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Risk Management and Corporate Governance: The Importance of Independence and Financial Knowledge for the Board and the Audit Committee

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ABSTRACT

The new NYSE rules for corporate governance require the audit committee to discuss and review the firm's risk assessment and hedging strategies. They also put additional requirements for the composition and the financial knowledge of the directors sitting on the board and on the audit committee. In this paper, we investigate whether these new rules as well as those set by the Sarbanes Oxley act lead to hedging decisions that are of more benefit to shareholders. We construct a novel hand collected dataset that allows us to explore multiple definitions for the *financially knowledgeable* term present in this new regulation.

We find that the requirements on the audit committee size and independence are beneficial to shareholders, although maintaining a majority of unrelated directors in the board and a director with an accounting background on the audit committee may not be necessary. Interestingly, financially educated directors seem to encourage corporate hedging while financially active directors and those with an accounting background play no active role in such policy. This evidence combined with the positive relation we report between hedging and the firm's performance suggests that shareholders are better off with financially educated directors on their boards and audit committees. Our empirical findings also show that having directors with a university education on the board is an important determinant of the hedging level. Indeed, our measure of risk management is found to be an increasing function of the percentage of directors holding a diploma superior to a bachelor degree. This result is the first direct evidence concerning the importance of university education for the board of directors.

Keywords: Corporate governance, risk management, corporate hedging, financial knowledge, board independence, audit committee independence, board of directors, university education, empirical test, unrelated directors, NYSE rules, Sarbanes Oxley act, audit committee size, financially educated directors, financially active directors, firm performance.

JEL classification: G 18, G 30.

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Introduction

The recent corporate scandals reported in the press have outraged the financial community and have clearly revealed serious flaws in the US corporate governance system. Of course, the board of directors, considered as an important part in a corporate governance system, took the largest part of the blame and directors were accused of failure in their watchdog role. For example in the Enron's case, the Powers¹ report concluded that Enron's board "failed to monitor ...to safeguard Enron's shareholders". These scandals have served as catalysts for legislative and regulatory changes. New rules were adopted in order to prevent the recurrence of disasters similar to the Enron or WorldCom's cases. In this context, the Sarbanes-Oxley act (SOX hereafter) enacted in 2002 tried to restore credibility to the US corporate governance system by setting stricter rules on the functioning and the independence of the external auditor, enabling the board of directors to acquire higher levels of fiduciary and statutory responsibilities and also by proposing new rules aimed to enhance the quality of financial disclosures by firms. More recently, the NYSE adopted a new set of rules designed to complement the SOX requirements in the matter of corporate governance².

Interestingly, the SOX does not set any particular requirements for the board as a whole entity, but does require that the audit committee should be entirely composed of independent directors and should count at least one financially knowledgeable member³. The new rules set by the NYSE define additional conditions concerning the independence of the board of directors and the composition of the audit, compensation and governance committees⁴. Overall, this new regulation on corporate governance significantly focuses on the audit committee and the independence of the board of directors.

¹ Report of investigation by the special investigation committee of the board of directors of Enron Corp, William C Powers Jr et al, 2002, at <http://news.findlaw.com/wp/docs/enron/specinv020102rpt1.pdf>

²We are aware that other US exchanges such as the AMEX amended rules to regulate corporate governance in their listed firms but we decided to limit our discussion to the regulation set by the NYSE because it is considered as the largest US Stock Exchange and consequently there is more money at stake motivating the analysis of its requirements. Indeed, according to the WFE official figures, as of December 31st, 2004, the NYSE market capitalization for domestic listed companies (excluding closed-end funds) is 12.7 trillions USD compared to 0.08 trillions USD for the AMEX and 3.7 trillions USD for the NASDAQ.

³ Section 301 of the Sarbanes-Oxley act requires that: "each member of the audit committee of the issuer shall be a member of the board of directors of the issuer, and shall otherwise be independent". Section 407 requires that "the commission shall issue rules...to require each issuer, together with periodic reports... to disclose whether or not, and if not, the reasons therefore, the audit committee of that issuer is comprised of at least 1 member who is a financial expert"

⁴ Section 303A.01 of the NYSE's listed company manual requires that "*listed companies must have a majority of independent directors*". Section 303A.04 requires that "*listed companies must have a nominating/ corporate governance committee composed entirely of independent directors*" while Section 303A.05 requires that "*listed companies must have a compensation committee composed entirely of independent directors*". Finally, Section 303A.07 requires that "*the audit committee must have a minimum of three members. Each member of the audit committee must be financially literate; as such qualification is interpreted by the company's board in its business judgment, or must become financially literate within a reasonable period of time after his or her appointment to the audit committee. In addition, at least one member of the*

We are aware that stricter rules for the audit committee and the independence of the board will help prevent financial scandals and ensure a better monitoring, but we are tempted to ask whether the independence of the board as a whole entity is sufficient to solve all the problems related to the US corporate governance system⁵. Obviously, no director of any board wants to find itself at the heart of a scandal. So, perhaps the scandals we observed recently are not caused by directors who lack the incentive to monitor properly the firm's management (the independence argument) but simply by directors who are unable to do so. Indeed, when the directors sitting on the board are generalists (even if they are totally independent) and lack the technical financial knowledge needed to understand the complicated reports and operations presented to them, they could unconsciously vote for resolutions that do not necessarily increase shareholders' wealth. In the Enron's case, the Powers report concludes that Enron's board "*should be faulted... for failing to probe and understand the information that did come to it*"⁶. The lack of financial expertise for the board members was recently confirmed by Buckley and Van Der Nat (2003) who reported disturbing levels of ignorance among independent directors in the matter of derivatives policy.

One might object that the lack of financial knowledge for directors is no longer a problem because the SOX and the new rules set by the NYSE do require the audit committee members to be financially knowledgeable. This statement would not hold for two reasons. First, the financial knowledge requirement applies only to the audit committee members, which will certainly lead to improved monitoring of the firm's accounting statements but not necessarily to a board that takes optimal decisions from a shareholder perspective. We think that financial knowledge should not be exclusive to the directors sitting on the audit committee.

Second, section 303A.07 of the NYSE's listed company manual requires all members of the audit committee to be financially knowledgeable ... or to become it in a reasonable period of time; and the definition of financially knowledgeable is left to the discretion of the board of directors. Even if a financially knowledgeable audit committee is sufficient to guarantee an effective monitoring from the board, this rule leaves too much room for interpretation. Section 303A.07 should provide a clearer

audit committee must have accounting or related financial management expertise, as the company's board interprets such qualification in its business judgment". Unfortunately, the time consuming aspect of data collection oblige us to limit our discussion only to the requirements concerning the audit committee.

⁵ We are considering problems other than accounting scandals which are supposed to be prevented by the regulation on the audit committee.

⁶ Rosen (2003) reports comments made by professor William H Widden in which the latter states: "*even though Enron was running a derivatives business, it seems that those on the finance committee and, more generally on the board, did not have*

definition for the *financially knowledgeable* term. Likewise, the SOX definition of financial knowledge primarily focuses on whether the director has prior accounting related experience. Such definition is very restrictive and will limit the pool of qualified directors [Defond, Hann and Hu, 2004]. In this paper, we explore multiple definitions for a director who is financially knowledgeable: a director whose current or past activities/positions are related to finance (example: present or former CFO, an insurer; a financial analyst, a financial consultant, a banker, ...etc), a director whose educational background includes financial literacy (MBA, BBA, B.Comm,) and finally a director with an accounting background (CA, CPA,...), in accordance with the SOX view.

