who believed in the theory of *decoupling*, a theory that states that the coexistence of a wealthy world in crisis and an emerging world in economic growth is possible. When he finished his speaking the head of the IMF insisted that "no one is going to be unharmed by the current crises as was the case with the Asian tigers

that have lost their teeth in this one; the expectations are that they will grow again soon.”¹³ According to the forecasts of the IMF, an economic growth of 2.7% is to be expected for the Asian region for 2009, a result that is half of what was predicted at the beginning of the year. Considering these facts, Colombia will not be isolated from the crisis. The point of debate is the intensity and duration of the crisis.¹⁴ There is a current consensus among the main economists of different economic schools. There is a high probability that the economic growth of the GDP in 2009 will be around 1.5% and 2.2%¹⁵. However, this amount has recently been revised and changed to the negative value of -0.3%.

Assets		Liabilities	
3.433.351.202		5.076.161.017	
		Insolute Debt at process start	
		1.642.809.815	0,324
70%	Asset Appreciation	Insolute Debt due to Appreciation	
70%	2.403.345.841	2.672.815.176	0,527
50%	Realized Assets	due to Realization	
35%	1.201.672.921	3.874.488.097	0,763
34%	Management Expenses 447,757 millions of pesos (13% of total Assets at the start of the process)	Insolute Debt due to Management Expenses	
	447.557.000	4.322.045.097	0,851
	Disposable Assets	Debt Payed	
22%	754.115.921	754.115.921	0,149
		Equity at process start	
		-1.642.059.154	
		Equity	

Bankruptcy in Colombia is a bad business. The next example is an aggregate and simplified balance sheet of the liquidated businesses in Colombia between 1995 and 2002 (table designed by the authors). Here we see that at the beginning of the bankruptcy process the assets have less value than to the liabilities and how the assets lose value through the mechanisms – for instance public auctions- of the bankruptcy process. At the end of the process, as was noted previously, the disposable assets represent 22% of the assets at the beginning while the liabilities that are paid are no more great than

15% of the initial debt because the liabilities were greater than the assets from the start and these lost their value through the liquidation process.

3. ¿Who articulated the interpretative concepts in Colombia and in the world about the prediction of the fragility of companies and their aggregates?

¹⁴ Forum of Fedesarrollo and the World Bank. Third week of January 2009.

¹⁵ Forum of Fedesarrollo and the World Bank. Third week of January 2009.

3.1 In Colombia

As was explained from the precepts of the Constitution of 1991,¹⁶ Colombia entered a globalization and economic deregulation process. Nevertheless, the academy and the regulators have been very slow in interpreting and responding to the new requirements that describe these forms of production with new investigation perspectives. ***Our analytic frameworks of the vulnerability of businesses pertain eminently to closed economies.*** We have not been able to go beyond the Altman's interpretations nor the econometric models with independent variables from the financial structure of firm's or sector and macroeconomic variables which in very few cases explain the bankruptcy of our companies. Colombian literature is strongly influenced by this stream, but the most serious problem is that neither the Central Bank of the Republic nor the Superintendence of Corporations have committed themselves seriously to a change of paradigm. Only a few weeks ago the Superintendence of Corporations published a book – "Colombian Companies: Present Time and Perspectives"¹⁷ that includes an article about an early alert model to predict insolvency of companies in the Colombian real sector and depicts the above mentioned analytic weakness. Likewise, the publications of the Central Bank of the Republic take the same analytical route: "Determinants of the capital structure of Colombian companies (1996-2002)" as an answer to the financial crisis of the 90's by Fernando Tenjo y López (Probit models) (2006); "The determinants of Colombian Firm's Debt Asset Ratio (1997- 2003)" by Enrique Pinzón García: "The goal of the study is to identify the determinants of insolvency presented in 2001 beginning with the financial statements of each company filed in 2004"; "Determinants of the fragility of Colombian companies" by Oscar Martínez; "Determinants of the probability of non-payment of debt Colombian companies by means of a multinomial Logit model ; liquidity, concentration of the debt portfolio, credit characteristics "(2007).¹⁸

¹⁶ The frame of the politic constitution of 1991 and in its normative development law 222 of 1995 and law 550 of 1999. Article # 333 of the Political Constitution states that "economic activity and private initiative are free, {but} within the limits of common wellbeing"; it recognizes the right to free economic competition, exercise that "assumes responsibilities." And with no prejudice of warranties the same norm states that: "the State by mandate of law will not allow an obstruction or restriction of economic freedom" and gives to the legislator the delimitation of this freedom, "whenever the social interest, the environment, or the national heritage requires it. On the other hand, article 334 entrusts the state with "the direction of economy" and the stimulation of entrepreneurial development and leaves it in charge of intervening the processes of "production, distribution, use and consumption of public and private goods (...)" with the purpose of rationalizing the activity and pursuing the "improvement of life quality of the inhabitants, equal distribution of opportunities and benefits of development" as stipulated in articles 58 and 333, it has as basis the firm, fulfilling a "social function that implies obligations"¹⁶. Article 189 of the Constitution entrusts the President of the Republic with this state intervention by ordering him/her through #24 of the mentioned article to "execute the inspection, vigilance and control over individuals who carry out financial activities, activities in the stock market, insurance or any other activity related to the management, profiteering or investment of resources perceived from the public. Likewise with regards to corporate entities and mercantile societies".

¹⁷ Various authors, 2009. Second week of April 2009.

¹⁸ "Determinants of the probability of unfulfillment of Colombian companies through a multinomial Logit model; liquidity, concentration of debt portfolio and funding characteristics". (2007).

In spite of what has been stated, a study that made a very significant leap was the one made by the ex-Minister Carrasquilla based on the graduation thesis of Camila **Aguilar Londoño**¹⁹ where it is concluded that: "...the contribution of this study, is that in analyzing the evidence at the level of Colombian companies, **the existence of differentiated effects taking into account their size and debt is proven in the presence of exogenous events as well as events that fit in the sector to which each company belongs.**" Additionally, this study determines which companies are most vulnerable and what variable of performance reflects this fact. This is done by using an innovative method that captures the effects of events that were not captured before with a data base of approximately 3,000 companies per year. It was found that the differences in the structure of the firms are a direct determinant of their reaction to conditions in their environment.

3.2 Internationally

Financial theory and empiric research have focused on determining the probability of bankruptcy of companies especially of those belonging to the real sector. In an innovative analysis of the relationship between capital structure and risk, Mulder, Perrelli and Rocha examined how an increase in debt can exacerbate disequilibrium and increase the probability of a macroeconomic crisis. They determined which variables in the financial statements have a strong impact on the probability as well as on the depth of the crisis. High levels of debt and short periods are associated with a high probability of macroeconomic crisis.

