SOX, Corporate Transparency, and the Cost of Debt

Sandro C. Andrade
University of Miami

Gennaro Bernile
University of Miami and SEC

Frederick M. Hood
Virginia Tech

First version: August 11, 2008.
This version: September 03, 2008.*

Abstract

We propose a new market-based measure of corporate transparency calibrated from a popular model of Credit Default Swaps (CDS) pricing. Less transparent firms according to this measure tend to have lower S&P Transparency and Disclosure ratings, and lower KLD or ISS corporate governance ratings. We use the measure to investigate the impact of the Sarbanes-Oxley (SOX) Act on corporate transparency and the cost of debt. Our tests show that corporate opaqueness and the cost of debt decrease significantly after SOX. Specifically, the typical firm in our sample experiences a 19bp reduction on its five-year CDS spread as a result of lower opaqueness following SOX, amounting to total annual savings of $ 1.65 billion for all firms in our sample. Furthermore, the reduction of opaqueness tends to be stronger for firms that were more opaque before SOX.

Keywords: Corporate transparency, Sarbanes-Oxley, CDS pricing

JEL number: G12

*We are grateful to Jeff Bohn, Vidhi Chhaochharia, Gregg Jarrell, Andy Leone and DJ Nanda. All errors are ours alone. E-mail addresses: sca@miami.edu, gbernile@miami.edu and fhood@vt.edu.

1 Introduction

The effect of corporate transparency on securities markets is a key topic for researchers, market participants, and regulators. Although for different purposes, all share the need to measure corporate transparency in a consistent and reliable manner. Current measures of transparency use either linear regressions involving financial statement variables (see Jones 1991 and Dechow, Sloan and Sweeney 1995), linear regressions involving equity returns and financial statement variables (see Berger, Chen and Li 2006), or scores relying on expert judgment (see Botosan 1997 and Francis, Nanda and Olsson 2008). We propose an alternative measure of corporate transparency derived from the price level of debt contracts (not changes in levels).

Recently, Ball, Robin and Sadka (2008) provide evidence that the demand for timely and reliable financial reports arises primarily in debt markets rather than equity markets. This is because debt covenants are based on financial ratios calculated from balance-sheet or income statements, and a violation of a covenanted ratio triggers additional contractual rights to debt holders.

Similarly, topical research in finance underscores the importance of corporate transparency for the pricing of debt-related contracts. In their influential work, Duffie and Lando (2001) show that, because of the asymmetric nature of debt payoffs, more opaque corporations pay higher interest rates on debt even when lenders are risk-neutral. Interestingly, this theory can rationalize non-negligible short term credit spreads for investment grade corporations, a robust empirical phenomenon that is hard to explain in a full information framework[1].

Our main goal in this paper is to propose an opaqueness measure that has a simple economic interpretation and can be easily estimated from market prices of debt contracts. A formal model of debt pricing is necessary to extract such a measure. Thus, we rely on the CreditGrades model, which delivers a simple, analytical debt pricing formula. The model, jointly developed by Goldman Sachs, JP Morgan and Deutsche Bank, has become a popular debt pricing tool amongst practitioners. Attesting to the popularity of the model, Yu (2006) and Duarte, Longstaff and Yu (2007), among others, use the CreditGrades model in recent academic studies. In contrast to models of debt pricing under full information, the CreditGrades model explicitly incorporates a parameter representing uncertainty about the true level of a firm's liabilities. The logic underlying this extension is that the level of liabilities

[1] Other theoretical models of debt pricing under incomplete information include Giesecke (2006) and Andrade, Bernile and Lyandres (2008). Empirical papers studying the impact of information on debt prices include Sengupta (1998), Yu (2005) and Duarte, Young and Yu (2008).

reported on a firm's balance sheet is potentially different from the fixed but unknown level of liabilities that will drive a corporation to default. The firm-period measure of corporate opaqueness we propose is the model's parameter that captures uncertainty about the firm's true financial leverage, after controlling for all the other inputs of standard debt pricing structural models. We calibrate such parameter for each firm-period by minimizing the sum of squared differences between market and model-implied prices.

The enactment of the Sarbanes-Oxley (SOX) Act in July 2002 is arguably one of the most significant regulatory events in US capital markets over the last twenty years. Advocates of the Act claim its main objective was to "rebuild the public's trust in US capital markets", whose well-functioning had been undermined by the deteriorating quality of accounting information (see Jorion, Shi and Zhang 2006) culminating in a series of high-profile accounting scandals (see Healy and Palepu 2003). To that end, Section 302 and 404 of the Act aim to improve the reliability of companies' disclosures by requiring CEOs and CFOs to certify financial statements under the penalty of imprisonment, and requiring firms to implement internal control procedures to ensure the accuracy of the information disclosed.

We focus on this purported benefit of the regulation and use our measure of corporate opaqueness to study the effect of SOX on corporate transparency as perceived by investors and the associated impact on the cost of debt. Admittedly, we do not provide a full cost-benefit analysis of SOX[2]. Rather, we aim to shed light on one particular benefit of SOX that is arguably hard to measure. Our results indicate that, following the enactment of SOX, most firms indeed experience a reduction in their calibrated opaqueness measure. We estimate this increase in corporate transparency reduces the cost of debt by 19 basis points per year for the typical firm in our sample. This is a economically large effect, considering that the risk-free rate and the typical credit spread where respectively 330 and 112 basis points in the period immediately after the passage of the Act. In dollar terms, the reduction in opaqueness translates into total savings of US$ 1.65 billions *per year* for the 252 firms in our sample. To the best of our knowledge, ours is the first estimate of the impact of SOX on the cost of debt.

The rest of the paper is organized as follows. In Section 2, we describe the data, reproduce the CreditGrades debt pricing formula and develop three hypotheses, whose empirical tests are reported in Section 3. First, we show that our measure of corporate transparency is correlated with other proxies of information quality encountered in the literature. Then, we document the reduction in market-implied opaqueness around the enactment of Sarbanes-

[2]See Bushee and Leuz (2005), Jain and Rezaee (2006), Chhaochharia and Grinstein (2007), Zhang (2007), Leuz (2007), Iliev (2007) and Hostak et al. (2008) for analyses of SOX's economic consequences.

Oxley and calculate its economic significance in terms of cost of debt. Finally, we present evidence supporting the conjecture that firms that are more opaque before SOX experience a larger decrease in the calibrated opaqueness parameter. In Section 4 we show our results are robust to sensible variations in our calibration procedure. Moreover, we investigate, and rule out, plausible alternative explanations of our main findings. Section 5 concludes the paper.

2 Data and Methodology

A Credit Default Swap (CDS) is an over-the-counter insurance contract on debt. The buyer and seller of insurance agree on a reference bond and on a notional value for the contract, typically US$ 10 million. The buyer of insurance pays the quoted spread over the contract's notional value to the seller of insurance, typically on a quarterly basis. In return, the seller must pay the contract's notional value to the buyer of insurance in the event of default, and in exchange receive defaulted reference bonds from the latter at their face value, amounting to the notional value of the contract. CDS spreads and bond spreads are closely related theoretically and empirically (see Duffie 1999 and Blanco, Brennan and Marsh 2005), but there are several advantages in using CDS rather than bond spreads in academic research. For example, CDS spreads are quoted directly, as opposed to bond spreads that depend on the choice of a default-free term structure of interest rates. More importantly, the CDS market has become much more liquid than the secondary market for corporate bonds (see Longstaff, Mithal and Neis 2005).

We use four different data sources to estimate corporate opaqueness using the CreditGrades model. The CDS data is from Markit Partners. Markit collects OTC dealer quotes on different tenors of CDS on a daily basis. Until recently, most of the volume in the CDS market was concentrated in 5-year contracts. Since we want liquid market quotes in our model calibration, we focus on the 5-year contract, as do other researchers. Also following the literature, we focus on US dollar denominated senior unsecured CDS contracts with the modified restructuring clause. The Markit database also includes a daily firm-specific estimate of the recovery value on a defaulted bond referenced by the CDS contract, provided by the quoting CDS dealers. We merge the Markit database with daily common stock closing prices from CRSP and balance sheet information from COMPUSTAT, based on the most recent annual statement available to investors at the time the market prices are quoted. Finally, we use the daily 5-year swap rate from the US Treasury website to calculate the risk-free rate.

2.1 CDS pricing formula

The CreditGrades CDS pricing model requires eight inputs: time to expiration T; stock price S; equity volatility σ_S; recovery rate R; risk-free rate r; reported liabilities per equity share D; expected location of the default boundary as fraction of liabilities $\overline{L}$; and a parameter λ representing uncertainty about the location of the default boundary. Formally, λ is the standard deviation of the log of the default boundary as a fraction of liabilities. We interpret λ as a measure of corporate opaqueness: when reported liabilities are less reliable there is more uncertainty about the true level of liabilities that will drive the firm to default. The CreditGrades manual (2002) shows that the CDS spread can be well approximated by the analytical formula below.

$$c(T) = r(1-R)\frac{1-q(0)+H(T)}{q(0)-q(T)e^{-rT}-H(T)}$$

The function $q(\cdot)$ is defined as

$$q(t) = \Phi\left(-\frac{A(t)}{2}+\frac{\ln(d)}{2}\right) - d\Phi\left(-\frac{A(t)}{2}-\frac{\ln(d)}{A(t)}\right),$$

where $\Phi(\cdot)$ is the standard normal c.d.f. and

$$\begin{aligned} d &= \frac{S+\overline{L}D}{\overline{L}D}e^{\lambda^2}; \\ A(t) &= \sqrt{\sigma^2 t+\lambda^2}\,; \\ \sigma &= \sigma_S\frac{S}{S+\overline{L}D}. \end{aligned}$$

Finally,

$$H(T) = e^{r\xi}\left(G(T+\xi)-G(\xi)\right),$$

where

$$G(t) = d^{z+\frac{1}{2}}\Phi\left(-\frac{\ln(d)}{\sigma\sqrt{t}}-z\sigma\sqrt{t}\right) + d^{-z+\frac{1}{2}}\Phi\left(-\frac{\ln(d)}{\sigma\sqrt{t}}+z\sigma\sqrt{t}\right),$$

and

$$\begin{aligned} \xi &= \frac{\lambda^2}{\sigma^2} \\ z &= \sqrt{\frac{1}{4}+\frac{2r}{\sigma^2}}. \end{aligned}$$

Based on market prices, we calibrate a $\widehat{\lambda}$ for each firm-period by minimizing the sum of squared differences between market CDS spreads and model-implied CDS spreads. To compute model spreads given a λ we need the other seven inputs of the CDS pricing formula above. The stock price and the time to expiration (5 years) are directly observable. Following Hull, Predescu and White (2004), we set the risk-free rate as the 5-year swap rate minus 10 basis points. Liabilities per share is equal to adjusted total liabilities (total liabilities minus minority interest minus deferred taxes) divided by number of shares outstanding. The recovery rate is from the Markit database. Equity volatility is the five year forecast from a GARCH(1,1) model fit on the full sample period[3].