The purpose of this paper is to verify the importance of the financial knowledge and independence arguments imposed by the new regulation. More precisely we have the intent to assess the effect, on the firm's hedging policy, of two requirements set by the SOX (audit committee entirely composed of independent members and at least one member considered as financially knowledgeable) and four requirements set by the NYSE (majority of independent directors on the board, audit committee with a minimum of three members, each member of the audit committee must be financially literate, and at least one member of the audit committee must have accounting knowledge). We decided to evaluate these rules by considering their possible impact on the risk management policy for three reasons.

First, section 303.07 (D) of the NYSE's listed company manual requires the audit committee "*to discuss policies with respect to risk assessment and risk management*". Consequently, there is a great chance that the rules concerning the board or at least those concerning the audit committee affect corporate hedging. Indeed, because these entities are henceforth legally responsible of the risk management policy, the changes in their composition or the background of their members is likely to affect their decisions in this matter.

Second, it is well documented in the literature that risk management is beneficial to the firm because it reduces its tax payments [Smith and Stulz, 1985], its financial distress costs [Stulz, 1984], its information asymmetry costs [Stulz, 1990; DeMarzo and Duffie, 1991; Breeden and Viswanathan, 1998] and its financing costs [Froot, Scharfstein and Stein, 1993; Morellec and Smith, 2002]. Accordingly, corporate hedging should improve the firm's performance. Our empirical evidence confirms this hypothesis. Indeed, we find that more corporate hedging leads to an increase in the firm's owners' rate of return, as measured by the return on equity. This finding holds even when we use an

a sufficient derivatives background to understand and evaluate what they were being told in the presentation. If they had this background, the identified risk mitigants would not have been accepted".

instrumental variable approach to control for the endogenous aspect of the hedging activity. Consequently, we can assert that every characteristic of the board (audit committee) that encourages the firm to increase its hedging ratio is beneficial to shareholders.

Third, risk management implies dealing with derivatives and other financially sophisticated tools. Thus, considering the risk management decision makes it possible to test whether an independent board/audit committee is capable of taking complicated mandatory decisions that benefit shareholders, or whether we need to impose financial knowledge on the directors to achieve this goal.

We contribute to the risk management literature by proposing a new set of explanatory variables that have never been explored before. To the best of our knowledge, we are the first to establish a relationship between corporate hedging and the background and education of the board and the audit committee members. We also add to the literature on corporate governance by considering a broader definition for financial knowledge. Previous papers limit their analysis to directors engaged in financial activities and more precisely to those with a banking/insurance experience. We are the first to consider that directors could have a financial background thanks to their education. Our empirical evidence shows the importance of education for directors and suggests that only financially educated members of the board and audit committee affect corporate hedging.

Our tests will shed light on the effectiveness of the new US corporate governance regulation but will also provide some references to make new recommendations and mainly to evaluate other corporate governance systems. This last point is very important in the present context because, as stated in Buckley and Van Der Nat (2003), the governance problem is not limited to a few rotten eggs in America.

Our empirical findings suggest that the new rules on the audit committee size and independence incite firms to seek more hedging while the requirement of a majority of unrelated directors on the board has no effect on the risk management level. Likewise, directors engaged in financial activities and those with an accounting background play no active role in the hedging policy. Only the directors' financial education affects such activity. Overall, our empirical findings show the importance of education, in general, and of financial education in particular, for directors sitting on the board and on the audit committee.

The remainder of the paper is organized as follow. Section I reviews the literature on the board and audit committee independence and financial knowledge. Section II contains our research design where

we describe our sample and variables. Section III and IV correspond respectively to the univariate and multivariate analysis. In section V we investigate the importance of university education for the directors sitting on the board and on the audit committee. Section VI reports the results of our investigation when the board and the audit committee characteristics are considered jointly. In section VII we test the effect of corporate hedging on the firm's performance. Section VIII concludes the paper.

I. Literature review

A. The board of directors as a corporate governance mechanism

A.1. The independence argument

The board of directors plays a central role in any corporate governance system and is viewed as a primary means for shareholders to exercise control over top management [Kose and Senbet, 1998]. The standard approach in empirical finance and in modern corporate America is to view the board's independence as closely related to its efficiency. Following the same reasoning, section 303A.01 of the NYSE's listed companies manual requires a majority of independent directors on the board. Indeed, outside directors are viewed as superior monitors because their careers are not tied to the firm's CEO and consequently they are free to take decisions that go against him without being afraid for their positions and future compensation. This view is often referred to as the *monitoring effect theory*. Also, outside directors have incentives to build reputations as expert monitors in order to obtain additional director appointments. Consequently, they are more likely to maintain proper control over the firm's top management [Fama, 1980; Fama and Jensen, 1983].

Several papers have reported evidence supporting the *monitoring effect theory*. Rosenstein and Wyatt (1990) show that the market has a significant positive reaction following the announcement of outsider board appointments in the *Wall Street Journal* while Weisbach's evidence (1988) suggests that CEO turnover is more sensitive to performance in firms with outsider dominated boards than it is in firms whose boards are dominated by insider directors. Likewise, MacAvoy and Millstein (1999) find that board independence is positively correlated with accounting-based measures of firm performance while Cotter et al. (1997) show that targets whose boards contain a majority of outside directors receive higher returns than similar firms without such majority. Other papers that reported evidence supporting

the benefit of having outside directors on the board are Brickley et al. (1994) who find a statistically positive and significant market reaction following the adoption of a poison pill clause when the board is dominated by a majority of outside directors; Beasley (1996) and Dechow and Sloan (1996) who show that a higher level of outside directors on the board will decrease the likelihood of fraudulent information in the firm's financial statements; and Klein (2002) who finds that companies with independent boards are less likely to manage their earnings by reporting abnormal accruals.

Based on the above mentioned papers, there seems little room to doubt that the firm and its shareholders are better off with outside directors on their boards. Unfortunately, the empirical findings on the board's independence are very mixed and a large part of the research has reported evidence against the *monitoring effect theory*. For example, Fosberg (1989) finds that firms with a large percentage of outside directors on their board do not have a higher performance as measured by the firm's ROE or sales. The absence of relation between the firm's performance and the independence of its board members has also been confirmed by Hermalin and Weisbach (1991), Klein (1998), Bhagat and Black (2002) and more recently by Hayes, Mehran and Scott (2004). Other papers having reported evidence refuting the superior monitoring attributed to outside directors are Subrahmanyam et al. (1997) and Harford (2000) for the acquisition transactions, Core et al. (1999) for CEO compensation and Agrawal and Chadha (2005) for earnings restatements.

