Credit Risk and Option Pricing:

Evidence from Italian Stock Market

The aim of this work is to analyze phenomena of the credit risk in the Italian Stock Market. The risk is measured by the default probability of each issuer. The sample is composed of firms listed on the Italian Stock Exchange and each company has been selected on the basis of specific balance sheet and market information, from January 1992 to December 2004. Accord to the option pricing theory and the KMV approach, the probabilities are estimated by the iterative non linear method. The Italian segment brings out a high credit risk, mainly in the last years of the panel period. Parmalat and Cirio cases affected the market sentiment about the general corporate solvency. Some general tests for panel analysis confirm the principal evidences about the credit risk. Finally, a sub sample, composed of all defaulted issuers, has been studied for assessing if the insolvencies were predictable.

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Introduction.

In the last years, financial and academic communities devoted an increasing interest to the issue of the credit risk and the capability of foreseeing the possible default's event. Basel Committee's moral suasion was the impulse to develop and sharpen new methodologies for analyzing the credit risk of a corporate issuer, notoriously riskier than a sovereign government. Thus, several approaches and models have been proposed to anticipate the financial crises of a firm.

Most of literature about the credit risk issue concerns on the traditional actuarial methods. A commercial product of this methodology is CreditRisk, developed by Credit Suisse First Boston in order to assess the portfolio credit risk; it is based on historical estimates of credit risk dynamics, as such the mean and standard deviation of the mortality rates. Another approach, frequently used by rating agencies, is based on the calculation of the rating category migrations, that is the probabilities of downgrade or upgrade by a specific rating category. CreditMetrics represents an important commercial product of analysis. Many of recent efforts in this area are trying to address the portfolio issue.

Modern credit risk analysis is in line of the continuous development of financial research on integration of the different uncertainties (market, credit, country and operational risks). The underlying approach follows directly the advances that have been proposed for market risks. This approach bases on the seminal works proposed by Black&Scholes (1973) and Merton (1974) about an arbitrage-free theory of option pricing or contingent claim analysis. These models can be used to assess the liability mix of a firm. The Merton model highlights the way to more complete ad more complex valuation. Besides, it provides the pricing of default risk spread of fixed income instruments. In an unique framework, it is possible to measure the impact on credit risk spreads of a change in asset volatility, a change in interest rate level or different maturities of debt. Again, we can calculate the default probability of a firm by a closed-form solution. KMV corporation offers several products based on the Merton's intuitions, with some adjustments. By market and balance sheet information, their method calculates the default probabilities of listed firms.

The following list of works is far from complete but covers some important topics in literature about structural models and empirical evidences.[2]

Merton's framework is an extreme simplification of the real world and author himself proposes also extensions of his analysis. Merton (1974) proposes the pricing of perpetual risky bond with continuous coupon payment. Later, Black and Cox (1976) propose an analysis in order to study the effect of safety covenants on the pricing of risky zero-coupon bond. Geske (1977) images the stockholders' position as a compound option: at each coupon payment date, they have the possibility of abandoning the firm to the bondholders or buying the next option, by paying the current coupon. Ingersoll (1977) proposes the pricing of convertible bond issues and analyzes the effect due to several seniorities; accord to the real world, the author assumes that the absolute priority rule is enforced.

Zhou (1997) highlights that a sudden drop of asset value could determine an unexpected default's event. Thus, a jump-diffusion approach for modelling the underlying asset ought to be more suitable than a continuous diffusion process, as such Wiener process.

In attempt to overpass the low credit spread generated by Merton model, Shimko et al. (1993) introduce the stochastic interest rates in the analysis, as Briys and de Varenne (1997), although in Black-Cox setting. Longstaff and Schwartz (1995b) propose a Black-Cox setting with stochastic interest rates under Vasicek's model.