The CreditGrades Technical Manual (2002) uses $\overline{L}$= $\frac{1}{2}$ for all firms. However, different industries may have different expected default boundaries due the nature of their businesses. For example, firms with less tangible assets and in more competitive environments may have higher $\overline{L}$'s. We, therefore, calibrate a different $\overline{L}$ for each industry, using the Fama-French 10-industry classification. For each industry we choose $\overline{L}$ to maximize the fraction of time that market CDS spreads are within the range delivered by the CreditGrades model for all possible values of λ. We used $\overline{L}$= $\frac{1}{2}$ as a robustness check. After calibrating $\overline{L}$ for each industry, we have all the seven other inputs of the model, and choose λ for each firm-period to minimize the sum of squared differences between market and model spreads. Appendix A has more details on the CreditGrades model and its calibration.

2.2 SOX and corporate opaqueness

Armed with the measure of corporate opaqueness, we examine the impact of the Sarbanes-Oxley Act on transparency and the cost of debt. In particular, we calibrate a $\widehat{\lambda}$ for each firm before and after SOX. We define the pre-SOX period[4] as January 1^{st} 2001 to July 31^{st} 2002, and the post-SOX period as August 1^{st} 2002 to December 31^{st} 2003. Because our measure of information opaqueness is calibrated from debt price levels rather than changes in price levels, our methodology is arguably less sensitive to small changes in the definition of event windows than event studies based on securities' returns.

To perform the calibration, we require each firm in the sample to have at least 30 CDS quotes in the pre-SOX period *and* 30 CDS quotes in the post-SOX period. We restrict the sample to non-financial firms and main entities, as opposed to subsidiaries. After applying these filters and merging the Markit database with CRSP and COMPUSTAT, there are 252

[3] See pages 471-474 of Hull (2006).

[4] The Markit database starts in January 2001, limiting our flexibility to define the pre-SOX period.

firms in our sample. Table 1 displays the spread and model component statistics for the pre-SOX and post-SOX periods. For each of the statistics, we take the time-series average of each firm and compute statistics based on the averages. In the table, one minus leverage is the stock price divided by the sum of the stock price and liabilities per share. Spreads are in basis points.

TABLE 1

The mean spread is $119.344 - 112.765 = 6.579$ basis points lower in the post-sox period. As the CreditGrade pricing formula shows, the CDS spread is a complex function of the model's eight inputs. Thus, reduced uncertainty about liabilities may not necessarily be the driver of the drop in spreads following SOX. Average leverage increases in the post-SOX period which, holding the other factors constant, should increase spreads. In addition, recovery rates decrease slightly in the post-SOX period which should also cause spreads to increase. However, equity volatility and risk-free rates decrease in the post-SOX period, in turn reducing spreads.

Due to non-linearities in the CDS pricing formula, relying on a linear regression to control for the other drivers of spread changes is not likely to accurately reflect such non-linearities. A distinct advantage of calibrating a structural model is that we can extract an economically meaningful market-implied measure of information uncertainty while accurately controlling for the interactions amongst spread determinants. We can then separate the change in the cost of debt implied by the change of the corporate opaqueness parameter from the effect of changes of all other model inputs.

In the pre-SOX period the mean number of time-series observations is lower than in the post-SOX period and its standard deviation is higher. This is because the number of firms in the Markit database has increased over time: not all 252 firms in our sample were part of the Markit database as of January 1^{st} 2001. However, all had at least 30 observations in the pre-SOX (and in the post-SOX) period.

2.3 Hypotheses

Below we state each hypothesis and articulate the logic behind it. Throughout, corporate opaqueness refers to the uncertainty parameter calibrated from market prices and the CDS pricing model (i.e., $\widehat{\lambda}$).

Hypothesis 1 : *Corporate opaqueness is lower for firms perceived to have more transparent disclosure and better corporate governance.*

This can be seen as external validation of our information opaqueness measure. If our new measure of corporate opaqueness is accurate, it should be inversely related to existing measures of corporate transparency, such as the S&P Transparency and Disclosure Rating of Pattel and Dallas (2002). The S&P rating is a publicly available measure of transparency based on expert judgement[5]. Moreover, our measure of corporate opaqueness should be negatively correlated with measures of corporate governance that attribute a large weight to the disclosure dimension of governance (see Anderson, Mansi and Reeb 2004; and Pittman and Fortin 2004). The KLD and ISS corporate governance ratings are examples of such measures. For the purposes of our analysis, some other measures of corporate governance (e.g., Gompers, Ishii and Metricks 2003) focus too much on anti-taker provisions or shareholders' voice and not enough on disclosure quality[6].

Hypothesis 2 : *Corporate opaqueness decreases after the enactment of* $Sarbanes - Oxley$.

Sections 302 and 404 of the Act aim to curtail insiders' ability and propensity to manipulate the information disclosed to market participants. In particular, Section 302 imposes substantial personal costs on corporate executives for fraudulent misrepresentations and/or omissions in their firms' financial statements. Firms' propensity to hide liabilities like in the Enron, Tyco or Worldcom cases is presumably affected by such provision. On the other hand, Section 404 of the Act is designed to enhance internal controls on financial disclosure and to improve the quality and reliability of external auditors (see Chhaochharia and Grinstein 2007) thus reducing insiders' ability to report unreliable information. Consistent with these objectives, there is evidence indicating that the probability of financial misreporting declines significantly in the post-SOX period (e.g., Lobo and Zhou, 2006; Cohen et al., 2007; Bartov and Cohen, 2007). Therefore, we conjecture that SOX increases the likelihood that publicly reported liabilities accurately reflect the true liabilities of the corporation. In other words, the uncertainty about the location of the default boundary decreases after SOX.

[5] In section 3.3 we also analyze how our corporate opaqueness measure relates to an accruals-based measure of earnings quality.

[6] Cremers, Nair and Wei (2007) report that shareholder control is associated with *higher* credit spreads if the firm is exposed to takeovers.

Hypothesis 3 : *After the enactment of SOX, corporate opaqueness decreases more for firms that are less transparent prior to SOX.*

Firms that are less opaque prior to SOX presumably already have better internal controls and more detailed disclosure before the Act, which makes them less likely to be affected by the enactment of SOX. Consistent with this notion, the evidence reported in Zhang (2007) shows the impact of SOX on equity values varies inversely with the pre-SOX level of firm-specific corporate governance quality. By the same logic, we expect to see a more pronounced decrease in the opaqueness measure for firms that are perceived to be less transparent in the pre-SOX period.

3 Empirical Analysis

We use quoted CDS prices to calibrate our measure of corporate opaqueness in the pre and post-SOX periods for firm in our sample. Figure 1 presents the time-series of the median observed spread and the median model-implied spread, calculated with the calibrated parameters. Model-implied spreads are calculated based on firm-specific parameters calibrated separately in the pre-SOX and post-SOX periods. Overall, model fit is good, and model spreads are not systematically below or above the market spread in either sub-period. Note that there is a pronounced decrease in model spreads at the border between the pre-SOX and the post-SOX periods. This is the first sign that the corporate opaqueness parameter may be smaller in the post-SOX period for the typical firm in our sample.

FIGURE 1

Table 2 presents statistics on the calibrated opaqueness parameters in the pre and post-SOX periods. At each percentile, the post-SOX opaqueness parameter is lower or equal to the pre-SOX one. The mass of calibrated parameters that are equal to zero correspond to corner solutions in the calibration (see Appendix A for details). Market spreads of some firm-periods tend to be lower than the minimum spreads generated by the model for any level of information opaqueness, i.e., when the opaqueness parameter λ is equal to 0. This happens for 26 of the 252 firms in the pre-SOX period and 42 in the post-SOX period. On the other hand, market spreads tend to be larger than the maximum spread generated by the model for some firm-periods, which also generates corner solutions in the calibration. This happens for 44 firms in the pre-SOX period and 21 firms in the post-SOX period.

TABLE 2

Figure 2 displays a quantile-quantile plot of the corporate opaqueness parameters pre and post-SOX. Each dot on the graph represents the average of a bucket based on percentile. The percentiles are determined by sorting the data by the pre and post-SOX opaqueness measure. The 45 degree line on the plot represents no change post-SOX. As the plot shows, the pre-SOX the opaqueness decreases across the entire percentile space[7]. This is evidence that our results are not driven by a very large decrease in post-SOX measures for only a handful of firms. Moreover, the plot indicates a larger decrease in calibrated opaqueness for firms that were more opaque before SOX.

FIGURE 2

Figure 3 suggests that our information corporate opaqueness measure is an intrinsic firm characteristic that tends to persist over time. The scatter plot shows there is a strong positive relationship between a firm's opaqueness measure in the pre-SOX period in its equivalent in the post-SOX period. The correlation between the two is 0.816, while the Spearman rank-correlation is 0.808. Both are statistically significant at 1%.

FIGURE 3

3.1 Testing hypotheses

In this section we discuss results of the empirical analysis we perform to test the three hypotheses presented earlier.