Few papers have linked the board composition to the firm's risk management activity and the reported findings seem to refuel the debate on the benefit of outside directors. Indeed, while Borokhovich et al. (2004) show that interest rate derivatives usage increases with the proportion of outside directors on the board, Dionne and Triki (2004) and Mardsen and Prevost (2005) report evidence suggesting that the presence of such directors has no effect on the firm's risk management policy. Particularly, Mardsen and Prevost (2005) results indicate that the presence of outside directors on the board has no effect either on the decision to hedge or the extent of hedging. Whidbee and Wohar (1999) have also investigated the effect of the board's independence on the decision to hedge with derivatives for a sample of bank holding companies. Their evidence suggests that the probability of using derivatives increases with outside membership on the board only when insiders hold large blocks of shares in the firm.

Consequently, given the mixed empirical findings on the board's independence, it is difficult to say whether or not firms are better off with outside directors on their boards. While Fields and Keys (2003) claim that there is overwhelming support for outside directors providing superior monitoring and

advisory functions to the firm, we could not predict a unique and clear sign for the effect of the new rules set by the NYSE, concerning the board's independence, on any specific decision made by the firm including the risk management one.

A.2. The benefit of financial knowledge for the board

Although a tremendous amount of papers studied the effect of the board's independence, little research has been done on the value of the board's financial knowledge. The debate on this topic started with official reports such as the California Public Employees' Retirement System Corporate Governance Market Principles (CalPERS) issued in 1997 and the National Association of Corporate Directors (NACD) Blue Ribbon Commission Report issued in 1998. At the time, both reports recognized the importance of the board's independence but also recommended financial literacy/expertise for directors given their important function in monitoring the firm's performance. The new regulation provided by the SOX and the NYSE rules do not require financial knowledge for the board as a whole entity but only for its members who sit on the audit committee.

The few papers having investigated the financial knowledge argument for board members do support the idea that financial directors add value to the firm. Indeed, Booth and Deli (1999) and more recently Guner, Malmendier and Tate (2004) report a positive relation between the presence of a commercial banker in the board and the firm's debt level⁷. Their findings suggest that commercial bankers provide the financial expertise needed to enable the firm to contract more debt. Also, Rosenstein and Wyatt (1990) find that the positive abnormal returns associated with the addition of an outsider to the board are higher when the latter is an officer of a financial firm. This result has subsequently been confirmed by Lee, Rosenstein and Wyatt (1999). They were however unable to report any statistically significant difference in reaction among the three categories of financial outside directors they consider: commercial bankers, insurance company officers and investment bankers. More recently, Agrawal and Chadha (2005) have reported evidence supporting the benefit of having outside financial directors on the board. They find that the probability of earnings restatement is lower in firms whose boards have an independent director with a background in accounting or finance. The independence argument taken alone seems to have no explanatory power in their case.

⁷ Guner, Malmendier and Tate (2004) show that bigger corporate loans go mostly to firms with good credit quality and they use this finding to conclude that commercial bankers do not act in the interest of shareholders but rather in the interest of credit holders.

The literature on the board's financial knowledge has focused mainly on the earnings management problem. To the best of our knowledge, no paper has ever investigated the impact of the board's financial knowledge on the risk management policy⁸. Our paper is the first to establish such link. To the extent that financially knowledgeable directors have a better understanding of the sophisticated financial tools involved in the risk management transactions, we expect firms whose boards count financially knowledgeable directors to engage more actively in risk management.

B. The role of the audit committee

The primary task of the audit committee is to oversee the firm's financial performance and ensure the reliability of its financial reporting. Periodic review of the firm's risk assessment system and the managerial actions used to manage its risks is a critical step toward fulfilling this task. The new rules set by the SOX require the presence of at least one financially knowledgeable director on the audit committee and the independence of all its members while the NYSE listed company manual requires that all members of the audit committee be independent and financially knowledgeable. The NYSE also requires that at least one member of the audit committee must have accounting knowledge. We would expect audit committees with such characteristics to provide effective monitoring because they are free of any influence from the firm's CEO and possess the financial background needed to understand what is going on in the firm. A large body of academic literature has investigated the extent to which audit committee independence and financial literacy/expertise are beneficial to shareholders.

The reported empirical evidence supports the argument that financially knowledgeable audit committees are beneficial to the firm. Indeed, Agrawal and Chadha (2005) show that the probability of earnings restatement is lower in firms whose audit committees have an independent director with a background in accounting or finance while Abbott, Parker and Peters (2002) find that the absence of a financial expert on the audit committee is significantly associated with an increased probability of financial misstatement and financial fraud. Furthermore, Xie, Davidson, and DaDalt (2003) show that the presence of investment bankers on the audit committee is associated with lower discretionary accruals in the firm and, Defond, Hann and Hu (2004) and Davidson et al. (2004) report a positive market response to the addition of a financial expert to the audit committee. Both papers find that the reaction is primarily driven by the appointment of directors with auditing/ accounting experience.

⁸ Borokhovich et al (2004) include a dummy variable indicating the presence of a bank executive in the board in their test of corporate hedging theories. However, this variable is aimed to control for the firm's access to financing by banks.

The benefit of having independent directors on the audit committee is however still the subject of much debate because of the conflicting results reported in the literature. Indeed, Hayes, Mehran and Scott (2004) show that the firm's performance measured by the market to book ratio is unrelated to the fraction of outside directors serving on the audit committee and Beasley (1996) finds that the presence of an audit committee and its composition do not affect the likelihood of financial statement fraud. Likewise, Agrawal and Chadha (2005) report evidence indicating that the independence of the audit committee members has no effect on the probability of earnings restatement. These empirical findings suggest that the independence of the audit committee members provides no superior benefit to the firm. However, Klein (2002) shows that firms with independent audit committees are less likely to manage their earnings by reporting abnormal accruals than firms with insider-dominated audit committees. Moreover, Abbott, Parker and Peters (2002) find that the presence of audit committees comprised entirely of independent directors decreases the likelihood of both financial misstatement and financial fraud, whereas Carcello and Neal (2000) report an inverse relation between the likelihood of receiving a going-concern report and the percentage of affiliated directors sitting on the audit committee.

To the best of our knowledge no paper has ever tried to establish a relation between the composition of the audit committee, the background of its members, and corporate hedging. Our paper is the first to establish such link. Given the conflicting empirical evidence reported for the independence argument, we offer no directional expectations about the effect, on the firm's risk management activity, of the new rules set by the SOX and the NYSE concerning the audit committee independence. Likewise, because audit committee members with financial backgrounds have the experience and training to understand the risk management operations, we expect firms with at least one financially knowledgeable director on their audit committees and those whose audit committees is entirely composed of financially knowledgeable directors to engage more actively in risk management.

Furthermore, in addition to imposing the presence of independent and financially knowledgeable directors on the audit committee, the NYSE's listed company manual requires that the audit committee be composed of at least three members. This rule is likely motivated by the desire to encourage firms to devote significant director resources to their audit committees. Indeed, audit committees with more members should be able to monitor the firm's management more efficiently. However, communication between members might become more difficult in large audit committees which could deteriorate the quality of monitoring. Therefore, to the extent that the increase in the audit committee's size does not hinder communication among its members, we expect firms complying with this requirement to report a higher hedging ratio.

II. Research design

A. The sample

A.1. Sample construction procedure

In order to conduct our tests, we need quarterly observations on the composition of the board and audit committee and on the background of their members. Unfortunately, this information is published on an annual base in the firm's proxy statement. Therefore, we suppose that the firm's corporate governance characteristics will remain constant between two consecutive general annual meetings. We believe this assumption is reasonable since directors are usually elected, for at least a one year term, at the general annual meeting.