In the last ten years, the increasing attention has been placed to the link between the capital structure and credit spread. Black and Cox (1976) model in advance the idea of the default boundary for endogenizing the bankruptcy decisions. In different ways, Brennan and Schwartz (1979, 1980) study in deep the capital structure choice. Fischer et al. (1989) explore the tax advantage of debt and bankruptcy costs, besides the optimal policy for callable bonds. Leland (1994) proposes a model for perpetual corporate debt and he studies the stockholders' optimal decision of abandoning the firm to the bondholders; of course, only coupon level is relevant for corporate default decisions. In Leland and Toft (1996), the perpetual debt assumption is relaxed and the optimal leverage ratio is studied by the smooth-pasting condition. Further, the

[2] For exhaustive presentation of main topics about structural models, Lando (2004) shows most of refinements of Merton methodology.

work measures the impact of the optimal capital structure policy (included the maturity) on the credit spread. Aghion and Bolton (1992) present a dynamic model, based on the game theory, for the restructuring of debt. The structural models represent a suitable base for studying the agency problems proposed by Jensen and Meckling (1976) and by Myers and Majluf (1984). Thus, Anderson and Sundaresan (1996) design a game framework for assessing the strategic behaviour of the equityholders by a binomial approach. Mella-Barral and Perraudin (1997) propose a real option model with the output price of a firm as underlying process and with perpetual bond paying a consistent coupon.

Mauer and Triantis (1994) assess financing and production decisions under debt covenants for the maximization of the firm value. Ericsson (1997) proposes an analysis of the asset substitution's problem. Thus, Leland (1998) explores the impact of asset substitution and the agency costs.

Jones et al. (1984) is the first test for Merton approach on a sample of companies with simple capital structure. The results highlight low theoretical spreads compared to actual spreads.

Ronn and Verma (1986), as Lardic and Rouzeau (1999), present a procedure for estimating jointly the asset value and the asset yield's volatility (unobservable parameters) of claims (equity and/or debt) publicly traded. Duan (1994) and Ericsson et al. (2001) propose a maximum likelihood estimation for the same state variables.

Sarig and Varga (1989) confirm the results of Merton methodology on corporate bond data. Their analysis covers also the models for stochastic interest rates (Shimko et al., 1993, Longstaff and Schwartz, 1995).

Helwege and Turner (1999) expose an analysis of market credit spreads, highlighting an increasing term structure for non investment grade, on the contrary of Merton model. Several works tend to compare the Merton model and its evolutions to the market credit spread data. Thus, Delianedis and Geske (1999) confirm the evidence proposed by Helwege and Turner '99, whilst Ericsson and Reneby (2002) analyse the refinements about the endogenous bankruptcy decisions, finding that Leland and Toft '96 model overestimates market credit spreads.

With regard to the rating, Altman and Kinshore (1996a) show a time-lag between the rating changes and actual changes of credit risk. Thus, Hite and Warga (1997) find evidence about the same time-lag in upgrading and downgrading of ratings as regarding trends of market credit spreads on corporate bond data. Already Hettenhouse et al. (1976), Weistein (1977) and Pinches and Singleton (1978) show that rating changes do not take any new information in the market. Recently, Clark et al. (1997) highlight that only rating changes of low size firms (listed on equity or debt markets) express new information for investors.

The works of Crosbie (2002) and Bohn (2000) propose a presentation of KMV approach and its tool for credit risk analysis. Crouhy et al. (2000) present the comparison of several tools for credit risk analysis, as such CreditRisk, KMV, RiskMetrics, CreditPortfolioView.

In this work, the analysis approach is based on the option pricing theory proposed in Merton '74 and in KMV methodology.

The recent global recession of new millennium highlights an increasing number of corporate defaults: Enron, United Air Line, WorldCom in USA and Parmalat in Europe represent the major and famous cases. In the Italian country, there were ten default events (recorded by official statements – Bloomberg) in the range 2002-2004, on over 230 firms listed in the Italian Stock Exchange.

The aim of this work is to study phenomena of credit risk in the Italian country. Composing a sample of 180 industrial firms listed on the Italian Stock Exchange, this paper analyzes the behaviour of the default probability for each issuer.

Methodology for the default probabilities' estimation.

In Merton model, as well as in KMV approach, the probability of default can be estimated from market data. Thus, the probabilities reflect the market sentiment about the credit risk of the issuers. This instruments has frequently used for monitoring the firms' capability to carry out own commitments.