Hypothesis 1: Table 3 compares the calibrated measure of transparency across subsamples obtained by grouping firms according to the quality of their disclosure and governance. The break down of high versus low transparency and better versus worse governance was chosen so that the number of firms in each bin is as similar as possible. The total number of firms is below 252 because not all firms in our sample have transparency or governance ratings by S&P, KLD or ISS.

[7] In fact, this is true for all percentile levels, before averaging quantile percentile buckets. In other words, the empirical distribution of pre-SOX corporate opaqueness first-order stochastically dominates the empirical distribution of post-SOX opaqueness.

The S&P Transparency and Disclosure ratings are available for 189 firms. As shown in the table, the mean (median) measure of corporate opaqueness is higher in the sample of firms classified as having less transparent disclosure. The differences are statistically significant, supporting rejection of the null hypothesis that the mean (median) information opaqueness is the same across firms with high and low disclosure according to S&P. This evidence is consistent with Hypothesis 1 and supports the notion that our opaqueness measure derived from CDS spreads is indeed related firms' disclosure policies.

We are able to match between 227 and 231 firms with governance ratings, depending on rating provider and time period. Sorting firms by governance quality confirms our earlier inference. For the KLD measure, means and medians of the corporate opaqueness measure are higher for lower rated firms, both in the pre and post-SOX periods. Results are confirmed for ISS 2003 ratings: worse governance is associated to higher opaqueness. Altogether, the empirical evidence consistently indicates that the CDS-based measure of opaqueness varies with firms' disclosure and corporate governance quality as predicted by the first Hypothesis.

TABLE 3

Hypothesis 2: Table 4 reports univariate statistics of the corporate opaqueness measure in the pre and post-SOX periods. Based on the test statistics in the table, we can comfortably reject the null hypothesis that the pre and post-SOX measures are drawn from distributions having the same mean or median. The mean (median) opaqueness measure in the pre-SOX period is 0.679 (0.536) and decreases to 0.498 (0.409) following enactment of SOX, a 26% (24%) reduction. The differences in means and medians across sub-periods are significant at a 1% probability level, providing strong statistical support to the hypothesis that distribution of the corporate opaqueness parameter shifts after SOX.

It is, however, harder to judge the economic relevance of this result. Although a one quarter reduction in the opaqueness parameter is arguably rather substantial in and of itself, its economic significance needs to be assessed in light of its effect on the model-implied CDS spreads. In the next section, we provide a more detailed discussion of the economics behind the statistical evidence discussed here.

TABLE 4

Hypothesis 3: Panels A and B of Table 5 report the results of our tests of the third

Hypothesis. Overall, the evidence in the table indicates that the change in the opaqueness measure following SOX depends on the level of transparency prior to the Act.

In particular, Panel A reports mean and median changes in the opaqueness measure for various subsamples obtained by segmenting firms based on their pre-SOX opaqueness measure or S&P disclosure rating. Firms with high opaqueness during the pre-SOX period typically experience a larger reduction of calibrated opaqueness following SOX. Similarly, results held when firms are grouped by the S&P transparency rating. The test statistics for the differences in mean and median changes across subsamples support rejection of the null hypothesis of no difference.

Panel B reports OLS estimates of the relation between changes in the calibrated measure around SOX (i.e. post minus pre) and the level of pre-SOX corporate opaqueness. Consistent with the third Hypothesis, the estimated coefficient is negative and statistically significant at conventional levels, implying that larger reductions of corporate opaqueness are indeed associated with higher pre-Act levels of opaqueness.

TABLE 5

3.2 Economic significance

Did SOX and the associated reduction of information opaqueness cause a large decrease in the cost of debt? To answer this question we compute model-implied spreads in the post-SOX period using the pre-SOX calibrated measures of information opaqueness. For each of the 252 firms we compare the time series of post-SOX model spreads calculated with post-SOX opaqueness with time series of post-SOX model spreads calculated with pre-SOX opaqueness. By keeping all the other seven inputs of the CDS pricing formula unchanged, we are able to calculate the change in model-implied spreads for each firm due exclusively to the reduction of corporate opaqueness. For each firm we compute the time-series median difference in spreads then compute the cross-sectional median. For the typical firm in our sample, SOX reduces CDS spreads by 19 basis points per year. This is a large reduction in the cost of debt, given that the median spread in the post-SOX period is 112.765 basis points. To the best of our knowledge, this is the first basis point estimate of the impact of SOX on the cost of debt.

To put a dollar figure in the reduction of the cost of debt, we obtain the total amount of (interest-bearing) debt for each of the firms in our sample throughout the post-SOX period

from COMPUSTAT. We then multiply the spread difference for each firm in each day by the corresponding level of debt. Taking the median across firms of the time-series median of the product of spread change multiplied by debt, we conclude that the reduction of the cost of debt amounts to 3.5 million dollars per year for the typical firm in our sample. Taking the sum across the 252 firms, we estimate that SOX reduces the cost of debt by 1.65 billion dollars per year for all firms in our sample.

3.3 Earnings quality

In this section we examine whether the measure of corporate opaqueness derived from CDS spreads is related to a widely used measure of accounting information quality. Several studies use discretionary accruals as a firm-specific measure of information opaqueness[8]. Given these studies, one should expect our CDS-based measure of corporate opaqueness to be correlated to firms' earnings quality due to accrual management.

Following Collins and Hribar (2002), we define total accruals as the difference between income before extraordinary items and discontinued operations and operating cash-flows from continuing operations, and estimate discretionary accruals using the Jones (1991) model or the modified-Jones model (Dechow et al., 1995). Following the literature (e.g., DeFond and Subramanyam 1998; Kothari, Leone, and Wasley 2005), we estimate the discretionary accruals models grouping firms by industry (i.e. two-digit SIC code) and year. Furthermore, as recommended by Kothari et al. (2005), we compute performance-matched abnormal accruals for each firm. Similar to Hutton, Marcus, and Tehranian (2008), we use the three-year average absolute performance-matched abnormal accruals as our proxy of earnings quality.

TABLE 6

Panels A and B of Table 6 present OLS estimates of the relation between the corporate opaqueness measure and the accruals-based measures of earnings quality in the pre and post-SOX periods[9]. The opaqueness measure is positively and significantly related to accrual-

[8] A short list includes Defond and Jiambalvo (1994), Rees et al.(1996), Sloan (1996), Teoh, Welch and Wong (1998a, 1998b), Degeorge, Patel and Zeckhauser (1999), Richardson et al.(2001), and Hutton, Marcus, and Tehranian (2008).

[9] In this Section the definition of the post-SOX period is different from the rest of the paper because the accrual-based measure requires an average of 3 years. The post-SOX period here is the calendar year of 2005: the first year for which we only use post-SOX data (financial statements of 2002, 2003 and 2004) when calculating the accrual-based measure.

based earnings quality during the pre-SOX period (Panel A), but not significantly associated to discretionary accruals in the post-SOX period (Panel B). These results support the conjecture that our CDS-based measure captures significant aspects of earnings quality. Furthermore, the evidence is in line with the recent literature. First, the probability of financial misreporting declines significantly in the post-SOX period (e.g., Lobo and Zhou 2006, Cohen et al. 2007, and Bartov and Cohen 2007). Second, a PCAOB-sponsored study by Hranaiova and Byers (2007) shows that restatements' announcements are associated with significantly less negative returns compared to the pre-SOX environment, while Andrade, Bernile, and Hood (2008) document similar patterns in CDS spreads around restatements' announcements. Finally, consistent with the notion that opaqueness associated with earnings management declines following the enactment of SOX, Hutton, Marcus, and Tehranian (2008) find that the predictive power of discretionary accruals disappears in the post-SOX years. Consistent with these studies, and with Cohen, Dey and Lys (2005,2008), our evidence supports the notion that SOX changes the nature of accruals by reducing management discretion.

4 Robustness checks

In this section we perform two kinds of robustness checks. We investigate the effect of changes in our methodology on our results and address the plausibility of alternative explanations of our findings.

4.1 Unique expected default boundary for all firms

In our baseline results we calibrate a different expected default boundary $\overline{L}$ for each industry using Fama and French's 10-industry classification before we calibrate the corporate opaqueness λ for each firm-period. We check whether our results hold if use the CreditGrades Technical Manual (2002) suggestion of $\overline{L}= \frac{1}{2}$ for all firms. Results are on table 7. In Panel A, B and C we check Hypotheses 1, 2 and 3 respectively. In Panel D we re-test the relationship between abnormal accruals and corporate opaqueness.

TABLE 7

Panel A shows that our measures of corporate opaqueness are still in line with alternative proxies of corporate disclosure. The statistical tests on the difference in means and medians

are even stronger here than in Table 3. Moreover, Panel B results are consistent with Table 4: the null hypotheses that the mean and median levels of opaqueness are the same before and after SOX are strongly rejected. Panel C displays evidence that the reduction in opaqueness is still stronger for firms that were more opaque in the pre-SOX period. The regression coefficient is negative and more than three standard errors from zero. Panel D shows that the estimates of the regression coefficients are qualitatively similar to Table 6, Panel A. In each of the regressions, the slopes are all positive and we can reject that the coefficient is zero. Therefore, all our results still hold when we use the same $\overline{L}= \frac{1}{2}$ for all firms. Appendix A has further comparisons of the two alternatives specifications for the expected default boundary.

4.2 Discarding corner solutions of the calibration process

Our baseline results use calibrations for all the 252 firms in our sample. Here we use a restricted sample with only the 162 firms for which there is an interior solution for the calibrated opaqueness parameter both in the pre-SOX and post-SOX periods[10]. Results are in Table 8. In Panel A, B and C we check Hypotheses 1, 2 and 3 respectively. In Panel D, we report the relationship between abnormal accruals and corporate opaqueness in the pre-SOX period.

