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The Influence of Qualified Foreign Institutional Investors on the Association between Default Risk and Audit Opinions: Evidence from the Chinese Stock Market

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ABSTRACT

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Research Question/Issue: Numerous studies demonstrate that audit opinions provide strong signals to investors/debt holders warning of firms' default probability. When foreign investors were allowed to enter the Chinese stock market, the role of audit opinions grew in importance. In this study, we examine the relationships between audit opinions and default probability within the Chinese stock market, and explore whether there was any significant shift in this relationship following the entry of Qualified Foreign Institutional Investors (QFIIs).

Research Findings/Insights: We find that audit opinions began providing signals of potential default risk only after QFIIs entered the market; suggesting that in the post-December 2002 period, auditors' decisions in China became more conservative, and that institutional investors began to play a monitoring role.

Theoretical/Academic Implications: This study provides support for institutional theory through the provision of empirical evidence showing that audit opinions, as signals of potential default risk, may actually be less efficient in immature markets than in more mature markets. Furthermore, the role of audit opinions in providing such signals to outside investors can clearly be affected by the introduction of new monitoring mechanisms. The results imply that market maturity could prompt

China has managed to achieve and maintain an extremely rapid economic growth rate since the implementation of its economic reforms in 1978, a time when the Chinese leadership demonstrated a significant shift toward more pragmatic and open-door policies in virtually all fields.[1] Following this trend, many international investors have also begun to experiment in the Chinese market.[2] In order to keep pace with the changing times, the Chinese government decided to amend many of its relevant laws and administrative regulations so as to encourage international capital inflows into the financial markets of China. To this end, the Chinese government promulgated the law on "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors" (hereafter referred to as "QFIIs"), which came into effect on December 1, 2002, and for the first time, allowed foreign investors to operate within the domestic Chinese share market.

Nevertheless, a number of invisible problems in China were to subsequently give rise to uncertainty for many foreign investors. These problems were essentially created by China's distinctive political and institutional settings (**Hamilton and Biggart, 1988**; **Whitley, 1994**). Thus, a growing body of literature has begun to indicate the inappropriateness of attempting to analyze the emerging Chinese economy in conventional Western terms (**Goto, 1982**; **Aoki, 1984; 1990**; **Biggart and Hamilton, 1992**; **Boisot and Child, 1996**). To add insult to injury, with the rise in the Chinese economy, a spate of corporate scandals also began to surface within the country's emerging market. **Sun and Zhang (2006)** revealed that since the establishment of the Chinese stock market in the early 1990s, about 20 per cent of all publicly listed firms in China had been found guilty of serious fraud by the China Securities Regulations Committee. It would therefore seem clear that foreign investors need to pay particular attention to who may be best placed to monitor and provide better signals of corporate risk for outsiders.

Many of the prior studies have shown that auditing opinions provide a clear signal summarizing information on firms for use by outsider investors (**Dye, 1993**; **Franz, Crawford and Johnson, 1998**; **Willenborg, 1999**; **O'Reilly, Leitch and Tuttle, 2006**). **Lennox (2000)** found that highly leveraged companies, who clearly had inherently higher bankruptcy risk, were also more likely to receive modified audit reports, while **Haskins and Williams (1990)** and **Citron and Taffler (1992)** also noted that financial distress was an important indicator and a strong reason for auditors to issue modified opinions. These studies, among others, have indicated that auditor reports are useful in predicting the risk of bankruptcy (**Hopwood, McKeown and Mutchler, 1989; 1994**) and provide some explanatory power with regard to predicting bankruptcy resolution (**Kennedy and Shaw, 1991**). Put simply, an audit report communicates the auditor's findings to market participants and plays a crucial role in warning financial statement users of the glossing of financial statements and/or impending bankruptcy risk.

Hay and Knechel (2004) went on to argue that the demand for auditing would be raised when

for investors in China to capture the bankruptcy risk of firms in this – the world's largest emerging market.

It is clear, however, that many studies have already examined the influence of new laws, regulations, and monitoring mechanisms on auditors, in terms of the resultant, more discreet and discerning, issuing of audit opinions. Geiger, Raghunandan and Rama (2005), for example, indicated that the attitudes of auditors within the US had been greatly affected by the implementation of the Sarbanes-Oxley Act in 2002, noting that auditors were subsequently more likely to issue modified audit opinions in the post-Sarbanes-Oxley Act period. Thus, the role of audit opinions in signaling information on inconspicuous agency problems to outsider investors can clearly be affected by the introduction of new monitoring mechanisms.

Several studies have provided evidence to show that institutional investors are active monitors (*Wall Street Journal*, 1995a,b; 1996a,b; 1997); nevertheless, Kane and Velury (2004) went on to extend the research on the monitoring role of institutional investors within the context of auditing. They found that institutional owners were quite influential and that they demanded high-quality earnings information; thus, institutional investors should have a positive association with the provision of high-quality auditing. In addition, given their greater capital resources, institutional investors are more capable of litigating against auditors who issue irrelevant audit opinions.

Thus, we posit that following the promulgation of the law on "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors," thereby allowing foreign institutional investors into the Chinese stock market, auditors will, as a result, be more careful when issuing opinions. Thus, the signaling role of audit opinions, warning outside investors of risks and hidden agency problems, will undoubtedly have become more prudent.

Our study makes several important contributions to the literature in this field. First, investments in unsafe and deficient markets will be accompanied by higher risk; therefore, audit opinions providing signals warning investors or debt holders of the probability of a firm defaulting are extremely important. We intend to determine whether such audit opinions can provide good signals for investors warning of the default risk of firms in the Chinese market. Second, we examine whether the relationship between audit opinions and default risk has been changed by the promulgation of "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors."

