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THE OPTION PRICING THEORY FOR FORECASTING THE CORPORATE FAILURES: SOME EVIDENCES FROM ITALIAN STOCK MARKET

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Jel classification: G13, G14, G33.

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1 – Introduction.

Over the last few years, financial and academic communities have devoted increasing attention to the issues of credit risk and whether possible defaults can be foreseen. The moral suasion of the Basel Committee provided an impulse to develop and perfect new methodologies for analysing the credit risk of a corporate issuer, which is notoriously higher than that of a sovereign government. Thus, several approaches and models have been proposed to anticipate financial crisis in a company.

Modern credit risk analysis forms part of the continuing research in the field of finance into the integration of different types of uncertainty (market, credit, country and operational risks). The underlying approach (of the present work?) follows on directly from the advances that have been made in the field of market risk, and is based on the seminal works by Black and Scholes (1973) and Merton (1974), which proposed 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 provides a more complete and complex valuation and in addition provides a way of pricing the default risk spread for fixed income instruments. In one single framework, it is possible to measure the impact of a change in asset volatility and a change in the level of interest rates or different maturities of debt on credit risk spreads. A firm's probability of default can thus be calculated using a closed-form equation. The KMV Corporation offers several products based on Merton's intuitions, with some adjustments. Using market and balance sheet information, their method calculates the probability of default for listed firms.

The focus of this work is a test of the ability of the KMV-Merton model to predict the failure of a company; although other contributions have already been made on this issue, this paper provides and compares several estimates for the probability of default, in order to further understanding of forecasting ability and solve some general doubts about the use of this approach. Furthermore, the paper presents an estimation system of unobservable parameters, allowing us to obtain both the risk neutral and physical default probabilities from market stock price data. The analyses were performed on a sample of 170 firms listed on the Italian stock exchange during the period 1992-2004.

This work was originally inspired by two considerations. Firstly, the new Basel agreement has recognized the KMV-Merton approach as providing an appropriate model for evaluating credit risk, thus encouraging the model's diffusion among practitioners in the financial community. The fact that this model is not fully reliable may generate operational risk; hence, new empirical evidence and analysis could improve accuracy in its application. The second consideration concerns the specific test used. Insufficient academic literature has so far been produced concerning the default prediction tests of the Merton approach, and for several years research focused mainly on the pricing-spread issue. In recent years, a renewed interest in predicting bankruptcy has opened discussion on the reliability of credit risk estimates and hence a new way of testing the model.

The remainder of the paper is organised as follows. The next section is dedicated to a review of literature on the testing of the original model and the KMV version. Section 3 proposes a structural framework of analysis, while Section 4 describes the sample data. Section 5 gives the results of the estimates in two steps: a general statistical overview and the results of the testing process. Section 6 presents the conclusions of this work.

2 – Literature review

Merton's framework is an extreme simplification of the real world; many refinements of the original analysis have been suggested by empirical works. Further, structural models represent a suitable basis for studying the agency problems posed by Jensen and Meckling (1976) and Myers and Majluf (1984).The following list of works is far from complete, but covers some important topics in the literature on structural models and empirical evidence.[1]

Tests of the Merton model can be grouped into two main categories: the pricing-spread of debt, and the prediction of default. For both areas, Jones et al. (1984) provides the first test of the Merton approach on a sample of companies with simple capital structure. The results reveal how low theoretical spreads compare to real spreads.

Odgen (1987) tests the ability of the model to explain issue price and initial rating for a sample of 57 callable and sinkable corporate bonds, by modelling the stochastic interest rate in order to improve the accuracy of pricing. Lyden and Saraniti (2000) provide a test based on the pricing-spread errors calculated on 66 bonds. Their analysis covers the Merton model and its refinements, and the results demonstrate that the greater mathematical complexity of the model does not produce a greater accuracy of calculation. The contribution confirms the Merton model's underestimation of the yield spread. Ericsson and Reneby (2005) analyse the refinements of endogenous bankruptcy decisions, finding that the Leland and Toft (1996) model overestimates market credit spreads, although the authors need to double check their results because this finding is usually attributed to Eom et al. (2004), whose work tested the Merton model on a sample of 182 bonds, confirming that the original approach predicts spreads which are too low.

Some authors have examined the general patterns implied in the structural models of credit spreads. Sarig and Varga (1989) confirm the results of Merton's methodology for corporate bond data.

Helwege and Turner (1999) provide an analysis of market credit spreads, highlighting an increasing term structure for non-investment grade, in contrast with Merton's model. Several works compare the Merton model and its evolutions to market credit spread data. Thus, Delianedis and Geske (1998) confirm the evidence proposed on bond rating changes. Dufresne et al. (2001) analyse bond spreads and Huang and Huang (2003) document the fact that most structural models cannot explain both yield spread and default rates simultaneously, a finding now referred to as the "credit risk puzzle".

The second area of research (more recent than first) concerns the ability of the Merton model to predict the failure of a firm; this stream of literature arose partly thanks to the diffusion of commercial products based on this financial technology.

The works of Crosbie (2002) and Bohn (2000) present the KMV approach and its tool for credit risk analysis. Crouhy et al. (2000) compare several tools for credit risk analysis, such as CreditRisk, KMV, RiskMetrics, and CreditPortfolioView. The first contributions regarding testing of the KMV-Merton model were produced by practitioners employed by KMV and Moody's, such as Sobehart et al. (2000), Stein (2000), Sobehart and Stein (2000), and Sobehart and Keenan (1999). All these authors propose hybrid models and conclude that the Merton-KMV approach could be improved. Kealhofer and Kurbat (2001) highlight how the model captures all information relative to agency ratings and accounting variables. More recently, other academic works have contributed to the discussion on the ability of the model to predict failure. Thus, Hillegeist et al. (2004), Du and Suo (2004) and Bharath and Shumway (2008) analyze its predictive power in similar ways, confirming the failings of the model. Aretz and Bonnett (2011) find model-implied default risk estimates evidence an important informative content if the firm's debt is constrained by covenants; moreover, the liquidity risk of the asset value and other variables also relate to forecasting power.

In this work, the analitical approach is based on the option pricing theory proposed in Merton (1974) and in KMV methodology, following this last area of research. With respect to previous papers, this study also proposes several types of default probability estimates, for two reasons: firstly, to support the results concerning the reliability of the test of the model; secondly, to clear some practical doubts about the use of the appropriate equity volatility estimation in order to better predict the failure of a firm. Further, this work presents a comparison between several default probability averages and analysis of the lagged variables.

3 – Simultaneous estimation of risk neutral and physical default probabilities

According to both the Merton model and the KMV approach, the probability of default can be estimated from market data. This implies that probabilities reflect the market's perception of the credit risk of the issuers. The Merton and KMV instruments are frequently used for monitoring the ability of firms to respect their own commitments.

The intuition underlying the Merton model is that of imagining the equity of a firm as a call option, with the value of its own assets as underlying.[2] Thus:

$$E_T = max[A_T - F, 0] \tag{1}$$

or

$$E_T = f(A, \sigma_A, F, T, r_f) = A_T N(d_1) - Fe^{-r_f T} N(d_2) \tag{2}$$

where A is the asset value, F is face value of debt and $N(\ldots)$ is the cumulative standard normal distribution. $N(d_1)$ and $N(d_2)$ are respectively the probabilities of exercising the call option and of repaying the debt. Hence, $N(d_2)$ is the probability of non-default. Thus,

$$N(-d_2) = N\left(-\frac{\ln\left(\frac{A}{F}\right) + \left(r_f - \frac{\sigma_A^2}{2}\right)T}{\sigma_A\sqrt{T}}\right) \tag{3}$$

which represents the risk-neutral probability of default.

According to the KMV approach and Huang and Huang (2003), the physical default probability can be quantified by defining the expected return of asset (k_A – cost of capital for the firm), the time horizon T (equal to one) and the value of the liabilities which represents a default barrier DPT. Hence:

$$N(-DD) = N\left(-\frac{\ln\left(\frac{A}{DPT}\right) + \left(k_A - \frac{\sigma_A^2}{2}\right)T}{\sigma_A\sqrt{T}}\right) \tag{4}$$

where DD indicates the distance to default and DPT is the default point, equal to current liabilities plus half of noncurrent liabilities. It is important to note that the KMV rating system adopts a large historical database of defaulted and non-defaulted firms mapped by distance to default (DD) in order to quantify the probability of failure. Unfortunately, in this equation there are three unknown variables: the asset value, the expected return on the asset and its volatility.

Generally, the asset value and its volatility are estimated by market data (KMV) and the cost of capital k_A is estimated in a successive step, raising questions as regards the consistency of the estimation procedures. In order to attempt to overcome these issues, this work extends the information dataset for obtaining three estimates for the three unknown variables simultaneously and consistently.

For estimating these variables, and in order to obtain simultaneous estimates of the risk neutral and physical default probabilities, it is necessary to implement and solve a system of three (mutually independent) non-linear equations:

$$\begin{cases} E = AN(d_1) - Fe^{-r_f T}N(d_2) & \textbf{OPT} \\ \sigma_E = N(d_1)\dfrac{A}{E}\sigma_A & \textbf{OPT} \\ \beta_E = N(d_1)\dfrac{A}{E}\beta_A & \textbf{\textit{CAPM}} \end{cases} \tag{5}$$

In accordance with Ito's lemma, the second equation points out the relation between the equity value and its volatility. The third relation is the Capital Asset Pricing Model (CAPM) in the Option Pricing framework as reported by Hsia (1981). Using a Newton strategy (iterative method), we can calculate the three parameters simultaneously (given market capitalization, its volatility, the equity systematic risk, the face value of all liabilities and the level of interest rates).

4 – Data.

The empirical investigation considers a large cross-section of industrial firms with the all issuers listed on the Italian Stock Exchange. Because of the different nature of the financial industry, our attention is restricted to industrial firms, as in the literature. The data was collected by DataStream and Bloomberg, with the sample covering a 12-year period between 1992 and 2004. The Italian Stock Exchange lists more than 230 industrial firms; any issuer presenting insufficient information for this analysis was excluded. For each issuer, the data set consists of their balance sheet and market price information. The latter concerns the daily quoted values for market capitalization. Furthermore, the data set contains each issuer's sector, as reported by its DATASTREAM INDC3 function (basic, cyclical consumer goods, cyclical services, generals, technologies, non-cyclical

consumer goods, non-cyclical services, resources, utilities) . The final data set (panel A) includes 170 issuers.
As mentioned above, it is necessary to provide an estimation of the volatility of the equity. For this study, volatility has been estimated three times, considering all daily quoted values relative to the three different time ranges previous to the valuation date: the last 40 (260 or 520) business days of trading. A different window for calculating the volatility would probably express a different weight for the past information.
Finally, the Libor rate for the Italian market represents an estimation for the level of interest rates, and the FTSE Italy is considered as the market portfolio.
Table 1 contains statistics on the sample information for panel A, including market capitalization, the firm's liabilities, volatility and the Libor rate. There were more than 300,000 total observations. Average market capitalization is just 1.5 billion euros, while the average volatility swings from 30% to 42%, according to common stock estimates. The analogous reason can be made about the equity beta and CAPM-return.[3]

Table 1

Table 2

The sub panel B (Table 2) consists of all issuers (15) of Panel A with a Standard and Poor's rating in December 2004. The rating represents another benchmark for this analysis. Later, a comparison of the S&P ratings with those calculated on the basis of the estimates is presented, as such statistics.

Table 3

Sub panel C (Table 3) contains all the issuers (10) in the sample who defaulted. The aim is to investigate to what extent these events were predictable.

5 – Empirical results.

The aim of the panel analysis is to investigate the ability of the Merton approach to predict the failure of a firm listed on financial markets. The first part of this section presents a general overview with regard to the estimates and some general tests of default probabilities and the main factors impacting on credit risk. The second part concerns a focused test of the model on the sample data in order to highlight where the trends of default probability can help to forecast the failure of a company.

5.1 – General statistical overview of default probabilities

The estimates of the default probabilities are tested for several purposes. The first question concerns whether the probabilities effectively diverge from zero. If average default probability is equal to zero, we could argue that the Merton model cannot represent the actual credit risk. The test ought to confirm previous studies concerning the predicting ability of this approach. All results are presented three times for each statistic in line with the three volatility estimates (40, 260 and 520 bd) in order to highlight some specific effects. Furthermore, all results provide two types (risk neutral and physical/real) of estimates for the probability of default.

The results highlight the fact that the average risk neutral and physical probabilities of default along the sample fluctuate respectively between 1.45%-2.05% and 1.25%-1.76% (a non-investment grade), and volatility is 8%. The Italian market displays a high risk of running into financial distress, although some sectors appear healthy (such as oil and natural resources). The final rows of Tables 4a, 4b and 4c (Tables 5a, 5b and 5c) report the associated *t* test value and relative p-value in the pooled sample; there is strong evidence that average probability of default is economically and statistically divergent from zero.

Tables 4a

Table 4b

Table 4c

It is interesting to note that the estimate of the default probability increases (decreases) according to the time range used for estimating the equity volatility in the different years of panel A. The different cross-volatility trends seem to reflect some influences stemming from interest rate trends and hence the economic cycle. The first years (1992-1996) of panel A are dominated by high levels and volatilities of Italian interest rates compared to the European area. This effect is due to high levels of inflation and a difficult economic situation after the US recession in 1991. In a second time step (1997-2000), Italy entered the Euro Monetary Agreement, adjusting many public finance indicators to common European standards. If the economic cycle was positive (negative), the probability of default generally was growing (decreasing) according to the time span.