TABLE 8

The results still hold when only interior solutions are used. Panel A shows higher corporate opaqueness is related to lower S&P transparency ratings and worse corporate governance ratings. Panel B shows that information opaqueness drops significantly after the enactment of SOX. Panel C confirms that the negative relationship between pre-SOX opaqueness the change in opaqueness following SOX is not driven by the calibration details. Finally, Panel D confirms the positive relationship between the accrual-based measure of accounting quality and our measure of opaqueness in the pre-SOX period.

[10] We had $\widehat{\lambda} = 0$ for 26 of the 252 firms in the pre-SOX period and 42 in the post-SOX period.And we had $\widehat{\lambda} = \lambda^*$ (parameter λ associated to the maximum spread) for 44 firms in the pre-SOX period and 21 firms in the post-SOX one.

4.3 Systematic risk

The CreditGrades model does not accommodate for differences in CDS spreads due to differences in systematic risk. It is possible that, for the same expected loss, firms whose value process is more correlated with the overall state of the economy display higher spreads because such firms tend to default in bad times. Therefore, one could conjecture that our corporate opaqueness measure simply proxies for systematic risk premia: higher opaqueness actually means larger loadings on sources of systematic risk. In the cross-section, we address this concern by comparing our measures of opaqueness to the (equity) CAPM beta and the Fama-French (equity) factor loadings. Table 9 shows the results.

TABLE 9

We regress the firm's opaqueness parameter onto the firm's (equity) loadings on sources of systematic risk, both in the pre and post-SOX periods. Results show the CAPM beta is negatively related to the calibrated opaqueness in both periods. While this relationship is statistically different from zero, it goes in the wrong direction of explaining away our results. When we regress the opaqueness measure on loadings on the Fama-French three-factor model, we find a similar negative pattern between opaqueness and systematic risk. Therefore, to the extent that loadings on CAPM and Fama-French factors are good proxies of exposure to systematic risk, a systematic risk explanation of our results can be ruled out because it fails in the cross-section.

A skeptical reader may still argue that a systematic risk explanation cannot be discarded because CAPM beta and Fama-French factor loadings are bad proxies for systematic risk, and the price of risk faced by all firms may have decreased in the post-SOX period. For constant risk loadings (not proxied by CAPM betas or Fama-French factor loadings), this would have caused a decrease in systematic risk premia for all firms, which we would capture in the form of lower opaqueness measures. To address this concern, we investigate the systematic risk explanation in the time series by calibrating our opaqueness measure for the 2004 and 2005 periods as well. The cross-sectional average of information opaqueness is 0.470 for 2004 and 0.491 for 2005. In both 2004 and 2005 the average measures are close to the post-SOX average of 0.498 and much lower than the pre-SOX average of 0.679, both reported in Table 2. These results provide evidence against the alternative story investigated here because it is unlikely that the price of risk would drop so much after SOX and then remain stable at low levels for several years. The combined cross-sectional and time-series evidence indicates

that systematic risk premia is unlikely to explain away our results.

4.4 Ratings and liability structure

The CreditGrades model does not differentiate between types of liabilities or incorporate non-public information about liabilities available to rating analysts and incorporated in credit ratings. Perhaps we feed the model an overly coarse measure of liabilities, while the market takes a much more nuanced look at the liability side of a firm's balance sheet. For example, while we ignore differences between short term and long term liabilities, or interest-bearing and non-interest bearing liabilities, CDS spreads might be affected by them. Moreover, rating agencies are supposed to have access to non-public information, and incorporate such information on their credit ratings. CDS spreads would therefore reflect not only public balance sheet information but also non-public information conveyed by credit ratings. In this case, our measures of opaqueness could simply be proxying for the structure of a firm's liabilities and for the special information conveyed by ratings. We address this concern by regressing our measures of opaqueness onto credit ratings and ratios reflecting different types of liability structures. Results are on table 10 below.

TABLE 10

Contrary to the critique outlined above, the regressions on levels of Table 10 show that credit ratings are actually positively correlated with our measure of information. This goes against the alternative story outlined before. However, the regressions on levels provide some evidence that some variables describing the liability structure, especially the ratio of current liabilities divided by total liabilities, may somewhat contaminate our measure of corporate opaqueness. Nonetheless, the explanatory power of such variables is small: only at most 14.85% of the cross-sectional variability of opaqueness is explained by them and the credit ratings. More importantly, the regression in changes contradicts the regression in levels. For the regression using levels, firms with relatively more short term liabilities have higher calibrated opaqueness. However, the coefficient on the ratio of short term liabilities over total liabilities in the regression using changes is negative, indicating that firms with large increases in short-term liabilities relative to total liabilities tended to have larger reductions in calibrated opaqueness. We conclude that our results are not driven by the fact that the model does not take into account information on ratings and the firm's liability structure.

4.5 Supply of default insurance in the CDS market

The CreditGrades model does not accommodate potential demand and supply shifts in the market for default insurance that could affect spreads if financial markets are not frictionless. For example, suppose CDS dealers had some degree of monopoly power in the pre-SOX period, and that these dealers were net sellers of insurance in the CDS market, and net buyers of insurance in equity and option markets (they are hedged in overall terms). One could conjecture that such dealers extracted rents from buyers of insurance by charging high spreads in the pre-SOX period, and that, over time, more dealers entered the CDS market and these rents were competed away. In this case, our measure of information is proxying for the degree of competition in the CDS market. To address this concern, we form an empirical proxy of the degree of competition in the CDS market. We use the number of dealers providing quotes for the CDS spread of each company in each day, also included in the Markit database. If this alternative story is true, the decrease in the opaqueness measure is larger for firms with a larger increase in the number of dealers providing quotes. Table 11 displays the results of this analysis.

TABLE 11

Panels A and B show we can reject this alternative explanation. Panel A splits the sample of 252 firms according to the increase in the number of dealers providing quotes in the CDS. Results show that firms with higher increase in the number of brokers actually experienced a smaller reduction in the opaqueness parameter. Panel B confirms this result in a regression framework. The slope of the regression of post-SOX minus pre-SOX opaqueness parameters on the increase of the number of quoting brokers is positive.

5 Conclusion

In a recent paper, Ball, Robin and Sadka (2008) provide evidence that the demand for timely and reliable financial reports arises primarily in debt markets rather than equity markets. If so, it is natural to conjecture that measures of corporate opaqueness extracted from debt prices are at least as useful as measures extracted from equity prices. In this paper we propose a new measure of corporate transparency extracted from the levels of CDS spreads using a CDS pricing model. We use this measure to examine the effect of SOX on corporate opaqueness and the cost of debt.

Using daily CDS prices, we calibrate the corporate opaqueness measure for 252 firms in two time periods: pre-SOX (January 2001 to July 2002), and post-SOX (August 2002 to December 2003). We show our measures tend to agree with other proxies of corporate transparency: firms with higher CDS-calibrated opaqueness tend to have lower S&P Transparency and Disclosure ratings, lower KLD and ISS corporate governance ratings, and high absolute abnormal accruals (in the pre-SOX period). We show our measures of corporate opaqueness are lower in the post-SOX period than in the pre-SOX one. Moreover, the decrease in calibrated opaqueness is stronger for firms that were more opaque in the pre-SOX period. These results supports the conjecture that the enactment of Sarbanes-Oxley increased corporate transparency. We estimate that the reduction of opaqueness following SOX caused a 19 bp reduction in the 5-year CDS spread of the typical firm in our sample. Thus, SOX reduced the cost of debt substantially for the typical firm in our sample. Furthermore, we show our results are robust to changes in our calibration procedure. Finally, we investigate three plausible alternative explanations and rule out each of them.

References

[1] Ali, Ashiq, Sandy Klasa and Eric Yeung (2008) “The impact of product market competition on a firm’s disclosure policy and its information environment" University of Texas-Dallas, University of Arizona and University of Georgia working paper.

[2] Anderson, Ronald C., Sattar A. Mansi and David M. Reeb (2004) "Board characteristics, accounting report integrity, and the cost of debt" Journal of Accounting and Economics 37, 315-342.

[3] Andrade, Sandro C., Gennaro Bernile and Evgeny Lyandres (2008). “Uncertain liabilities, leverage and systematic risk" University of Miami and Boston University working paper.

[4] Andrade, Sandro C., Gennaro Bernile and Fred M. Hood (2008). “Restatements, corporate opaqueness, and the cost of debt" University of Miami and Virginia-Tech University working paper.

[5] Ashbaugh-Skaife, H., D. W. Collins, W.R. Kinney, and R. LaFond (2007) “The effect of internal control deficiencies on firm risk and cost of equity.” Working Paper. University of Wisconsin. Available on SSRN.

[6] Ball, Ray, Ashok Robin and Gil Sadka (2008). “Is financial reporting shaped by equity markets or debt markets? An international study of timeliness and conservativism”. Review of Accounting Studies 13, 168-205.

[7] Bartov, E., and D. A. Cohen (2007) “Mechanisms to meet/beat analyst earnings expectations in the pre- and post-Sarbanes-Oxley Eras.” Working Paper. New York University. Available on SSRN.

[8] Berger, Phillip G., Huafeng Chen and Feng Li (2006) "Firm specific information and cost of equity". University of Chicago, University of British Columbia and University of Michigan Working Paper.

[9] Blanco, Roberto, Simon Brennan and Ian W. Marsh (2005) "An empirical analysis of the dynamic relation between investment-grade bonds and Credit Default swaps". Journal of Finance LX(5), 2255-2281.

[10] Botosan, Cristina (1997) "Disclosure level and the cost of equity capital" The Accounting Review 72, 323-349.

[11] Bushee, Brian J. and Christian Leuz (2005) "Economic consequences of SEC disclosure regulation: evidence from the OTC bulletin board" Journal of Accounting and Economics 39(2), 199-238.

[12] Chhaochharia, Vidhi and Yaniv Grinstein (2007) "Corporate governance and firm value: the impact of the 2002 governance rules" Journal of Finance Vol 62, No. 4.

[13] Collins, Daniel W. and Paul Hribar (2003) "Errors in estimating accruals: implications for empirical research" Journal of Accounting Research 40(1), 105-134.