Finally, our resultant empirical findings should help investors gain an understanding of the warning role of audit opinions and thereby provide support for their appropriate investment decision making. These results may also provide some suggestions for the Chinese government that a good auditing environment and complete legal systems will provide better protection for investors and attract more

that the introduction of foreign institutional investors into the Chinese stock market would seem to have placed greater pressure on auditors to issue audit opinions with greater prudence.

The remainder of this paper is organized as follows. A review of the related literature is undertaken in the second along with the development of our hypotheses. This is followed in the third section by a description of the variable definitions and the empirical methodology adopted for this study. The penultimate section presents the empirical results and analysis, with the final section summarizing the conclusions drawn from the study.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Default Risk

Many models have been developed and enhanced throughout the years in attempts by econometricians to provide effective forecasting of the probability of business failures. The earliest and most-often cited studies predicting the probability of firms defaulting include the "financial ratio analysis model" of Beaver (1966) and the "Z-score model" of Altman (1968). These models are capable of providing accurate predictions of corporate bankruptcy; they have, nevertheless, been subjected to numerous revisions. Altman (2000), for example, provided a detailed description of the construction of the second-generation ZETAR credit risk model, which saw several enhancements being added to the original model.

There are also many other approaches to the prediction of bankruptcy risk in which attempts have been made to overcome the shortcomings of the earlier models (Ohlson, 1980; Shumway, 2001; Walker, 2005; Männasoo, 2007); however, within these studies there has been a general tendency to use historical data as the means of predicting such default risk. This approach may not, however, be capable of adequately reflecting the actual probability of bankruptcy within a changing market (Hillegeist, Keating, Cram and Lundstedt, 2004).

Oderda, Dacorogna and Jung (2003) also indicated that the Z-score was defined as a linear combination of accounting ratios, with the result that the linearity of the model has been criticized essentially because the path to bankruptcy can be extremely nonlinear. Furthermore, as the process is entirely based on accounting ratios, which appear only at discrete intervals, the ability of the model to detect any risk of default in rapidly deteriorating conditions has also been questioned. Thus, the use of linear historic ratios as a substitute for default risk would seem to be inappropriate.

The Kealhofer, McQuown and Vasicek (KMV) model is based upon compelling and intuitive theory, and as it uses equity market data, it incorporates the most up-to-date information available on a firm's financial health condition. Oderda *et al.* (2003) demonstrated that the time-varying characteristics and

from its ability to react appropriately to the condition of a firm, the KMV model is also able to provide important information for investors. Thus, in this study, we adopt the KMV model as our empirical model of default probability in order to effectively evaluate the likelihood of default.

Audit Opinions

Modified audit opinion decisions can be modeled as a two-stage process wherein the auditor initially assesses the probability of client failure and then compares the assessed probability of failure with the indifference probability of failure to identify those cases where there is substantial doubt. Auditors will subsequently issue a modified audit opinion when the assessed probability of client failure is higher than the indifference probability (**Geiger *et al.*, 2005**). Accordingly, a good, accurate audit opinion could provide investors and debt holders with an important decisive signal alerting them as to which firms have higher default risk.

In general, the results of many of the prior studies have indicated that modified audit opinions are useful in predicting bankruptcy and that they do provide some explanatory power in predicting bankruptcy resolution (**Clark and Weinstein, 1983**; **Hopwood *et al.*, 1989; 1994**; **Eberhart, Moore and Roenfeldt, 1990**; and **Kennedy and Shaw, 1991**). **Hudaib and Cooke (2005**) also noted that companies that were financially distressed were most likely to receive a qualified audit report, while **DeFond, Raghunandan and Subramanyam (2002**) and **Biddle and Hilary (2006**) considered that modified opinions were more relevant among financially distressed companies. If such failure subsequently occurs, the surprise associated with the failure event would therefore differ between firms receiving a going-concern opinion and those receiving an unqualified auditor's report.

However, when auditors feel inclined to issue modified opinions, they may also be faced with pressure from their clients; as a result, the audit opinions which are issued may not be entirely appropriate. Many of the prior studies have noted that less than half of all companies filing for bankruptcy had been issued with a prior modified audit opinion in the period immediately preceding the reporting of their financial statements (**Altman, 1982**; **Hopwood *et al.*, 1989**; **McKeown, Mutchler and Hopwood, 1991**; **Raghunandan and Rama, 1995**; **Carcello, Hermanson and Huss, 1995; 1997**).

Furthermore, as noted in several studies, it is quite puzzling, indeed, difficult to understand, why investors would be prepared to use audit opinions as their ultimate judgment of the default risk of a firm in an environment characterized by immature security laws covering the administration of such auditors. The analysis of **Carcello and Palmrose (1994**) provided evidence to show how modified reports issued prior to bankruptcy succeeded in protecting the issuing auditors from litigation, while in **Geiger *et al.* (2005**), it was argued that the association between auditor opinions and market reaction to bankruptcy filings might be affected by the current status of the legal environment.

clearly be of interest to determine whether audit opinions are capable of communicating the potential default risk of firms to market participants in China and whether they play a crucial role in providing effective warnings to users of financial statements. This study therefore discusses the relationship that exists between audit opinions and the probability of firms' defaulting in the Chinese stock market.

Whether the clearer signals warning of default risk that were provided by audit opinions in China is interesting but not well document. As the results of the majority of the prior studies have shown that firms with higher default risk do indeed experience the increased issuing of modified audit opinions, we therefore construct the first of our related hypotheses, as follows:

> *Hypothesis 1: The relationship between the probability of a firm defaulting and receiving a modified audit opinion in China is positive.*

The QFIIs in the Chinese Securities Market

The government in China promulgated the law, "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors" in December 2002; thereafter, starting in July 2003, QFIIs were allowed to operate within the Chinese A-share market for the first time. The government hoped that allowing QFIIs to enter the market would help demonstrate an example of stability, from which domestic investors might begin to take a more long-term approach to investment, rather than speculating for short-terms gains which, in the past, had caused share prices to fluctuate wildly.