The debt crisis of the 90's was examined through different approaches: Goldstein, Kandinsky, Reinhart (2000) provide a review of the subject of prediction. Stone (2000) examines the dynamics of economic sectors during the systematic financial crisis. Claessens, Djankov and Nenova examine global corporate risk measures and establish relationships with levels of firms, institutions and macroeconomic factors. One of the appeals is its global nature, and they include in their list of corporate risk measures the ratio, the operational cash flow and interest expenses. Similar to this document are the studies of Bernanke and Campbell (1988), in which they examine the levels plus corporate debt and the debt services in the 1969-1986 period. Besides documenting the coverage of interest, they simulate the impact of recession on liquidity and they quantify it through an index that measures the relationship between the interest paid and the operational cash flow.

Jack Glen (2004) supports the idea that there is a strong relationship between crisis in firms and economic deterioration in his article "Debt and Firm Vulnerability". He did an empirical study with a sample of more than 6,000 companies in 41 countries to establish the debt payment capacity through financial expenses over cash flow indicator (ratio) in the 1991-1994 period. He examined the level of firms, economic sectors and macroeconomic factors. The results demonstrate a close relationship between macroeconomic conditions and the ability to pay debt. In a situation of deterioration in the growth of the GDP, the ability of firms to generate high cash flows is diminished and with it the possibility of paying off debt. The statistics for Colombia depict that 70% of the companies that go bankrupt had previously undertaken a restructuring process.

¹⁹ The impact of exogenous and sector related events in the performance of companies in Colombia: An analysis for Colombia, 1995-2001

4. The Models

We will proceed to get general probability models for companies taking a logistic regression as a basis. Once the models have been established, particular models will be inferred in order to quantify probabilities on the sector and subsector levels. For the analysis of the results, a matrix will be considered in order to analyze the sign, the coefficient and the marginal effect of each independent variable with respect to the probability of the event to proceed with the determination of a critical value that optimizes the classification of the firms according to the observed data. When the critical value is established and a model adjusted and calibrated, is the vulnerability of the sectors and their probabilities of bankruptcy and/or default over a time interval that goes from t up to $t+p$ will be determined.

Initial considerations:

4.1 When evaluating these types of probabilities, the institutional investors or natural persons in Colombia must take into account the fact that the information available on the sector is one year out of date. This means that when evaluating the probability of liquidation or default of a sector or subsector at moment t , the available information systematized by the Superintendence of Corporations in its information system, SIREM is actually $t-1$.

4.2 With the goal of to establishing the risk asymmetry within the sectors, the subsector will be treated as a unit of analysis. The structure of subsectors in Colombia includes of 475 subsectors. Nevertheless, the scope of this investigation will be limited to n -subsectors corresponding to the manufacturing sector. The results from the level of subsectors compared to its root sector will allow us to conclude if it is better for investors to perform their analysis on an aggregate or a specific level.

5. General Structure of the Econometric Logit Regression Model for the determination of probability²⁰

A general explanation of the functioning of the Logit model and of how its parameters are estimated is given. Then the variables and the final probability equation of the two models are explained. Consider a random sample of n Colombian firms that turn their financial statements in to the Superintendence of Corporations, $i = 1, \dots, n$. Each company i is observed for t periods, $t = 1, \dots, t$. Assume an existing variable y_{it}^* that indicates the event of liquidation or default (depending on which of the two models is being used) of the firm i during year t . Assume that this unobservable variable y_{it}^* is a linear function of a vector of k determinant variables (independent), x_{it} , of a constant α and a random error ε_{it} .

$$y_{it}^* = \alpha + \beta'x_{it} + \varepsilon_{it} \quad (1)$$

²⁰ Structure constructed with the model used by Marcel Peter in “Estimating Default Probabilities of Emerging Market Sovereigns: A New Look at a Not-So-New Literature”. INSTITUT UNIVERSITAIRE DE HAUTES ETUDES INTERNATIONALES THE GRADUATE INSTITUTE OF INTERNATIONAL STUDIES, GENEVA. HEI Working Paper No: 06/2002.

where b is a vector of parameters ($k \times 1$).

This model has two assumptions concerning random error. The first assumption is that ε_{it} are independent and identically distributed throughout firms and throughout time. They have mean zero and unitary variance:

$$\varepsilon_{it} \sim i.i.d. [0, 1] \text{ for all } i \text{ and } t. \quad (2)$$

The second assumption is that these errors ε_{it} have a logistic distribution,

$$\varepsilon_{it} \sim \Lambda[0, 1]. \quad (3)$$

The function of a cumulative logistic distribution has the following form:

$$\Lambda(X) = \frac{e^{\left(\frac{\pi X - \mu}{\sqrt{3} \sigma}\right)}}{1 + e^{\left(\frac{\pi X - \mu}{\sqrt{3} \sigma}\right)}} \quad (4)$$

This implies that the probability density function is:

$$\lambda(X) = \frac{e^{\left(\frac{\pi X - \mu}{\sqrt{3} \sigma}\right)}}{\frac{\pi}{\sqrt{3}} \cdot \sigma \cdot \left(1 + e^{\left(\frac{\pi X - \mu}{\sqrt{3} \sigma}\right)}\right)^2} \quad (5)$$

Where μ = mean and σ = standard deviation. The cumulative distribution function of the standardized random error is:

$$\Lambda(\varepsilon_{it}) = \frac{e^{\left(\frac{\pi}{\sqrt{3}} \varepsilon_{it}\right)}}{1 + e^{\left(\frac{\pi}{\sqrt{3}} \varepsilon_{it}\right)}} \quad (6)$$

If it is assumed that the errors are logistically distributed, the Logit model can be used, but if it is assumed that the errors are normally distributed, a Probit model would be used.

For this study it is assumed that if the unobservable variable y_{it}^* is more than zero, the firm is bankrupt or in default (depending on which of the two models is being used). In contrast, if the indicator is less than zero, the firm is not under the circumstances that the model is trying to establish.

$$p_{it} = \begin{cases} 1 & y_{it}^* > 0 \\ 0 & y_{it}^* \leq 0 \end{cases} \quad (7)$$

Here p_{it} is the binary dependent variable that takes the value of 1 when the firm is bankrupt (or in liquidation if we are using the second model) and 0 when it is not. Therefore, the probability of this event happening in year t , the probability $p_{it} = 1$ is:

$$\begin{aligned} Prob(p_{it} = 1) &= Prob(y_{it}^* > 0) = Prob(a + b'X_{it} + \varepsilon_{it} > 0) \\ &= Prob(\varepsilon_{it} > -a - b'X_{it}) \end{aligned}$$

From equation (6) we can infer that:

$$Prob(p_{it} = 1) = Prob(\varepsilon_{it} < a + b'X_{it}) = \frac{e^{(\alpha + \beta'X_{it})}}{1 + e^{(\alpha + \beta'X_{it})}} \quad (8)$$

The probability of the event not happening is:

$$Prob(p_{it} = 0) = 1 - Prob(p_{it} = 1) = \frac{1}{1 + e^{(\alpha + \beta'X_{it})}} \quad (9)$$

Where $\alpha = \frac{\pi}{\sqrt{3}}a$ y $\beta = \frac{\pi}{\sqrt{3}}b$.