[14] Cohen, Daniel A., Aiyesha Dey and Thomas Z. Lys (2008) "Real and accrual-based earnings management in the pre- and post-Sarbanes Oxley periods". The Accounting Review, March.

[15] Cohen, Daniel A., Aiyesha Dey and Thomas Z. Lys (2007) "Trends in Earnings Management and Informativeness of Earnings Announcements in the Pre- and Post-Sarbanes Oxley Periods", Working Paper.

[16] CreditGrades Technical Document (2002), http://www.creditgrades.com/resources/pdf/CGtechdoc.pdf

[17] Cremers, K. J. M., Vinay B. Nair and C. Wei (2007) "Governance mechanisms and bond prices" Review of Financial Studies 20(5), 1359-1386.

[18] Dechow, P., R. Sloan, and A. Sweeney (1995) "Detecting earnings management" The Accounting Review 70: 193-225.

[19] DeFond, M. and K.R. Subramanyam. (1998)."Auditor changes and discretionary accruals" Journal of Accounting and Economics 25: 35-67.

[20] Duffie, Darrell (1999) "Credit swap valuation" Financial Analysts Journal 55(1), 73-87.

[21] Duffie, Darrell and David Lando (2001) "Term structures of credit spreads with incomplete accounting information" Econometrica 69(3), 633-664.

[22] Duarte, Jefferson, Lance Young and Fan Yu (2008) "Credit spreads, governance and information asymmetry" University of Washington and Michigan State University working papers.

[23] Duarte, Jefferson, Francis Longstaff and Fan Yu (2007) "Risk and return in fixed Income arbitrage: nickels in front of a steamroller?" Review of Financial Studies, 20(3), 769-811.

[24] Francis, Jennifer, Dhananjay Nanda and Per Olsson (2008) "Voluntary disclosure, earnings quality, and cost of capital" Journal of Accounting Research 46, 53-99.

[25] Giesecke, Kay (2006) "Default and information" Journal of Economic Dynamics and Control, 30(11), 2281-2303.

[26] Gompers, Paul A., Joy L. Ishii and Andrew Metrick (2003) "Corporate governance and equity prices" Quarterly Journal of Economics 118, 107-155.

[27] Healy, Paul M. and Krishna G. Palepu (2003) "The fall of Enron" Journal of Economic Perspectives 17(2), 3-26.

[28] Hostak, Peter, Emre Karaoglu, Thomas Lys, and Yong Yang (2008) "An Examination of the Impact of the Sarbanes-Oxley Act on the Attractiveness of US Capital Markets for Foreign Firms". Working Paper.

[29] Hranaiova, J., and S.L. Byers (2007) "Changes in market responses to financial statement restatement announcements in the Sarbanes-Oxley Era." Working paper. Available at pcaob.org.

[30] Hull, John C. (2006) "Options, Futures and Other Derivatives" 6^{th} edition, Prentice-Hall.

[31] Hull, John C., Mirela Predescu and Alan White (2004) "The relationship between credit default swap spreads, bond yields, and credit rating announcements" Journal of Banking and Finance, 28, 2789-2811.

[32] Hutton, Amy, Alan J. Marcus and Hassan Tehranian (2008) "Opaque financial reports and the distribution of stock returns" Boston College working paper.

[33] Iliev, Peter (2007) "The Effect of the Sarbanes-Oxley Act (Section 404)" Brown University working paper.

[34] Jain, Pankaj K. and Zabihollah Rezaee (2006) "The Sarbanes-Oxley Act of 2002 and capital market behavior: Early evidence" Contemporary Accounting Research 23, 629-654.

[35] Jones, J. (1991). "Earnings management during import relief investigation". Journal of Accounting Research 29: 193-228.

[36] Jorion, Philippe, Charles Shi and Sanjian Zhang "Tightening credit standards: the role of accounting quality". UC Irvine working paper.

[37] Kothari, S.P., Andrew J. Leone and Charles E. Wasley (2005) "Performance matched discretionary accrual measures" Journal of Accounting and Economics 39(1), 163-197.

[38] Larcker, D. F., S. A. Richardson, A and I. Tuna. (2007) "How important is corporate governance?" The Accounting Review 82(4): 963–1008.

[39] Leuz, Christian (2007) "Was the Sarbanes-Oxley Act of 2002 really this costly? A discussion of evidence from event returns and going-private decisions". Journal of Accounting Economics 44, 146-165.

[40] Lobo, G. J., and J. Zhou (2006). “Did conservatism in financial reporting increase after the Sarbanes-Oxley Act? Initial evidence.” Accounting Horizons 20 (1): 57–73.

[41] Longstaff, Francis, Sanjay Mittal and Eric Neis (2005) "Corporate yield spreads: default risk or liquidity? New evidence from the Credit Default Swap market". Journal of Finance LX(5), 2213-2253.

[42] Mansi, Sattar, William F. Maxwell and Darius P. Miller (2008) "Analyst forecast characteristics and the cost of debt" Working paper.

[43] Patel, S.A. and George Dallas (2002) "Transparency and disclosure: overview of methodology and study results - United States" Standard&Poor's report

[44] Pittman, Jeffrey A. and Steve Fortin (2004) "Auditor choice and the cost of debt capital for newly public firms" Journal of Accounting and Economics 37, 113-136.

[45] Rees, L., Gill, S., Gore, R., (1996) "An investigation of asset write-downs and concurrent abnormal accruals" Journal of Accounting Research 34, 157-169

[46] Rezaee, Z. (2007). Corporate Governance Post-Sarbanes-Oxley. John Wiley & Sons, Hoboken, New Jersey.

[47] Richardson, Scott, Richard G. Sloan, Mark T. Soliman, and İrem Tuna, (2005) “Accrual reliability, earnings persistence and stock prices” (2005). Journal of Accounting and Economics 39, 437-485.

[48] Sengupta, P. (1998) "Corporate disclosure quality and the cost of debt". The Accounting Review 73(4), 459-474.

[49] Sloan, Richard G.,(1996) "Do stock prices fully reflect information in accruals and cash flows about future earnings?" Accountng Review 71, 289–315.

[50] Teoh, Siew Hong, Ivo Welch, and T. J. Wong, (1998a) "Earnings management and the long-run performance of initial public offerings" Journal of Finance 53, 1935–1974.

[51] Teoh, Siew Hong, Ivo Welch, and T. J. Wong, (1998b) "Earnings management and the underperformance of seasoned equity offerings" Journal of Financial Economics 50, 63–99.

[52] Xie, B., W. N. Davidson III, and P. J. DaDalt. (2003) “Earnings management and corporate governance: the role of the board and audit committee.” Journal of Corporate Finance 9 (3): 295–295.

[53] Yu, Fan (2006) "How profitable is capital structure arbitrage?" Financial Analysts Journal, 62(5), 47-62.

[54] Yu, Fan (2005) “Accounting transparency and the term structure of credit spreads". Journal of Financial Economics, 75(1), 53-84.

[55] Zhang, Ivy Xiying (2007) "Economic consequences of the Sarbanes-Oxley Act of 2002" Journal of Accounting Economics 44, 74-115.

Appendix A: Model and Calibration Details

Total firm value per equity share is a Geometric Brownian Motion with zero drift and volatility σ. Reported liabilities per equity share is constant at D. Default happens the first time the value process hits an uncertain default boundary given by LD, where L is lognormally distributed and independent of the value process V_t. The expected value of L is $\overline{L}$, and the standard deviation of the log of L is λ. If the firm defaults before the expiration of the CDS contract, the seller of protection stops receiving spread payments and has to make a lump-sum payment pay of $(1-R)$ Given these assumptions, the CreditGrades manual (2002) shows that the fair CDS spread is well approximated by the closed-form formula in Section 2.1.

It is important to mention that the credit spread is not a monotonic function of the uncertainty parameter λ. Given the other seven inputs of the CDS pricing formula, there is a λ^* such that the function $c(T,\lambda)$ reaches a maximum spread. This is the only critical point of the function $c(T,\lambda)$: the function is monotonically increasing for $0<\lambda<\lambda^*$, and monotonically decreasing in $\lambda>\lambda^*$. This is an unpleasant feature of the model, and a consequence of simplifying assumptions such as exogenous recovery. We address this issue by performing a constrained optimization: we minimize the sum of squared differences between market and model spreads under the constraint that the calibrated $\widehat{\lambda}$ for a given firm-period has to be in the interval $[0,\overline{\lambda^*}]$, where $\overline{\lambda^*}$ is calculated at each observation at the firm-period level. This implies that there can be corner solutions both on the low side, when market spreads tend to be below the model spread at $\lambda=0$; and on the high side, when market spreads tend to be above the model spread when $\lambda=\overline{\lambda^*}$.

In our baseline results, we first calibrate $\overline{L}$ for all firms in a given industry before we obtain $\widehat{\lambda}$ for each firm-period. For each industry, we choose the $\overline{L}$ that maximizes the proportion of time that market spreads are within the range of model spreads. This increases the likelihood of interior solutions in the posterior calibration of λ for each firm-period. The last column of Table A.1 has the calibrated $\overline{L}$ for each industry.

TABLE A.1

Not only model fit is improved by using industry-specific expected default boundaries, but also the measure of accounting opaqueness displays a much less pronounced industry pattern. When when a unique $\overline{L}=\frac{1}{2}$ is used, the standard deviations of accounting opaqueness across the 10 industries are 0.385 in the pre-SOX period and 0.367 in the post-SOX period. In

contrast, when $\overline{L}$ is industry-specific, the standard deviation is 0.254 in the pre-SOX period and 0.181 in the post-SOX period. The reduction is desirable since it is unlikely that there are huge differences in accounting opaqueness across industries. The remaining cross-industry variation in opaqueness could be due to cross-industry differences in the optimal level of corporate disclosure (see Ali, Klasa and Yeung 2008).

Figure 1 – Market versus Model CDS Spread (medians).