There has been a steady rise in the amount of foreign capital entering into the Chinese securities market over recent years, with foreign investors demonstrating an ever-increasing interest in Chinese equities and consequently calling for increase in the available quotas; and indeed, China's State Council did approve such an increase in the total amount of investment permitted by QFIIs in September 2005. The quota for QFIIs was raised from US$6 billion to US$10 billion – which then accounted for around 10 per cent of total investment in the Shanghai and Shenzhen securities markets – resulting in QFIIs, as the second largest investors, subsequently having become a major driving force in the Chinese securities markets.

The involvement of QFIIs in the Chinese stock market provides the country with new sources of capital, while simultaneously helping the QFIIs themselves to explore this fledgling, and potentially huge, market. In 2006, the extremely bullish market in China grew by more than 130 per cent, with domestic investors demonstrating their passionate speculative nature to trade heavily in their attempts to amass rapid returns on the price differences. Given that the entrance into the Chinese

reliant upon private information in conducting their everyday business, as opposed to publicly verifiable information (such as auditing or credit reports). Globerman and Shapiro (2003) and Li and Filer (2007) demonstrate that countries with a more impartial and transparent legal system, as well as improved protection of property rights, will tend to attract more foreign direct investment (FDI), while countries with the lack of any appropriate legal system, and characterized by inadequate protection of property rights, will attract less FDI.

With the entry of QFIIs into the Chinese stock market, in 2003, a revision of the "Company Law of the People's Republic of China" was undertaken in 2003. In addition to the main purposes of regulating the organization and operations of companies, the revised Company Law, which was formally promulgated in 2004, also focused on providing protection for the legitimate rights and interests of companies, their shareholders and creditors. In addition, the Chinese Institute of Internal Auditing also promulgated the "Auditing Law of the People's Republic of China" in 2003, which was aimed at supervising and evaluating organizational activities.

Furthermore, the National Audit Office of the People's Republic of China promulgated many National General Auditing Standards in an attempt to improve auditing efficiency and to provide guarantees of the quality of auditing work. These standards included the "Auditing Authority Standards for Internal Control Assessment,""Auditing Authority Standards for Analytical Review,""Auditing Authority Standards for Audited Item Assessment," and "Auditing Authority Standards on the Importance of Auditing and Audit Risk Assessment."

Institutional theory also attends to the aspects of the change of social structure, such as the improvement of the laws, regulations and norms (North, 1990). DiMaggio and Powell (1983) earlier argued that firms subjected to similar environments will respond to these pressures in similar ways; and indeed, they may subsequently begin to resemble each other structurally, or in other words, their response is to become more homogenous. Therefore, when there are changes in the regulatory environment, such firms will make every effort to conform to the new rules in order to maximize and protect their interests. As the enhanced maturity of the regulatory environment specifies the roles of auditors, the firms' audit opinions could provide clearer signals warning investors or debt holders of potential default.

Consistent with this argument, Geiger *et al.* (2005) explored the intense legislative and media scrutiny following the widely publicized series of corporate failures, including those of Enron and WorldCom, along with the paradigm shift in the overall regulation of the auditing profession in the US in 2002 following the implementation of the Sarbanes–Oxley Act. They found that a monitoring role was provided by the introduction of this Act which ensured that auditors were much more careful in their subsequent issuing of audit opinions in general; indeed, they noted that auditors had become more likely to issue modified opinions in the period after December 2001.[4]

likelihood of modified opinions being issued. Furthermore, following the institutional theory, individuals and organizations are the players who try to maximize and protect their interests by adjusting the strategies according to the game rules. When the auditors subject to the pressures of the institute of new laws or regulation, they might provide more useful opinion to warning firms' default risk in order to avoid higher misclassification costs.

To summarize, the entry of QFIIs into the Chinese stock market in 2003 was accompanied by many security standards aimed at improving the investment environment and thereby increasing the misclassification costs of auditors. Accordingly, the results of institutional theory lead us to believe that the probability of the issuing of modified opinions by auditors in China may have been similarly affected by the promulgation of the law on "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors." We therefore construct our second related hypothesis as follows:

> *Hypothesis 2: The positive relationship between the probability of a firm defaulting in China and receiving a modified audit opinion is stronger after the year 2003 than in any period prior to that year.*

DATA AND METHODOLOGY

Data Description

The data adopted for our discussion of the relationship between default risk and audit opinions were acquired from the China stock market and Accounting Research Database. The scope of the sample comprised of all publicly listed enterprises in the Shanghai and Shenzhen Stock Exchange, with the study period covering the seven-year period from 1999 to 2005, inclusive.

Only those firms whose data corresponded with our selection criteria were used in the analysis. First, we confined our focus to firms whose financial year ends in December of each year; this would ensure that the information drawn from the financial statements would be available for each year of the study period. Second, we selected only those firms that had no missing data (the book value of total debts and assets, the market value of equity, the volatility of stock prices, and so on) over the period 1999 to 2005. These criteria satisfied the requirements of our related computations associated with the KMV model.

The selection process yielded a total of 520 firms, providing a total sample of 3,360 firm years. The total sample was subsequently separated into two subsamples based upon the 2002 promulgation of

capable of determining the "expected default frequency" (EDF) based upon the company's capital structure, the volatility of the assets returns and the current asset value, in accordance with the option pricing model of Black and Scholes (1973) and Merton (1974). The related EDF derivation process is detailed in Appendix B.