We first check the fiscal year end for each firm in the sample during the period considered. Next, we match the general annual meeting date with the closest fiscal quarter end in order to determine in what fiscal quarter the meeting occurred. For example if the firm's fiscal year end for 1997 is December 31st, and the general annual meeting is held on May 28th, 1997, we suppose that the general annual meeting is held in the second quarter of fiscal year 1997. Then, we collect data on the corporate governance characteristics of the firm. To avoid endogeneity problems, all our independent variables are measured one quarter prior to the one in which the hedge ratio is observed. Therefore, we use the corporate governance data collected from a proxy statement for all the risk management observations following the quarter in which the general annual meeting is held and we stop at the quarter in which the next annual general meeting occurs. Using the example mentioned above, if we suppose that the 1998 general annual meeting is held in the second quarter of 1998, the corporate governance data collected from the 1997 proxy statement is used for the third and fourth quarters of 1997 and the first and second quarters of 1998. Figure 1 summarizes the procedure used to construct our sample.

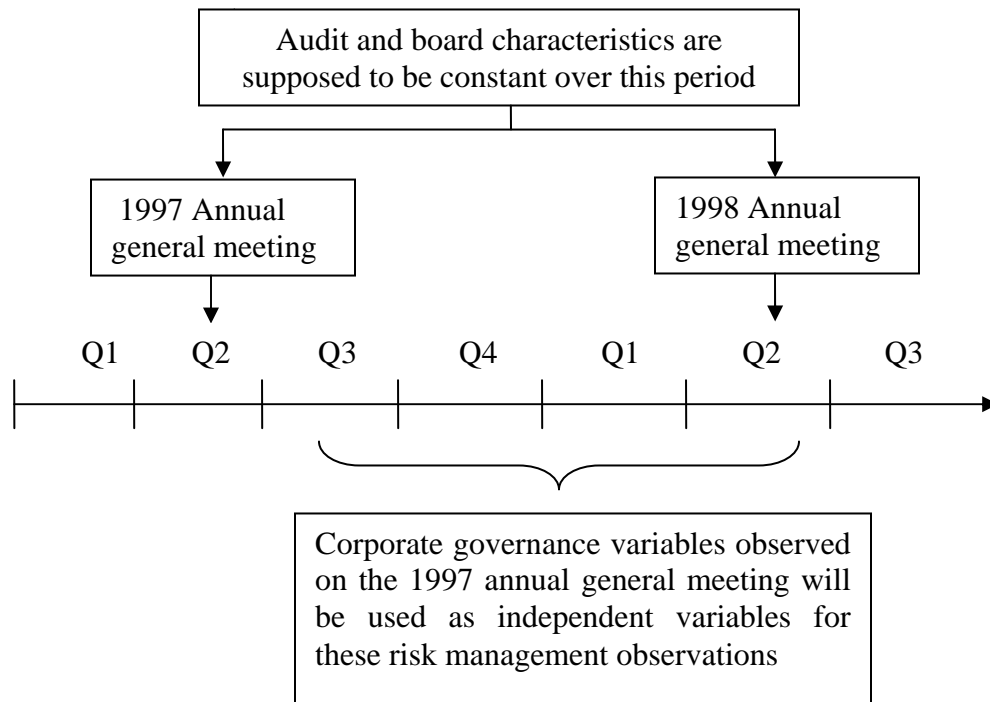


Figure 1: Sample constitution procedure

A.2. Data

Data on the firm’s risk management activities, leverage, the convexity-based tax advantage of hedging, the investment opportunities and the firm’s home country comes from Dionne and Triki (2004). The initial sample covers the period running from January 1993 to December 1999 and corresponds to a panel dataset of 485 observations relative to 36 North American gold mining firms. We collect from proxy statements information concerning the board and the audit committee sizes, the name of each director sitting on the board and on the audit committee, their education, current and former functions, as well as information concerning the age of the CEO, the number of common shares and the value of options he holds⁹. Institutional shareholding is obtained from the 13-F and 13-G forms available on the SEC website, and from the proxy statements.

We categorize directors as unrelated if they are independent of the firm’s management and free from any interest or relationship that could conceivably affect their ability to act in the best interests of the

⁹ Information from the proxy statements concerning the age of the CEO was available only for few Canadian firms because the publication of such information is not mandatory under Canadian law. Also, during our sample period there were only few details concerning the activities of the directors sitting on the board especially for Canadian firms and practically no information concerning the directors’ education for the whole sample.

firm, other than interests arising from shareholdings. We eliminate current or former employees of the firm or of a related entity, directors who are employees, partners or owners of companies that have provided some service to or received some form of compensation from the sample firm during the fiscal year. In order to achieve this classification we search (1) the biographical background of D&O, (2) the directors' compensation and (3) certain relationships and related transactions sections available in the proxy statements as well as biographical information available in the data sources listed in Appendix 1.

We also search these same data sources for information to determine whether the director has a current or former activity related to finance. A director is defined as financially active if he is presently or was formerly a CFO, treasurer, officer of an insurance or investment company, or of a mutual fund; a financial analyst, a financial consultant, a banker,or if he holds or formerly held any position related to finance. Moreover, we search the data sources for information concerning the directors' education because this information is available only for few firms through proxy statements. Our search of the proxy statements and the different sources listed in Appendix 1 yields data on the education of almost 70% of the 387 directors in our sample (corresponding to the initial 485 observations obtained from Dionne and Triki (2004)). In order to complete our dataset, we send an information request asking for details about the degrees held by the directors and their specialty to (1) the directors themselves, (2) the firms in our sample for which they have been or still are directors¹⁰, (3) other firms where they have served or still serve as directors. Data collection using the questionnaire was very difficult because many of the directors in our sample are retired now (some are even dead) and consequently, neither they nor the firms in which they were directors are obliged to disclose information about them.

The data on education is also used to categorize directors as being financially educated or not. A director is classified as financially educated if he holds a degree or was enrolled in a program offering finance courses (BBA, MBA, Chartered accountant designation, Bachelor in commerce.....). Several directors in our sample enrolled in professional programs such as the Harvard Advanced Management Program (AMP) and the Program for Management Development (PMD) or the Stanford Executive Program. After checking the list of courses offered by these programs, we categorize these directors as financially educated. Finally, the information on education and activity is explored to determine whether the director has an accounting background. A director is said to have an accounting

¹⁰ In some cases, these firms had filed for bankruptcy and we were unable to contact them. Also, some firms in our sample were acquired or merged. In this case we contacted the entity remaining in place after the transaction.

background if he is a chartered accountant (CA, CPA), or have an education or activity related to accounting.

We were able to collect complete information about the directors' education for 324 observations. For the remaining variables our sample corresponds to 347 observations relative to 36 firms: 11 US and 25 Canadian.

B. Variables definition

B.1. The dependent variable

The firm's risk management activity is measured by the delta percentage (*Delta%*) defined as the delta of the risk management portfolio held by the firm divided by its expected production¹¹. The *Delta%* is measured at the quarter end.