Average values for each year are highly significant, suggesting that default probability levels affect stock prices during the entire business cycle. It can be seen that probabilities of default were relatively lower during the years 1999-2001, but in the period 1993-1996 they were very high; this result is probably due to the high level of government debt, the high national deficit (close to 10% of the Italian GDP) and the exit of the Italian currency from the European monetary agreement (European Monetary System) in 1992 and the subsequent devaluation of the Italian Lira.

Table 5a

Table 5b

Table 5c

As for the results regarding the time, Tables 5a,5b and 5c indicate the sector-specific effects on the probability of default. Again, each class shows an average value which significantly diverges from zero. Here too, we observe the effect noted above about the time range's size of the volatility used. Nevertheless, underlying reasons suggest another interpretation of this effect: a decreasing trend pairs to a low level of credit risk. Three industries (cyclical consumer goods, oil & resources and utilities) reveal decreasing trends with low levels of probability of default. All other sectors reveal an opposite trend. This result seems to suggest that issuers characterized by first behavior are considered reliable debtors.

Table 6a

Table 6b

Table 6c

Tables 6a,b and c illustrate probability estimates grouped according to debt levels. Each group represents the use of a specific proportion of debt. In this case, leverage is a market variable. As expected, the probability of default increases constantly with the firm's debt load. It is interesting to note that probability of default is significant even for firms with a relatively low level of leverage. With leverage of less than 20%, the average physical default probabilities are respectively 1.71%-2.02% corresponding to Standard & Poor's B rating range, no investment grade.[4]

On the other hand, a default could be determined by excessive riskiness of the firm's assets. This observation suggests the need to study the relationship between default probability and riskiness of the firm's assets. Tables 7a, 7b and 7c illustrate the impact of several asset risk levels on the default probability.

Table 7a

Table 7b

Table 7c

The volatility of asset value is disaggregated into four classes with a minimum number of observations. A low volatility (< 20%) should determine a low probability that the firm's expected asset value is sufficient to cover its own commitments. Nevertheless, these low risk assets are more leveraged than the other classes (expect for the highly risky firms). With a volatility of between 20% and 40%, the default probability average goes down. According to the classical theory and empirical evidence, a low (high) risk asset shows a high (low) financial leverage, except for an excessive risk of the assets; in fact, if the asset volatility is higher than 60%, the average leverage is equal to 88%.High uncertainty would probably lead to negative information in the market. It is interesting to note that the empirical relationship between asset volatility and leverage follows the phenomenon known as "volatility skew or smile".

Another question concerns the different impact of each factor (time, leverage, industry and asset volatility) on the level of default probability.

Table 8a

Table 8b

We may suppose that the average default probability for an industrial cyclical firm is different from that for an oil company. Thus, different averages can exist between several leverage ratios or asset volatility levels. For this purpose the anova (analysis of variance) test is performed to check for the equality of the averages. Tables 8a and 8b give the results of these tests. As expected, there is strong economic evidence that average default probabilities differ between issuers. Thus, even for the factors time-year, industry, leverage and asset volatility, the averages are different. The anova tests confirm the general evidence about credit risk.

As explained above, subpanel B (Table 9) 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 physical default probability average calculated from market data. Nevertheless, it is important to remember that the Standard and Poor's rating is the result of a qualitative and quantitative valuation process, whilst Merton's default probability is merely a quantitative measure.

Table 9

Except for Fiat, L'Espresso and Parmalat, the ratings, calculated on the basis of the physical default probability average, highlight seven upgrades and five downgrades compared to S&P valuations. Autostrade, Edison, SeatPG and Telecom Italia suffer a high level of leverage; all these companies underwent several takeovers during sample years. Some issuers show ratings higher than the S&P benchmark, such as the utility and oil industries (Acea, Aem, ASM Brescia, Enel and Eni). In such cases, the differences could depend on a lower rating of the Italian sovereign debt, equal to AA on the time sample analyzed. It is important to note that the rating calculated is a highly volatile output, depending on market data.

Finally, the sub sample composed of all issuers defaulting in the period 1992-2004 is investigated to highlight possible falls in the relative default probability. Tables 10a and 10b show the default probabilities of each issuer recorded at specific moments previous to the default (1, 3, 6 months and 1, 2 years) and some statistics (min, max, average, median) for the physical default probabilities for the two years before the official failure date.

Table 10a

Table 10b

The purpose of the test is to check for a possible downward trend in probability on moving closer to the default event. Generally speaking, each failure is different from the others, because in some cases the default event is a surprise to the market and the bankruptcy procedures are significantly efficient, while in others the market is able to anticipate (or discount) possible default or financial distress. From Table 10a it can be seen that at the default date only four issuers were not suspended from trading and only Cirio showed a level of default probability higher than 20%, the canonical threshold used by KMV. Table 10b highlights how the dynamics of the default probability for each issuer, except for Olcese, are much greater than 20%. Parmalat and Cirio, the most significant European corporate failures, are two very different cases: the first was a strong negative surprise, while the second was a predictable event.

The business cycle effect is a significant issue. Since the probability level depends on the business cycle, a simple comparison between issuers' probability levels at different times may prove to be inadequate. The business cycle influences the default probability level inversely. The KMV approach assumes that a firm is in default if its probability is higher than 20%, but the business cycle effect suggests that this absorbent boundary could vary over time. A complementary measure for the credit risk of each issuer could be the percentage of companies in the sample with a higher default probability at that instant. Thus, in both Tables 10a and 10b, on the right of each probability, a value expresses the percentage of issuers with higher default probability at the same time. This variable ought to tend to zero for firms in financial distress.

This statistical overview of default probability estimates suggests the imperfect ability of the KMV-Merton approach to predict a company's failure, although in some cases the default event is predictable months before, which could confirm a market efficiency hypothesis. In some cases, the probabilities (market prices) seem to reflect publicly available information and private information available to insiders in accordance with agency cost and asymmetric information theories. On the other hand, it is not surprising that the disclosure of information is a relevant factor in the market's perception of security riskiness. However, the use of this approach could be counterproductive if it generates too many false alarms.

5.2 – A statistical test to evaluate the Merton approach

As already stated, the aim of this work is to test statistically the ability of the model to predict the failure or success of a company. To achieve this goal, in this section two sets of information are presented. The first block concerns Type I and Type II errors for several thresholds of default, while the second gives the results of some probit regressions carried out in order to discover if the variable "default probability" has some explicative power and for which kinds of estimates; finally, the section includes the results of a comparison between a hybrid model (including the physical default probability as regressor) and a naive model, composed of just balance sheet and ratio indicators.

In statistics, the calculation of Type I and Type II errors is commonly carried out to extrapolate the abilities of a model to fit the actual world. The null hypothesis is when the model fits the empirical evidence correctly, and would lead us to assume that the KMV-Merton approach can always forecast all defaults and non-defaults perfectly.

Table 11

The Type I error (or false positive or alpha error) is the percentage of events signalled by the model as "non-default", even though in the real world default occurred. The Type II error (or false positive or beta error) expresses the percentage of events signalled as "default", even though no failure was declared. Naturally, of the two errors the former is more important, due to the high costs of bankruptcy, the second error not generating default costs. Table 11 shows the results for the whole sample, consisting of all defaulters (10 defaulting issuers) and the control group (160 surviving issuers), for each year of the sample data. As expected, for a lower default threshold the Type I error increases with the threshold's level, in contrast with the Type II error.

Because of the fact that all default events occurred over two years (2003/2004), after the new economy bubble burst, the Type I error can be calculated only for this period. Another problem concerns the low number of observations for the default event (10 issuers in default). Thus, the test for this error is not highly significant. However, the high level of errors reveals the inability of the model to predict the default events for whatever reason. On the contrary, the information regarding Type II errors should be reliable (160 issuers), and indeed the percentage of false negative signals is between 10% and 16% for a threshold of 20%, which is the default point (boundary) assumed by the major rating agencies.

The second step is to check the explicative power of the default probability estimates with regard to the real world. To this end, some probit regressions were carried out in order to discover whether the independent variable "default probability" (DP) fits the empirical data. The dependent variable is a dummy taking a value of "1" in the case of default, "0" otherwise. The results of the regressions are presented in Tables 12a-12b-12c and concern several estimates for DP according to the different kinds of equity volatility estimated. The three tables are relative to the three different time spans used for the estimation of equity volatility: 40, 260 and 520 business days (bd) previous to the evaluation date. Of course, different "windows" involve different weights for the historical data and so different default probabilities. For example, the DP estimated in 40 bd expresses a content of more recent information than DP 520 bd. However, all probabilities (40, 260 and 520 bd) are highly volatile in the short and long term, and in order to reduce this intensive volatility some averages have been calculated. Thus, for each of the three classes of DP, the 1-year, 2-year, 3-year and 5-year averages have been extrapolated for a time span previous to each evaluation date.

Further, to test the ability of the model to forecast events, the different variables, with their relative averages, were lagged for 1, 2, 3, and 5 periods (years). If the DP is a good predictor, the lagged variables should forecast default events at least one period in advance.

Thus, each row of each table expresses the main results of a probit regression between the dependent variable described above and a specific DP variable (recorded at the end of year, 1-year, 2-year, 3-year and 5-year averages). The outputs of the regressions concern the coefficient ($\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$) respectively of the intercept and the independent variable DP, standard errors, *t*-tests with *p*-values, the logarithm of the likelihood (*LL*)[5] and the pseudo R^2.[6]

At a glance, the results suggest non-reliability of DP in predicting the success or failure of a company in advance. The DP estimated in the previous 40 bd seems to perform better than the other estimates (DP 260 and DP 520 bd). R-square clearly indicateds a major explicative power. Thus, the recent information is relevant for predicting corporate default and a long-term forecast seems similar to a bet on an unpredictable event.

Some averages (3-year or 5-year), created in order to reduce the high volatility of the DP estimates, show a good significance of the coefficient by proofing major information content, although the r-square is not very high as for DP 40 bd recorded at the end of the year. On the other hand, the failure may come as a surprise to the general market, while for insiders it is the result of more and/or less recent events and this information could be better summarised in averages.

The results of the regressions with lagged variables confirm the previous result of non-ability of the model; in fact, the significance of the coefficients and r-square is lower with respect to the non-lagged variables.

Table 12a

Table 12b

Table 12c

Table 13

The last set of results, reported in Table 13, concern some probit regressions on several hybrid and naive models. All 15 models highlight significant estimates of the parameters, but not all exhibit the same explicative power as regards the actual data. Models (1) and (6) are hybrid in that they provide balance sheet and market variables as regressors; all the other models are naive. The last four columns of Table 13 present models with variables lagged for one or two years. The naive models show better performance than the hybrid models. In fact, on observing the pairs of models (1)-(2) and (5)-(6), the explicative contribution of the physical default probability variable is seen to be rather low. All other regressors, except for TL/TA, reveal a good explicative power; in particular, the CASH/TL, SALES GROWTH and NUMBER OF EMPLOYEES fit the real world singularly well, even better than the physical default probability variable, models (8), (9) and (10). Surprisingly, the singular variable TL/TA is not significant in predicting failure (these results are omitted in Table 13) even though the results change to positive if one considers other variables together, as in models (3) and (4). The gross domestic product of Italy, included as a control regressor for taking the possible contagion effect into account, is not strongly relevant, as is revealed by models (7) and (8).

On the basis of the naive models' greater ability to fit real data than the KMV-Merton approach, the last four columns, models (12), (13), (14) and (15), explore the capacities of naive models to predict

a failure. All variables, except for SALES GROWTH, have been lagged for one or two periods in the probit regression. The results indicate a persistent explicative power, higher than those expressed by the lagged default probabilities (comparing Tables 12a and 13).
Finally, the results of various tests on the sample of 170 Italian issuers confirm the superiority of naive models compared to the KMV-Merton approach.
In an attempt to interpret and/or explain these results, it could be argued that market information does not offer any advantage in the prediction of a failure over the informative content provided by issuers' financial statements; indeed, market information generally seems to distort the balance sheet value, confusing investors.
Another explanation could be found in the structural characteristics of the sample (and therefore the target market); in fact, the Italian stock exchange is unrepresentative of the national economy and suffers from a smaller number of issuers than other European exchanges. Thus, the results of this test could strengthen the argument for the structural inefficiency of the Italian stock market.

6 – Conclusions.

This work presents a test of the KMV-Merton approach for a sample of firms listed on the Italian stock market, from January 1992 to December 2004. The test concerns the ability of this approach to predict failure. For each issuer, market data and balance sheet information have been collected. The analysis highlights a high level of credit risk (physical default probability average between 1.25%-1.76% — non investment grade) for a pooled sample of issuers, especially over the last year of the panel period.
Some tests of default probability behaviour confirm other available evidence; for example, credit risk level depends on market factors (interest rates, market prices) and specific factors (industry, leverage, asset volatility). Furthermore, the default probability level is inversely influenced by the economic cycle. Because of a consistent default threshold (20% for the major rating agencies - if default probability is equal to or higher than 20%, the issuer is considered insolvent), default probability is conditioned by the procyclical effect. As a result banks might perceive a high risk of default in a recession context, which could in turn give rise to credit rationing. New directions for future research could include a non-consistent default threshold.
The general analysis of the panel reveals some specific patterns for the “default probability” (DP) variable in function of the breadth of the time range used for estimating equity volatility (three windows: last 40, 260 or 520 business days). In some specific years and industries, the probability of failure increases or decreases with an increasing time span. As regards the time factor, decreasing

DP while increasing the estimation range is generally associated with high levels of default probability, indicating an economic recession or downturn, however, an investors' average preference for liquidity. In some industries, increasing the size of time range used, the DP is associated with low levels of probability when compared with others, signalling reliable debtors.