The intuition behind Merton model is considering the equity of a firm as a call option, with the value of the own assets as underlying.[3] Thus:

[3] This approach is equal to the work proposed in Merton (1974), Bohn (2002) and Crouhy (2000).

$$E_T(V_T) = \max(0, V_T - F)$$

or

$$E_t(V,T,\sigma,r,F) = V_t N(d_1) - Fe^{-rT} N(d_2)$$

where V points out the asset value, F is face value of debt and $N(\dots)$ is the cumulative standard normal distribution. $N(d_1)$ and $N(d_2)$ are respectively the probabilities relative to the exercise of the call option and repayment of debt. Hence, $N(d_2)$ is the probability of the event opposite to the default. Thus,

$$N(-d_2) = N\left(-\frac{ln\left(\frac{V_t}{F}\right) + \left(r_f - \frac{\sigma_V^2}{2}\right)T}{\sigma_V \sqrt{T}} \right)$$

which represents the probability of default.

Accord to KMV approach, the unique differences concern the time horizon (equal to one) and the value of the liabilities which represents a default barrier. Hence:

$$N(-DD) = N\left(-\frac{ln\left(\frac{V_t}{DPT}\right) + \left(r_f - \frac{\sigma_V^2}{2}\right)T}{\sigma_V \sqrt{T}} \right)$$

where DD (equal to d_2) indicates the distance to the default and DPT is the default point, equal to current liabilities plus half of non current liabilities.

Unfortunately, in these equation there are two unknown variables: the asset value and the volatility of its value. Both parameters are unobservable.

For estimating these variables, it is necessary to implement and solve a system of two non linear equation:

$$\begin{cases} E_t = V_t N(d_1) - Fe^{-rT} N(d_2) \\ E_t = \dfrac{\sigma_V}{\sigma_E} V_t N(d_1) \end{cases}$$

By Ito's lemma, the latter points out the relation between the equity value and its volatility. By a Newton strategy (iterative method), we can calculate simultaneously the two parameters (given the market capitalization and its volatility, the face value of all liabilities and the level of interest rates).

Data.

The empirical investigation considers a large cross-section of industrial firms. All issuers belong to the Italian Stock Exchange. The data have collected from DataStream as well as Bloomberg. Because of the financial industry presents different features, the attention has restricted to industrial firms, accord to the literature. The sample covers the 12-years period from 1992 to 2004. The Italian Stock Exchange contains more of 230 industrial firms listed; nevertheless, any issuer presents insufficient information for this analysis and the natural consequence was its exclusion. For each issuer, the data set concerns balance sheet and market price information. In the first case, the information is relative to current and non current liabilities, whilst the latter type concerns the daily quotes for the market capitalization. Further, the data set contains the sector for each issuer, as reported by INDC3 function (basic, cyclical consumer goods, cyclical services, generals, technologies, non cyclical consumer goods, non cyclical services, resources, utilities) of DATASTREAM. The final data set (panel A) includes 180 issuers.

As above mentioned, it is necessary an estimation of the equity's volatility. For this work, the volatility has been estimated considering all daily quotes relative to the year previous the valuation date. Probably, another window for calculation the volatility would express a different weight for the past information.

Finally, the Libor rate for the Italian market is the estimation for the level of interest rates.

The Table 1 contains statistics on the sample information of panel A, as such the market capitalization, firm liabilities, volatilitiy and Libor rate. The total observations are more than 321 thousands. The market capitalization mean is just 1,6 billion euro, while the volatility mean is equal to 42%, accord to common stock estimates. The leverage is calculated as ratio between debt and the sum of the market capitalization and debt (D/D+E); so, the variable can assume values between zero and one (0 and 100%).[4]

Table 1 (a) Panel A.

	N. Obs.	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Mkt Capitalization	321085	,00	128697,38	1619,7040	6782,87017
Cap. Volatility	321085	,00	3,75	,4221	,25960
Current Liabilities	321085	,00	39792,99	999,1866	3848,21399
Total Liabilities	321085	,00	60470,99	1557,0183	6085,58796
Leverage (D/D+E)	321085	,00	1	,4925	,24046
Risk free rate	321085	,02	,18	,0503	,03185

a Statistics for each sample variables in period 1992-2004.

The sub panel B is composed by all issuer (15) of Panel A with a Standard and Poor’s rating at December 2004. Rating represents another benchmark for this analysis. Later, a comparison will be presented between the S&P ratings and those calculated on the base of estimates, as such mean.