B.2. Test variables

We are evaluating the impact of the board and audit committee independence and financial knowledge on corporate hedging. To be consistent with the SOX requirements, we code the following variables:

- *Tot_ind_aud*: is a dummy equal "1" if the audit committee is entirely composed of unrelated directors, "0" otherwise.
- *OnefinAct_aud*: is a dummy equal "1" if at least one member of the audit committee is financially active, "0" otherwise.
- *OnefinEdu_aud*: is a dummy equal "1" if at least one member of the audit committee is financially educated, "0" otherwise.
- *OneAcc_aud*: is a dummy equal "1" if at least one member of the audit committee has an accounting background, "0" otherwise.

The three last variables correspond to the different definitions we propose for financial knowledge. The last one describes also the NYSE requirement concerning the presence of at least one director with an accounting background on the audit committee.

To be consistent with the NYSE requirements, we code these additional variables:

- *Maj_unr_board*: is a dummy equal “1” if the board has a majority of unrelated directors, “0” otherwise. As in Dechow et al. (1996), we use a cut-off rule of 50% to define the board’s majority.
- *Minsize_aud*: is a dummy equal “1” if the audit committee has at least three members, “0” otherwise.
- *AllfinAct_aud*: is a dummy equal “1” if all the directors sitting on the audit committee are financially active, “0” otherwise.
- *AllfinEdu_aud*: is a dummy equal “1” if all the directors sitting on the audit committee are financially educated, “0” otherwise
- *%Acc_aud*: is the proportion of directors with an accounting background sitting on the audit committee. Because no firm in our sample has an audit committee entirely composed of directors with an accounting background we were unable to construct a variable that measures the effect of having only accountants on this committee. We believe that *%Acc_aud* is a good alternative that will capture the benefit, if there is any, of having accountants on the audit committee.

Also, because we are interested in evaluating the effect of financial knowledge and independence for board members that do not sit necessarily on the audit committee, we code the following variables:

- *%unr_board*: is the proportion of unrelated directors on the board. It is calculated by dividing the number of unrelated directors by the board’s size. This variable allows us to investigate further the relation between the board’s independence and the risk management level in the firm.
- *MajfinAct_board* (*MajfinEdu_board*): is a dummy variable equal “1” if the majority of the directors sitting on the board are financially active (educated), “0” otherwise. Initially, we wanted to investigate the effect of extending the NYSE rules concerning financial knowledge to all the board members. However, we realized that such rule is unlikely to be implemented in practice because it ignores the benefit of having a board with a diversified background. It is true that financial knowledge is important but it is not the only valuable skill needed to manage a

¹¹ For more details concerning the definition and calculation of the delta percentage please refer to Tufano (1996).

firm. Therefore, we consider the alternative rule of having a majority of financially knowledgeable members on the board.

- *%Acc_board*: is the proportion of directors with an accounting background sitting on the board. It is calculated by dividing the number of directors with an accounting background by the board's size. Because no firm in our sample has a board with a majority of directors with an accounting background, we could not code a variable similar to *MajfinAct_board* and *MajfinEdu_board* for this definition of financial knowledge.
- *OneAcc_board*: is a dummy equal "1" if at least one member of the board has an accounting background, "0" otherwise. Unfortunately, all the firms in our sample have at least one director on their board that is financially active (educated). Therefore, we could not test empirically the effect of having at least one director with such skills on the board. However, inferences could be drawn from the audit committee's results because such firms do verify this condition.

B.3. Control variables

Several papers argue that whether information asymmetry concerns the cash flows generated from managerial investment decisions [Stulz, 1990], the firm's dividend stream [DeMarzo and Duffie, 1991], managerial quality [Breen and Viswanathan, 1998] or the magnitude and characteristics of the risks the firm faces [DeMarzo and Duffie, 1995]; the more important it is, the more attractive would be risk management because it reduces the costs associated with such asymmetry. As in Graham and Rogers (2002) we use the percentage of shares held by institutions (*%inst*) as a proxy for information asymmetry. We also control for the convexity-based tax advantage of hedging [Smith and Stulz, 1985] by including a variable (*taxsave*) constructed with a modified version of the simulation approach proposed by Graham and Smith (1999)¹². We expect firms to hedge more extensively when they have a greater fiscal advantage in doing so.

Moreover, prior research finds that managerial risk aversion is an important determinant of the risk management policy in the gold mining industry [Tufano, 1996; Pertersen and Thiagarajan, 2000]. We use three variables to proxy managerial risk aversion: the number of the firm's common shares held by the CEO (*CEO_CS*), the value of options held by the CEO (*ValCEO_op*) and the CEO age (*CEO_age*). The two first variables capture the Smith and Stulz (1985) argument that compensation packages

¹² For a detailed description of this procedure and the modifications introduced, please refer respectively to Graham and Smith (1999) and Dionne and Triki (2004).

leading to a concave (convex) function between the managers' expected utility and the firm's value encourage managers to hedge more (less)¹³. *CEO_age* is expected to be negatively related to corporate hedging because older CEOs have a smaller fraction of their revenues and human capital tied to the firm's value and therefore are less risk averse. However, Tufano (1996) argues that older CEOs facing imminent retirement might prefer reducing fluctuations in the firm's value and hence hedge more extensively. Recall also that the CEO age could proxy its experience.

Additionally, we control for the firm's financial distress costs because they are considered as an incentive for firms to increase their hedging ratio. Our proxy for the firm's financial distress costs is leverage (*Leverage*) measured as the book value of the long-term debt divided by the firm's market value. Likewise, we control for the firm's investment opportunities. Firms with attractive investment opportunities should hedge more extensively in order to ensure the availability of internally generated funds aimed to undertake these investments [Froot, Scharfstein and Stein, 1993; Morellec and Smith, 2002]. Our proxy for the firm's investment opportunities is (*Explo*), the firm's exploration expenditures scaled by its market value. Finally, we control for the firm's home country by including a dummy variable equal "1" if the firm is US, "0" otherwise (*Dum_US*) because our sample includes both US and Canadian firms.

III. Univariate analysis

Table I reports the descriptive statistics for our test and control variables. Firms in our sample seem to pay attention to the independence of their boards and in a lesser extent to the independence of their audit committees. Indeed, the mean proportion of unrelated directors on the board is 61.3% and 76.1% of the firms in our sample have a board with a majority of unrelated directors while only 51.9% of the firms have an audit committee entirely composed of unrelated directors. Also, all the firms in our sample have at least one director who is financially educated (active) on their board while the mean proportion of firms with at least one accountant is 70%. Likewise, the mean proportion of firms with at least one financially educated (active) director on their audit committee is almost 88% while it is only 47.3% for directors who are accountants. Overall, these results suggest that having at least one financially knowledgeable director on the board and audit committee is a common practice. Finally,

¹³ We decided to focus on the CEO holdings because (1) variables based on D&O holdings mix the incentive of different agents with different motives and (2) the CEO has the ultimate authority over an important decision like corporate hedging.

over 90% of the firms in our sample have an audit committee with at least three members suggesting that the new regulation on the audit committee size will probably not represent a constraint for firms because they already, to a large extent, meet with this requirement.

(Insert Table I here)

In Table II, we break down the sample into two groups according to the hedging ratio reported by the firm. The first group has a low level of risk management (*Delta%* less or equal to 50%) and the second group has a high level of risk management (*Delta%* strictly superior to 50%). Table II reports descriptive statistics for both groups as well as results corresponding to a t-test of the differences in the means (column 3) and to a non parametric Wilcoxon rank sum test (column 6).