The analysis of a subpanel of the issuers rated by Standard & Poor's clarifies any mismatching between the S&P ratings and those calculated on the basis of default probability estimation. 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 the literature. However, some companies show a high financial leverage and it is quite normal that the market assesses these expectations negatively. In the panel of defaulters, some insolvencies (particularly that of Parmalat) were very unexpected in the financial market; these events have a common factor in a high rate of accounting and financial fraud, suggesting some legal and/or specific variables as predictors. Some issuers reveal a high level of credit risk as of at least 6 months or one year before default occurs. These arguments could induce us to believe that in some cases market prices 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 hypotheses concerning market efficiency and asymmetric information could be explored.

The main aim of this paper concerns the ability of the Merton model (KMV approach) to predict corporate default. The final step presents a test of the model, in line with past and more recent literature. The test contemplates several probit regressions in order to investigate the ability of the model to predict default, and which types of equity volatility estimation are more useful to this aim.

The results point out a greater likelihood when more recent information is used. Equity volatility estimated over a time range close to the default event seems to better reflect a high risk of bankruptcy. Considering a wider time span, equity volatility gives less weight to recent data.

The different averages of default probability, calculated to reduce the high volatility of the probability of failure, do not reveal a significant predictive power, although the 3-year and 5-year averages have a good significance but a lower r-square. Likewise, the lagged default probabilities (including the averages) do not reveal a substantial ability of the KMV-Merton model to forecast the failure of a company. This work suggests that the approach can be used as a tool for monitoring the credit risk over the short term, while it does not give reliable guarantees of prediction in the long term.

In the last part of the work, some probit regressions on naive models have been considered in order to explore their prediction capacity, and the results demonstrate the superiority of naive models with respect to the KMV-Merton approach. It could be argued that market information does not offer any advantage over information available from issuers' financial statements in the prediction of a failure. Another explanation could be the structural characteristics of the sample analyzed, and the results of this test could lend weight to a hypothesis concerning the structural inefficiency of the Italian stock market.

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Table 1 – Statistics for the variables of panel *A*, composed of 170 firms listed on the Italian Stock Exchange, over the period 1992-2004, including number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis and sum for each variable of the sample. The equity volatilities have been estimated on three different windows (last 40, 260 and 520 business days). The equity beta has been estimated on the last 260 business days, as has cost of equity. All market or balance sheet information is expressed in millions of Euros. The FTSE Italy gives statistics for the effective daily returns of the Italian FTSE index (previously the MIB All Share index) in the panel period. The free risk rate is the Italian Libor 12-month rate. Data sources: Thomson-Reuters Datastream and Bloomberg.

	Obs N.	Min	max	average	median	Standard deviation	25° percentile	75° percentile	skewness	kurtosis	Sum
Equity	342075	1.03	1.287e+005	1513.2	159.6	6404.3	64.69	472.46	7.868	76.535	5.3479e+008
σ_E 40 bd	342075	0.0036736	7.4034	0.38042	0.3227	0.31621	0.24254	0.43363	9.7794	161.19	1.3013e+005
σ_E 260 bd	342075	0.0057117	3.7538	0.42046	0.36363	0.26704	0.29736	0.46165	5.3324	43.966	1.2947e+005
σ_E 520 bd	342075	0.0059904	2.8213	0.43682	0.38108	0.24712	0.31669	0.47001	4.4453	30.075	1.1584e+005
β_E	342075	2.8151e-006	6.1901	1.4096	1.2836	0.86365	0.80799	1.83	1.1053	4.8426	4.1907e+005
k_E	342075	0.019334	0.66516	0.19142	0.17751	0.089217	0.12601	0.24063	0.89036	4.0064	56909
Total Liabilities	342075	0.672	87142	1836.3	192.62	7684.6	62.158	693.47	6.5433	50.717	7.6511e+008
Current Liabilities	342075	0.578	39793	931.04	126.77	3710.8	39.849	430.51	6.3891	46.927	3.8867e+008
Cash	342075	0.008	11087	227.98	29.429	946.56	6.991	104.09	7.6438	67.301	9.4993e+007
Sales	342075	0	61240	1619.2	221.52	6167.8	72.41	774.98	6.3981	47.141	6.7551e+008
Total Dividend	342075	0	3440.9	55.689	1.8447	294.04	0	8.4969	7.348	60.744	1.9661e+007
Employees	342075	2	3.0324e+005	7085.3	1246	25528	382	3226	7.1096	61.1	2.9096e+009
R_M – FTSE Italy	342075	-0.036812	0.026996	0.00012482	8.7462e-005	0.0053705	-0.0026513	0.0029964	-0.42776	6.1794	77.537
Risk-free rate	342075	0.019249	0.18375	0.06768	0.053125	0.037504	0.034662	0.10312	0.46786	1.9539	42053

Table 2 – The subpanel *B* is composed of all issuers in panel *A* (170 firms listed on the Italian Stock Exchange in the period 1992-2004) with a Standard & Poor's rating, recorded at December of 2004. Parmalat's rating is relative to October 2004. Data source: Standard and Poor's.

Panel B – Issuers	S&P rating
Acea	A^+
Aem	A
ASM Brescia	A^+
Autostrade	A
Edison	BBB^+
Enel	A^+
Eni	AA
Fiat	BB^-
L'Espresso	BBB^-
IT Holding	B^+
Lottomatica	BBB
Reno de Medici	B^+
Parmalat	BBB^+
Seat Pagine Gialle	BB^-
STMicroelectronics	A^-
Telecom Italia	BBB^+

Table 3 –Subpanel *C* contains the issuers from panel *A* (170 firms listed on the Italian Stock Exchange in the period 1992-2004) which defaulted in the sample period. All events are concentrated in two years (2003-2004) after the new economy bubble burst. Data source: Bloomberg.

Panel C – Issuers	Defaulted	suspended	delisted
Cirio Finanziaria	08/01/2003		03/08/2004
Giacomelli Sport Group	10/14/2003		05/21/2004
Opengate Group	11/05/2003		12/09/2003
Necchi	12/01/2003	11/28/2003	
Parmalat	12/27/2003	12/23/2003	
Arquati	01/14/2004	11/20/2003	
Gandalf	02/19/2004		03/29/2004
Tecnodiffusione	09/24/2004	01/29/2004	
Olcese	10/19/2004	09/23/2004	
Finmatica	12/09/2004	07/29/2004	

Table 4a – Statistics for the risk-neutral (first row for each year) and physical (second row for each year) probabilities of default (calculated on the last 40 business days) for the years of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Year	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
1992	50	12972	0	1	0.013387	1.0145e-005	0.069067	1.0442e-011	0.0022504	11.369	154.46	173.66	22.076	4.729e-106
			0	1	0.010231	8.0242e-007	0.066818	2.1716e-013	0.00073262	12.498	177.97	132.72	17.44	2.4204e-067
1993	51	12985	0	1	0.015801	7.7585e-005	0.089462	3.6639e-008	0.0027916	9.0961	91.905	205.18	20.126	9.7195e-089
			0	1	0.01351	1.3916e-005	0.08751	3.4992e-009	0.00094646	9.503	99.115	175.43	17.592	1.7669e-068
1994	51	13216	0	0.99993	0.016443	9.8537e-005	0.07977	3.2559e-007	0.0019837	8.1121	80.072	217.31	23.696	1.3243e-121
			0	0.99993	0.013939	1.9874e-005	0.076962	3.7304e-008	0.00068755	8.662	89.384	184.21	20.82	9.3035e-095
1995	55	13733	0	0.9853	0.020131	3.0209e-006	0.12138	1.281e-009	0.00037739	6.8759	49.92	276.45	19.435	5.0922e-083
			0	0.98433	0.019039	4.3508e-007	0.11988	1.0857e-010	0.00012649	6.9563	51.023	261.46	18.611	2.2723e-076
1996	65	16209	0	0.99994	0.022255	2.058e-006	0.10096	1.027e-010	0.00078366	7.1643	61.328	360.73	28.064	2.9354e-169
			0	0.99994	0.021019	4.3151e-007	0.099917	1.5461e-011	0.00030698	7.341	63.759	340.69	26.782	1.1975e-154
1997	74	18105	0	0.99959	0.011987	7.851e-006	0.083625	7.4928e-010	0.0007192	10.038	108.78	217.02	19.287	4.6307e-082
			0	0.99957	0.011053	2.4525e-006	0.082775	1.2638e-010	0.00032446	10.225	112.25	200.11	17.967	1.4824e-071
1998	85	20608	0	0.9953	0.016718	0.00014343	0.082936	5.5639e-007	0.0032291	7.9107	72.432	344.53	28.938	1.6157e-180
			0	0.9953	0.014539	4.6589e-005	0.080749	1.2053e-007	0.0015633	8.1987	77.305	299.63	25.848	5.2082e-145
1999	103	24244	0	0.37944	0.0045503	2.4785e-006	0.028266	1.8759e-009	0.00018609	9.656	104.81	110.32	25.065	6.5668e-137
			0	0.37944	0.0039172	5.8808e-007	0.026873	2.0266e-010	7.0166e-005	10.14	115.15	94.968	22.696	7.3545e-113
2000	135	30219	0	0.94625	0.013373	3.9527e-006	0.069436	1.8646e-010	0.00067709	8.3379	83.388	404.11	33.48	2.4823e-241
			0	0.94625	0.012121	1.2779e-006	0.067662	2.4388e-011	0.00038557	8.6578	88.999	366.27	31.14	1.4154e-209
2001	154	38342	0	0.97117	0.016166	7.215e-006	0.071953	1.0268e-009	0.001808	7.8921	77.559	619.82	43.992	0
			0	0.96455	0.012366	1.5569e-006	0.065565	9.8768e-011	0.00072482	9.0874	99.557	474.12	36.93	2.168e-293
2002	160	41383	0	0.95486	0.015855	2.2344e-005	0.071501	3.6139e-009	0.0018911	7.8271	75.543	656.14	45.11	0
			0	0.94553	0.012333	4.0116e-006	0.065458	2.2898e-010	0.0006135	8.7674	91.974	510.38	38.328	7.164e-316
2003	163	41936	0	0.99969	0.015649	3.0864e-007	0.091342	2.6299e-012	0.00024698	8.2537	77.051	656.24	35.083	8.7556e-266
			0	0.99969	0.013866	3.2257e-008	0.08839	9.5313e-014	6.2803e-005	8.6658	84.356	581.49	32.125	1.0236e-223
2004	158	41403	0	0.9995	0.013876	1.118e-010	0.083547	0	7.767e-006	7.7637	69.026	574.51	33.795	5.3777e-247
			0	0.9995	0.012652	2.3836e-012	0.080583	0	7.0705e-007	8.0683	74.336	523.83	31.947	2.9175e-221
Total	170	336078	0	1	0.014473	2.995e-006	0.079301	6.7455e-011	0.00070925	8.7037	88.786	4864.2	105.81	0
			0	1	0.01252	5.6278e-007	0.076412	4.8478e-012	0.0002682	9.2285	98.482	4207.6	94.984	0

Table 4b – Statistics for the risk-neutral (first row for each year) and physical (second row for each year) probabilities of default (calculated on the last 260 business days) for the years of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Year	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
1992	50	12891	0	0.10233	0.0031759	7.1622e-006	0.011325	1.4096e-010	0.00046963	5.1498	31.761	40.94	31.838	3.325e-214
			0	0.08147	0.0021707	6.4052e-007	0.0097732	3.4503e-012	8.473e-005	6.0094	40.114	27.982	25.218	5.2209e-137
1993	51	13022	0	0.98442	0.011776	0.00029707	0.055646	2.7544e-006	0.004651	14.113	234.45	153.35	24.15	4.328e-126
			0	0.98421	0.0089223	7.6584e-005	0.054279	4.2609e-007	0.0018879	15.257	261.86	116.19	18.758	1.7468e-077
1994	51	13098	0	0.98169	0.026636	0.00018509	0.13209	4.8392e-006	0.0020827	6.587	46.491	348.88	23.079	1.5085e-115
			0	0.98169	0.023844	3.8812e-005	0.13105	8.4204e-007	0.0009797	6.7628	48.435	312.3	20.823	9.1127e-095
1995	55	13369	0	0.63872	0.023005	9.372e-005	0.0968	1.6248e-006	0.0010093	5.143	29.246	307.56	27.479	9.3558e-162
			0	0.60208	0.020412	1.7312e-005	0.090342	3.0044e-007	0.00060313	5.2419	30.3	272.89	26.125	8.9274e-147
1996	65	14518	0	0.95298	0.052886	1.2849e-005	0.16866	3.4377e-008	0.0027893	3.7074	16.77	767.79	37.781	4.9411e-298
			0	0.95234	0.049795	3.9201e-006	0.16341	1.116e-008	0.0011796	3.863	18.233	722.92	36.716	2.677e-282
1997	74	16567	0	0.97469	0.024555	4.2836e-005	0.11611	4.3835e-008	0.002006	6.2756	44.499	406.81	27.221	1.1638e-159
			0	0.97469	0.02345	9.1741e-006	0.11523	8.5896e-009	0.00096175	6.3527	45.404	388.5	26.193	3.2396e-148
1998	85	18671	0	0.95412	0.020255	0.00017154	0.090008	7.6635e-007	0.0020897	6.9785	56.292	378.18	30.749	1.392e-202
			0	0.95412	0.017993	5.0608e-005	0.088378	1.1848e-007	0.00087337	7.3488	60.902	335.94	27.818	6.4889e-167
1999	103	21443	0	0.69568	0.0099917	0.00015995	0.065072	3.5728e-006	0.0019887	9.6036	96.869	214.25	22.485	1.1175e-110
			0	0.69568	0.0087135	5.8192e-005	0.064697	1.025e-006	0.00080592	9.7885	99.585	186.84	19.722	8.0171e-086
2000	135	24975	0	0.54029	0.0087653	5.9501e-005	0.045376	1.0983e-006	0.00083555	8.4712	81.645	218.91	30.527	5.5575e-201
			0	0.49697	0.0068024	2.3176e-005	0.040831	3.2247e-007	0.00044858	9.22	93.333	169.89	26.329	1.0221e-150
2001	154	31365	0	0.58749	0.01027	1.5855e-005	0.042287	3.9605e-008	0.00065398	6.9861	67.014	322.11	43.01	0
			0	0.54733	0.0065431	2.5545e-006	0.032201	4.6804e-009	0.000146	8.8859	108.74	205.22	35.986	6.2151e-278
2002	160	38777	0	0.6115	0.016061	0.00019682	0.061087	1.3966e-006	0.0044034	6.1075	45.258	622.78	51.772	0
			0	0.54724	0.011157	4.6426e-005	0.050635	2.7516e-007	0.0014911	6.8107	55.064	432.63	43.389	0
2003	163	40718	0	0.90109	0.020632	8.5196e-005	0.095125	2.466e-007	0.0032106	7.0675	56.746	840.11	43.767	0
			0	0.90109	0.017242	2.3655e-005	0.091864	4.2992e-008	0.0010427	7.5907	63.897	702.04	37.873	1.6969e-308
2004	158	41074	0	0.88936	0.021178	9.9623e-008	0.10407	8.4044e-014	0.0002789	6.4698	46.702	869.88	41.244	0
			0	0.88936	0.018749	8.3789e-009	0.10043	1.6653e-015	5.5375e-005	6.8298	51.571	770.09	37.835	6.1402e-308
Total	170	300586	0	0.98442	0.01827	4.7903e-005	0.088775	9.3504e-008	0.0016343	7.4121	63.911	5491.7	112.83	0
			0	0.98421	0.015448	1.1164e-005	0.085109	1.5186e-008	0.00057273	7.9726	72.846	4643.6	99.516	0