To find parameters α and β , we will use the method of maximum likelihood to maximize the likelihood function $L(\alpha, \beta'X_{it})$.

$$L = \frac{\prod_{i=1}^N \prod_{t=1}^T e^{[(\alpha + \beta'X_{it})p_{it}]} }{\prod_{i=1}^N \prod_{t=1}^T [1 + e^{(\alpha + \beta'X_{it})}]} \quad (10)$$

Once the parameters are found, the effect of each determinant variable concerning the probability can be analyzed separately. The difference is that this interpretation cannot be made the same way as it can with a linear regression model because in the Logit model the parameters, as well as the explanatory variables, are of a non-linear nature.

Here $X_{it,k}$ is the k -th element in the X_{it} determinant variables vector and β_k the k -th element of parameters β . To find the marginal effect of $X_{it,k}$ within probability, partially equation (8) is derived to obtain:

$$\frac{\delta}{\delta X_{it,k}} Prob(p_{it} = 1) = \frac{e^{(\alpha + \beta'X_{it})}}{(1 + e^{\alpha + \beta'X_{it}})^2} \beta_k \quad (11)$$

Therefore, when we have to determine the marginal effect of a variable k regarding probability, the previous expression has to be evaluated while considering the other k variables to find the quantity and direction.

5.2 Variables included in the Probability of Liquidation Model

5.2.1 Dependent variable

Logit (P_1): Dependent variable equivalent to the natural logarithm of the ratio of the probability of occurrence and the probability of non occurrence. $[Log(p_{it}/(1-p_{it}))]$.

p_{it} : Probability of the event $Y_{ij}^*=1$, or the bankruptcy situation $p_{it}=P(Y=1/X)$.

5.2.2 Explanatory variables:

Endogenous variables vector:

The information used for the calculation of the endogenous variable vector corresponds to the data presented by the companies to the Superintendence of Corporations.

1. **Working Capital/Total Assets** $X1_{it}$: This is a measurement of liquidity; it is obtained by the difference between the current assets and current liabilities over the total assets of a given year.
2. **Retained Earnings/Total Assets** $X2_{it}$: This measurement considers the cumulative earnings of the firm over time (Altman 1968). It is equal of the retained earnings over the total assets.
3. **EBIT/Total Assets** $X3_{it}$: This measurement tries to quantify the productivity of the assets; it is calculated by the earnings before interest and taxes (EBIT) over the total assets.
4. **Book Value of Equity/Book Value of Debt** $X4_{it}$: This ratio depicts how much the value of the assets can fall before the liabilities surpass the assets and the company is heads into insolvency.
5. **Sales/Total Assets** $X5_{it}$: This is a measurement of competitiveness; sales over total assets.
6. **Financial Obligations/Total Assets** $X6_{it}$: This indicator shows what percentage of assets is being used with resources of financial institutions.
7. **Size Dummy Variable** Ta_{iz} : This variable seeks to measure the incidence of the size of companies within the probability of bankruptcy. There are 4 sizes (micro, small, medium and large firms) classified according to the quantity of their assets in terms of current minimum legal salaries $z= [1, 2, 3, 4]$.
8. **Operational Cycle Variable** CO_j : This indicator quantifies the companies' need for financial funding. It is calculated in days: $((Inventory/Cost\ of\ goods\ sold)*360)+((accounts\ receivable/Sales)+360)$.

Vector of Sector Variables:

1. **Structure of Sector Dummy Variable** $ESEC_j$: this seeks to measure the incidence of the concentration of sales in the probability of liquidation. As criteria we will use the Pareto law, where it is assumed that 20% of the firms hold 80% of sales. It will have a value of 1 when there is evidence of an oligopoly in the market (a group of companies that constitute less than 20% of the sector and control 80% or more of the sales of this sector).

Vector of Macroeconomic Variables:

1. **Consumer Price Index Variable:** The percent change for each year will be used. This indicator measures the consumer prices according to an index provided by DANE. The notation of this measure is IPC_t where t is equivalent to the corresponding year of the financial statements.

2. **Interest Rates:** This is the total active average interest rate for the year; information taken from the web site of the Central Bank of the Republic of Colombia. The notion is I_t .
3. **% Change of the GDP:** This is the change of the real value of all goods and services produced in Colombia during a given year in comparison to the previous year. These changes are published in statistics by DANE. The notation is $\Delta\%PIB_t$.

Vector of External Variables:

1. **Exchange Rate TRM_t :** this is the exchange value of one United States dollar (USD) for Colombian Pesos (COP) at a given moment. The TRM information is available in the publications of the Central Bank of the Republic of Colombia. The average for each year will be used for this study.
2. **Balance of Trade Xn_t :** The difference between the value of exported and imported is measured. The information on the variable is available through the temporal publications of DIAN and in the statistical publications of DANE.
3. **Flow of Direct Foreign Investment FDI_t :** This measures the foreign capital that enters the country as direct foreign investment for a specific time. This information is periodically published by DANE.
4. **USA's GDP Growth $\Delta\%PIBUSA_t$:** The USA is Colombia's main commercial partner; therefore, this variable is included to quantify the impact of the USA's economic cycle on the probability of bankruptcy and/or default of Colombian firms. This information is gathered from the web site of the U.S. Department of Commerce.
5. **Venezuela's GDP Growth $\Delta\%PIBVEN_t$:** Venezuela is Colombia's second commercial partner; therefore this variable is included to quantify the impact of Venezuela's economic cycle on the probability of bankruptcy and/or default of Colombian firms. The information is obtained from the web site of the National Institute of Statistics of Venezuela.

5.2.3 Liquidation Probability Model

Notice that for each of the independent variables there is a sub-index t in which we try to capture the effect of time on the probability of liquidation. This is done to make sure for every variable that was described there will be a version for each year to capture the incidence of lagged variables. For example, firm i has $X1_t$ variable for its last financial statement but also has an $X1_{t-1}$ in the statement before it.