The sub panel C contains all sample issuers (10) defaulted. The aim is to investigate about the prediction of these events.

[4] On the contrary, in the real world leverage can be higher than 100%. In the section dedicated to results, the leverage is calculated on own asset value estimated by market data and sometime this ratio is significantly higher.

Empirical results.

The estimates of the default probabilities are tested for several purposes. The first question concerns if the probabilities are effectively different from zero. The default probability mean along sample is equal to 1,79%, a non investment grade, and its volatility is more than 8%. The Italian segment shows a high risk of the financial distress, although any sector appears healthy (as such oil and resources). Last row of Table 2 (Table 3) reported the associated *t* test value and relative p-value in the pooled sample; there is a strong evidence that the default probability mean is economically and statistically different from zero.

The original sample has been disaggregated by time, industry, debt loads (leverage) and asset volatility level. The purpose is to investigate the effect of each factor on the default probability level. The Table 2 presents the probabilities' means for each year and relative *t* test for the averages equal to zero.

Table 2 (a) Panel A.

TimeY	*N. Issuers*	*N. Obs*	*Mean*	*Std. Deviation*	*t Student*	*p-value*
1992	57	13886	,0031	,01033	35,274	,000
1993	57	13727	,0143	,06061	27,558	,000
1994	58	13875	,0427	,17884	28,144	,000
1995	60	14155	,0218	,09243	28,118	,000
1996	65	15277	,0376	,12162	38,165	,000
1997	74	17595	,0241	,11740	27,189	,000
1998	83	19595	,0196	,08916	30,847	,000
1999	98	22238	,0093	,06535	21,164	,000
2000	119	26361	,0042	,01726	39,569	,000
2001	154	33647	,0091	,03815	43,624	,000
2002	170	41947	,0161	,06168	53,598	,000
2003	178	44710	,0224	,09344	50,599	,000
2004	175	44072	,0209	,10207	43,088	,000
Total	180	321085	,0179	,08701	116,528	,000

a Default probabilities means for each year and *t* Student (null hypothesis: mean equal to zero) with the own *p*-value.

The means are highly significant in each year and it suggests that default probabilities' levels affect stock prices during the entire business cycle. It is possible to note that the default probabilities is relatively lower during boom years 1999-2001.

Similarly to the results about time-years, the Table 3 indicates the industry effect on the probabilities of default. Again, each class shows a mean significantly different from zero.

Table 4 brings out probability estimates grouped according to debt levels. Each group represents the employment of a specific proportion of debt. In this case, the leverage variable is calculated as ratio between the debt level and the asset market value implied by the market capitalization (D/V). Sometimes, the ratio is higher than 100%, contrary to the leverage (D/D+E).

Table 3 (a) Panel A.

Industry	*N. Issuers*	*N. Obs*	*Mean*	*Std. Deviation*	*t Student*	*p-value*
Basic	28	63383	,0173	,09076	47,902	,000
Cyclical consumer goods	25	57527	,0045	,02110	51,092	,000
Cyclical services	41	60288	,0224	,08551	64,302	,000
General	22	40105	,0142	,08150	34,820	,000
Technology	27	30880	,0313	,09833	55,933	,000
Non cyclical consumer goods	15	31937	,0282	,13410	37,595	,000
Non cyclical services	4	7285	,0270	,05933	38,870	,000
Oil and Resources	3	7104	,0001	,00031	32,939	,000
Utilities	15	22576	,0181	,10598	25,664	,000
Total	180	321085	,0179	,08701	116,528	,000

a Default probabilities means for each industries and *t* Student (null hypothesis: mean equal to zero) with the own *p*-value.

Table 4 (a) Panel A.

Leverage (D/V)	*N. Obs*	*Mean*	*Std. Deviation*	*t Student*	*p-value*
Lev < = 0.30	70540	,0057	,05174	29,022	,000
0.30 < Lev < = 0.60	112887	,0071	,05019	47,486	,000
0.60 < Lev < = 0.90	88657	,0144	,05580	76,612	,000
0.90 < Lev < = 1.20	43495	,0424	,10907	81,133	,000
1.20 < Lev < = 1.50	4374	,0827	,17154	31,890	,000
Lev > 1.5	5506	,2592	,37843	50,697	,000

a Default probabilities means for leverage’s proportions and *t* Student (null hypothesis: mean equal to zero) with the own *p*-value.