Table 4c – Statistics for the risk-neutral (first row for each year) and physical (second row for each year) probabilities of default (calculated on the last 520 business days) for the years of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Year	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
1992	50	200	0	0.059134	0.0032122	5.2931e-005	0.0091985	1.4531e-006	0.0016079	4.7462	27.56	0.64243	4.9385	1.6636e-006
			0	0.044548	0.0020239	1.2259e-005	0.0070113	7.7029e-008	0.00055151	4.8988	28.029	0.40478	4.0823	6.4556e-005
1993	51	13050	0	0.89605	0.0068998	5.7433e-005	0.045535	1.0918e-006	0.002812	17.383	327.12	90.043	17.31	2.1712e-066
			0	0.89514	0.0052817	1.2009e-005	0.045045	1.692e-007	0.00086609	18.013	343.44	68.926	13.395	1.2042e-040
1994	51	13000	0	0.89261	0.024419	0.00017003	0.12474	9.9322e-006	0.003789	6.5397	44.863	317.45	22.321	2.4834e-108
			0	0.89261	0.021745	4.8448e-005	0.12426	1.7737e-006	0.0014149	6.6594	46.067	282.68	19.953	2.8606e-087
1995	55	13098	0	0.87538	0.029814	0.0001636	0.12469	1.3743e-005	0.0022174	5.5377	34.956	390.51	27.364	2.2675e-160
			0	0.87538	0.026982	5.1659e-005	0.12119	3.5625e-006	0.0013362	5.7925	37.858	353.41	25.481	8.001e-140
1996	65	13741	0	0.83751	0.046653	7.8039e-005	0.13678	1.0928e-006	0.0038939	3.8417	19.381	641.06	39.983	0
			0	0.8353	0.042664	2.8273e-005	0.13112	2.681e-007	0.0022582	4.1675	22.576	586.25	38.141	1.1796e-302
1997	74	14474	0	0.9165	0.04658	6.9968e-005	0.15478	1.9455e-007	0.0024604	4.0784	19.809	674.19	36.205	7.6002e-275
			0	0.9165	0.044675	1.7287e-005	0.15212	4.4183e-008	0.0014576	4.1668	20.601	646.63	35.332	2.239e-262
1998	85	16572	0	0.87101	0.02283	8.8796e-005	0.10498	5.8612e-007	0.0022362	6.3545	44.092	378.35	27.996	1.4896e-168
			0	0.86507	0.020784	2.7932e-005	0.10372	1.1212e-007	0.000817	6.525	45.78	344.43	25.796	6.7463e-144
1999	103	18900	2.8866e-015	0.76872	0.016416	0.00031748	0.072222	9.3446e-006	0.0028982	6.3066	44.98	310.27	31.249	4.6492e-209
			1.1102e-016	0.76076	0.014805	0.0001137	0.07082	2.3414e-006	0.0012066	6.3972	45.884	279.82	28.74	8.0158e-178
2000	135	21407	0	0.44364	0.0087785	0.0001316	0.046928	2.8749e-006	0.0012886	7.6	63.109	187.92	27.369	3.9344e-162
			0	0.44364	0.0076284	5.7763e-005	0.045159	8.2925e-007	0.00081998	7.9744	69.443	163.3	24.716	5.3039e-133
2001	154	24823	0	0.51805	0.0099961	6.7489e-005	0.050334	1.0534e-006	0.00084162	7.3818	61.336	248.13	31.289	8.1425e-211
			0	0.48768	0.0071789	1.8051e-005	0.043079	2.2512e-007	0.00029233	8.4625	79.135	178.2	26.255	6.9433e-150
2002	160	31051	0	0.47995	0.012792	0.00017394	0.044039	2.143e-006	0.0027141	5.5038	39.662	397.19	51.183	0
			0	0.44411	0.0082613	4.5454e-005	0.033803	4.8216e-007	0.00082324	6.915	62.452	256.52	43.065	0
2003	163	37966	0	0.73059	0.020063	0.00019014	0.078719	1.9509e-006	0.0044963	6.2091	46.538	761.73	49.661	0
			0	0.73059	0.016059	6.4605e-005	0.073862	4.4729e-007	0.0014894	6.9733	57.453	609.71	42.365	0
2004	158	39575	0	0.72582	0.022741	1.5741e-005	0.099809	4.081e-009	0.0012646	5.4759	33.44	899.98	45.326	0
			0	0.7044	0.019709	2.8814e-006	0.094597	4.2122e-010	0.0003759	5.7445	36.482	779.97	41.447	0
Total	170	257857	0	0.9165	0.020544	0.00011263	0.091289	9.4402e-007	0.0022582	6.5487	50.592	5297.5	114.28	0
			0	0.9165	0.017646	3.08e-005	0.08765	1.8915e-007	0.00086392	7.0146	57.204	4550.3	102.23	0

Table 5a – Statistics for the risk-neutral (first row for each industry) and physical (second row for each industry) probabilities of default (calculated on the last 40 business days) for the nine industries in panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Industry	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Basic	25	58466	0	0.99999	0.013411	2.2009e-005	0.075669	4.8962e-009	0.0013159	9.3087	101.69	851.34	44.655	0
			0	0.99999	0.011484	5.2125e-006	0.073188	6.0922e-010	0.00056083	9.8555	112.52	728.99	39.534	0
Cyclical consumer goods	23	52710	0	0.85485	0.0058174	6.7933e-006	0.038378	5.9235e-009	0.00049265	14.538	252.32	336.08	36.434	2.2703e-287
			0	0.83909	0.0044675	1.3502e-006	0.035501	5.6355e-010	0.00019069	16.037	299.21	258.09	30.247	2.0619e-199
Cyclical services	41	60392	0	0.99994	0.021736	3.5077e-006	0.094799	1.3431e-011	0.001584	6.6798	53.71	1496.4	60.161	0
			0	0.99994	0.019028	5.486e-007	0.09098	6.0196e-013	0.00068352	7.1131	60.183	1310	54.877	0
General	22	39991	0	0.99969	0.011552	2.1905e-007	0.072826	1.5867e-012	0.0001681	9.6007	106.1	513.92	33.457	2.1004e-242
			0	0.99969	0.010402	5.7201e-008	0.071053	1.7414e-013	6.6436e-005	9.925	112.29	462.75	30.878	3.7174e-207
Technology	25	28215	0	0.99462	0.027239	1.3371e-005	0.10756	8.2219e-010	0.0032853	6.0463	43.967	912.23	46.343	0
			0	0.99393	0.022951	1.5343e-006	0.10231	1.8854e-011	0.00098025	6.5478	50.411	768.63	41.053	0
Non cyclical consumer goods	12	26853	0	1	0.017526	6.3146e-006	0.10154	1.9814e-011	0.00073068	8.3312	76.468	511.76	29.494	2.0292e-188
			0	1	0.016181	1.4765e-006	0.10069	1.5539e-012	0.00029714	8.5191	79.201	472.49	27.46	6.4304e-164
Non cyclical services	4	7964	0	0.84921	0.019214	1.5777e-007	0.096946	1.6653e-015	0.0012283	6.8872	52.601	174.25	18.874	5.7292e-078
			0	0.82288	0.015929	1.823e-008	0.091906	0	0.00030554	7.2587	57.298	144.46	16.505	2.5387e-060
Oil and resources	3	7129	0	0.089947	0.0015806	7.0822e-007	0.0076252	4.9367e-010	9.4524e-005	6.7526	54.139	12.311	18.294	3.1207e-073
			0	0.11844	0.0013943	1.2266e-007	0.0087745	3.8989e-011	3.0005e-005	9.0301	92.771	10.86	14.024	3.794e-044
Utilities	15	18866	0	0.59497	0.0025472	6.4517e-010	0.028091	1.1102e-016	4.4669e-006	17.866	350.79	55.902	13.433	5.5949e-041
			0	0.59497	0.0023361	6.7512e-011	0.027748	0	1.3605e-006	18.325	366.47	51.268	12.472	1.3996e-035
Total	170	336078	0	1	0.014473	2.995e-006	0.079301	6.7455e-011	0.00070925	8.7037	88.786	4864.2	105.81	0
			0	1	0.01252	5.6278e-007	0.076412	4.8478e-012	0.0002682	9.2285	98.482	4207.6	94.984	0

Table 5b – Statistics for the risk-neutral (first row for each industry) and physical (second row for each industry) probabilities of default (calculated on the last 260 business days) for the nine industries of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Industry	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Basic	25	58466	0	0.98442	0.018366	0.00016722	0.094231	1.599e-006	0.002405	7.5515	64.608	1073.8	47.127	0
			0	0.98421	0.015964	4.6106e-005	0.090504	3.4672e-007	0.00099275	7.9233	71.393	933.35	42.65	0
Cyclical consumer goods	23	52710	0	0.28811	0.00408	4.2888e-005	0.021236	7.0177e-007	0.00072845	9.7832	112.81	215.06	44.111	0
			0	0.23254	0.0026794	1.0192e-005	0.016804	1.0923e-007	0.00023384	10.545	125.64	141.23	36.606	9.9121e-290
Cyclical services	41	60392	0	0.96009	0.026726	0.00011807	0.10541	1.3492e-007	0.0044821	6.023	42.937	1614	62.307	0
			0	0.95933	0.022993	2.999e-005	0.10293	2.0322e-008	0.0016095	6.4115	47.421	1388.6	54.894	0
General	22	39991	0	0.90109	0.01447	2.7829e-006	0.080277	2.5391e-009	0.00069034	8.9776	92.239	578.65	36.045	5.1444e-280
			0	0.90109	0.012719	6.3155e-007	0.078569	4.8135e-010	0.00022231	9.4896	100.68	508.63	32.372	5.9527e-227
Technology	25	28215	0	0.66951	0.036523	0.00038527	0.10549	1.0355e-006	0.012789	3.9532	19.067	1030.5	58.157	0
			0	0.61499	0.027794	7.9137e-005	0.091529	8.0378e-008	0.0039278	4.3391	22.322	784.21	51.007	0
Non cyclical consumer goods	12	26853	0	0.97469	0.029386	8.8966e-005	0.13962	1.261e-007	0.00088179	5.3328	30.732	789.09	34.489	4.2785e-255
			0	0.97469	0.028349	1.9278e-005	0.13924	3.5209e-008	0.0003877	5.3522	30.909	761.27	33.363	3.563e-239
Non cyclical services	4	7964	0	0.32323	0.022538	2.7364e-005	0.053729	7.8024e-011	0.018347	3.1564	13.091	179.49	37.434	1.1645e-282
			0	0.29923	0.014922	4.2405e-006	0.039856	2.3567e-012	0.0050105	3.4007	15.009	118.84	33.412	3.5137e-229
Oil and resources	3	7129	0	0.0051407	0.00022556	8.3775e-006	0.00056108	1.1418e-008	0.00018253	4.603	28.722	1.608	33.943	3.1512e-234
			0	0.0019925	7.7785e-005	1.6602e-006	0.00020251	1.6611e-009	4.4093e-005	4.5402	28.464	0.55453	32.431	2.4683e-215
Utilities	15	18886	0	0.061829	0.00050626	1.0554e-007	0.0034091	1.8224e-011	2.1199e-005	14.087	233.36	9.551	20.397	1.7099e-091
			0	0.040499	0.00036722	2.1213e-008	0.0023325	2.2489e-012	6.0485e-006	12.05	178.57	6.928	21.624	1.8551e-102
Total	170	300586	0	0.98442	0.01827	4.7903e-005	0.088775	9.3504e-008	0.0016343	7.4121	63.911	5491.7	112.83	0
			0	0.98421	0.015448	1.1164e-005	0.085109	1.5186e-008	0.00057273	7.9726	72.846	4643.6	99.516	0