Using the model of equation (8) the equation for this model can be written:

$$\begin{aligned}
 \ln\left(\frac{p_{it}}{1-p_{it}}\right) &= \text{Logit}(p_{it}) \\
 &= \alpha + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + \beta_5 X5_{it} + \beta_6 X6_{it} + \beta_7 CO_j + \gamma_j ESEC_j + \beta_8 IPC_t \\
 &\quad + \beta_9 I_t + \beta_{10} \Delta\%PIB_t + \beta_{11} TRM_t + \beta_{12} Xn_t + \beta_{13} FDI_t + \beta_{14} \Delta\%PIBUSA_t + \beta_{15} \Delta\%PIBVEN_t \\
 &\quad + \varphi_i T a_{iz} + \varepsilon_{itj}
 \end{aligned} \tag{12}$$

The final equation of the bankruptcy probability:

$$p_{it} = \frac{e^{\text{Logit}(p_{it})}}{1 + e^{\text{Logit}(p_{it})}} \tag{13}$$

Where:

t is the change over time.

i refers to a certain firm $i = [1 \dots 2 \dots \dots 30000]$.

j is referred to the number of the sector classified by the Superintendence of Corporations:

$j = [1 \dots 2 \dots \dots 66]$.

z refers to the size of the firm according to the classification of the Superintendence of Corporations:

$z = [1, 2, 3, 4]$.

5.3 Variables that are included in the Default Probability Model

5.3.1 Dependent Variable

Logit(d_{it}): Dependent variable that is equivalent to the natural logarithm of the ratio of the occurrence probability and the non occurrence probability. $[Log(d_{it}/(1-d_{it}))]$.

d_{it} : Probability of the event $Y_{ij}^* = 1$, or the situation of default as the definition of firms in the process of restructuring²¹. $d_{it} = P(Y=1/X)$.

5.3.2 Independent Variables

The independent variables that explain the default situation (defined by the Superintendence of Corporations data base of restructured firms) will be taken from the document written by Jack Glen (2004) titled "Debt and Firm Vulnerability." This document correctly identifies these variables and it proves the statistical significance as well as the economic relevance. The variables are:

Vector of Endogenous Variables

- 1. Coefficient Variation of Interest Expenditures Variable.** $IntCV_{it}$: this is the standard deviation of the interest expenditures divided by its mean. The calculation is made starting from the financial statements of a company in the period that is under study. This variable has the purpose of quantifying the inherent risk of the company with the volatility in the interest expenditure. (Glen 2004)
- 2. Coefficient of Variation of EBIT Variable** $EBITCV_{it}$: this is the standard deviation of EBIT divided by its mean. The calculation is made by starting from the financial statements of a company in the period that is studied. This variable has the purpose of quantifying the inherent risk of the company associated with the volatility of EBIT. (Glen 2004).
- 3. Size Dummy Variable** Ta_{iz} : This variable seeks to measure the effect of the size of the companies on the probability of default. There are 4 sizes (micro, small, medium and large firms) classified on the basis of the quantity of their assets in terms of current minimum legal salaries; where $z = [1, 2, 3, 4]$.
- 4. Capital Structure Variable** EC_{it} : This is calculated by total liabilities over total assets. The intention of this variable is to quantify the effect of leverage in the probability of non-payment of a firm.

²¹ Data base of restructured firms of the Superintendence of Corporations.

5. Assets Structure Variables $ACAT_{it}$: This is the current assets divided by the total assets. It seeks to measure the effect of concentration of the assets in the probability of non payment of a company.

6. Operational Cycle Variable CO_j : This variable seeks to quantify the need of firms to get financing. It is quantified in days and calculated as follows: $((\text{Inventory}/\text{Cost of goods sold}) * 360) + ((\text{accounts receivable}/\text{Sales}) * 360)$.

Vector of Sector Variables

1. Structure of Sector Dummy Variable $ESEC_j$: this seeks to measure the effect of the concentration of sales in the probability of default. The Pareto law, where it is assumed that 20% of the firms hold 80% of sales will be used as criteria. It will have the value of 1 when there is evidence of an oligopoly in the market (a group of companies that constitutes less than 20% of the sector and controls 80% or more of the sales of this sector).

Vector of Macroeconomic Variables:

1. Consumer Price Index Variable IPC_t : the percentage change for each year will be taken. This macroeconomic variable measures the consumer prices in Colombia over a specific period according to an index given by DANE.

2. % Change of the GDP $\Delta\%PIB_t$: This is the change in the real value of all goods and services produced in Colombia in a given year in comparison to the previous year. These changes are published as statistics by DANE.

Vector of External Variables:

1. Exchange Rate TRM_t . This is the exchange value of one United States dollar (USD) for Colombian Pesos (COP) in a given moment. The TRM information is available in the publications of the Central Bank of the Republic of Colombia. The average for each year will be used for this study.

2. Balance of Trade Xn_t : The difference between the value of exports and imports is measured. The information about the variable is available through the publications of DIAN and in the statistical publications of DANE.

3. Flow of Direct Foreign Investment FDI_t : This measures the foreign capital that enters the country as direct foreign investment for a specific time. This information is periodically published by DANE.

4. USA's GDP Growth $\Delta\%PIBUSAt$: The USA is Colombia's main commercial partner; therefore, this variable is included to quantify the impact of the USA's economic cycle on the probability of bankruptcy and/or default of Colombian firms. This information is gathered from the web site of the U.S. Department of Commerce.

5. Venezuela's GDP Growth $\Delta\%PIBVEN_t$: Venezuela is Colombia's second commercial partner, therefore this variable is included to quantify the impact of Venezuela's economic cycle on the probability of bankruptcy and/or default of Colombian firms. The information is obtained from the web site of the National Institute of Statistics of Venezuela.

5.3.3 Default Probability Model

Notice that for each of the independent variables there is a sub-index t in which we try to capture the effect of time on the probability of liquidation. This is that for every variable that was described there will be a version for each year to capture the incidence of lagged variables. For example, firm i has xI_t variable for its last financial statement but also has an xI_{t-1} in the statement before it.