Guided by the related theories drawn from the prior studies, the control variables in this study include the debt ratio (*DEBT*), the return on assets (*ROA*), the size of the CPA firm (*CPAFIRM*), the total assets (*ASSET*) and the equity growth rate. Dummy variables are also included for the calendar year to specify the likely time effects on default risk. The empirical model can be described as follows.

$$\begin{aligned} Risk_{it} = {} & \beta_0 + \beta_1 OPINION_{it} + \beta_2 DEBT_{it} + \beta_3 ROA_{it} \\ & + \beta_4 CPAFIRM_{it} + \beta_5 ASSET_{it} + \beta_6 Y00_{it} \\ & + \beta_7 Y01_{it} + \beta_8 Y02_{it} + \beta_9 Y03_{it} + \beta_{10} Y04_{it} \\ & + \beta_{11} Y05_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

where *Risk* is the default risk of firm *i* in year *t* computed from the KMV model; *OPINION* is a dummy variable representing the i^{th} firm's audit opinions, which is equal to 1 if the audit opinion is a modified opinion (unqualified with an explanatory note, qualified, disclaimer or diverse), otherwise 0; *DEBT* is the debt ratio of firm *i* in year *t*; *ROA* is the return on assets for firm *i* in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if firm *i* is a client of the 'Big Four' CPA firms, otherwise 0. *ASSET* is the log of total assets for firm *i* in year *t*; and ε_{it} is the error term of Model (1) for firm *i* in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy variables controlling for the effects of calendar years. If the data are extracted from the year 2000, then *Y*00 is 1, otherwise 0; if the data are extracted for the year 2001, then *Y*01 is 1, otherwise 0; for the 2002 data year, *Y*02 is 1, otherwise 0; and so on, for all years up to 2005.

Predicted Signs

As in the results of the majority of the prior studies examining the relationship between firms' audit opinions and the probability of default risk, we find that when a firm with a higher risk of default has received modified audit opinions (*OPINION* = 1), then the coefficient of *OPINION* will be significantly positive. This finding, which provides support for our Hypothesis 1, is also reflected by the findings of the studies by Clark and Weinstein (1983), Eberhart *et al.* (1990), Chen and Church (1996), and Hudaib and Cooke (2005).

According to several of the prior studies, other firm-related financial variables can also affect a firm's default risk (Carcello *et al.*, 1995; Wald, 1999; Vassalou and Xing, 2004; and Chen, Firth, Gao and Rui,

Vasiliou, Eriotis and Daskalakis (2003) noted that firms with high profitability ratios tended to amass less debt than firms which did not generate such high profits. We therefore infer that firms with higher profitability will have a lower probability of default. As we apply the firm's return of assets (*ROA*) to substitute for its performance, we expect that the coefficient of *ROA* will be significantly negative.

Finally, Warner (1977) and Bradbury and Lloyd (1994) revealed the existence of a strong negative relationship between default risk and firm size. Accordingly, as we use total assets (*ASSET*) as a proxy for firm size in this study, we anticipate a negative relationship between *ASSET* and the probability of bankruptcy.

EMPIRICAL RESULTS AND ANALYSIS

Summary Statistics

The descriptive statistics of all of the related variables included in our balanced panel regression model are presented in Table 1, with Panel A providing the descriptive statistics for all 520 firms (3,360 firm-year observations) for the full sample period from 1999 to 2005. We find that the average default risk for firms which had received modified audit opinions was .04, which was significantly higher than the average for firms with standard unqualified audit reports. Firms with modified audit opinions were also found to have a very high average debt ratio, at about 96.81 per cent.

Table 1.
Summary of the Descriptive Statistics, 1999–2005

Variables[a]	Standard unqualified audit reports			Modified audit opinions		
	Mean[b,c]	Standard deviation	Median	Mean	Standard deviation	Median
Panel A: 1999–2005 – Full Sample (n = 3,360)						
RISK	.003***	.03	.00	.04	.18	.00
DEBT	.51***	.24	.51	.97	2.41	.66
ROA	.03***	.10	.04	−.14	.59	.00
CPAFIRM	.06***	.24	.00	.02	.13	.00
ASSET	14.21***	.92	14.15	13.75	.95	13.80
Total No. of	2.982			378		

Variables	Standard unqualified audit reports	Modified audit opinions

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the KMV model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*.

[b] The two-tailed t-test was adopted in order to examine the means according to discretionary accruals (positive vs. negative).

[c] †p < .10; *p < .05; **p < .01; and ***p < .001.

The average returns on assets (*ROA*) were negative for firms with modified audit opinions. Conversely, those firms with standard unqualified audit reports had, on average, a positive *ROA*. Furthermore, comparisons between the modified audit opinions and standard unqualified audit reports revealed significant differences (p < .01) between various control variables, such as *CPAFIRM* and *ASSET*.

As noted earlier, we divided our total sample into two subgroups based upon the year 2002, the year when China declared the law on "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors" as a means of attracting foreign capital into the Chinese stock market. Panel B provides the descriptive statistics on the 1,920 firm-year observations obtained for the pre-implementation period (1999–2002), while Panel C provides the descriptive results for the 1,440 firm-year observations in the post-implementation period (2003–2005), with the results in Panels B and C being similar to those in Panel A.

We find that the default risk during the pre-implementation period was significantly higher for firms with standard unqualified audit reports, while the default risk was significantly lower for firms with modified audit opinions during the same period. This suggests that following the implementation of the law allowing the entry of QFIIs, audit opinions may be providing clearer signals for determining firms' default risks.

Empirical Analysis

Prior to running the regression, in order to ensure the selection of the more accurate model, we used an F test to determine whether the OLS model or the panel data model was more appropriate (Baltagi, 2005). The results showed that the F value was 7.29 (p < .01), thereby rejecting the null hypothesis; thus, we used the panel data model to investigate our hypotheses. We also adopted the Hausman test (1978) for the selection of the fixed- or random-effects model, with the results clearly

Table 2.