Table 5 (a) Panel A.

		Default Probability		*Leverage (D/V)*	
Asset Volatility	***N. Obs***	***Mean***	***Std. Deviation***	***Mean***	***Std. Deviation***
VolA < = 0.10	81681	,0122	,06247	,7367	,39694
0.10 < VolA < = 0.20	106385	,0092	,04556	,6189	,23342
0.20 < VolA < = 0.30	72802	,0110	,04687	,4476	,22303
0.30 < VolA < = 0.40	32831	,0161	,07130	,3441	,24199
0.40 < VolA < = 0.50	14232	,0271	,09017	,3360	,24570
0.50 < VolA < = 0.60	6964	,0231	,08428	,2426	,21067
VolA > 0.60	6190	,3069	,37423	,8808	1,5886

a Default probabilities and leverage ratios means for different levels of asset volatility.

As expected, the default probability trend is monotonically increasing over the firm's debt load. It is interesting to note that the default probability is significant even for firms with relatively low level of leverage. With less than 30%, the mean is equal to 57 basis points, corresponding to the Standard & Poor's rating range BBB^--BB, between investment and non investment grade.[5]

On the other hand, a default event could be determined by an excessive risky of the firm's assets. This observation could suggest to study the effect between the default probability and the risky of the firm's assets.

The Table 5 highlights the impact of several asset risk levels on the default probability and leverage trends. The volatility of asset value is disaggregated in seven ranges with a minimum number of observations. A low volatility (< 10%) could determine a low probability that the firm's expected asset value are sufficient to cover the own commitments. These low risk assets are more leveraged than the other classes (expect for the high risky firms). With a volatility included between 10% and 30%, the default probability mean goes down, highlighting a downward leverage. According to the classical theory and empirical evidence, a low (high) asset risk show a high (low) financial leverage, except of an excessive assets' risky; in fact, if the asset volatility is higher than 60%, the leverage mean is equal to 88%. Probably, a high uncertainty would create bad information in the market.

[5] The scale between S&P ratings and corresponding default probability range can be found in Crouhy et al. (2000).

The latter question concerns the different impact of each factor (time, leverage, industry and asset volatility) on the default probability's level. For this purpose the anova (analysis of variance) test is performed for the equality of the means. The Tables 6 and 7 point out the result of these tests. As expected, there exists a strong economic evidence that the default probability means, between several issuers, are different. Thus, even for the factors time-year, industry, leverage and asset volatility, the results highlight means are different. The anova tests confirm the general evidences about the credit risk.

As introduced above, the sub panel B represents the set of issuers rated by Standard & Poor's at December 2004. The aim is to compare this benchmark (S&P) with the rating corresponding to the default probability's average calculated from market data.

Table 6 (a)

Anova									
	Issuers			***Years***			***Industries***		
	Between group	***Within group***	***Total***	***Between group***	***Within group***	***Total***	***Between group***	***Within group***	***Total***
Sum of Squares	530,52	1900,35	2430,87	29,28	2401590	2430,87	23,93	2406,94	2430,87
df	179	320905	321084	12	321,072	321084	8	321076	321084
Mean Square	2,964	,006		2,440	,007		2,991	,007	
F	500,486			326,193			398,954		
Sig.	,000			,000			,000		

a Anova table for the equality test of the means for the factors issuer, year and industry.

Table 7 (a)

Anova						
	Leverage (D/V)			***Asset Volatility***		
	Between group	***Within group***	***Total***	***Between group***	***Within group***	***Total***
Sum of Squares	923121,892	538468,423	1461590,315	606232,405	855357,911	1461590,315
df	5	656634	656639	6	656633	656639
Mean Square	184624,378	,820		101038,734	1,303	
F	225139,746			77564,451		
Sig.	,000			,000		

a Anova table for the equality test of the means for the factors leverage and asset volatility.

Tabella 8 (a) Panel B.