(14)

$$\begin{aligned} \text{Logit}(d_1) = & \alpha + \beta_1 IPC_t + \beta_2 I_t + \beta_3 \%PIB_t + \beta_4 INTCV_{it} + \beta_5 EBITCV_{it} + \beta_6 EC_{it} + \beta_7 ACAT_{it} + \beta_8 CO_j \\ & + \gamma_j ESEC_j + \beta_9 \Delta\%PIBUSAt + \beta_{10} \Delta\%PIBVEN_t + \beta_{11} TRM_t + \beta_{12} Xn_t + \beta_{13} FDI_t + \varphi_i Ta_{iz} \\ & + \varepsilon_{ijt} \end{aligned}$$

Therefore:

(15)

$$d_1 = \frac{e^{\text{Logit}(d_1)}}{1 + e^{\text{Logit}(d_1)}}$$

Where:

i refers to a firm given by the data base of the Superintendence of Societies. $i = [1, 2, 3, \dots, 30000]$.

t refers to time in years corresponding to the period of the sample.

j refers to the economic sector to which the company i belongs as classified by the Superintendence of Societies. $j = [1, 2, 3, \dots, 66]$.

z refers to the size of the firm according to the classification of the Superintendence of Societies $z = [1, 2, 3, 4]$.

5.4 Statistical Assumptions of the Models

1. The errors are normally distributed with mean 0 and constant variance during the levels of the independent variables.
2. There is no multicollinearity existing between the explanatory variables.
3. The observations are independent from each other.
4. There is linearity between the Logit of the dependent variable and the independent variables.

1. Where does the information in our Data Base come from?

Our sample begins with 3 independent data bases.

1. Database of the firms which file their financial statements to the Superintendence of Societies of Colombia.
2. Database of firms which were in the process of forced liquidation according to the Superintendence of Societies of Colombia during the 1995-2008 period.
3. Database of firms which are in process of restructuring according to the Superintendence of Societies of Colombia during the 1995-2008 period.

In both models, will be used the firms in the first database that did not file bankruptcy nor default (such as in the cases of non occurrence or $y^*=0$). For the liquidation model, will be used the database of firms which are in the process of forced liquidation (such as case of occurrence $y^*=1$). For the default probability model database of firms which are in the process of restructuring (such as case of occurrence $y^*=1$) we will use.

6. Results

6.1 How to determine the probability of bankruptcy and default of companies, subsector and mayor economic sectors in Colombia in the 1995-2008 period?

Based on the results -and excluding those variables that did not prove to be significant at a 5% confidence level-, the equations for estimating the probability of bankruptcy and default are as follows:

For the Liquidation Model:

(16)

$$p_{it} = \frac{e^{-15,0084-0,1083x_1-2,9928x_4-0,8478x_5-4,2651ta_1-1,5745ta_2-0,6150ta_3+0,0197I_t+0,0036Trm_t+0,0004Xn_t+0,0310PibVen_t}}{1 + e^{-15,0084-0,1083x_1-2,9928x_4-0,8478x_5-4,2651ta_1-1,5745ta_2-0,6150ta_3+0,0197I_t+0,0036Trm_t+0,0004Xn_t+0,0310PibVen_t}}$$

Logistic model for liquidacion

Classified	True		Total
	D	~D	
+	1	3	4
-	240	126503	126743
Total	241	126506	126747

Classified + if predicted $Pr(D) \geq .5$
True D defined as liquidacion != 0

Sensitivity	Pr(+ D)	0.41%
Specificity	Pr(- ~D)	100.00%
Positive predictive value	Pr(D +)	25.00%
Negative predictive value	Pr(~D -)	99.81%
False + rate for true ~D	Pr(+ ~D)	0.00%
False - rate for true D	Pr(- D)	99.59%
False + rate for classified +	Pr(~D +)	75.00%
False - rate for classified -	Pr(D -)	0.19%
Correctly classified		99.81%

Using statistical software STATA™ a goodness of fit test was used to determine at what level the model adjusted to reality. Then is using as a critical value for the probability 50% (chosen by STATA), so the model could correctly identify 99.81% of the firms in the database.

So, if we want to know the probability a given firm going to of bankruptcy, we should replace equation (16) the firm's variables and the exogenous information for that period. If the result is greater than 50%, the firm is at risk of bankruptcy.

For the Default Model:

(17)

$$d_1 = \frac{e^{4,7245-0,6774INTCV_t-2,3972ACAT_t-.34Nolarge_t-0,3197ESEC1_t-0,4525IPC_t+0,2421PIB_t-0,0013Trm_t+0,0009Xn_t-0,0003FDI_t-0,6852PIBUSA_t-0,274PIBVEN_t}}{1 + e^{4,7245-0,6774INTCV_t-2,3972ACAT_t-.34Nolarge_t-0,3197ESEC1_t-0,4525IPC_t+0,2421PIB_t-0,0013Trm_t+0,0009Xn_t-0,0003FDI_t-0,6852PIBUSA_t-0,274PIBVEN_t}}$$

Logistic model for Default

Classified	True		Total
	D	~D	
+	0	0	0
-	239	123886	124125
Total	239	123886	124125

Classified + if predicted $Pr(D) \geq .5$
True D defined as Default != 0

Sensitivity	$Pr(+ D)$	0.00%
Specificity	$Pr(- \sim D)$	100.00%
Positive predictive value	$Pr(D +)$.%
Negative predictive value	$Pr(\sim D -)$	99.81%
False + rate for true ~D	$Pr(+ \sim D)$	0.00%
False - rate for true D	$Pr(- D)$	100.00%
False + rate for classified +	$Pr(\sim D +)$.%
False - rate for classified -	$Pr(D -)$	0.19%
Correctly classified		99.81%

Just as was done with the previous model, the critical value chosen for the classification probability is 50%. When looking the probability of default for a given firm, the same procedure than that of the previous model is used but, on this time, instead of using equation (16), equation (17) is used.

6.2 Which variables would determine that a company and its aggregates would fall into a liquidation process and which would determine default?

The results were as follow:

General Liquidation Model:

Type	Variable	Code	Sign	Coefficient	z	p value
Endogenous	Working Capital/Total Assets	x1	-	-0,1083878	-1,82	0,069
	Retained Earnings/Total Assets	x2	+	0,0258491	0,55	0,581
	EBIT/Total Assets	x3	-	-0,0570189	-1,04	0,3
	Book Value of Equity/Book Value of Debt	x4	-	-2,992892	-16,93	0
	Sales/Total Assets	x5	-	-0,8477804	-8,71	0
	Financial Obligations/Total Assets	x6	-	-0,0751292	-1,31	0,191
	Operational Cycle Variable	co	-	-7,47E-06	-1,38	0,167
Sectorial	Structure of Sector Dummy Variable	esec1	-	-0,1792699	-1,21	0,226
	Size Dummy Variable	ta1	-	-4,265112	-2,97	0,003
		ta2	-	-1,574463	-7,37	0
		ta3	-	-0,6149517	-4,26	0
Macroeconomic	Consumer Price Index	ipct	-	-0,0197104	-0,24	0,811
	Interest Rates	it	+	0,1962708	3,7	0
	% Change of the GDP	pibt	+	0,0376679	0,5	0,615
International	Exchange Rate	trmt	+	0,003584	7,67	0
	Balance of Trade	xnt	+	0,000399	3,59	0
	Flow of Direct Foreign Investment	fdit	+	0,0000633	1,53	0,126
	USA's GDP Growth	pibusat	+	0,0470365	0,49	0,627
	Venezuela's GDP Growth	pibvent	+	0,0310104	2,48	0,013

Highlighted Variables are Significant at a 5% confidence level.