Table 5c – Statistics for the risk-neutral (first row for each industry) and physical (second row for each industry) probabilities of default (calculated on the last 520 business days) for the nine industries of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Industry	Issuers	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Basic	25	52237	0	0.89605	0.023091	0.0002261	0.10318	1.2019e-005	0.0033034	6.4254	48.392	1206.6	51.157	0
			0	0.89514	0.020332	7.3026e-005	0.09949	2.7499e-006	0.0013849	6.8526	54.591	1062.5	46.718	0
Cyclical consumer goods	23	46731	0	0.17217	0.003175	0.00010303	0.014212	5.4144e-006	0.00075419	7.3541	61.546	148.37	48.293	0
			0	0.17217	0.0019645	2.8478e-005	0.010239	9.1159e-007	0.00027338	7.9873	73.073	91.805	41.477	0
Cyclical services	41	50273	0	0.87101	0.030416	0.00025138	0.11028	1.0248e-006	0.0077249	5.3215	33.953	1529.1	61.838	0
			0	0.86507	0.026749	7.9352e-005	0.10813	1.8706e-007	0.0026674	5.5348	36.125	1344.7	55.467	0
General	22	34362	0	0.73059	0.018332	6.3318e-006	0.089521	2.9915e-008	0.00084243	6.9045	52.442	629.92	37.96	6.6181e-309
			0	0.73059	0.016304	1.6645e-006	0.086251	7.0318e-009	0.00044709	7.1573	55.385	560.25	35.041	2.4382e-264
Technology	25	21975	3.3307e-015	0.51805	0.039892	0.0012526	0.097081	1.2901e-005	0.013771	2.9081	10.782	876.63	60.914	0
			0	0.48768	0.030295	0.00026713	0.081368	2.0192e-006	0.0068647	3.2542	13.312	665.72	55.192	0
Non cyclical consumer goods	12	23833	0	0.9165	0.032075	0.00011712	0.13618	2.9486e-006	0.0011127	4.6461	23.783	764.43	36.361	8.596e-282
			0	0.9165	0.031112	2.9828e-005	0.13512	6.8811e-007	0.00050032	4.6733	24.077	741.49	35.547	9.9766e-270
Non cyclical services	4	6669	0	0.14752	0.020143	0.00086973	0.03313	1.9306e-009	0.032563	2.1536	7.2979	134.33	49.651	0
			0	0.13342	0.01176	0.00017321	0.024633	1.0308e-010	0.01124	3.0766	12.487	78.431	38.988	1.0193e-299
Oil and resources	3	6349	0	0.0040634	0.00020064	1.6911e-005	0.00048294	5.6571e-008	0.00013915	3.7104	18.371	1.2739	33.104	7.8987e-222
			0	0.0013823	6.6478e-005	3.1843e-006	0.00016404	6.8953e-009	4.4286e-005	3.7219	18.235	0.42207	32.291	6.0608e-212
Utilities	15	15408	0	0.053276	0.00043825	6.4849e-007	0.0030639	1.4326e-009	4.9982e-005	15.171	252.03	6.7525	17.755	7.8312e-070
			0	0.041566	0.00031754	1.97e-007	0.0023866	3.23e-010	1.3366e-005	14.92	245.26	4.8927	16.515	9.451e-061
Total	170	257857	0	0.9165	0.020544	0.00011263	0.091289	9.4402e-007	0.0022582	6.5487	50.592	5297.5	114.28	0
			0	0.9165	0.017646	3.08e-005	0.08765	1.8915e-007	0.00086392	7.0146	57.204	4550.3	102.23	0

Table 6a – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 40 business days) for five leverage classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Leverage (40 bd)	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Lev ≤ 20%	26211	0	0.99999	0.017609	6.47e-012	0.11965	0	1.0701e-006	7.5915	60.416	736.22	30.093	7.5968e-197
		0	0.99999	0.017117	9.0683e-013	0.11881	0	2.7216e-007	7.6805	61.634	715.68	29.459	8.3079e-189
20% < Lev ≤ 40%	68870	0	0.99758	0.0090717	8.4372e-009	0.067774	1.1102e-014	2.1736e-005	10.321	119.51	812.55	40.06	0
		0	0.99677	0.0081265	9.5997e-010	0.065564	4.4409e-016	6.0465e-006	10.748	128.54	727.89	37.095	6.3808e-299
40% < Lev ≤ 60%	86789	0	1	0.0099701	3.1339e-006	0.059528	8.03e-010	0.00038132	9.6196	109.64	963.53	52.067	0
		0	1	0.0084668	6.0231e-007	0.056319	7.3632e-011	0.00014112	10.152	120.38	818.25	46.736	0
60% < Lev ≤ 80%	72599	0	1	0.018008	0.00016651	0.078532	1.0428e-006	0.0037873	7.7155	73.114	1352.5	62.842	0
		0	1	0.014904	4.8524e-005	0.074558	1.4357e-007	0.0017812	8.4118	85.014	1119.4	54.782	0
80% < Lev ≤ 100%	32507	0	0.97104	0.030332	0.0018275	0.092788	6.172e-005	0.015737	5.2318	34.51	999.42	59.337	0
		0	0.9707	0.02508	0.00065086	0.087661	1.0753e-005	0.0084383	5.6231	39.213	826.39	51.934	0

Table 6b – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 260 business days) for five leverage classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Leverage (260 bd)	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Lev ≤ 20%	25849	0	0.97469	0.021244	9.9085e-010	0.12053	1.0297e-014	8.0692e-007	5.8204	36.05	702.43	32.05	5.4895e-222
		0	0.97469	0.020381	1.0328e-010	0.11774	5.5511e-016	1.172e-007	5.9017	37.27	673.89	31.477	2.5982e-214
20% < Lev ≤ 40%	70035	0	0.95845	0.015024	6.0049e-007	0.099026	3.8526e-010	8.9363e-005	7.7739	64.803	1163.9	42.229	0
		0	0.95834	0.013795	1.155e-007	0.097024	3.4218e-011	2.0268e-005	8.039	69.038	1068.7	39.573	0
40% < Lev ≤ 60%	86338	0	0.97334	0.0076826	4.6847e-005	0.048274	5.8912e-007	0.00072038	13.365	222.15	679.02	47.313	0
		0	0.97334	0.0056615	1.1947e-005	0.0444	1.0294e-007	0.0002482	15.896	298.36	500.39	37.908	6.1211e-312
60% < Lev ≤ 80%	69794	0	0.97916	0.025438	0.00062451	0.091434	4.5355e-005	0.0083177	6.3379	51.222	1780.1	73.595	0
		0	0.97916	0.02059	0.00020363	0.085851	9.6052e-006	0.0036692	7.0741	62.535	1440.9	63.445	0
80% < Lev ≤ 100%	31835	8.8818e-016	0.98442	0.036803	0.0040416	0.099294	0.00051468	0.019109	4.6636	29.045	1166.3	65.982	0
		8.8818e-016	0.98421	0.030286	0.0015431	0.094238	0.00013184	0.0094826	5.1041	34.078	959.77	57.211	0

Table 6c – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 520 business days) for five leverage classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

Leverage (520 bd)	Obs.	min	max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
Lev ≤ 20%	20667	0	0.88398	0.02023	2.6256e-009	0.10806	1.702e-013	5.2492e-007	5.6564	35.011	516.08	29.902	3.9618e-193
		0	0.88379	0.01949	3.692e-010	0.10586	8.6875e-015	1.1088e-007	5.7639	36.416	497.22	29.407	5.9599e-187
20% < Lev ≤ 40%	62386	0	0.9165	0.0096365	1.7181e-006	0.05994	5.2393e-009	8.2704e-005	8.2232	82.588	620.13	40.783	0
		0	0.9165	0.0083884	3.8969e-007	0.056721	7.7656e-010	1.9364e-005	8.8373	96.508	539.81	37.516	1.0112e-304
40% < Lev ≤ 60%	77220	0	0.84258	0.013689	0.00012736	0.082756	6.6511e-006	0.00090759	8.0464	69.157	1060.9	46.05	0
		0	0.83206	0.011852	4.0802e-005	0.080089	1.1989e-006	0.00038938	8.3604	73.812	918.5	41.197	0
60% < Lev ≤ 80%	62250	0	0.87101	0.027867	0.00088234	0.095962	9.9607e-005	0.010776	5.9296	44.014	1735.3	72.466	0
		0	0.86507	0.02293	0.00033748	0.091024	2.7194e-005	0.0052603	6.5728	52.62	1427.9	62.863	0
80% < Lev ≤ 100%	28225	2.3219e-009	0.89605	0.048363	0.0048269	0.1303	0.0007742	0.022133	4.3982	25.063	1365.1	62.358	0
		1.3202e-009	0.89514	0.041341	0.0016787	0.12616	0.00021522	0.010478	4.7747	28.758	1166.8	55.05	0

Table 7a – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 40 business days) for four asset volatility classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

asset volatility (40 bd)	Obs.	min	Max	average	median	St. Dev.	25° prc.	75° prc.	skewness	kurtosis	sum	t stat	p-value
$\sigma_A \leq 20\%$	218470	0	1	0.0044429	5.1923e-007	0.028099	2.4925e-012	0.0002737	18.036	473.3	970.65	73.906	0
		0	1	0.00328	7.6061e-008	0.026081	1.1779e-013	8.7162e-005	21.251	622.06	716.58	58.783	0
$20\% < \sigma_A \leq 40\%$	92038	0	1	0.010386	9.0185e-006	0.050682	1.4629e-009	0.00093621	9.2557	115.25	955.9	62.169	0
		0	1	0.0082594	2.2822e-006	0.046359	1.5567e-010	0.0003907	10.537	147.87	760.18	54.05	0
$40\% < \sigma_A \leq 60\%$	16534	0	0.7563	0.030116	0.0004137	0.081993	2.6932e-006	0.015099	4.3088	24.823	497.93	47.229	0
		0	0.75154	0.024734	0.00020761	0.075395	6.3349e-007	0.0088886	4.7568	29.386	408.95	42.183	0
$\sigma_A > 60\%$	9036	2.6856e-012	0.99999	0.27	0.099097	0.32864	0.0043417	0.46581	1.0145	2.6212	2439.7	78.095	0
		2.6856e-012	0.99999	0.25696	0.074815	0.32583	0.0023361	0.43663	1.0848	2.7709	2321.9	74.965	0

Table 7b – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 260 business days) for four asset volatility classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

asset volatility (260 bd)	**Obs.**	**min**	**Max**	**average**	**median**	**St. Dev.**	**25° prc.**	**75° prc.**	**skewness**	**kurtosis**	**sum**	**t stat**	**p-value**
$\sigma_A \leq 20\%$	173858	0	0.7549	0.0055031	4.6197e-005	0.024052	7.7874e-008	0.0011224	10.193	153.79	956.76	95.399	0
		0	0.67891	0.0037967	1.0525e-005	0.020965	1.2364e-008	0.00040455	11.932	199.78	660.09	75.51	0
$20\% < \sigma_A \leq 40\%$	102865	0	0.70273	0.01133	1.8483e-005	0.048366	3.5533e-008	0.0011496	7.3498	70.787	1165.4	75.131	0
		0	0.67306	0.0085615	4.2343e-006	0.042261	6.3861e-009	0.0003803	8.7021	98.218	880.67	64.974	0
$40\% < \sigma_A \leq 60\%$	17451	0	0.69214	0.046151	0.00048847	0.11678	2.0735e-006	0.01462	3.2003	13.262	805.38	52.207	0
		0	0.66907	0.038136	9.9274e-005	0.10905	2.9094e-007	0.0063589	3.6018	16.119	665.52	46.2	0
$\sigma_A > 60\%$	6412	2.4807e-009	0.98442	0.3999	0.41086	0.35523	0.033085	0.68101	0.22961	1.4702	2564.2	90.144	0
		8.3653e-010	0.98421	0.38011	0.32852	0.35754	0.012814	0.68014	0.32132	1.5291	2437.3	85.131	0

Table 7c – Statistics for the risk-neutral (first row for each class) and physical (second row for each class) probabilities of default (calculated on the last 520 business days) for four asset volatility classes of panel *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each year the table gives the number of issuers, number of daily observations, minimum, maximum, average, median, standard deviation, 25° and 75° percentiles, skewness, kurtosis, sum, *t* Student (null hypothesis: average equal to zero) with the own *p*-value. The probabilities have been calculated on the basis of market data and the KMV-Merton approach. Data sources: Thomson-Reuters Datastream and Bloomberg.

asset volatility (520 bd)	**Obs.**	**min**	**Max**	**average**	**median**	**St. Dev.**	**25° prc.**	**75° prc.**	**skewness**	**kurtosis**	**sum**	**t stat**	**p-value**
$\sigma_A \leq 20\%$	142222	0	0.85561	0.0075346	0.00015508	0.031392	3.661e-006	0.0020684	8.7583	109.97	1071.6	90.515	0
		0	0.85561	0.0053454	4.8493e-005	0.027056	7.1161e-007	0.00080697	10.28	154.6	760.23	74.509	0
$20\% < \sigma_A \leq 40\%$	96616	0	0.89605	0.01271	2.7042e-005	0.054246	7.314e-008	0.000993	6.5793	57.924	1228	72.83	0
		0	0.89514	0.010014	6.4325e-006	0.048484	1.1061e-008	0.0003819	7.4917	76.145	967.55	64.202	0
$40\% < \sigma_A \leq 60\%$	12475	0	0.89003	0.026681	0.00021663	0.082047	5.7759e-007	0.0071626	4.9882	33.886	332.84	36.321	1.1539e-274
		0	0.89003	0.021797	4.8465e-005	0.076832	3.7462e-008	0.0028211	5.481	40.759	271.92	31.686	5.3111e-212
$\sigma_A > 60\%$	6544	8.9144e-010	0.9165	0.40724	0.40838	0.31065	0.054064	0.71018	0.052679	1.6157	2665	106.05	0
		2.8094e-010	0.9165	0.38976	0.37851	0.3134	0.038504	0.69002	0.14581	1.5941	2550.6	100.61	0

Table 8a – Results for the analysis of variance (ANOVA) for the risk neutral probabilities of default (estimated on three different equity volatility windows: 40, 260 and 520 business days) of panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The analysis provides an equality test of the averages for the following factors: issuer, year and industry, leverage and asset volatility classes. Data sources: Thomson-Reuters Datastream and Bloomberg.