According to the results reported in Panel B and C, the mean proportion of firms whose board contains at least one director with an accounting background is greater for the high risk management group (84.9% compared to 66.8% and the difference is statistically significant at the 1% level) and the presence of directors with an accounting background on the audit committee seems to reduce corporate hedging. This finding suggests that the presence of directors with an accounting background could have opposite effects on the hedging ratio depending on where they sit.

Furthermore, the results indicate that the presence of unrelated directors on the board reduces corporate hedging. Indeed, the mean and median proportion of unrelated directors are higher for the low risk management group (the difference is statistically significant at the 1% level). However, the non significance of *Maj_unr_board* does not support the hypothesised negative relation between hedging the board's independence.

The results reported in Panel C also show that all the firms in the high risk management group have an audit committee composed of at least three members, whereas the mean proportion of firms meeting this standard for the low risk management group is 89.4% (the difference is statistically significant at the 1% level for both tests). This finding suggests that the NYSE requirement on the audit size should lead to an increase in the firm's hedging ratio. Additionally, the mean proportion of firms whose audit committee is entirely composed of financially active directors is more important for the low risk management group (9.5% compared to 1.4% and the difference is statistically significant at the 1% level) which suggests that financially active directors discourage corporate hedging. However, the non significance of *OnefinAct_aud* does not support this hypothesis. Finally, the results reported in panel C concerning the director's education are very similar to the ones reported for the whole board in panel B

and show that highly educated directors encourage risk management while those holding only a bachelor degree discourage corporate hedging.

Overall, the univariate tests reported in Table II suggest that board independence and the education of the directors sitting on the board and on the audit committee is an important determinant of the hedging extent. The presence of directors with an accounting background seems also to affect this activity but the net effect is not clear. Given the multivariate aspect of the firm's characteristics, these univariate tests should be interpreted with caution. Thus, multivariate analysis is necessary and will be the subject of the next section.

(Insert Table II here)

IV. Multivariate analysis

In this section, we use multivariate analysis to examine the effect of the board/ audit committee independence and financial knowledge on the corporate hedging policy. We use a Tobit model to run our regressions in order to account for the censoring of our dependent variable (*Delta%*). Also, because our sample corresponds to a panel dataset, we had to choose between a random effect and a fixed effect specification. Greene (2004) shows that the incidental parameters problem affecting the fixed effect specification does not lead to biased estimates of the slope in the case of a Tobit model, but does cause a downward bias in the estimated standard deviations. Such a problem might lead to erroneous conclusions concerning the statistical significance of the variables used in the regressions. Accordingly, we opted for the random effect specification.

For the audit committee, our empirical tests are based on the following model:

$$\begin{aligned} \text{Delta\%} = & \alpha_0 + \alpha_1 \text{CEO_CS} + \alpha_2 \text{ValCEO_op} + \alpha_3 \text{Taxsave} + \alpha_4 \text{Leverage} + \alpha_5 \text{Explo} + \\ & \alpha_6 \text{Dum_US} + \alpha_7 \text{Indaud} + \alpha_8 \text{Finaud} + \alpha_9 \% \text{Inst} + \alpha_{10} \text{CEO_age} + \alpha_{11} \text{Minsize_aud} \\ & + u_i + \varepsilon_{it} \end{aligned}$$

For the board of directors, our empirical tests are based on the following model:

$$\begin{aligned} \text{Delta\%} = & \alpha_0 + \alpha_1 \text{CEO_CS} + \alpha_2 \text{ValCEO_op} + \alpha_3 \text{Taxsave} + \alpha_4 \text{Leverage} + \alpha_5 \text{Explo} + \\ & \alpha_6 \text{Dum_US} + \alpha_7 \text{Indbor} + \alpha_8 \text{Finbor} + \alpha_9 \% \text{Inst} + \alpha_{10} \text{CEO_age} + u_i + \varepsilon_{it} \end{aligned}$$

Where *Indaud* (*Indbor*) and *Finaud* (*Finbor*) correspond, respectively, to the different variables described in the previous section we use as proxies for the audit committee (board of directors) independence and financial knowledge.

Results in Table III correspond to our first definition of financial knowledge, i.e. financial activity. Panel A reports the results for the audit committee. Unlike Klein (2002), we find that the total independence of the audit committee is beneficial to the firm. Indeed, *Tot_ind_aud* has a positive and significant coefficient (at the 1% level) suggesting that an audit committee entirely composed of unrelated directors will encourage the firm to seek more hedging. However, the financial activity of the audit committee members is an irrelevant determinant of the hedging policy (*OnefinAct_aud* and *AllfinAct_aud* have insignificant coefficients). This result contradicts the findings of previous papers supporting the benefit of financially active directors on the audit committee [Abbott, Parker and Peters, 2002; Xie, Davidson, and DaDalt, 2003; Agrawal and Chadha, 2005]. In Models 3 and 4, we interact the independence and financial activity variables. The results suggests that audit committee independence increases the firm's risk management level, and this increase is greater when there is at least one financially active director on this committee but not when all the members of the committee are financially active. Our findings also confirm the conclusion we draw from the univariate analysis concerning the effect of having at least three members on the audit committee. *Minsize_aud* has a positive and significant coefficient (at the 1% in models 1 and 3 and at the 5% level in models 2 and 4) indicating that the NYSE requirement on the audit committee size will probably lead firms to seek more hedging.

Panel B reports the results for the entire board of directors. According to our findings, having a majority of directors who are independent or financially active has no effect on the firm's risk management activity (*Maj_unr_board* and *MajfinAct_board* have insignificant coefficients). However, the positive and significant (at the 1% level) coefficient reported for *%unr_board* suggests that the presence of unrelated directors on the board increases the hedging ratio but that the marginal benefit is limited because it disappears once the number of these directors becomes important compared to the board's size. This conclusion does not support the intentions of the new guidelines promulgated by the NYSE. The results reported for model 3 in panel B also show that the benefit of having unrelated directors on the board is not affected by the presence of a majority of financially active directors. Finally, the coefficients reported for our control variables suggest that firms hedge in order to satisfy managerial risk aversion and to increase their value through a reduction of their financial distress and information asymmetry costs (*Leverage (%inst)* have a positive (negative) and significant coefficient at

the 1% level), and through a higher convexity tax advantage of hedging (*Taxsave* has a positive and significant coefficient at the 1% level).

(Insert Table III here)

Table IV reports the results for our second definition of financial knowledge, i.e. financial education. Panel A reports the results for the audit committee while Panel B reports the results for the entire board. Our conclusions concerning the benefit of having an audit committee entirely composed of unrelated directors and an audit committee composed of at least three members remain unchanged. Interestingly, *Delta%* is positively associated with directors' financial education which confirms that directors will act in the interest of shareholders when they have the financial background to understand the decisions they are taking. Indeed, firms whose audit committee is entirely composed of financially educated directors and those whose board has a majority of financially educated directors are more active in managing their risks (*AllfinEdu_aud* and *MajfinEdu_board* have a positive and significant coefficient at the 10% and 1% levels, respectively). However, the presence of only one financially educated director on the audit committee is insufficient to affect the risk management policy (*OnefinEdu_aud* has an insignificant coefficient). The two variables proxying the board's independence, *%unr_board* and *Maj_unr_board*, have positive and significant coefficients (at the 1% level) indicating that independent boards encourage firms to seek more hedging. Furthermore, the different interaction variables we use in models 3 and 4 reported in panel A and model 3 reported in Panel B have positive and significant coefficients (*Tot_ind_aud x OnefinEdu_aud* and *Tot_ind_aud x AllfinEdu_aud* coefficients are significant at the 1% level and *%unr_board x MajfinEdu_board* coefficient is significant at the 10% level) suggesting that the benefit of independence increase when combined with financial education. This result confirms the importance of financial education for the board and the audit committee members.