General Default Model:

Type	Variable	Code	Sign	Coefficient	z	p value
Endogenous	Coefficient of Variation of Interest Expenditures	INTCV	-	-0,6773817	-4,88	0
	Coefficient of Variation of EBIT	EBIT	-	-3,27E-07	-0,01	0,992
	Capital Structure	EC	+	0,0008694	0,57	0,57
	Assets Structure	ACAT	-	-2,397217	-10,43	0
	Operational Cycle	CO	+	9,75E-10	0,5	0,619
	Size Dummy Variable	nolarge	-	-0,3234861	-2,32	0,021
Sectorial	Structure of Sector Dummy Variable	ESEC1	-	-0,3196721	-2,22	0,027
Macroeconomic	Consumer Price Index	IPCt	-	-0,4525319	-2,86	0,004
	% Change of the GDP	PIBt	+	0,2421249	4,37	0
International	Exchange Rate	TRMt	-	-0,001269	-2,16	0,031
	Balance of Trade	XNt	+	0,0008784	6,62	0
	Flow of Direct Foreign Investment	FDIt	-	-0,0002742	-5,07	0
	USA´s GDP Growth	PIBUSAt	-	-0,6851692	-6,4	0
	Venezuela´s GDP Growth	PIBVENT	-	-0,0274459	-2	0,045

As the main conclusion for these models, international evidence suggests the existence of a direct relationship between GDP deterioration and an increase in bankruptcy probability. However, given the nature of the econometric model used in this research, this effect is captured in the sensitivity that is show in the current GDP's deterioration and the increase in default probability. Nevertheless, this topic will be covered in further study using m-logit models to test this international hypothesis in the Colombian case as well as determine the frequency distribution of liquidations of firms and sectors.

Likewise, we want to highlight the way in which the liquidation model to **captures in a significantly way**, the impact that Venezuela's GDP has to liquidation probability.

When speaking about the default model, it is satisfying to see how it explains the implications in GDP's deterioration and Colombian firms' ability to pay debt determined by external sector behavior. As was said before, the drop in the GDP affects Colombian corporate system liquidity.

6.3 Is there any difference between the analyses performed on a general point of view and an analysis done at sector and subsector levels?

The sector chosen for this analysis was sector 28. Vehicle Commerce and Related Activities.

When running the default model for this sector only, the result was as follows:

Log pseudolikelihood = -8.9459047 Pseudo R2 = 0.0098

default	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
intcv	-.2579476	.0337941	-7.63	0.000	-.3241829	-.1917123
ebit	.0006347	.0003291	1.93	0.054	-.0000103	.0012796
acat	-.7101294	.0891831	-7.96	0.000	-.8849251	-.5353337
co	-.0035765	.0002046	-17.48	0.000	-.0039775	-.0031756
_cons	-7.013422	1.003286	-6.99	0.000	-8.979827	-5.047017

The subsector chosen for the analysis pertains to sector number 28. It is CIU code is G5030. Vehicle Parts and Accessories Commerce.

When running the default model with this subsector only, the result was as follows:

Logistic regression	Number of obs	=	4292
	wald chi2(4)	=	62.00
	Prob > chi2	=	0.0000
Log pseudolikelihood = -35.433359	Pseudo R2	=	0.2201

default	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]
intcv	-1.081116	.5235377	-2.07	0.039	-2.107231 - .0550009
ebit	.003219	.0022435	1.43	0.151	-.0011782 .0076162
acat	-3.252612	1.589786	-2.05	0.041	-6.368536 -.1366877
co	-.0180289	.0053541	-3.37	0.001	-.0285227 -.0075351
_cons	-1.792622	.7346458	-2.44	0.015	-3.232502 -.3527431

From these tables, it can be stated that through the existing differences in signs and coefficients as well as the number and type of the significant variables, there is an asymmetry in the way risk is measured in a general sectorial and sub-sectorial level.

6.4 How will this new international crisis impact the future of Colombian businesses and their liquidation?

According to the liquidation model:

Type	Variable	Code	Sign	Coefficient	z	p value
International	Exchange Rate	trmt	+	0,003584	7,67	0
	Balance of Trade	xnt	+	0,000399	3,59	0
	Flow of Direct Foreign Investment	fdit	+	0,0000633	1,53	0,126
	USA´s GDP Growth	pibusat	+	0,0470365	0,49	0,627
	Venezuela´s GDP Growth	pibvent	+	0,0310104	2,48	0,013

According to the default model:

Type	Variable	Code	Sign	Coefficient	z	p value
International	Exchange Rate	TRMt	-	-0,001269	-2,16	0,031
	Balance of Trade	XNt	+	0,0008784	6,62	0
	Flow of Direct Foreign Investment	FDIt	-	-0,0002742	-5,07	0
	USA´s GDP Growth	PIBUSAt	-	-0,6851692	-6,4	0
	Venezuela´s GDP Growth	PIBVENT	-	-0,0274459	-2	0,045

It is satisfactory to register this explanatory grade in deterioration the Colombian corporate and its capacity to respond to liquidity needs and, in consequence, the increase in the probability of default related to the 5 external variables that pertain to an open economy. This fact is not that evident for the liquidation model but its conclusions may be altered through a lagged model.

Then, following the idea, a significative increase in the number of firms and subsectors with liquidity problems can be expected in the short term (especially when Colombia's relationship with its main regional economic partners is not at it's in the best moment). Also a significative increase in the number of firms and subsectors that start a liquidation process is expected in the median term.

6.5 How does this new productive structure affect and how will it affect the fragility of companies and their aggregates, and additionally how does this affect and how will it affect the small players (SMEs) in the productive system?