ANOVA – risk neutral probability of default							
Factors			Sum of Squares	Degrees of freedom	Mean Square	F	p-value
Issuer	Groups	40 bd	229.61	169	1.3586	235.69	0
		260 bd	579.99	169	3.4319	576.15	0
		520 bd	847.24	164	5.1661	1022.8	0
	Error		1874.5	3.2519e+005	0.0057645		
			1788.9	3.0032e+005	0.0059566		
			1301.6	2.5769e+005	0.0050512		
	Total		2104.1	3.2535e+005			
			2368.9	3.0049e+005			
			2148.9	2.5786e+005			
Time (years)	Groups		4.3764	12	0.3647	56.508	0
			29.324	12	2.4437	313.85	0
			31.188	12	2.599	316.45	0
	Error		2099.8	3.2534e+005	0.006454		
			2339.5	3.0048e+005	0.0077861		
			2117.7	2.5784e+005	0.0082131		
	Total		2104.1	3.2535e+005			
			2368.9	3.0049e+005			
			2148.9	2.5786e+005			
Industry	Groups		18.579	8	2.3224	362.3	0
			36.652	8	4.5815	590.27	0
			39.757	8	4.9696	607.55	0
	Error		2085.6	3.2535e+005	0.0064103		
			2332.2	3.0048e+005	0.0077617		
			2109.1	2.5785e+005	0.0081797		
	Total		2104.1	3.2535e+005			
			2368.9	3.0049e+005			
			2148.9	2.5786e+005			
Leverage	Groups		14.999	4	3.7497	583.95	0
			25.512	4	6.378	817.84	0
			36.483	4	9.1207	1113.3	0
	Error		2089.1	3.2535e+005	0.0064212		
			2343.4	3.0048e+005	0.0077986		
			2112.4	2.5785e+005	0.0081923		
	Total		2104.1	3.2535e+005			
			2368.9	3.0049e+005			
			2148.9	2.5786e+005			
Asset Volatility	Groups		612.07	3	204.02	44488	0
			980.69	3	326.9	70760	0
			1009	3	336.35	76087	0
	Error		1492.1	3.2535e+005	0.004586		
			1388.2	3.0048e+005	0.0046198		
			1139.8	2.5785e+005	0.0044205		
	Total		2104.1	3.2535e+005			
			2368.9	3.0049e+005			
			2148.9	2.5786e+005			

Table 8b – Results for the analysis of variance (ANOVA) for the physical probabilities of default (estimated on three different equity volatility windows: 40, 260 and 520 business days) of panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The analysis provides an equality test of the averages for the following factors: issuer, year and industry, leverage and asset volatility classes. Data sources: Thomson-Reuters Datastream and Bloomberg.

ANOVA – physical probability of default							
Factors			Sum of Squares	Degrees of freedom	Mean Square	F	p-value
Issuer	Groups	40 bd	195.09	169	1.1544	213.72	0
		260 bd	487.3	169	2.8834	512.4	0
		520 bd	738.13	164	4.5008	933.2	0
	Error		1756.4	3.2519e+005	0.0054012		
			1690	3.0032e+005	0.0056273		
			1242.8	2.5769e+005	0.004823		
	Total		1951.5	3.2535e+005			
			2177.3	3.0049e+005			
			1981	2.5786e+005			
Time (years)	Groups		3.8469	12	0.32057	53.55	0
			29.008	12	2.4173	338.1	0
			30.761	12	2.5634	338.92	0
	Error		1947.6	3.2534e+005	0.0059865		
			2148.3	3.0048e+005	0.0071496		
			1950.2	2.5784e+005	0.0075635		
	Total		1951.5	3.2535e+005			
			2177.3	3.0049e+005			
			1981	2.5786e+005			
Industry	Groups		14.156	8	1.7695	297.15	0
			27.096	8	3.387	473.31	0
			30.753	8	3.8442	508.25	0
	Error		1937.3	3.2535e+005	0.0059547		
			2150.2	3.0048e+005	0.0071559		
			1950.2	2.5785e+005	0.0075635		
	Total		1951.5	3.2535e+005			
			2177.3	3.0049e+005			
			1981	2.5786e+005			
Leverage	Groups		10.266	4	2.5664	430.13	0
			18.321	4	4.5802	637.47	0
			25.789	4	6.4473	850.27	0
	Error		1941.2	3.2535e+005	0.0059666		
			2159	3.0048e+005	0.007185		
			1955.2	2.5785e+005	0.0075826		
	Total		1951.5	3.2535e+005			
			2177.3	3.0049e+005			
			1981	2.5786e+005			
Asset Volatility	Groups		557.36	3	185.79	43358	0
			890.12	3	296.71	69265	0
			933.48	3	311.16	76596	0
	Error		1394.1	3.2535e+005	0.004285		
			1287.2	3.0048e+005	0.0042836		
			1047.5	2.5785e+005	0.0040624		
	Total		1951.5	3.2535e+005			
			2177.3	3.0049e+005			
			1981	2.5786e+005			

Table 9 – Comparison between the Standard and Poor's rating and those calculated on the base of the KMV-Merton physical default probabilities (estimated on three different equity volatility windows: 40, 260 and 520 business days) for panel *B*, containing all (14) issuers with a Standard & Poor's rating at December 2004 (except for Parmalat's rating, relative to October 2004). *B* is a subpanel of *A*, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. Data sources: Thomson-Reuters Datastream and Bloomberg.

Panel B – Issuers	S&P rating	Rating (40bd)	Rating (260bd)	Rating (520bd)
Acea	A^+	A	AAA	AAA
Aem	A	AAA	AAA	AAA
ASM Brescia	A^+	AAA	AAA	AAA
Autostrade	A	B	BB	A
Edison	BBB^+	AAA	AAA	AAA
Enel	A^+	AAA	AAA	AAA
Eni	AA	AAA	AAA	AAA
Fiat	BB^-	BB^-	BBB^-	BBB^+
L'Espresso	BBB^-	BBB^-	AA	AAA
IT Holding	B^+	BB	BBB^-	BBB^+
Lottomatica	BBB	A	AAA	AAA
Reno de Medici	B^+	B	B^+	BB^-
Parmalat	BBB^+	BBB^+	AAA	AAA
Seat Pagine Gialle	BB^-	CC	B^-	NaN
Telecom Italia	BBB^+	CCC	CCC	B^-

Table 10a – Physical probabilities of default for all sample defaulting issuers and grouped in panel *C*, a subpanel of A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The columns show the default probability for each issuer, recorded at fixed instants previous to default and estimated on three different time ranges (40, 260 and 520 business days); next to each probability, a value expressing the percentage of issuers with the greatest default probability at that instant. This variable ought to tend to zero for firms in financial distress. Data source: Thomson-Reuters Datastream and Bloomberg.

Issuer		Default date		- 1 m		- 3 m		- 6 m		- 1 y		- 2 y	
Arquati	40 bd	0	0.69182	0.0032557	0.04321	0.048012	0.055556	0.0016982	0.093168	0.00099517	0.16561	0.0030061	0.097403
	260 bd	0.0031961	0.14194	0.0049558	0.125	0.006694	0.12102	0.01224	0.089172	0.11866	0.026144	0.0058534	0.12766
	520 bd	0.046503	0.047297	0.051778	0.059211	0.059199	0.066667	0.053094	0.067568	0.053019	0.043478	0.0011595	0.18692
Necchi		NaN	NaN	NaN	NaN	0.73581	0.012422	0.43767	0	0.54259	0.0125	0.56827	0.012903
		NaN	NaN	NaN	NaN	0.63961	0.012739	0.23538	0.0064516	0.10778	0.032468	0.50609	0
		NaN	NaN	NaN	NaN	0.6136	0.0066667	0.67175	0.0070922	0.38592	0	0.36684	0.0093458
Olcese		NaN	NaN	0	0.61392	0.00014266	0.11392	0.079545	0.031646	8.5587e-012	0.60494	0.00052585	0.45625
		0.0058377	0.082278	0.006022	0.075949	0.0048638	0.10828	0.0018503	0.15385	6.1276e-007	0.57325	0.00020502	0.42484
		0.0012777	0.17763	0.0016891	0.15132	0.0020558	0.14474	0.0014302	0.2	0.00030435	0.32667	0.00092698	0.32308
Tecnodiffusione		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.44054	0.024845	0.0019183	0.20625
		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.065289	0.050955	0.18709	0.03268
		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.15351	0.04	0.09571	0.039683
Finmatica		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.1851	0.03125
		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0.025618	0.077419
		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Parmalat		0.0012499	0.098765	2.4195e-006	0.23457	0.014736	0.086957	0.0020895	0.10559	0.025328	0.0625	0.49881	0.019481
		0.021664	0.10625	0.025894	0.10127	0.047874	0.063694	0.057252	0.044872	0.021643	0.083333	0.06358	0.042254
		0.022201	0.091503	0.059559	0.046358	0.052237	0.08	0.049857	0.068493	0.037247	0.071429	0.037968	0.064815
Cirio		0.0016783	0.10559	0.0029781	0.080745	0.01542	0.056604	0.014863	0.044304	5.5624e-006	0.31447	0.0026768	0.10204
		0.014884	0.095541	0.012012	0.10256	0.010671	0.10323	0.0069555	0.13072	0.0091704	0.11806	0.092492	0.023622
		0.20176	0.033333	0.017136	0.089041	0.015874	0.092199	0.077539	0.036232	0.054514	0.036697	0.13306	0.020408
Gandalf		NaN	NaN	NaN	NaN	0.019636	0.018519	8.8015e-007	0.23602	0.0014983	0.15	9.4658e-006	0.26115
		NaN	NaN	NaN	NaN	0.01365	0.10828	0.010663	0.10191	0.002678	0.21429	0.00077783	0.23404
		NaN	NaN	NaN	NaN	0.0042962	0.16556	0.0042642	0.2	0.0015041	0.23913	0.0010445	0.18692
Giacomelli		NaN	NaN	0.010012	0.08642	0.0019315	0.086957	0.26459	0.00625	0.0049065	0.28125	0.00085032	0.67742
		NaN	NaN	0.032936	0.089172	0.026229	0.063694	0.02592	0.058065	0.0028749	0.23529	0.12032	0.030769
		NaN	NaN	0.01369	0.11333	0.075244	0.054054	0.061255	0.056738	0.048232	0.054688	0.072917	0.040816
Opengate		1.33e-011	0.54938	0.0048257	0.10494	6.4448e-013	0.59006	0.000732	0.18868	0.080564	0.04375	0.41016	0.019355
		0.001105	0.17834	0.002541	0.16561	0.0060553	0.13376	0.18224	0.019355	0.18439	0.025974	0.040394	0.044444
		0.057468	0.066225	0.083405	0.053333	0.096815	0.046667	0.10393	0.028369	0.12827	0.022556	0.058414	0.048077

Table 10b – Physical probabilities of default for all sample defaulting issuers and grouped in panel *C*, a subpanel of A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. For each issuer, the columns give some statistics (min, max, average and median) for the default probabilities estimated on three different time range (40, 260 and 520 business days). The statistics are calculated on two different time ranges: one (*1y*) and two (*2y*) years previous to company failure. Data sources: Thomson-Reuters Datastream and Bloomberg.