Emittente	*S&P*	*Mean*	**Δ**
Acea	A^+	AAA	+
Aem	A	AAA	+
ASM Brescia	A^+	AAA	+
Autostrade	A	B^+	-
Edison	BBB^+	CCC	-
Enel	A^+	AAA	+
Eni	AA	AAA	+
Fiat	BB^-	BB^-	
L'Espresso	BBB^-	AA	+
IT Holding	B^+	BBB^-	+
Lottomatica	BBB	AAA	+
Reno de Medici	B^+	B	-
Parmalat	BBB^+	BBB^+	
Seat Pagine Gialle	BB^-	B^-	-
STMicroelectronics	A^-	AAA	+
Telecom Italia	BBB^+	CCC	-

a The panel B contains all issuers with a Standard & Poor's rating at December 2004, expect of the Parmalat's rating, relative to October 2004. Second column represents the ratings calculated by the mean of the default probability distribution of each issuer. Finally, delta expresses the sign of the difference between the mean and S&P rating, positive for upgrading and negative for downgrading.

Nevertheless, it is important to note the Standard and Poor's rating is resulting of a qualitative and quantitative valuation process; whilst Merton's default probability is a (quantitative) risk neutral measure, that is each economic agent is not averse to risk. A risk neutral probability is greater than corresponding actual probability. The Table 8 reports these estimates.

Expect of Fiat and Parmalat, the ratings, calculated on the base of own average default probability, highlight nine upgrade and five downgrade than S&P valuations. Autostrade, Edison, SeatPG and Telecom Italia suffer a high level of leverage; all these companies were objects of several takeovers in the recent past. Some issuers show ratings higher than S&P benchmark, as such the utility and oil sectors (Acea, Aem, ASM Brescia, Enel, Eni). In such cases, the differences could depend on lower rating of Italian sovereign debt, equal to AA; probably, for S&P agency each Italian corporate rating cannot be better. This represents an upper barrier, thus the rating of several companies could be undervalued. It is important to note the rating calculated is a high volatile output, depending on the market data.

Finally, the sub sample, composed of all defaulted issuers in period 1992-2004, is investigated to highlight possible falls of the relative default probability. Table 9 shows the default probabilities of each issuer recorded at fixed instants previous to the default (1, 2, 3 months and 1, 2 years).

The purpose of test is to watch a possible downward trend in the probability, close to the default event. For some company (Arquati, Necchi, Olcese), the default is an expected event, because of specific management statements; the natural consequence is that probability is not very high, close to the default. The market has already discounted this information about the credit risk. On the other hand, some issuers highlight a great level of credit risk since at least 6 months, one or two years before own default's event (Tecnodiffusione, Cirio, Gandalf, Giacomelli, Opengate). That confirms the capabilities of monitoring of this approach. Nevertheless, Parmalat and Finmatica show low levels of probability, previous to the default, and these events were strongly unexpected. A possible answer is due to business cycle effect. Since probability level depends on the business cycle, the simple comparison between the issuers' probability levels, in different times, could be inadequate. Further, KMV assumes that a firm is in default if its probability is higher than 20%, but the business cycle effect suggests this absorbent barrier is variable in time.

Tabella 9 (a) Panel C.

	1 m	3 m	6 m	1 y	2 y
Arquati	0.0088	0.0101	0.0092	0.1038	0.0113
	(13%)	(14%)	(18%)	(5%)	(15%)
Necchi	0.0420	0.0471	0.0501	0.0141	0.1490
	(8%)	(10%)	(8%)	(14%)	(2%)
Olcese	0.0317	0.0418	0.0225	0.0482	0.0859
	(6%)	(7%)	(9%)	(7%)	(5%)
Tecnodiffusione	0.1062	0.1273	0.1342	0.0135	0.2968
	(3%)	(4%)	(3%)	(13%)	(1%)
Finmatica	0.0231	0.0244	0.0189	0.0000	0.0002
	(5%)	(7%)	(10%)	(50%)	(48%)
Parmalat	0.0042	0.0029	0.0043	0.0006	0.0001
	(15%)	(24%)	(24%)	(38%)	(46%)
Cirio	0.1512	0.1113	0.0840	0.0193	0.1649
	(3%)	(4%)	(6%)	(13%)	(8%)
Gandalf	0.1076	0.1269	0.0933	0.0221	0.2796
	(4%)	(3%)	(7%)	(12%)	(1%)
Giacomelli	0.1648	0.1468	0.0603	0.0562	NaN
	(4%)	(4%)	(6%)	(6%)	NaN
Opengate	0.1119	0.0782	0.0311	0.0137	0.0347
	(6%)	(8%)	(9%)	(13%)	(4%)