Overall, our findings show the benefit of having financially literate directors not only on the audit committee, as required by the NYSE new rules, but also on the other committees of the board. It also provides support for the majority of unrelated directors' requirement set by the NYSE. Finally, gold mining firms seem to hedge in order to increase their value and decrease their managerial risk aversion.

(Insert Table IV here)

Table V reports the results for our third definition of financial knowledge, i.e. accounting background. Panel A shows that, as for the two previous definitions considered, the presence of an audit committee

entirely composed of unrelated directors and with at least three members will increase the firm's risk management activity. However, the presence of directors with an accounting background on the audit committee does not affect the risk management policy (*OneAcc_aud* and *%Acc_aud* have insignificant coefficients). This conclusion does not support the definition of financial knowledge provided by the SOX nor the findings of Defond, Hann and Hu (2004) and Davidson et al. (2004). More importantly, this result suggests that the NYSE rule requiring at least one director with an accounting background is not necessarily of benefit to shareholders. Interestingly, the interaction variables in models 3 and 4 reported in Panel A have positive and significant coefficients (at the 1% level) indicating that the benefit of an audit committee entirely composed of independent directors increases when there are directors with an accounting background on it.

Panel B of Table V reports the results for the entire board. We measure the board's independence by two variables: *Maj_unr_board* and *%unr_board*. The presence of at least one director with an accounting background on the board (*One_Acc_board*) and the percentage of directors with such skills (*%Acc_board*) are insignificantly related to the *Delta%*. Also, the presence of unrelated directors on the board seems to encourage corporate hedging but the benefit of such directors is limited. Indeed, while *%unr_board* has a positive and significant coefficient (at the 1% level), *Maj_unr_board* has an insignificant one. The interaction variables we use in models 5 and 6 reported in panel B have insignificant coefficients also suggesting that the presence of directors with an accounting background on the board does not amplify the benefit of having unrelated directors in this entity. Finally, our conclusions concerning the other determinants of the risk management policy remain unchanged.

(Insert Table V here)

The results from the multivariate analysis show that the requirements concerning the audit committee's size and independence are beneficial to shareholders because they incite the firm to increase its risk management activities. Moreover, the benefit of having an audit committee entirely composed of unrelated directors increases when it is combined with the presence of financially educated directors or directors with an accounting background on it. Little support is provided for the NYSE rule requiring a majority of unrelated directors on the board and the presence of at least one director with an accounting background. Interestingly, only the directors' financial education is shown to affect the firm's risk management activity. This result implies that the SEC should probably provide a narrower definition of the financially knowledgeable term, one that is closer to the notion of financial education. Finally,

consistent with Tufano (1996), our evidence suggests that the CEO's age has no effect on the firm's risk management activity.

V. The importance of education for directors

Results from the previous section show that the directors' financial education is an important determinant of the hedging ratio. This finding indicates that, when the directors have the skills required to understand the different operations involved in the risk management policy, they will make decisions that are optimal from the shareholders perspective. This result leaves us wondering whether we need to require a minimum of education on the directors sitting on the board in order to ensure more efficient corporate decision-making. Of course, we are not saying here that directors without a university degree are not capable of doing a good job but we all know that a college degree does guarantee a minimum level of knowledge. In this section, we investigate the effect of the directors' education on the risk management activity. To conduct our tests we code the following variables:

- *%ba_board*: is the proportion of directors holding a bachelor degree on the board. It is calculated by dividing the number of directors holding such a degree by the board's size.
- *%supba_board*: is the proportion of directors holding a degree higher than a bachelor on the board. It is calculated by dividing the number of directors holding a degree higher than a bachelor (M.Sc, MBA, graduate degree, doctorate, etc) by the board's size.
- *%ba_aud*: is the proportion of directors holding a bachelor degree on the audit committee. It is calculated by dividing the number of directors holding only a bachelor by the audit committee's size.
- *%supba_aud*: is the proportion of directors holding a degree higher than a bachelor on the audit committee. It is calculated by dividing the number of directors holding a degree higher than a bachelor (M.Sc, MBA, graduate degree, doctorate, etc) by the audit committee's size.

The model we estimate for the board of directors in this section is:

$$\Delta\% = \alpha_0 + \alpha_1 CEO_CS + \alpha_2 ValCEO_op + \alpha_3 Taxsave + \alpha_4 Leverage + \alpha_5 Explo + \alpha_6 Dum_US + \alpha_7 Indbor + \alpha_8 Ed_board + \alpha_9 \%Inst + \alpha_{10} CEO_age + u_i + \varepsilon_{it}$$

For the audit committee, our empirical tests are based on the following model:

$$\begin{aligned} \Delta\% = & \alpha_0 + \alpha_1 CEO_CS + \alpha_2 ValCEO_op + \alpha_3 Taxsave + \alpha_4 Leverage + \alpha_5 Explo + \\ & \alpha_6 Dum_US + \alpha_7 Indaud + \alpha_8 Ed_aud + \alpha_9 \%Inst + \alpha_{10} CEO_age + \alpha_{11} Minsize_aud \\ & + u_i + \varepsilon_{it} \end{aligned}$$

Where *Ed_board* and *Ed_aud* correspond respectively to the different variables, previously described, we use as proxies for the board and the audit committee education.

Panel A and B of Table VI report respectively the results for the audit committee and the entire board of directors. According to the reported coefficients and p-values, the education of audit committee members has no effect on the risk management activity. Interestingly, the results corresponding to the entire board show that the hedging level is a decreasing function of the proportion of directors holding only a bachelor degree (*%ba_board* has a negative and significant coefficient at the 1% level) and an increasing function of the percentage of directors holding a degree superior to a bachelor (*%supba_board* has a positive and significant coefficient at the 1% level). Our findings suggest that (1) education is important for the directors sitting on the board, (2) directors holding a bachelor degree do not necessarily have the required skills to monitor properly the firm's top management and consequently the latter will decrease the level of risk management even if it is beneficial to the firm, (3) directors holding a degree higher than a bachelor exercise a better control and the firm will increase its risk management activity in their presence. Our findings provide the first empirical evidence concerning the importance of university education for the directors sitting on the board. Our conclusions pertaining to the board/audit committee independence and other determinants of the hedging policy remain unchanged.