Panel Regression Estimation Results for the Total Sample, Using KMV Default Risk as the Dependent Variable

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Intercept	.067**	2.97	<.01
OPINION	.002	.73	.47
DEBT	.027***	22.32	<.001
ROA	−.060***	−14.09	<.001
CPAFIRM	.003	.60	.55
ASSET	−.005**	−3.01	<.01
*Y*00	−.002	−.79	.43
*Y*01	−.006†	−1.93	.05
*Y*02	−.008**	−2.70	<.01
*Y*03	−.012***	−3.75	<.001
*Y*04	−.006†	−1.90	.06
*Y*05	−.007*	−2.15	.03
Total No. of Observations		3,360	

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the KMV model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy variables controlling for the effect of calendar years; if the data are extracted from year 2000, then *Y*00 is 1, otherwise 0; for the 2001 data year, *Y*01 is 1, otherwise 0; if the data year is 2002, then *Y*02 is 1, otherwise 0; for the year 2003, *Y*03 is 1,

associated with China's independent auditing profession, as argued by Cheung and Zhang (1996), Xiang (1998) and DeFond *et al.* (2000).

The estimated coefficient of *DEBT* is positive and significant at the 1 per cent level, indicating that those firms with higher debt ratios also have a higher risk of default; a finding which is consistent with the results reported in both Feder (1980) and Opler and Titman (1994). The estimated coefficient of *ROA* is negative and significant at the 1 per cent level, indicating that a rise in the operating performance of a firm reduces its probability of default; a result which is also consistent with the findings of Billings (1999) and Vasiliou *et al.* (2003).

The relationship between firm size and default risk is significantly negative at the 1 per cent level, suggesting that firms with more capital have a lower risk of bankruptcy. This result is in line with the findings of Vassalou and Xing (2004). The division of the total sample into two subgroups based upon the year 2002 was undertaken to facilitate an investigation of the effects of the law on "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors" on the issuing of audit opinions.

The related empirical results of the panel regression are reported in Table 3, with Panel A presenting the results for the pre-implementation period (1999–2002) and Panel B presenting the results for the post-implementation period (2003–2005). In both subgroups, the F value was significantly different from zero (the respective F values were 6.48 and 4.83); therefore, we used the panel data model to examine our hypotheses.

Table 3.
Panel Regression Estimation Results on the Subsamples, 1999–2002 and 2003–2005, Using KMV Default Risk as the Dependent Variable

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Panel A: 1999–2002			
Intercept	.026	.96	.34
OPINION	−.005	−1.59	.11
DEBT	.095***	18.62	<.001
ROA	−.035***	−4.15	<.001

Variables	Total sample		
	Coefficient	t-value	p-value

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the KMV model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy variables controlling for the effect of calendar years; if the data are extracted from year 2000, then *Y*00 is 1, otherwise 0; for the 2001 data year, *Y*01 is 1, otherwise 0; if the data year is 2002, then *Y*02 is 1, otherwise 0; for the year 2003, *Y*03 is 1, otherwise 0; if the data are obtained from year 2004, then *Y*04 is 1, otherwise 0; if the data are obtained from year 2005, then *Y*05 is 1, otherwise 0.

[b] †p < .10; *p < .05; **p < .01; and ***p < .001.

Although the Hausman test was insignificant in the post-implementation period (p = .87), we nevertheless selected the random-effects model for both subperiods in order to compare the results for different groups.[6] Furthermore, the Chow test (1960) has also been applied to determine whether structural changes occurred during the two subperiods (1999–2002 versus 2003–2005). The F value was found to be 81.08 (p < .001); accordingly, the model confirmed the presence of structural changes following the entry of QFIIs into the Chinese stock market. The estimated coefficient of *OPINION* in Panel A is not significant; however, the coefficient of *OPINION* in Panel B is significantly positive at the 5 per cent level (t = 2.11, p = .04), thereby providing support for Hypothesis 2. This indicates that in the post-implementation period, audit opinions are now providing clearer signals warning investors or debt holders of the default risk of firms.

Following the decision of the Chinese government, on December 1, 2002, to allow the entry of QFIIs into the Chinese security markets, auditors do appear to be paying more attention to the issuing of audit opinions to provide better signals of firms' default risk, a result which provides support for Hypothesis 2, that firms with a higher probability of bankruptcy were more likely to receive modified audit opinions after December 2002 than in the pre-implementation period. The other control variables are consistent for the whole sample.

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apparently amassed their capital in a small number of specific firms. Therefore, the opportunity presents itself to attempt to determine whether the clearer signals warning of default risk that were provided by audit opinions are found only in those firms with QFIIs ownership, or whether their effect has been felt in all listed firms within the Chinese securities market.

Following our standard sample selection process, we were able to identify a total of 62 firms with QFII capital during our sample period. We separated our sample into two groups based upon whether or not the firm had any QFII ownership between 2003 and 2005. The first of these two subgroups contained all of the firms with any level of QFII ownership (62 firms), while the second group contained all of the firms with no QFII ownership (418 firms), from which we were able to compare the divergent effects of audit opinions on each of these two groups.

In the group of firms with QFII ownership, the estimated coefficient of *OPINION* was positively significant in both the pre- and post-implementation periods. The estimated coefficient of *OPINION* in the pre-implementation period was .003 ($t = 1.73$, $p = .08$), while in the post-implementation period the coefficient was .020 ($t = 2.29$, $p = .03$). This indicates that those firms with QFII ownership have a preference for investing in firms on which audit opinions had already been issued, which suggests that the audit opinions do provide clearer signals warning investors or debt holders of the potential default risk of firms.