Issuer		min		max		average		median	
		1y	2y	1y	2y	1y	2y	1y	2y
	40 bd	0	0	0.071748	0.54607	0.0092143	0.063501	0.0025578	0.0054441
Arquati	260 bd	0.0026064	0.0026064	0.11869	0.13006	0.042873	0.054699	0.012185	0.040597
	520 bd	0.046503	0.0011595	0.063073	0.063073	0.054449	0.039176	0.053907	0.05022
		0.18459	0	0.73581	0.73581	0.53806	0.42467	0.56007	0.48915
Necchi		0.10778	1.0658e-014	0.71753	0.71753	0.55734	0.41319	0.63144	0.50662
		0.18318	0	0.71454	0.71454	0.53088	0.38055	0.54971	0.438
		0	0	0.1633	0.1633	0.020916	0.010394	0.0010579	2.6149e-006
Olcese		6.6028e-010	6.6028e-010	0.0064132	0.0064132	0.0025108	0.001392	0.0017121	0.00021418
		7.2983e-006	7.2983e-006	0.0022707	0.012423	0.0011138	0.0016941	0.001393	0.0011185
		0	0	0.45695	0.45695	0.20153	0.086222	0.18562	0.020047
Tecnodiffusione		0.064589	0.0060933	0.10332	0.21322	0.08499	0.070357	0.086437	0.068508
		0.04268	0.04268	0.15982	0.15982	0.13114	0.1237	0.14718	0.12302
		NaN	6.8712e-005	NaN	0.73154	NaN	0.18099	NaN	0.011751
Finmatica		NaN	2.5216e-006	NaN	0.70211	NaN	0.17005	NaN	0.032936
		NaN	0.0024823	NaN	0.72959	NaN	0.40623	NaN	0.51729
		1.7509e-006	1.7363e-007	0.26975	0.49919	0.041875	0.075161	0.0045599	0.016928
Parmalat		0.020562	0.020562	0.064079	0.096844	0.04698	0.054427	0.049792	0.05505
		0.022201	0.022201	0.062759	0.062759	0.050349	0.041676	0.049977	0.036836
		4.0383e-006	1.6523e-010	0.7435	0.7435	0.016031	0.026517	0.0059758	0.0046557
Cirio		0.00017514	0.00017514	0.57306	0.57306	0.01369	0.052461	0.010263	0.011538
		0.00026086	0.00026086	0.53448	0.53448	0.060945	0.088548	0.062491	0.072065
		0	0	0.78888	0.78888	0.055009	0.028393	0.0035004	0.0035025
Gandalf		0.0015829	0.00061289	0.66934	0.66934	0.040166	0.019291	0.014799	0.0020693
		0.0002648	0.0002648	0.69977	0.69977	0.025947	0.012626	0.0044944	0.0015564
		5.3805e-008	1.9137e-010	0.29775	0.29775	0.049884	0.026982	0.006021	0.0020968
Giacomelli		0.0027058	0.0015112	0.035585	0.13544	0.016585	0.05061	0.017505	0.030349
		0.012077	0.012077	0.080213	0.080213	0.047998	0.051911	0.047911	0.052488
		4.8184e-014	4.8184e-014	0.09808	0.81402	0.0094334	0.094421	0.0023519	0.0039144
Opengate		0.001105	0.001105	0.20138	0.26555	0.12967	0.1099	0.1797	0.11037
		0.056709	0.015347	0.13521	0.2454	0.10404	0.089661	0.10477	0.10324

Table 11 – Type I and II errors with regard to the KMV-Merton approach for credit risk analysis for panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The errors have been calculated for each year of the sample period and for the whole sample. In this experiment, the model signals default if in a previous time range (1 or 2 years) the issuer showed a default probability higher than a selected threshold. The type I error shows the percentage of real default events the model did not signal; the type II error shows the percentage of real non-default events the model signalled as failures. Data sources: Thomson-Reuters Datastream and Bloomberg.

		5%		10%		15%		20%		30%		40%		50%	
		1y	2y	1y	2y	1y	2y	1y	2y	1y	2y	1y	2y	1y	2y
TYPE I ERROR															
2003	40bd	0	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.6	0.4	0.6	0.4	0.6	0.4
	260 bd	0.2	0	0.4	0.2	0.4	0.4	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6
	520 bd	0	0.2	0.4	0.4	0.6	0.4	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6
2004		0	0	0.2	0	0.2	0	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2
		0.2	0.2	0.4	0.2	0.6	0.4	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6
		0.2	0.2	0.4	0.4	0.6	0.4	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6
All sample		0	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.5	0.3	0.5	0.3	0.5	0.3
		0.2	0.1	0.4	0.2	0.5	0.4	0.5	0.4	0.6	0.6	0.6	0.6	0.6	0.6
		0.1	0.1	0.4	0.4	0.6	0.4	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6
TYPE II ERROR															
1993		0.18367	0.32653	0.12245	0.22449	0.10204	0.18367	0.10204	0.14286	0.061224	0.081633	0.061224	0.081633	0.061224	0.061224
		0.081633	0.10204	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408	0.020408
		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1994		0.2	0.29412	0.16	0.23529	0.12	0.19608	0.1	0.17647	0.08	0.13725	0.04	0.098039	0.02	0.078431
		0.06	0.08	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.02	0.02
		0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
1995		0.12245	0.27451	0.12245	0.2549	0.10204	0.19608	0.081633	0.17647	0.081633	0.15686	0.081633	0.11765	0.081633	0.098039
		0.11765	0.11765	0.098039	0.098039	0.098039	0.098039	0.078431	0.078431	0.078431	0.078431	0.058824	0.058824	0.039216	0.058824
		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.06	0.06	0.02	0.02	0.02	0.02
1996		0.28571	0.32143	0.23214	0.28571	0.16071	0.23214	0.14286	0.19643	0.125	0.17857	0.071429	0.125	0.071429	0.125
		0.16981	0.16981	0.15094	0.15094	0.15094	0.15094	0.15094	0.15094	0.13208	0.13208	0.09434	0.09434	0.075472	0.075472
		0.15385	0.15385	0.15385	0.15385	0.13462	0.13462	0.13462	0.13462	0.096154	0.096154	0.019231	0.038462	0.019231	0.038462
1997		0.12308	0.26154	0.092308	0.24615	0.076923	0.16923	0.061538	0.15385	0.046154	0.13846	0.046154	0.092308	0.046154	0.092308
		0.096774	0.16129	0.064516	0.14516	0.048387	0.12903	0.048387	0.12903	0.048387	0.1129	0.032258	0.080645	0.032258	0.064516
		0.15094	0.15094	0.15094	0.15094	0.13208	0.13208	0.11321	0.13208	0.09434	0.09434	0.037736	0.037736	0.037736	0.037736
1998		0.16216	0.2027	0.12162	0.13514	0.10811	0.10811	0.094595	0.10811	0.094595	0.094595	0.094595	0.094595	0.081081	0.081081
		0.089552	0.10448	0.089552	0.10448	0.074627	0.089552	0.029851	0.044776	0.029851	0.044776	0.029851	0.029851	0.029851	0.029851
		0.1129	0.16129	0.064516	0.12903	0.048387	0.1129	0.032258	0.096774	0.032258	0.080645	0.032258	0.032258	0.032258	0.032258
1999		0.10465	0.2093	0.093023	0.17442	0.046512	0.13953	0.046512	0.12791	0.023256	0.10465	0	0.081395	0	0.069767
		0.065789	0.078947	0.052632	0.078947	0.026316	0.065789	0.026316	0.039474	0.013158	0.026316	0.013158	0.026316	0.013158	0.026316
		0.086957	0.11594	0.028986	0.057971	0.028986	0.043478	0.028986	0.028986	0.028986	0.028986	0.028986	0.028986	0.014493	0.028986
2000		0.23301	0.27184	0.18447	0.20388	0.14563	0.16505	0.1165	0.12621	0.067961	0.07767	0.048544	0.048544	0.029126	0.029126
		0.033333	0.088889	0.022222	0.066667	0.011111	0.033333	0.011111	0.033333	0.011111	0.022222	0.011111	0.022222	0	0.011111
		0.064935	0.090909	0.025974	0.038961	0.025974	0.038961	0.025974	0.038961	0.012987	0.025974	0.012987	0.025974	0	0.012987
2001		0.29104	0.40741	0.19403	0.28889	0.14925	0.21481	0.1194	0.17778	0.074627	0.11852	0.059701	0.096296	0.044776	0.088889
		0.083333	0.11111	0.055556	0.074074	0.037037	0.046296	0.0092593	0.0092593	0.0092593	0.0092593	0.0092593	0.0092593	0.0092593	0.0092593
		0.022472	0.067416	0.011236	0.022472	0.011236	0.022472	0.011236	0.022472	0.011236	0.022472	0.011236	0.022472	0	0
2002		0.22222	0.38312	0.15686	0.25974	0.12418	0.22078	0.11111	0.18831	0.091503	0.13636	0.071895	0.1039	0.052288	0.084416
		0.071429	0.092199	0.071429	0.085106	0.042857	0.056738	0.042857	0.042553	0.021429	0.021277	0.0071429	0.014184	0.0071429	0.014184
		0.066038	0.084112	0.037736	0.056075	0.018868	0.028037	0.009434	0.0093458	0.009434	0.0093458	0.009434	0.0093458	0	0
2003		0.20513	0.34395	0.17308	0.26752	0.13462	0.21656	0.12821	0.19745	0.096154	0.1465	0.076923	0.11465	0.070513	0.095541
		0.098039	0.10458	0.071895	0.091503	0.058824	0.065359	0.045752	0.058824	0.03268	0.045752	0.03268	0.039216	0.03268	0.039216
		0.10145	0.10145	0.057971	0.057971	0.050725	0.050725	0.050725	0.050725	0.043478	0.050725	0.014493	0.021739	0.0072464	0.0072464
2004		0.14557	0.26415	0.12025	0.2327	0.10127	0.19497	0.094937	0.18239	0.075949	0.15094	0.06962	0.13208	0.056962	0.11321
		0.090909	0.10968	0.077922	0.090323	0.058442	0.070968	0.045455	0.051613	0.045455	0.045161	0.038961	0.03871	0.032468	0.032258
		0.054054	0.081081	0.054054	0.060811	0.047297	0.060811	0.033784	0.047297	0.033784	0.040541	0.027027	0.027027	0.02027	0.02027
All sample		0.19594	0.30789	0.15093	0.2386	0.11739	0.19123	0.10327	0.16754	0.07767	0.12807	0.061783	0.10088	0.051192	0.085965
		0.08547	0.10712	0.067426	0.087203	0.052232	0.068255	0.041785	0.053092	0.034188	0.042672	0.02754	0.034138	0.023742	0.030345
		0.076271	0.094191	0.055085	0.066678	0.047669	0.058233	0.041314	0.050838	0.034958	0.042363	0.020127	0.024355	0.013771	0.016949

Table 12a – Results of the probit regressions with the real/physical probabilities of default (40 bd) as single regressors. The dependent variable is a dummy taking a value of 1 if a failure has been recorded (otherwise 0) in panel A composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The table is divided into five blocks (default probabilities recorded at the end of each year and four averages from 1 to 5 years) and each row shows a regression for the variable probability of lagged default. Thus the third row of the second block gives the result for the 1-year average lagged for two years. Regression results cover several different kinds of statistical information, such as the coefficients of regression (β), standard errors (se), t-tests and p-values, log likelihoods or deviance (LL) and the measure pseudo R^2 (McFadden), ***, ** and * point out that the coefficient is significant respectively to 1%, 5% and 10%. Data sources: Thomson-Reuters Datastream and Bloomberg.

	β_1	β_2	se β_1	se β_2	t-test β_1	t-test β_2	p-value 1	p-value 2	LL	R^2
Default probability recorded at the end of the year										
lag = 0	- 3.1517	2.2972	0.3082	0.7457	- 10.2280	3.0807	0.0000	***0.0021	21.20	0.8139
lag = 1	- 2.8892	- 3.1611	0.2248	19.5030	- 12.8550	- 0.1621	0.0000	0.8712	29.07	0.7448
lag = 2	- 2.8539	- 10.3930	0.0229	0.0230	- 124.3600	- 452.7500	-	***-	28.61	0.7488
lag = 3	- 2.8113	- 1.5204	0.2298	11.1390	- 12.2330	- 0.1365	0.0000	0.8914	28.07	0.7535
lag = 5	- 2.6821	- 0.8877	0.2387	7.3184	- 11.2390	- 0.1213	0.0000	0.9035	26.49	0.7674
1-year average default probability										
lag = 0	- 2.9379	4.5849	0.2290	1.8616	- 12.8290	2.4629	0.0000	**0.0138	37.52	0.6705
lag = 1	- 2.7583	0.8515	0.1993	4.0053	- 13.8380	0.2126	0.0000	0.8317	40.79	0.6419
lag = 2	- 2.7855	3.6713	0.2119	2.5638	- 13.1470	1.4320	0.0000	0.1522	38.79	0.6594
lag = 3	- 2.6640	1.3413	0.2049	3.4696	- 13.0020	0.3866	0.0000	0.6991	38.87	0.6587
lag = 5	- 2.5204	0.1588	0.2107	4.4777	- 11.9610	0.0355	0.0000	0.9717	36.78	0.6770
2-year average default probability										
lag = 0	- 2.4752	3.1261	0.1408	2.1340	- 17.5820	1.4649	0.0000	0.1429	91.91	0.1929
lag = 1	- 2.5192	5.0955	0.1584	2.0820	- 15.9010	2.4474	0.0000	**0.0144	77.05	0.3234
lag = 2	- 2.4914	5.7342	0.1630	2.0260	- 15.2890	2.8303	0.0000	***0.0047	73.48	0.3548
lag = 3	- 2.4903	3.3115	0.1753	2.3826	- 14.2080	1.3899	0.0000	0.1646	57.47	0.4954
lag = 5	- 2.4584	3.0649	0.1992	2.4960	- 12.3400	1.2279	0.0000	0.2195	45.23	0.6029
3-year average default probability										
lag = 0	- 2.5495	7.5118	0.1556	1.9156	- 16.3830	3.9214	0.0000	***0.0001	88.88	0.2195
lag = 1	- 2.4138	6.5397	0.1500	2.0805	- 16.0970	3.1433	0.0000	***0.0017	89.96	0.2101
lag = 2	- 2.5158	6.8321	0.1783	2.5505	- 14.1080	2.6787	0.0000	***0.0074	63.31	0.4441
lag = 3	- 2.3774	0.8025	0.1735	4.2963	- 13.7000	0.1868	0.0000	0.8518	57.09	0.4987
lag = 5	- 2.4797	4.5260	0.2068	2.5290	- 11.9930	1.7896	0.0000	*0.0735	43.68	0.6164
5-year average default probability										
lag = 0	- 2.5929	9.1249	0.1855	2.9063	- 13.9760	3.1397	0.0000	***0.0017	62.53	0.4509
lag = 1	- 2.4929	6.0735	0.1840	3.6928	- 13.5460	1.6447	0.0000	*0.1000	56.18	0.5067
lag = 2	- 2.4953	7.3083	0.1887	3.6202	- 13.2230	2.0187	0.0000	**0.0435	54.59	0.5207
lag = 3	- 2.5295	7.1053	0.2096	3.8479	- 12.0700	1.8465	0.0000	*0.0648	44.27	0.6113
lag = 5	- 2.5085	5.7246	0.2341	4.1168	- 10.7160	1.3905	0.0000	0.1644	33.74	0.7037

Table 12b – Results of the probit regressions with the real/physical probabilities of default (260 bd) as single regressors. The dependent variable is a dummy taking a value of 1 if a failure has been recorded (otherwise 0) in panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The table is divided into five blocks (default probabilities recorded at the end of each year and four averages from 1 to 5 years) and each row shows a regression for the variable probability of lagged default. Thus the third row of the second block gives the result for the 1-year average lagged for two years. The result of regressions concern several statistical information as the coefficients of regression (β). standard errors (se). t-tests and p-values. log likelihoods or deviance (LL) and the measure pseudo R^2 (McFadden). ***, ** and * point out that the coefficient is significant respectively at the 1%, 5% and 10%. Data sources: Thomson-Reuters Datastream and Bloomberg.