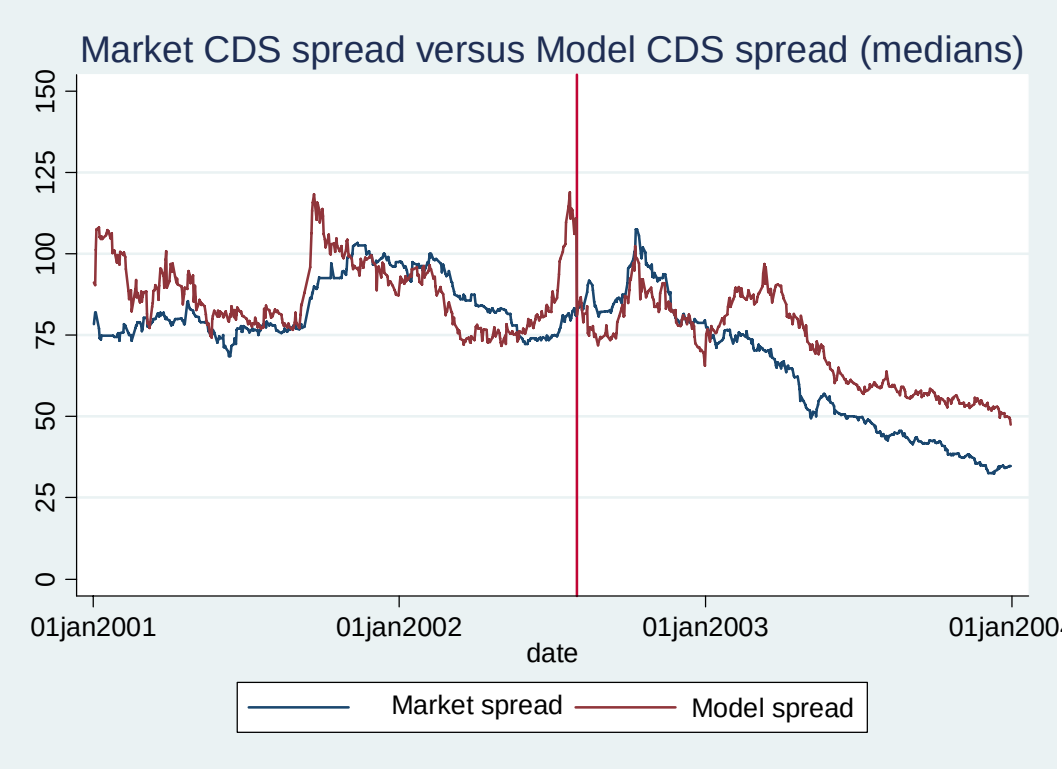

Figure 2 – Quantile-quantile plot of calibrated information opaqueness before and after enactment of the Sarbanes-Oxley Act (July 30, 2002).

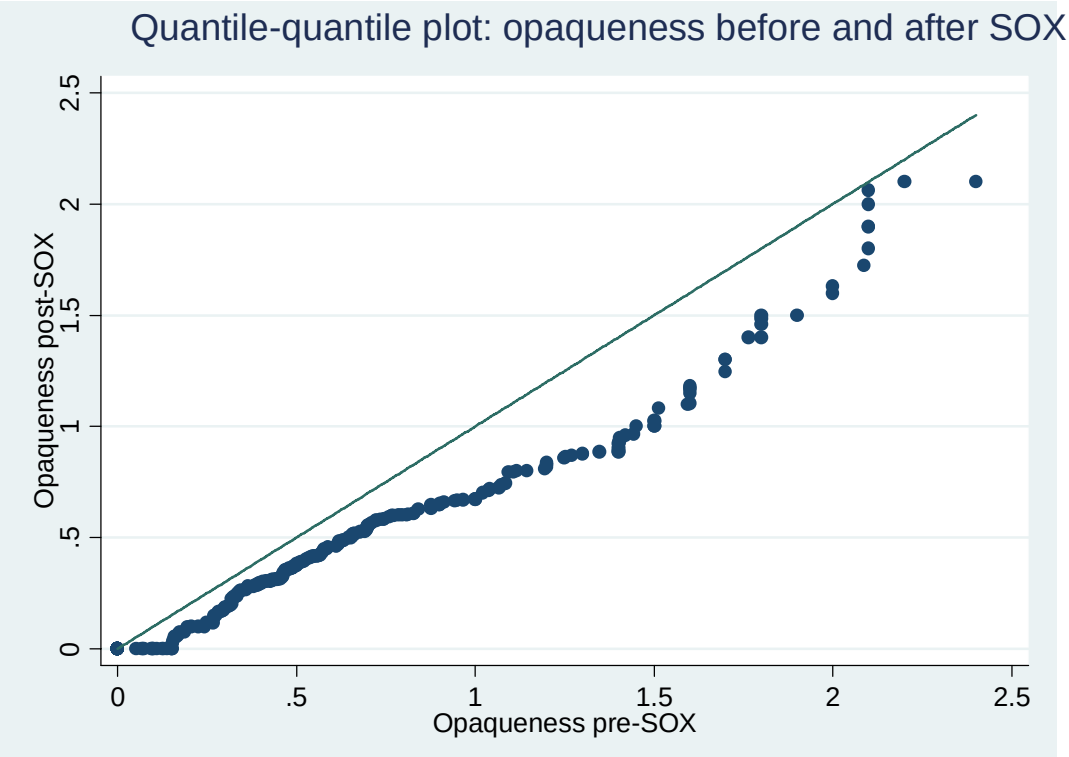

Figure 3 – Scatter plot of calibrated information opaqueness before and after enactment of the Sarbanes-Oxley Act (July 30, 2002).

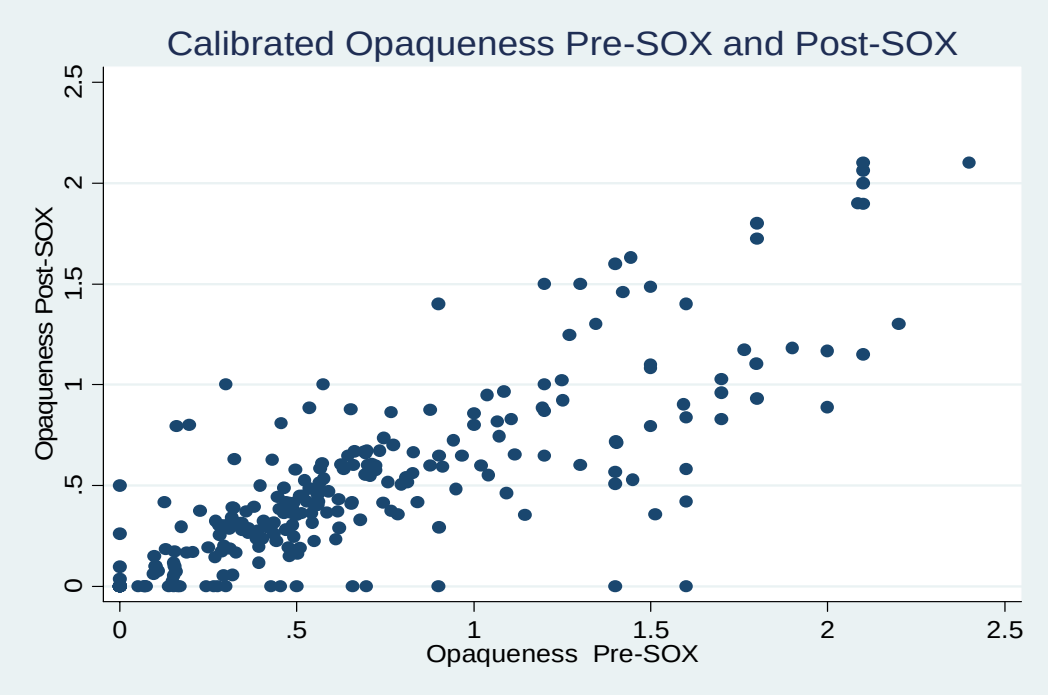

Table 1 – Sample mean and standard deviation of inputs for the CDS Spread Pricing model.
The table reports cross-sectional means and standard deviations of time-series averages of the 252 firms in the sample. *CDS spreads* are from 5-year US dollar denominated contracts. *Pre-SOX* refers to Jan/2001-Jul/2002 and *Post-SOX* to Aug/2002-Dec/2003. *Equity Volatility* is the 5-year equity volatility forecast at a point in time from a GARCH (1, 1) model fitted using daily data from Jan/2001 to Sep/2007. *Risk-free rate* is the 5-year swap rate minus 10 basis points. *Recovery Rate* is from the Markit database. *(1 Minus Leverage)* is the stock price divided by the stock price plus the liabilities per share. *Number of Time-Series Obs.* is the number time-series observations used to perform the calibration.

	Pre-SOX		*Post-SOX*	
	Mean	Std. Deviation	Mean	Std. Deviation
CDS Spread (bp)	119.344	112.765	111.246	118.682
Equity Volatility	0.331	0.124	0.329	0.116
Risk-free rate	0.049		0.033	
Recovery Rate	0.427	0.037	0.41	0.019
1 Minus Leverage	0.604	0.191	0.576	0.189
Number of Time-Series Obs.	261.5	125.3	350.1	58

Table 2 – Sample distribution of calibrated information opaqueness measure before and after enactment of the Sarbanes-Oxley Act (July 30, 2002).
The table reports the distribution of the information opaqueness parameter calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. *CDS spreads* are from 5-year US dollar denominated contracts. *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003.

N=252	Mean	Median	Std Dev	Min	1st Pctl	5th Pctl	10th Pctl	25th Pctl	75th Pctl	90th Pctl	95th Pctl	99th Pctl	Max
Pre-SOX	0.679	0.536	0.556	0	0	0	0	0.293	0.958	1.513	1.8	2.1	2.4
Post-SOX	0.498	0.409	0.453	0	0	0	0	0.171	0.668	1.082	1.483	2.061	2.1

Table 3 – Are better corporate governance and more accounting transparency associated with lower information opaqueness?