In the group of firms with no QFII ownership, although the estimated coefficient of *OPINION* was not significant in the pre-implementation period, it was significantly positive in the post-implementation period ($t = 1.99$, $p = .05$). This result is similar to the primary results, thereby indicating that in the post-implementation period, audit opinions are providing clearer signals warning investors of the potential default risk of firms.

In summary, it is apparent that the QFIIs have a preference for investing in those firms on which audit opinions have already been issued, given that such audit opinions are capable of providing clear signals warning investors of the potential default risk of firms. Following the Chinese government's promulgation of the law allowing foreign investors into the domestic Chinese share market, in order to attract the QFIIs, it seems that the firms were more prepared to provide useful information on their performance, such that the firms' audit opinions do now appear to have adopted the role of supplying more obvious signals warning of the potential default risk of firms.

It is also clear that the audit opinions, which are now widely used across all listed firms in China, began providing signals of the potential risk of default by firms only after QFIIs entered the Chinese stock market. This result provides general support for institutional theory, indicating that once the appropriate laws and regulations are in place and sufficiently matured, audit opinions are capable of providing greater information on the default risk of firms, and that this situation is now widespread

Table 4.

Robustness Analysis Results on the Total Sample, Using Z-score as the Dependent Variable

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Intercept	−5.394***	−47.93	<.001
OPINION	.018	1.21	.23
DEBT	5.420***	935.78	<.001
ROA	−3.511***	−168.50	<.001
CPAFIRM	−.025	−.98	.33
ASSET	−.028**	−3.43	<.01
*Y*00	.011	.74	.46
*Y*01	−.007	−.48	.63
*Y*02	.023	1.50	.13
*Y*03	.030†	1.94	.05
*Y*04	.030†	1.92	.06
*Y*05	.043**	2.78	<.01
Total No. of Obs.		3,360	

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the Z-score model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy variables controlling for the effect of calendar years; if the data are extracted from year 2000, then *Y*00 is 1, otherwise 0; for the 2001 data year, *Y*01 is 1, otherwise 0; if the data year is 2002, then *Y*02 is 1, otherwise 0; for the year 2003, *Y*03 is 1, otherwise 0; if the data are obtained from year 2004, then *Y*04 is 1, otherwise 0; if the data are obtained from year 2005, then

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Panel A: 1999–2002			
Intercept	−5.481***	−41.18	<.001
OPINION	.020	.95	.34
DEBT	5.732***	184.31	<.001
ROA	−2.963***	−53.95	<.001
CPAFIRM	−.001	−.03	.98
ASSET	−.022*	−2.24	.03
*Y*00	.011	.59	.56
*Y*01	.002	.10	.92
*Y*02	.021	1.14	.25
Total No. of Obs.		1,920	
Panel B: 2003–2005			
Intercept	−5.459***	−43.12	<.001

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the Z-score model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy variables controlling for the effect of calendar years; if the data are extracted from year 2000, then *Y*00 is 1, otherwise 0; for the 2001 data year, *Y*01 is 1, otherwise 0; if the data year is 2002, then *Y*02 is 1, otherwise 0; for the year 2003, *Y*03 is 1, otherwise 0; if the data are obtained from year 2004, then *Y*04 is 1, otherwise 0; if the data are obtained from year 2005, then *Y*05 is 1, otherwise 0.

[b] †p < .10; *p < .05; **p < .01; and ***p < .001.

encounter when estimating the governance/performance relationship (Arellano and Bover, 1995; Blundell and Bond, 1998). As shown in Tables 6 and 7, the results remain similar to those obtained earlier, thereby indicating the overall robustness of the results of this study.

Table 6.

Robustness Analysis Results on the Total Sample, Using the Generalized Method of Moments to Solve for Endogeneity Problems (Dependent Variable: KMV Default Risk)

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Intercept	.035†	1.94	.05
OPINION	.003	1.14	.25
DEBT	.030***	26.01	<.001
ROA	−.062***	−14.70	<.001
CPAFIRM	.004	.78	.44
ASSET	−.003*	−2.06	.04
*Y*00	−.003	−.91	.36
*Y*01	−.007*	−2.17	.03
*Y*02	−.009**	−3.02	<.01
*Y*03	−.013***	−4.17	<.001
*Y*04	−.008*	−2.42	.02
*Y*05	−.009**	−2.84	<.01
Total No. of Obs.		3,360	

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the KMV model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*: *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4"

Table 7.

Robustness Analysis Results on the Subsamples, 1999–2002 and 2003–2005, Using the Generalized Method of Moments to Solve for Endogeneity Problems (Dependent Variable: KMV Default Risk)

Variables[a]	Total sample		
	Coefficient[b]	t-value	p-value
Panel A: 1999–2002			
Intercept	.018	.72	.47
OPINION	−.005	−1.59	.11
DEBT	.094***	18.75	<.001
ROA	−.037***	−4.48	<.001
CPAFIRM	.006	.87	.38
ASSET	−.004†	−1.93	.05
*Y*00	−.004†	−1.69	.09
*Y*01	−.010***	−3.72	<.001
*Y*02	−.015***	−5.56	<.001
Total No. of Obs.		1,920	
Panel B: 2003–2005			
Intercept	.033	1.40	.16
OPINION	.011*	2.15	.03

Notes:

[a] *RISK* refers to the i^{th} firm's default risk computed from the KMV model in year *t*; *OPINION* is a dummy variable which represents the i^{th} firm's audit opinions, and which is equal to 1 if the audit opinion is modified (unqualified with an explanatory note, qualified, disclaimer, or diverse), otherwise 0; *DEBT* represents the i^{th} firm's debt ratio in year *t*; *ROA* is the i^{th} firm's return on assets in year *t*; *CPAFIRM* is a dummy variable which takes the value of 1 if the i^{th} firm's is a client of the "Big 4" CPA firms, otherwise 0; and *ASSET* refers to the i^{th} firm's log total assets in year *t*. *Y*00, *Y*01, *Y*02, *Y*03, *Y*04 and *Y*05 are dummy

default risk ($RISK_{t+1}$) as the dependent variable to test for the relationship between audit opinions and the future default probability of firms. The results reveal that while the estimated coefficient of *OPINION* is not significant in the pre-implementation period, it is significantly positive in the post-implementation period. This indicates that in the post-implementation period, audit opinions are now providing clearer signals warning investors or debt holders of the future potential default risk of firms.