a The Panel C contains all sample issuers defaulted. The columns highlight the default probability of each issuer, recorded at fixed instants previous to the default. Thus, the first column presents the probabilities recorded three months previous to the default of each issuer. Below each probabilities, the value between brackets expresses the percentage of issuers with default probability major in that instant. This variable ought to tend to zero for firms in financial distress.

A complementary measure for the credit risk of each issuer could be the percentage of companies with a higher default probability in that instant. Thus, in Table 9 below each probabilities, the value between brackets expresses the percentage of issuers with default probability higher in the same time. This variable ought to tend to zero for firms in financial distress. In this way, the percentages of Parmalat and Finmatica point out a high credit risk regard to the entire sample of issuers, on the contrary of default probability levels. In the other cases, the percentages confirm the level trends of default probabilities.

This analysis highlights the capabilities of credit risk monitoring provided by Merton approach. In some case, the default event is predictable at least 6 months before and that could confirm some market efficiency hypothesis. The probabilities (market prices) seem to reflect the publicly available information and the private information available to the insiders. However, the results suggest the existence of a time-lag between rating changes and the actual changes of credit risk, in accord to agency cost and asymmetric information theories.

Conclusions.

This work concerns phenomena of credit risk in the Italian stock market. In accordance with Merton model and KMV approach, the credit risk of a firm is measured by its default probability. Composing a sample of 180 companies listed on the Italian Stock Exchange, the purpose is to infer the credit risk of each issuer, from January 1992 to December 2004, on the base of market data and balance sheet information. The analysis highlights a high level of credit risk (default probability mean equal to 1,79% — probably non investment grade) for polled sample of issuers, in special way in the last year of panel period. First of all, the high level of credit risk is due to data source, therefore to the market equity prices. Further, general downgrading of credit risk is sustained by a concentrated number of defaults in the last years (ten insolvencies since 2002 to 2004). Parmalat and Cirio cases conditioned the market sentiment about general corporate capability of taking own commitments.

Some tests on default probability behaviour confirm common evidences; for example, the credit risk level depends on market (interest rates, market prices) and specific (industry, leverage, asset volatility) factors. Besides, the default probability level is inversely influenced by economic cycle and this effect refutes a consistent default boundary (20%) proposed in KMV approach (if the default probability is equal or higher than 20%, the issuer is insolvent). We expect the business cycle affects even the default boundary. Sometime, the default barrier could be excessively high if the economy is increasing; in fact, the default probability distribution of market tends to go away from KMV boundary. Other times, if the economic context is in recession, the default boundary could be too much low and not be able to avoid credit rationing.

The analysis of sub panel of issuers rated by Standard & Poor's agency brings out any mismatching between the S&P rating and those calculated on the base of the default probabilities' estimations. The difference could be due to a time-lag between the rating changes and the actual changes of corporate credit risk, as already pointed out in literature. However, some companies show a high financial leverage and it is quite normal the market prices negatively their expectations.

Another issue in this paper concerns Merton model's (KMV approach) capability of monitoring corporate credit risk. The final step represents the analysis of ten default events included in the panel data. Some insolvency were strongly unexpected (in special way Parmalat and Cirio). The aim is to verify an actual downgrading of credit risk for sample defaulted issuers, by recording the probability level at fixed dates previous to the insolvency. The results indicate that not all issuers highlight a downgrading of own default probability level. Nevertheless, by watching at same dates the percentage of sample issuers with higher default probability (a complementary measure for credit risk), the downgrading of corporate credit risk is clear. Some issuers highlight a great level of credit risk since at least 6 months or one year before the default's event. These arguments could induce us to think that some market prices look to reflect public and private information about a company's health; in any case, market data would contain information available only to the insiders of a firm. Some hypothesis about the market efficiency and asymmetric information could be explored.

Finally, this work confirms Merton (KMV) approach's a strong capability of monitoring, although any adjustments are important.

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