The next table shows an indicator based on sales concentration per sector and per year. It is measured according to Pareto's law, where 20% of a sector's firms control more than 80% of its sales when it is oligopoly. From a total of 65 sectors, the results are the following:

Year	Number of Sectors
1995	10
1996	10
1997	14
1998	14
1999	22
2000	28
2001	11
2002	19
2003	22
2004	17
2005	39
2006	34
2007	37
2008	38

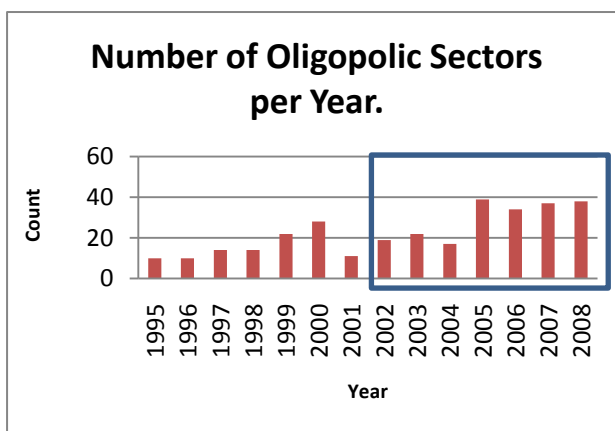


Table. Number of Oligopolic sectors per Year.

Notice that during this government period (blue case), the number of oligopolic sectors has increased.

For the Liquidation model:

Type	Variable	Code	Sign	Coefficient	z	p value
Sectorial	Structure of Sector Dummy Variable	esec1	-	-0,1792699	-1,21	0,226

For the Default Model:

Type	Variable	Code	Sign	Coefficient	z	p value
Sectorial	Structure of Sector Dummy Variable	ESEC1	-	-0,3196721	-2,22	0,027

Even when this variable holds no significance for the liquidation model, it is important to highlight the effect of oligopolies on the probabilities of liquidation and default. It is a serious fact that the number of irregular sectors has increased during the last few years because those firms that do not belong to an irregular sector may have difficulties meeting their obligations. This may be interpreted as a key variable for financial

institutions to use in evaluating credit scores while taking into account the fact that a firm that belongs to an oligopoly has a greater probability of meeting its obligations. According to economic theory, this will affect long term economic growth by creating unbalances and restraining perfect competition.

7. Conclusions and Discussion

Colombia is experiencing a new economic recession. Its depth and duration will affect the stability of Colombian companies. A firm's fragility will be determined by the development of the international crisis and also by the capacity the Colombia's economy to solve last year's macroeconomic disequilibrium. First of all, world recovery is still sending signals of weakness and that is supported by the volatility of main of the world's leading economies. The exception to this phenomenon is Europe, which still is not showing any signal of recovery. Besides this uncertainty there is the tension due to the international relations between Colombia and its closest economic partners, Venezuela and Ecuador. Secondly, the latest opinion polls show that the bottom has not been reached yet in Colombia's real sector. This crisis will play itself out over of pre-electoral and electoral period, thus raising investor's lack of confidence and postponing investing decisions.

Keeping this context in mind, authors present the following conclusions in order to give the national and international academics and regulators mathematical arguments that would allow them to build a reflexive process that is different from the common ones which dominate today's discussions.

1. From these mathematical results, it can be concluded that firm fragility in Colombia, keeping the bankruptcy model perspective as well as the default model one, is significantly determined by open economies variables. With this, further research can be done based on a new paradigm of analyzing these probabilities from an open economy perspective.
2. One of the most important conclusions derived from these models is that has an immediate impact of the decrease in GDP on the liquidity Colombian firm's. In a situation of deterioration in the growth of the GDP, the ability of firms to generate high cash flows is diminished and with it the possibility of paying off debt. The statistics for Colombia depict that 70% of the companies that go bankruptcy had previously undertaken a restructuring process. Besides, the impact of negative GDP growth in the frequency of Bankruptcies is reflected on Colombian firms with a lag of 2 years or more.
3. Another conclusion is that the analysis unit needs to be conceptualized again by dropping the 8 macro sectors and taking into account the 65 sectors and, sometimes, their sub-sectors. To state this, the risk asymmetry that exists between general, sectorial, and sub-sectorial models is evidenced in the analysis of sector 28 and one of its sub-sectors, number G5030.
4. The Colombian Corporative body has changed dramatically from 10% of the sectors being considered oligopolies in 1995 to 50% nowadays. This holds serious implications for the firms that do not belong to those oligopolies and increases their probability of default and/or liquidation.
5. This study also concludes that there is a difference between a general model and a sectorial model and reaffirms ex-minister Carrasquilla's conclusions in the previously mentioned article.

1. Bibliography

- Allayanis, George, Gregory Brown, and Leora Klapper. 2003. Capital Structure and Financial Risk: Evidence from Foreign Debt Use in East Asia. *Journal of Finance* 58 (6, December): 2667-710.

- Altman Edward I. Financial Ratios, Discriminated Analysis and the prediction of corporate Bankruptcy. The Journal Of Finance Vol. XXIII September 1968. No4
- Altman Edward I. The prediction of Corporate Bankruptcy: A *Discriminant* Analysis. The Journal Of Finance Vol. 23, No 1. 1968.
- Altman, Edward. The Success of Business Failure Prediction Models. Journal of Banking and Finance 8(2): 171-98. 1984
- Bernanke, Ben and John Campbell. 1988. Is there a Corporate Debt Crisis?. Brookings Papers on Economic Activity. 1988
- Bodnar, Gordon, and M. H. F. Wong. 1999. Estimating Exchange Rate Exposures: Some Weighty Issues. NBER Working Paper 7497. National Bureau of Economic Research, Cambridge, Mass. Processed.
- Claessens, Stijn, Simeon Djankov, and Leora Klapper. 1999. Resolution of Corporate Distress in East Asia. Policy Research Working Paper 2133. World Bank, Washington D.C. Processed.
- Claessens, Stijn, Simeon Djankov, and Tatiana Nenova. 2001. Corporate Risk around the World. Working Paper. University of Amsterdam, Faculty of Economics and Econometrics. Processed Corporations. Journal of Banking & Finance, 1, 1977.
- Cruz J. Sergio. La información dentro de un nuevo concepto de regulación para la gestión y la competencia. (2009)
- Cruz J. Sergio. Finanzas Corporativas Editorial Thomson 2002
- Drezner Zvi, Marcoulides George, Hoven Mark. 2001
- Elizondo, Alan 2003. Medición Integral del Riesgo de crédito 2003Ed. Limusa.
- Fan, P.H. Joseph, Sheridan Titman, and Garry Twite. 2003. An International Comparison of Capital Structure and Debt Maturity Choices. Working Paper. University of Science and Technology, Hong Kong; University of Texas at Austin, Department of Finance; and Australian Graduate School of Management. Proceed.
- Glen, Jack. Debt and Firm Vulnerability. Internacional finance Corporation. April 2004
- Glen, Jack, and Ajit Singh. 2003. "Capital Structure, Rates of Return, and financing Corporate Growth: Comparing Developed and Emerging Markets, 1994-2000". In Robert Litan, Michael Pomerleano, and V. Sundararajan, ed., The Future of Domestic Capital Markets in Developing Countries. Washington, D.C.; Brookings Institution Press.
- Haldeman and P. Narayanan, Zeta Analysis: A New Model to Identify Bankruptcy Risk of Corporations. Journal of Banking & Finance, 1, 1977.
- Haldeman and P. Narayanan, Zeta Analysis: A New Model to Identify Bankruptcy Risk of
- Horner, David. LEMEHOW, Stanley. Applied Logistic Regression. Wiley-Interscience, 2000
- Martínez Oscar. Determinantes de Fragilidad en las empresas Colombianas. de Oscar Martínez. 2004
- Peter, Marcel. Estimating Default Probabilities of Emerging Market Sovereigns: A New Look at a Not-So-New Literature. HEI Working Paper No: 06/2002.
- Pinzon Enrique. The determinants of Colombian Firm's Debt Asset Ratio (1997- 2003). 2006
- Tenjo Fernando. Determinantes de la estructura de capital de la Empresas Colombianas (1996-2002) en respuesta a la crisis del el 90. (2006)
- The determinantes of Colombian Firm's Debt Asset Ratio (1997- 2003) de Enrique Pinzón Garcia.
- Allayannis George Capital Structure and Financial Risk: Evidence From Foreign Debt Use in East Asia June 2002
- Zamudio , Nancy . Determinantes de la probabilidad de Incumplimiento de las empresas Colombianas. 2007