Furthermore, given that the entrance of QFIIs has clearly had some effect on audit opinions and default probability, based upon the change in institutional investor ownership, we also take into consideration the proportion of QFII ownership as a control variable in our model in order to test whether or not the relationship between audit opinions and default risk has changed in the 2003–2005 subsample periods. The results remain similar to those obtained earlier, thereby indicating the overall robustness of the results of this study. In addition, the control variable (the proportion of QFII ownership) is significantly negative, which indicates that QFIIs have a preference for investing in firms on which audit opinions have already been carried out as such opinions can provide a clear indication of those firms with lower default risk.

CONCLUSIONS

The continuing and deepening economic reforms which have taken place in China have brought with them many changes to society, from both social and economic perspectives. As a result of some of these changes, the auditing function in China has begun moving toward the provision of credible support for financial statements. However, it is argued in many studies that the independent auditing profession in China remains far from reliable. Accordingly, international capital investors may be justifiably worried about the accuracy of a firm's financial statements in China and they may feel that they cannot use audit opinions to determine such a firm's reasonable default risk. This could clearly influence whether such international investors are prepared to inject capital into the Chinese stock market. In this study, we have examined the relationship between audit opinions and the probability of firms defaulting in the Chinese stock market.

The results of our study indicate that audit opinions in China can provide appropriate disclosure for firms with higher default risk; however, we find that audit opinions cannot determine those firms with higher default risk for the full sample. These results provide some support for the arguments of Cheung and Zhang (1996), Xiang (1998) and DeFond *et al.* (2000), which considered that the Chinese securities market was immature and that its institutions were incapable of providing complete supervision of the audit opinions issued.

We have also explored whether this relationship has experienced a paradigm shift following the entry of QFIIs into the Chinese stock market. Following the separation of our sample into two different periods – pre- and post-2002, the year of the promulgation of the law on "Provisional Measures for

regulations. These results also provide some evidence that in the more recent (post-December 2002) period, institutional investors may now believe that audited opinions have begun to provide adequate signals of the potential risk of default among firms.

We conclude this section with a discussion on the limitations and possible extensions of this study. First, our paper has focused only on the relationship between bankruptcy and modified opinions; however, while such audit misclassifications continue to be the main focus for legislators and the media, it would also seem worthwhile to carry out an examination of whether there were any changes in the proportion of modified opinions for subsequently viable companies following the entry of QFIIs into the Chinese securities market. Second, despite the fact that there have been continuing, progressive improvements in the protection of investors and debt holders within the Chinese securities environment, in this study, the examination of cases of bankruptcy included only a three-year period, from 2003 onward. Therefore, an interesting issue for future research would clearly be an examination of whether the increased propensity for the issuing of modified audit opinions is merely a temporary phenomenon or a much more long-lasting effect.

Third, there is evidence to suggest that the increased conservatism of auditors, particularly in the period immediately after the implementation of the Sarbanes-Oxley Act, could have also had some influence of foreign corporate failures, such as the infamous Enron and WorldCom scandals. All of these important international events occurred during the period up to 2002, a period during which it is quite difficult for us to exclude the effects of Chinese audits. Finally, as noted by **Krivogorsky (2000)** and **Wright and Nguyen (2000)**, the privatization and development of the capital market are key aspects of economic reforms not only in China, but also in some of its neighboring countries, such as Russia and Vietnam. An interesting area for future research would therefore be to examine whether such a pattern (the influence on audit quality stemming from the entry of QFIIs into the market) might also be observed in Russia and Vietnam.

We conclude that the strengthening of the various security laws in China could well result in increased confidence among investors within the Chinese stock market. Moreover, we go on to provide some evidence and suggestions for market participants to indicate that the more accurate information and greater efficiency of audit opinions arising as a direct result of the entry of QFIIs into the market could well lead to significant expansion of the Chinese investment environment. Our results provide some support for institutional theory through the provision of evidence to show that audit opinions warning of the potential default risk of firms are influenced by the laws and regulations in place, as well as the state of maturity of these laws and regulations. Furthermore, we find that the influence of audit opinions is not limited to certain types of firms or firms with QFII ownership, but that it is widespread across all listed firms in the Chinese securities market. In conclusion, therefore, if these foreign institutional investors do indeed believe that the audits opinions are fairly accurate, they can

1 The trials and tribulations of the reform process have already been well documented (Groves, Hong, McMillan and Naughton, 1994; Gao, 1996; Cao, Qian and Weingast, 1999; Lin and Zhu, 2001) while analyses of the effectiveness of these reforms have also begun to appear in the relevant literature (Chen, Firth and Rui, 1998; Allen, Qian and Qian, 2005).

2 These include the impacts of FDI (Liu, Burridge and Sinclair, 2002; Pingyao, 2002), stock market volatility (Yeh and Lee, 2000; Xu and Chen, 2001), the effects of trading strategies (Kang, Liu and Ni, 2002) and the determinants of stock returns within the Chinese stock market (Bailey, Cai, Cheung and Zheng, 2003).