	β_1	β_2	se β_1	se β_2	t-test β_1	t-test β_2	p-value 1	p-value 2	LL	R^2
Default probability recorded at the end of the year										
lag = 0	- 2.9240	1.9298	0.2256	0.7057	- 12.9610	2.7346	0.0000	***0.0062	36.18	0.6823
lag = 1	- 2.7713	- 0.2002	0.1901	2.6982	- 14.5760	- 0.0742	0.0000	0.9409	41.32	0.6372
lag = 2	- 2.7400	0.8287	0.1965	1.3137	- 13.9470	0.6308	0.0000	0.5282	40.10	0.6479
lag = 3	- 2.6563	- 0.2409	0.1965	2.8661	- 13.5170	- 0.0840	0.0000	0.9330	39.24	0.6555
lag = 5	- 2.5232	- 0.5758	0.2045	3.5186	- 12.3390	- 0.1637	0.0000	0.8700	36.95	0.6756
1-year average default probability										
lag = 0	- 2.8051	1.0269	0.1965	1.2230	- 14.2780	0.8396	0.0000	0.4011	40.90	0.6408
lag = 1	- 2.7281	0.3957	0.1953	1.9161	- 13.9700	0.2065	0.0000	0.8364	40.32	0.6460
lag = 2	- 2.6872	0.4562	0.1975	1.9686	- 13.6070	0.2318	0.0000	0.8167	39.56	0.6526
lag = 3	- 2.6012	- 2.4879	0.2004	9.9118	- 12.9840	- 0.2510	0.0000	0.8018	38.37	0.6631
lag = 5	- 2.4911	- 1.3847	0.2075	5.7299	- 12.0050	- 0.2417	0.0000	0.8091	36.47	0.6798
2-year average default probability										
lag = 0	- 2.4701	1.4524	0.1446	1.2382	- 17.0840	1.1730	0.0000	0.2408	81.49	0.2844
lag = 1	- 2.4062	1.6123	0.1479	1.2397	- 16.2740	1.3005	0.0000	0.1934	78.68	0.3092
lag = 2	- 2.3902	0.8107	0.1553	1.6856	- 15.3880	0.4809	0.0000	0.6306	68.60	0.3977
lag = 3	- 2.4730	- 1.8736	0.1811	6.3753	- 13.6530	- 0.2939	0.0000	0.7688	48.24	0.5764
lag = 5	- 2.4370	1.5914	0.1961	1.3733	- 12.4270	1.1589	0.0000	0.2465	45.18	0.6033
3-year average default probability										
lag = 0	- 2.3855	2.8204	0.1397	1.1370	- 17.0700	2.4806	0.0000	**0.0131	95.11	0.1649
lag = 1	- 2.3080	1.7302	0.1428	1.4241	- 16.1590	1.2149	0.0000	0.2244	86.06	0.2443
lag = 2	- 2.4118	0.1884	0.1676	2.5897	- 14.3880	0.0728	0.0000	0.9420	58.24	0.4886
lag = 3	- 2.3403	- 1.3106	0.1699	4.3881	- 13.7780	- 0.2987	0.0000	0.7652	56.66	0.5025
lag = 5	- 2.4246	1.8709	0.1982	1.5902	- 12.2330	1.1765	0.0000	0.2394	44.79	0.6067
5-year average default probability										
lag = 0	- 2.4642	1.5491	0.1701	2.4566	- 14.4910	0.6306	0.0000	0.5283	58.75	0.4841
lag = 1	- 2.3984	0.8275	0.1709	2.8467	- 14.0310	0.2907	0.0000	0.7713	57.55	0.4947
lag = 2	- 2.4927	2.0866	0.1915	2.3212	- 13.0180	0.8989	0.0000	0.3687	46.97	0.5876
lag = 3	- 2.4491	2.0920	0.1948	2.2666	- 12.5750	0.9230	0.0000	0.3560	45.91	0.5969
lag = 5	- 2.5526	4.2708	0.2440	2.0983	- 10.4600	2.0354	0.0000	**0.0418	32.32	0.7162

Table 12c – Results of the probit regressions with the real/physical probabilities of default (520 bd) as single regressors. The dependent variable is a dummy taking a value of 1 if a failure has been recorded (otherwise 0) in panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. The table is divided into five blocks (default probabilities recorded at the end of each year and four averages from 1 to 5 years) and each row shows a regression for the variable probability of lagged default. Thus the third row of the second block gives the result for the 1-year average lagged for two years. The result of regressions concern several statistical information as the coefficients of regression (β). standard errors (se). t-tests and p-values. log likelihoods or deviance (LL) and the measure pseudo R^2 (McFadden). ***, ** and * point out that the coefficient is significant respectively at the 1%, 5% and 10%. Data sources: Thomson-Reuters Datastream and Bloomberg.

	β_1	**β_2**	**se β_1**	**se β_2**	**t-test β_1**	**t-test β_2**	**p-value 1**	**p-value 2**	**LL**	**R^2**
Default probability recorded at the end of the year										
lag = 0	-2.8642	1.6286	0.2103	0.8331	-13.6200	1.9549	0.0000	*0.0506	39.00	0.6576
lag = 1	-2.7273	0.2838	0.1948	1.7820	-14.0040	0.1593	0.0000	0.8735	40.35	0.6457
lag = 2	-2.6683	0.3726	0.1986	1.6633	-13.4350	0.2240	0.0000	0.8227	39.23	0.6555
lag = 3	-2.5689	-6.7243	0.2044	28.9090	-12.5660	-0.2326	0.0000	0.8161	37.83	0.6678
lag = 5	-2.4510	-1.7779	0.2096	6.9039	-11.6950	-0.2575	0.0000	0.7968	35.79	0.6858
1-year average default probability										
lag = 0	-2.7393	0.6019	0.1972	1.4757	-13.8940	0.4078	0.0000	0.6834	40.29	0.6462
lag = 1	-2.6631	0.0689	0.1983	2.1806	-13.4300	0.0316	0.0000	0.9748	39.29	0.6550
lag = 2	-2.5895	-0.4436	0.2015	3.1275	-12.8530	-0.1418	0.0000	0.8872	38.10	0.6654
lag = 3	-2.5381	-5.2197	0.2049	19.0840	-12.3900	-0.2735	0.0000	0.7845	37.30	0.6725
lag = 5	-2.4604	0.3396	0.2137	1.6097	-11.5150	0.2110	0.0000	0.8329	35.61	0.6873
2-year average default probability										
lag = 0	-2.3955	1.0194	0.1460	1.0832	-16.4040	0.9411	0.0000	0.3467	79.29	0.3037
lag = 1	-2.3629	0.5569	0.1563	1.4113	-15.1140	0.3946	0.0000	0.6931	67.85	0.4043
lag = 2	-2.4208	-0.7795	0.1844	3.3203	-13.1310	-0.2348	0.0000	0.8144	47.04	0.5870
lag = 3	-2.3873	-1.5032	0.1861	4.8866	-12.8290	-0.3076	0.0000	0.7584	46.35	0.5930
lag = 5	-2.3623	0.9845	0.1967	1.2279	-12.0130	0.8017	0.0000	0.4227	44.38	0.6103
3-year average default probability										
lag = 0	-2.3002	1.1775	0.1412	1.2374	-16.2960	0.9515	0.0000	0.3413	86.58	0.2398
lag = 1	-2.3794	-0.1669	0.1683	2.4371	-14.1380	-0.0685	0.0000	0.9454	57.51	0.4950
lag = 2	-2.3079	-1.0029	0.1714	3.4657	-13.4650	-0.2894	0.0000	0.7723	55.77	0.5103
lag = 3	-2.3431	-0.1165	0.1913	2.3652	-12.2480	-0.0493	0.0000	0.9607	45.21	0.6030
lag = 5	-2.3648	1.3950	0.1993	1.3484	-11.8630	1.0345	0.0000	0.3009	43.90	0.6145
5-year average default probability										
lag = 0	-2.3949	0.3446	0.1690	2.6241	-14.1680	0.1313	0.0000	0.8955	57.70	0.4933
lag = 1	-2.4305	0.5879	0.1879	2.5475	-12.9370	0.2308	0.0000	0.8175	46.81	0.5890
lag = 2	-2.3903	1.0633	0.1930	2.1455	-12.3860	0.4956	0.0000	0.6202	45.52	0.6003
lag = 3	-2.3524	1.4317	0.1983	1.9137	-11.8650	0.7481	0.0000	0.4544	44.21	0.6118
lag = 5	-2.4803	4.0524	0.2590	1.7659	-9.5752	2.2948	0.0000	**0.0217	29.43	0.7416

Table 13 – Results of several probit regressions with 15 different (single or multi-factor) models. The dependent variable is a dummy taking a value of 1 if a failure has been recorded (otherwise 0) in panel A, composed of the 170 firms listed on the Italian Stock Exchange in the period 1992-2004. Each column represents a specific model with a (the) particular regressor(s), which are physical default probability (PDP 40bd end year) recorded at the end of each year and estimated on last 40 business days of stock price, the total liabilities to total asset ratio (TL/TA), cash to total liabilities ratio (CASH/TL), sales growth, number of employees and the Italian gross domestic product (Italy GDP). With regard to the predicting failure ability of a model, the last four columns show the result for four models with variables lagged for one or two periods. For each model, the table show the estimates of parameters with its own t-test p-values. Each parameter estimated is significant to a level of 1%, while one, indicated with an asterisk (*), is significant to 5%. The table is divided into five blocks (default probabilities recorded at the end of each year and four averages from 1 to 5 years) and each row shows a regression for the variable probability of lagged default. Thus the third row of second block shows the result for the 1-year average lagged for two years. At the bottom of the table, the last two rows give the log likelihoods (LL) or deviance and the measure of a pseudo R^2 (McFadden). Data sources: Thomson-Reuters Datastream and Bloomberg.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12) Lag = 1	(13) Lag = 2	(14) Lag = 1	(15) Lag = 2
COSTANT	-6.9272	-6.7123	-7.2615	-4.4913		-5.7996	-6.7564	-2.9922	-3.0411	-3.28	-3.1032	-7.8215	-6.6317	-7.0684	-6.6081
	0	0	0	0		0	0	0	1.5104e-024	5.3864e-018	2.4662e-015	0	0	0	0
PDP 40bd end year	-8.8347					-6.9708									
	0					0									
TL/TA	1.7623	1.5809	1.8771	2.1037								1.5141	0.10017		
	0	0	0	0								0	0.0092873		
CASH/TL	-0.57942	-0.6193			-5.8584	-0.40612			-0.49023		-0.39686	0.0041455	-1.1659	-0.34432	-1.2085
	0	0			0	0			0		6.4595e-296	0	0	0	0
SALES GROWTH	-1.1179	-1.1197			-0.40069	-1.0812				-1.3506	-1.2853				
	0	0			0	0				0.031901	0.043117*				
NUMBER OF EMPLOYEES	-6.8814e-005	-7.8433e-005	-4.053e-005	-5.0747e-005	-1.0754	-8.191e-005	-3.5061e-005	-5.2896e-005			-3.1696e-005	-4.8043e-005	-3.5647e-005	-4.0775e-005	-3.2948e-005
	0	0	0	0	0	0	0	0			1.4356e-110	0	0	0	0
ITALY GDP	2.1147e-006	2.0379e-006	2.3249e-006		-8.1025e-005	2.247e-006	2.9127e-006					3.1465e-006	3.2109e-006	3.3869e-006	3.2352e-006
	0	0	0		0	0	0					0	0	0	0
LL – deviance	10.232	10.466	12.516	13.323	11.558	11.442	14.368	15.348	15.696	13.166	12.433	13.176	13.367	13.745	13.371
McFadden R^2	0.91349	0.91151	0.89417	0.88735	0.90227	0.90325	0.87573	0.86725	0.86424	0.88613	0.89247	0.88603	0.88438	0.88112	0.88435

[1] For an exhaustive presentation of the main points regarding structural models, see Lando (2004), who explains the majority of the refinements of Merton's methodology.

[2] The model presented is similar to those proposed in Merton (1974), Bohn (2002) and Crouhy (2000).

[3] In this work beta has been estimated on the last year of observation with respect to the valuation date. The market risk premium is constant and equal to 10%, in accordance with common practice.

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

[5] Specifically, this output is defined as a deviance or a generalization of the residual sum of squares. Generally, it is used to compare several models with a different number of terms.

[6] In these analyses this statistic is the McFadden pseudo r-square.