Attachment # 1. Number of businesses organized by sector and year.

Rótulos de file	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total general
1	423	396	381	374	386	448	415	412	404	394	639	737	699	710	6818
2	17	22	28	26	27	28	27	26	27	27	48	65	63	71	502
3	80	86	89	97	94	86	84	77	68	64	81	92	98	119	1215
4	55	55	49	48	57	63	54	51	45	39	69	96	100	117	898
5	322	297	306	326	358	371	357	358	358	370	573	659	619	634	5908
6	51	52	46	46	50	56	51	50	51	45	63	71	68	68	768
7	1	1	1	1	2	2	2	2	2	1	4	4	4	4	31
8	115	105	92	88	95	98	96	91	95	83	124	138	137	135	1492
9	215	205	210	213	193	198	182	182	171	183	364	450	409	406	3581
10	41	32	32	31	31	31	24	22	21	27	44	56	52	45	489
11	34	44	39	40	40	40	35	31	28	30	73	82	75	68	659
12	37	32	24	25	29	30	23	23	24	27	63	61	59	59	516
13	52	46	42	49	56	59	53	53	51	45	63	78	74	78	799
14	137	136	150	152	150	161	151	147	144	159	316	366	346	351	2866
15	257	251	245	244	260	272	259	257	251	252	391	474	456	456	4325
16	24	22	21	20	26	28	24	24	24	22	44	53	55	56	443
17	150	152	154	164	174	174	170	173	163	168	310	364	334	333	2983
18	15	16	13	15	13	14	13	12	13	15	25	27	26	25	242
19	52	51	56	51	61	62	56	55	58	56	92	104	105	110	969
20	38	37	37	40	50	48	42	37	36	29	53	56	50	48	601
21	41	40	37	39	45	52	45	44	45	46	80	96	81	92	783
22	149	152	142	137	159	165	157	145	140	150	313	377	340	360	2886
23	81	84	84	82	86	88	76	76	80	73	131	148	135	134	1358
24	14	14	16	14	17	16	16	12	14	14	19	16	18	21	221
25	156	152	159	152	163	166	167	162	164	180	372	423	377	389	3182
26	18	11	14	22	22	21	19	23	19	21	38	50	44	52	374
27	870	839	645	696	634	618	458	436	435	424	762	994	751	882	9444
28	345	328	347	349	355	365	337	327	307	387	797	963	890	961	7058
29	1344	1275	1276	1326	1326	1394	1342	1305	1327	1538	3227	3902	3522	3548	27652
30	418	393	452	413	431	470	107	445	476	636	1979	2351	2144	2131	12846
31	67	75	76	84	94	104		99	97	101	185	216	205	212	1615
32	46	48	65	57	58	76		46	39	76	127	149	121	134	1042
33	3	2	4	3	8	7		3	3	5	32	32	27	29	158
34	844	842	823	790	798	994		807	786	717	926	1025	960	1006	11318
35	570	590	656	619	627	804		686	672	692	1318	1788	1704	1838	12564
36													2	2	4
37	6	7	7	8	19	19		15	16	14	105	125	116	128	585
38	43	43	40	39	44	44		40	42	36	81	81	79	85	697
39	98	100	99	113	136	167		135	141	143	347	417	357	354	2607
40													1		1
41	43	47	49	62	63	72		69	65	90	242	294	307	331	1734
42	46	45	51	52	53	60		54	50	54	98	123	125	121	932
43	223	226	233	225	230	296		259	244	247	485	588	545	553	4354
45	19	17	16	17	18	17		16	17	14	22	30	30	29	262
46	48	45	40	48	50	50		43	40	46	92	118	98	100	818
47	18	17	21	22	23	27		23	22	23	41	53	44	37	371
48	111	115	121	115	125	121		115	110	121	216	252	234	243	1999
49	23	17	19	18	20	23		7	7	8	24	22	13	13	214
50	50	56	57	65	69	72		16	14	14	16	17	16	12	474
51	3	3	4	3	3	3					1				20
52	66	70	66	69	85	96		35	19	25	57	55	43	58	744
53	4	5	4	4	6	6		6	6	5	6	7	6	8	73
54	82	89	106	103	121	134		105	97	115	179	188	186	200	1705
55	68	76	88	111	128	155		136	135	132	229	278	249	236	2021
56	55	54	62	60	68	88		78	74	65	88	99	91	89	971
59	33	31	23	24	24	31		27	27	29	51	51	46	43	440
60	26	22	26	34	46	56		53	62	81	219	278	270	297	1470
61	368	375	447	448	510	641		602	601	677	1504	1827	1671	1717	11388
62	228	245	264	264	264	257		219	221	233	497	612	740	709	4753
63	138	141	194	177	173	184		173	173	177	395	473	374	383	3155
64	89	90	87	93	93	91		87	82	86	118	141	133	163	1353
65	32	38	45	46	50	62		60	56	66	200	230	200	203	1288
66	20	19	22	25	26	37		33	38	66	149	167	144	159	905
Total general	9022	8876	9002	9078	9422	10418	4842	9105	8997	9663	19207	23089	21268	21955	173944