3 Refer to website http://www.ronalddomingues.com/ dated August 24, 2004 for a detailed description of the KMV model.

4 The announcement of the intended implementation of the Sarbanes–Oxley Act (2002) was made in December 2001.

5 Geiger *et al.* (2005) indicated that there were two types of misclassifications in the context of audit opinions and bankruptcies, each with associated costs. A Type I misclassification occurs when a client receives a going-concern modified opinion from the auditor, but subsequently remains viable. Auditors may lose their client as a result of Type I misclassifications, which is what constitutes a "Type I misclassification cost." Conversely, a Type II misclassification occurs when a company becomes bankrupt despite not having received a prior going-concern modified opinion from the auditor in the period immediately preceding the bankruptcy filing. When audits involve Type II misclassifications, the auditors will be at an increased risk of losses from litigation, which is what constitutes a "Type II misclassification cost." Although there are costs associated with both types of misclassifications for auditors, their clients and financial statement users, the focus of legislators and the public has been fixed almost exclusively on instances of Type II misclassifications.

6 We also used the fixed-effects model to test the pre-implementation period and found that the results were quite similar to those of the random-effects model.

APPENDIX A

The promulgation of the "Provisional Measures for the Administration of Domestic Securities Investments by Qualified Foreign Institutional Investors" led to the introduction of QFIIs into the Chinese securities market. The law comprised of three parts: general provisions, punishment for violations of the existing implementation rules, and supplementary provisions.

The general provisions require QFIIs to entrust a domestic securities company, which had already obtained the appropriate qualifications in the Chinese stock exchange, to handle its relevant securities trading activities. The proportion of shares to be held by QFIIs engaging in domestic securities trading activities are limited; the A shares held by an individual QFII in any listed company must not exceed 10 per cent of the total capital stock of the company, and the total A shares held by any combination of QFIIs in the same listed company must not exceed 20 per cent of the total capital stock of the company. When the A shares held by a combination of QFIIs in the same listed company reach 16 per cent of the total capital stock of the company, with each 2 per cent increase thereafter, at the end of the trading day, the stock exchange is required to disclose the proportion of the total capital stock of the company held by the QFIIs through the stock exchange web page.

As regards punishment for violations of the implementation rules dealing with the shares held by

We use the KMV model – a model developed by the KMV Company in 1993 – to estimate and measure the default risk for the firms used in this study. The KMV model calculates the EDF based on the firm's capital structure, the volatility of the asset returns, and the current asset value in accordance with the option pricing model of Black and Scholes (1973) and Merton (1974). This model is best applied to publicly traded companies for which the value of equity is determined by the market.

There are three steps involved in deriving the actual probability of default. First, we estimate the asset value and the volatility of the asset returns. Financial models usually consider the market value of assets, not the book value, as the latter represents only the historical cost of the physical assets, net of depreciation. Second, we calculate the default point. According to the KMV model, default occurs when the asset value reaches a level somewhere between the values of total liabilities and short-term debt. This point, which is referred to as the default point (*DPT*), is considered within the KMV model as the sum of the short-term debt plus half of the long-term debt. Third, we calculate the "distance to default" (*DD*), an index measure of default risk, which is the number of standard deviations between the mean of the distribution of the asset value and *DPT*. We then scale the *DD* to the actual probability of default using a default database. The estimation procedure is as follows:

$$\frac{dV_A^t}{V_A^t} = +udtdZ\sigma_{At} \tag{2}$$

where V_A^t is the total market value of the assets for the firm at time t for China; u is the expected rate of return; and σ_A is the volatility of the asset returns. Thus, we can state the above equation in accordance with the option-pricing model as follows:

$$V_E = V_A N(d_1) - Xe^{-r_f t} N(d_2) \tag{3}$$

$$d_1 = \frac{\ln\left(\frac{V_A}{X}\right) + \left(r_f + \frac{\sigma_A}{2}\right)t}{\sigma_A \sqrt{t}}, \quad d_2 = d_1 - \sigma_A \sqrt{t} \tag{4}$$

$$\sigma_E = \frac{V_A}{V_E} N(d_1)\sigma_A \tag{5}$$

The implied market value and volatility of the asset, V_A and σ_A, can be calculated from equations (3) and (5). We also need to compute the *DD*. Given that the total debt is regarded as the *DPT* for the firm, after being standardized by the standard deviation of asset returns, its *DD* can be expressed as:

$$DD = \frac{\ln(V_A) - \ln\left(u - \frac{\sigma_A^2}{2}\right)t}{\sigma_A\sqrt{t}} \tag{6}$$

The implied default risk for any period *t*– that is, the probability that the market values of the assets will be lower than those of the liabilities at maturity – is measured in accordance with the risk-neutral method. The procedure is as follows:

$$EDF_t = \Pr[V_A^t \le X_t \,|\, V_A^0 = V_A] = \Pr[\ln V_A^t \le \ln X_t] \tag{7}$$

After being represented in compliance with the Ito Process, the market values of the assets can be expressed in logarithmic form as follows:

$$\ln V_A^t = \ln V_A^0 + \left(u - \frac{\sigma_A^2}{2}\right)t + \sigma\sqrt{T}\varepsilon \tag{8}$$

where ε denotes a random factor of asset returns.

We replace equation (8) into equation (7) after hypothesizing that the asset returns follow normal distribution. After arranging the related term, we obtain the default probability EDF_t as follows:

$$\begin{aligned} EDF_t &= \Pr\left[V_A^t \le X_t \,|\, V_A^0 = V_A\right] \\ &= \Pr\left[\ln V_A^0 + \left(u - \frac{\sigma_A^2}{2}\right)t + \sigma\sqrt{TZ_t} \le X_t\right] \\ &= \Pr\left[Z_t \le -\frac{\ln\left[\frac{V_A^0}{X_t}\right] + \left[r - \frac{\sigma_A^2}{2}\right]t}{\sigma\sqrt{t}}\right] \end{aligned} \tag{9}$$

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