The table reports mean, median, and standard deviation of the information opaqueness parameter calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. Firms are grouped according to accounting transparency or corporate governance rankings. The row labeled *Difference* reports the difference between the mean and median of the information opaqueness parameter across groups. The figures in *italics* are the corresponding test statistics (t-statistic for the mean difference, z-statistic for Wilcoxon signed rank test for the median difference). ^, ^^, and ^^^ (*, **, and ***) indicate the corresponding test-statistic is significant at a 10%, 5%, and 1% probability level in a two-sided (one-sided) test, respectively.

		Pre-SOX		*Post-SOX*	
		Mean [St. Dev]	Median	Mean [St. Dev]	Median
(A) S&P Transparency and Disclosure 2002 Ratings	High Transparency (N=65)	0.5949 [0.0649]	0.4862	0.4451 [0.0484]	0.4079
	Low Transparency (N=124)	0.7507 [0.0530]	0.5999	0.5255 [0.0449]	0.4118
	Difference	-0.1557 *-1.86^** *	-0.1137 *-1.79**	-0.0804 *-1.22*	-0.0039 *-0.51*
(B) KLD Corporate Governance 2002 Ratings	Better Governance (N=100)	0.6172 [0.0480]	0.4961		
	Worse Governance (N=127)	0.7457 [0.0542]	0.5624		
	Difference	-0.1285 *-1.77^** *	-0.0663 *-1.25*		
(C) KLD Corporate Governance 2004 Ratings	Better Governance (N=61)			0.4269 [0.0514]	0.3143
	Worse Governance (N=159)			0.5221 [0.0377]	0.4204
	Difference			-0.0952 *-1.49**	-0.1061 *-1.36*
(D) ISS Corporate Governance 2003 Ratings	Better Governance (N=104)	0.6339 [0.0504]	0.5041	0.4453 [0.0389]	0.3687
	Worse Governance (N=127)	0.7374 [0.0519]	0.5656	0.5557 [0.0428]	0.4326
	Difference	-0.1035 *-1.43**	-0.0615 *-1.21*	-0.1104 *-1.90^** *	-0.0639 *-1.63**

Table 4 – Is the enactment of Sarbanes-Oxley Act associated with a reduction in information opaqueness?
The table reports mean, median, and standard deviation of the information opaqueness parameter calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. The column labeled *Difference* reports the difference between the mean and median of the information opaqueness parameter across the two time periods. The column labeled *Test statistic for Difference* reports the corresponding test statistics (t-statistic for the mean difference, z-statistic for Wilcoxon signed rank test for the median difference). ^, ^^, and ^^^ (*, **, and ***) indicate the corresponding test-statistic is significant at a 10%, 5%, and 1% probability level in a two-sided (one-sided) test, respectively.

N=252	Pre-SOX	Post-SOX	Difference	*Test statistic for Difference*
Mean	0.6794	0.4979	-0.1815	*-8.96^^^****
[St. Error]	[0.0351]	[0.0285]		
Median	0.536	0.409	-0.127	*-9.43^^^****

Table 5 – Is the enactment of Sarbanes-Oxley Act associated with a larger reduction in information opaqueness for less transparent firms?

The table reports statistics of the change between a firm's *Post-Sox* information opaqueness parameter and its *Pre-Sox* one. Parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. In Panel A firms are grouped according to the information opaqueness parameter pre-SOX (A), or the *S&P Transparency and Disclosure 2002 Rankings* (B). The row labeled *Difference* reports the difference between the mean and median change in opaqueness parameter across firm groups. The figures in *italics* are the corresponding test statistics (t-statistic for the mean difference, z-statistic for Wilcoxon signed rank test for the median difference. Panel B reports results of a regression of the change in the information opaqueness parameter (*Post-SOX* minus *Pre-SOX*) on the information in the *Pre-SOX* period. Heteroskedasticity-robust standard errors are reported in brackets. *, **, and *** indicate statistical significance at a 10%, 5%, and 1% probability level, respectively.

Panel A – Typical changes in information opaqueness around enactment of Sarbanes-Oxley Act after segmenting the sample by pre-enactment level of information transparency.

		(Post-SOX) - (Pre-SOX) Mean [Std. Error]	Median
(A) High versus Low Pre-SOX Uncertainty	Low Uncertainty (N=126)	-0.0388 [0.0163]	-0.1011871
	High Uncertainty (N=126)	-0.3242 [0. .0324]	-0.3100118
	Difference	*-0.2855* *7.85****	*-0.2088* *7.41****
(B) S&P Transparency and Disclosure 2002 Rankings	High Transparency (N=65)	-0.1498 [0.0377]	-0.0784
	Low Transparency (N=124)	-0.2252 [0.0282]	-0.1881
	Difference	-0.0754 *1.60**	-0.1098 *2.38***

Panel B – Relation between changes in information opaqueness around enactment of Sarbanes-Oxley Act and the pre-enactment level of information transparency.

	Coeff. Est. [Std. Err.]
Intercept	0.0464** [0.0224]
Pre-SOX Uncertainty Parameter	-0.3355*** [0.0420]
N	252
Adj-R^2	0.337

Table 6 – Is information opaqueness associated with earnings quality?
Table reports OLS estimates of the relation between the calibrated information opaqueness parameters and various accruals-based measures of earnings quality, in the Pre and Post-SOX periods (Panels A and B respectively). Parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is the calendar year of 2005. Total accruals for a particular firm-year is measured as the difference between earnings before extraordinary items and discontinued operations and operating cash flows from continuing operations, scaled by beginning of the year total assets. The discretionary component of total accruals is estimated by either the Jones (1 and 2) or the modified-Jones (3 and 4) models, including an intercept (1 and 3) or not (2 and 4). All four measures are performance-adjusted by ROA and industry membership. *3-year Avg. Perf. Match Abs. Abn. Accruals (i)* is the equal-weighted mean of the annual absolute discretionary accruals for the years 1999, 2000, and 2001 (Panel A), or 2003, 2004 and 2005 (Panel B). Standard errors adjusted for heteroskedasticity are reported in brackets. *, **, and *** indicate statistical significance at a 10%, 5%, and 1% probability level, respectively.

Panel A – OLS estimates of the relation between information opaqueness and earnings quality *before* SOX.

	Linear Regression			
	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]
Intercept	0.5472*** [0.0662]	0.5610*** [0.0675]	0.5464*** [0.0669]	0.5626*** [0.0681]
3-year Avg. Perf. Match Abs. Abn. Accruals (1)	0.5659** [0.2482]			
3-year Avg. Perf. Match Abs. Abn. Accruals (2)		0.4966** [0.2497]		
3-year Avg. Perf. Match Abs. Abn. Accruals (3)			0.5771** [0.2568]	
3-year Avg. Perf. Match Abs. Abn. Accruals (4)				0.4955* [0.2571]
N	242	242	242	242
Adj-R^2	0.0286	0.0213	0.0281	0.0204

Panel B – OLS estimates of the relation between information opaqueness and earnings quality *after* SOX

	Linear Regression			
	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]
Intercept	0.4288*** [0.0373]	0.4342*** [0.0392]	0.4275*** [0.0374]	0.4325*** [0.0393]
3-year Avg. Perf. Match Abs. Abn. Accruals (1)	0.0678 [0.1632]			
3-year Avg. Perf. Match Abs. Abn. Accruals (2)		0.0394 [0.1699]		
3-year Avg. Perf. Match Abs. Abn. Accruals (3)			0.0746 [0.1656]	
3-year Avg. Perf. Match Abs. Abn. Accruals (4)				0.0481 [0.1719]
N	230	230	230	230
Adj-R^2	0.0007	0.0002	0.0008	0.0003

Table 7 – Unique default barrier (i.e. 50% of total liabilities) across different sectors.
Panels A, B C and D reproduce the tests in Tables 3, 4, 5 and 6 respectively, now assuming a unique default barrier equal to 50% of total adjusted liabilities. For a detailed description of the tests, refer to headings in Tables 3, 4, 5 and 6.

Panel A - Are better corporate governance and more accounting transparency associated with lower information opaqueness?

		Pre-SOX Mean [Std. Error]	*Post-SOX* Mean [Std. Error]
(A) S&P Transparency and Disclosure 2002 Rankings	High Transparency (N=65)	0.78748 [0.0766]	0.6244 [0.0667]
	Low Transparency (N=124)	1.0106 [0.0591]	0.766 [0.0575]
	Difference	-0.2231 *-2.26^^^***	-0.1416 *-1.52**
(B) KLD Corporate Governance 2002 Ratings	Better Governance (N=100)	0.7935 [0.0581]	
	Worse Governance (N=127)	1.0287 [0.0601]	
	Difference	-0.2352 *-2.81^^^****	
(C) KLD Corporate Governance 2004 Ratings	Better Governance (N=61)		0.5862 [0.0654]
	Worse Governance (N=159)		0.749 [0.0489]
	Difference		-0.1627 *-1.99^^***

Panel B - Is the enactment of Sarbanes-Oxley Act associated with a reduction in information opaqueness?

N=252	Pre-SOX	Post-SOX	Difference	*Test statistic for Difference*
Mean	0.9028	0.6988	-0.204	*-8.36^^^****
[St. Error]	[0.0276]	[0.0213]		
Median	0.7475	0.5682	-0.1793	*-8.97^^^****

Panel C - Is the enactment of Sarbanes-Oxley Act associated with a larger reduction in information opaqueness for less transparent firms?

	Coeff. Est. [Std. Err.]
Intercept	0.0479 [0.0375]
Pre-SOX Uncertainty Parameter	-0.2790*** [0.0339]
N	252
Adj-R^2	0.209

Panel D – Is information opaqueness associated with earnings quality before the Sarbanes-Oxley Act?

	Linear Regression			
	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]
Intercept	0.7121*** [0.0767]	0.7251*** [0.0773]	0.7076*** [0.0772]	0.7231*** [0.0776]
3-year Avg. Perf. Match Abs. Abn. Accruals (1)	0.8126*** [0.2825]			
3-year Avg. Perf. Match Abs. Abn. Accruals (2)		0.7403*** [0.2812]		
3-year Avg. Perf. Match Abs. Abn. Accruals (3)			0.8428** [0.2904]	
3-year Avg. Perf. Match Abs. Abn. Accruals (4)				0.7568*** [0.2886]
N	242	242	242	242
Adj-R^2	0.0438	0.0353	0.0446	0.0354

Table 8 – Restricted sample discarding corner solutions.
Panels A, B, C and D reproduce the tests in Tables 3, 4, 5 and 6 respectively, now discarding firms with corner solutions in the calibration process either in the *Pre-SOX* or in the *Post-SOX* period. The sample size drops from 252 firms to 162 firms accordingly. For a detailed description of the tests, refer to headings in Tables 3, 4, 5 and 6.

Panel A - Are better corporate governance and more accounting transparency associated with lower information opaqueness?

		Pre-SOX Mean [Std. Error]	*Post-SOX* Mean [Std. Error]
(A) S&P Transparency and Disclosure 2002 Ratings	High Transparency (N=43)	0.5694 [0.0458]	0.4403 [0.0319]
	Low Transparency (N=78)	0.7022 [0.0440]	0.5132 [0.0374]
	Difference	-0.1328 *-2.09^^^***	-0.0729 *-1.48**
(B) KLD Corporate Governance 2002 Ratings	Better Governance (N=71)	0.5913 [0.0480]	
	Worse Governance (N=74)	0.6644 [0.0542]	
	Difference	-0.0731 *-1.23*	
(C) KLD Corporate Governance 2004 Ratings	Better Governance (N=44)		0.4201 [0.0411]
	Worse Governance (N=97)		0.49346 [0.0288]
	Difference		-0.0733 *-1.46**

Panel B - Is the enactment of Sarbanes-Oxley Act associated with a reduction in information opaqueness?

N=162	Pre-SOX	Post-SOX	Difference	*Test statistic for Difference*
Mean	0.6142	0.4668	-0.1474	*-8.17^^^****
[St. Error]	[0.0276]	[0.0213]		
Median	0.539	0.415	-0.124	*-8.06^^^****

Panel C - Is the enactment of Sarbanes-Oxley Act associated with a larger reduction in information opaqueness for less transparent firms?

	Coeff. Est. [Std. Err.]
Intercept	0.1086*** [0.0328]
Pre-SOX Uncertainty Parameter	-0.4169*** [0.0598]
N	162
Adj-R^2	0.409

Panel D – Is information opaqueness associated with earnings quality before the Sarbanes-Oxley Act?

	Linear Regression			
	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]
Intercept	0.4693*** [0.0461]	0.4652*** [0.0463]	0.4699*** [0.0459]	0.4625*** [0.0463]
3-year Avg. Perf. Match Abs. Abn. Accruals (1)	0.6663*** [0.1745]			
3-year Avg. Perf. Match Abs. Abn. Accruals (2)		0.6828*** [0.1834]		
3-year Avg. Perf. Match Abs. Abn. Accruals (3)			0.6670*** [0.1738]	
3-year Avg. Perf. Match Abs. Abn. Accruals (4)				0.6958*** [0.1839]
N	155	155	155	155
Adj-R^2	0.0854	0.0825	0.0836	0.0833

Table 9 – Does information opaqueness simply capture differences in systematic risk not accommodated by the CDS Spread pricing model?

The table reports OLS estimates of the relation between the calibrated information opaqueness measure and loadings on systematic-risk factors. Opaqueness parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. Factor loadings are from the CAPM or the Fama-French 3-factor model, and estimated with daily equity returns in the *Pre-SOX* period or the *Post-SOX* one. Standard errors adjusted for heteroskedasticity are reported in brackets. *, **, and *** indicate statistical significance at a 10%, 5%, and 1% probability level, respectively.

	Pre-SOX		Post-SOX	
	Market Model	FF 3-Factor Model	Market Model	FF 3-Factor Model
Intercept	0.8587***	0.9768***	0.7102***	0.6753***
	[0.0948]	[0.1043]	[0.0852]	[0.0785]
Market factor loading	-0.1847**	-0.1834*	-0.2161***	-0.1013
	[0.0897]	[0.1067]	[0.0797]	[0.0798]
SMB factor loading		0.04893		0.0420
		[0.1026]		[0.0930]
HML factor loading		-0.2419***		-0.2275***
		[0.0772]		[0.0575]
N	252	252	252	252
Adj-R^2	0.0168	0.0755	0.0344	0.1456

Table 10 – Does the calibrated information opaqueness measure reflect publicly available information concerning credit worthiness not accommodated by the CDS Spread pricing model?

The table reports OLS estimates of the relation between the calibrated information opaqueness measure and proxies of firms' credit worthiness not explicitly included in the CreditGrades' model. Opaqueness parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. *Typical Rating* for each firm-period is the time-series average of daily numerical credit rating according to Moody's. *Total Adj. Liabilities* is total liabilities minus minority interest and deferred taxes. *Current Liabilities to Total Adj. Liabilities* is the time-series average of the ratio of current liabilities to total adjusted liabilities. *Short Term Debt to Long Term Debt* is the time series average ratio of debt in current liabilities to total debt (due in one year or more). *Debt to Total Adj. Liabilities* is the time series average of the ratio of total debt to total adjusted liabilities. The first four columns report regressions of levels on levels: the first two columns refer to the *Pre-SOX* period, and the other two to the *Post-SOX* one. The last column reports a regression in changes: P*ost-SOX* minus *Pre-SOX* parameters regressed on the changes on the variables in the first column across the post-SOX and pre-SOX periods. Standard errors adjusted for heteroskedasticity are reported in brackets. *, **, and *** indicate statistical significance at a 10%, 5%, and 1% probability level, respectively.

	Pre-SOX		*Post-SOX*		*(Post-SOX)-(Pre-SOX)*
	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]	Coeff. Est. [Std. Err.]
Intercept	-0.2766	-0.6180	-0.1277	-0.2113	-0.1881***
	[0.2195]	[0.4454]	[0.1829]	[0.3342]	[0.0237]
Typical Rating	0.1329***	0.1001***	0.0870***	0.0599**	0.2247
	[0.0317]	[0.0342]	[0.0265]	[0.0279]	[.2031]
Current Liabilities to Total Adj Liabilities		1.1625***		0.7925	-0.5438
		[0.4058]		[0.3186]	[.6222]
Short Term Debt to Long Term Debt		0.1892		-0.0217	0.2130
		[0.3497]		[0.2560]	[0.1950]
Debt to Total Adj Liabilities		-0.2939		-0.3797**	-0.5404
		[0.1977]		[0.1807]	[0.5377]
N	252	252	252	252	252
Adj-R^2	0.0566	0.1485	0.0362	0.1203	0.0117

Table 11 – Can greater competition in the CDS market explain the reduction in the calibrated information opaqueness measure?

The table reports statistics on the change in the calibrated information opaqueness parameter from the *Pre-SOX* to the *Post-SOX* one. Parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. In Panel A firms are grouped according to the change in the time-series average of the number of quoting CDS dealers. The row labeled *Difference* reports the difference between the mean changes in the calibrated information opaqueness measure across subsamples. The figures in *italics* are the corresponding test statistics (t-statistic for the mean difference, z-statistic for Wilcoxon signed rank test for the median difference). Panel B reports results of a OLS regression of the Post-SOX minus pre-SOX opaqueness parameters on the change in the number of quoting dealers. *, **, and *** indicate the corresponding test-statistic is significant at a 10%, 5%, and 1% probability level in a one-sided test, respectively.

Panel A – Typical changes in information opaqueness after segmenting the sample by the change in the level of competition (i.e. number of quoting dealers) for each firm-CDS contract.

		(Post-SOX) - (Pre-SOX) Mean [Std. Error]
Change in Number of Quoting Brokers	Above Median (N=126)	-0.1622 [0.02555]
	Below Median (N=126)	-0.2009 [0.0314]
	Difference	0.0387 *0.957*

Panel B – Relation between changes in information opaqueness and changes in the level of competition (i.e. number of quoting dealers) for each firm-CDS contract.

	Coeff. Est. [Std. Err.]
Intercept	-0.2099*** [0.0345]
Change in Number of Quoting Dealers	0.0105 [0.0103]
N	252
Adj-R^2	0.0001

Table A.1 – Mean calibrated information opaqueness by sector before and after enactment of the Sarbanes-Oxley Act (July 30, 2002).

The table reports the average calibrated information opaqueness parameter across different industries. Parameters are calibrated from market prices and the CreditGrades' CDS pricing model for each firm-period. The *Pre-SOX* period is Jan/2001-Jul/2002 and *Post-SOX* period is Aug/2002-Dec/2003. The *Unique* columns assume a unique expected default barrier equal to 50% of total adjusted liabilities for all industries. The *Industry-Specific* columns have a different expected default barrier for each industry, chosen to maximizes the proportion of time that market spreads are withing the range that can be generated by the pricing model for all possible opaqueness parameters.

	[1] Unique Expected Default Barrier		[2] Industry Specific Expected Default Barrier		
	Pre-SOX	*Post-SOX*	*Pre-SOX*	*Post-SOX*	*Default Barrier*
Durables Goods	0.4005	0.2238	0.5516	0.5371	30%
Energy	0.8343	0.5219	0.5473	0.3331	70%
Hi-Tech	1.1208	0.8351	0.683	0.4176	100%
Health	1.6893	1.5354	1.1646	0.8995	100%
Manufacturing	0.7747	0.5884	0.7747	0.5883	50%
Non-Durable Goods	1.1715	0.9607	0.6941	0.5009	100%
Shops	1.1174	0.8359	0.9432	0.6043	80%
Telecommunication	0.7231	0.5981	0.4043	0.3705	65%
Utilities	0.4169	0.3602	0.3463	0.3255	85%
Other	0.8001	0.5744	0.4546	0.3165	55%