(Insert Table VI here)

VI. Joint examination of the board and the audit committee characteristics

Thus far, we have analyzed the effect of board and audit committee independence, education and financial knowledge separately, as if these two institutions were independent. This way of doing does not allow us to determine whether it is the board or the audit committee characteristics that are driving the results. In this section, we combine in the same regression board and audit committee characteristics, in order to check the robustness of our findings. To do so, we construct for the board

(audit committee) a score variable called *govindexbor* (*govindexaud*) that combines information about the independence, education, and financial knowledge of its members. *Govindexbor* and *govindexaud* will be our proxies for the governance quality of the board and the audit committee. The higher the value of these variables, the better the governance quality of these institutions will be. Details concerning the methodology used to construct both scores are provided in Appendix 2.

The model we estimate in this section is the following:

$$\Delta\% = \alpha_0 + \alpha_1 CEO_CS + \alpha_2 ValCEO_op + \alpha_3 Taxsave + \alpha_4 Leverage + \alpha_5 Explo + \alpha_6 Dum_US + \alpha_7 govindexbor + \alpha_8 govindexaud + \alpha_9 \%Inst + \alpha_{10} CEO_age + u_i + \varepsilon_{it}$$

Table VII reports the results of our regression. Interestingly, *govindexbor* and *govindexaud* have positive and significant coefficients (at the 1% level) suggesting that a board/ audit committee with a good governance quality encourages corporate hedging. This finding confirms our previous conclusion that the board (audit committee) will act in the interest of shareholders when it has the competence to do so. The results also show that our previous findings concerning the board's independence and financial knowledge are not driven by those relative to the audit committee. Accordingly, regulators should not only focus on the audit committee characteristics when setting corporate governance rules for modern corporations. The other results reported in Table VII are consistent with our previous findings.

(Insert Table VII here)

VII. The effect of risk management on the firm performance

A. Basic model

The empirical results reported in the previous sections show that independent and financially educated directors encourage hedging activities. These findings do not, however, necessarily imply that shareholders are better off with such directors on their boards and audit committees. In order to answer this question, we investigate the effect of corporate risk management on the firm's performance. If a higher hedging ratio improves the firm's performance and if independent and financially educated directors encourage risk management activities, we can assert that shareholders are better off with such directors on their boards and audit committees.

We use the return on equity (*ROE*) as a measure for the firm's performance because it focuses on the actual financial rate of return to the firm's owners. Therefore, it is an appropriate measure in terms of determining whether corporate hedging enhances the wealth of shareholders. Below, we describe the different arguments we control for and the theoretical background behind their inclusion:

- *Size*: as the firm size increases, it becomes more difficult to sustain impressive performance [Banz, 1981]. Thus, larger firms are expected to report lower ROE. Allayannis and Weston (2001) reported evidence confirming this hypothesis. However, larger firms could report a higher performance because they benefit from greater diversification and economies of scale as well as cheaper sources of funds. We use the natural logarithm of net sales (*Lnsales*) as a proxy for the firm's size and we conjecture that it could have a negative or a positive coefficient.
- *Risk management*: different theories have been put forward to show that hedging is beneficial to the firm [Smith and Stulz, 1985; Stulz, 1990; DeMarzo and Duffie, 1991; Breeden and Viswanathan, 1998; Froot, Scharfstein and Stein, 1993; Morellec and Smith, 2002....etc.]. To the extent that hedging increases the firm's performance, the *ROE* should be positively associated with our measure of corporate hedging, i.e. the *Delta%*.
- *Leverage*: the impact of debt on the firm's performance is not clear. Indeed, according to the agency theory, the monitoring provided by debt financing reduces management's incentive to squander free cash flows, and consequently should lead to a better firm performance. On the other hand, higher leverage makes the debt burden heavier and limits the firm in its investment choices. Our proxy for leverage is the long term debt divided by the firm's market value (*Leverage*) and we offer no directional expectation concerning the sign of its coefficient.
- *Operational efficiency*: as in Jin and Jorion (2004), we control for this argument because we think that firms with high operational costs are less likely to report a good performance. We measure the firm's operational efficiency by its cash cost (*Cost*) defined as the operating cost of producing one ounce of gold, excluding all non-cash items such as depreciation, amortization and other financial costs. We expect the ROE to be negatively related to this variable.

- *Investment opportunities*: firms with greater investment opportunities are more likely to report a higher performance. We use the ratio of exploration expenditures to the firm's value (*Explo*) as a proxy for investment opportunities and expect a positive coefficient for this variable.
- *Corporate governance characteristics*: a strong corporate governance system should lead to a higher firm performance because the manager's interests are more aligned with those of the shareholders. We use two proxies for internal corporate governance mechanisms: the proportion of unrelated directors on the board (*%unr_board*) and a dummy equal one if the CEO is also the chairman of the board (*CEO_COB*), 0 otherwise. We also use the percentage of shares held by institutions (*%inst*) as a proxy for external corporate governance mechanisms. We expect a negative coefficient for *CEO_COB* and positive ones for *%unr_board* and *%inst*.
- *Country effect*: we think that the home country of the firm could affect its performance. We include a dummy variable that equals one if the firm is US, 0 otherwise (*Dum_US*) and we offer no directional expectation concerning its sign.
- *Market movements*: gold mining firms are more likely to report a high performance when the gold market is bullish. We include the price of an ounce of gold in the spot market (*Gold_price*) to control for market movements and expect a positive sign for its coefficient.
- *Change in the management*: newly hired managers usually need a certain amount of time to understand the firm's operations and improve its performance. We include a dummy variable equal one if the CEO of the firm has changed during the past year, 0 otherwise (*CEO_change*) and we expect it to be negatively related to the ROE.

The independent variables newly included in this section were hand collected except for the gold price which was obtained from DataStream and the *ROE* whose inputs were collected from COMPUSTAT Quarterly files. All independent variables are measured one quarter prior to the one in which the ROE is calculated in order to avoid endogeneity problems. The model we estimate in this section is:

$$ROE = \alpha_0 + \alpha_1 \Delta\% + \alpha_2 \text{Lnsales} + \alpha_3 \text{Leverage} + \alpha_4 \text{Cost} + \alpha_5 \text{Explo} + \alpha_6 \%unr_board + \alpha_7 \text{CEO_COB} + \alpha_8 \%inst + \alpha_9 \text{Dum_US} + \alpha_{10} \text{Gold_price} + \alpha_{11} \text{CEO_change} + u_i + \varepsilon_{it}$$

In order to check the robustness of our findings, we estimate our model with four specifications: (1) a random effect specification, (2) a pooled OLS specification where we correct for clustering and

heteroschedasticity with the Huber-White sandwich estimate of standard errors (3) a random effect specification where we control for time by including dummies for years and, (4) a random effect specification where we control for time by including dummies for quarters. The results and conclusions drawn from these specifications are very similar. For the sake of brevity, Table VIII reports only the results obtained with the random effect specification. Interestingly, the coefficient of *Delta%* is positive and significant (at the 10% level) confirming that risk management is beneficial to the firm and its shareholders¹⁴. This finding confirms the conclusions reached by Allayannis and Weston (2001) and by Carter, Rogers and Simkins (2003), though they are based on a different measure of the firm's performance, i.e. the Tobin's Q. Our evidence combined with the one reported in Carter, Rogers and Simkins (2003) suggest that firms benefit from hedging their commodity risks and this is true regardless of whether the risk affects their revenues or costs. The gold price has also a positive and significant coefficient (at the 1% level) indicating that gold mining firms report a higher performance when the gold market is bullish. Furthermore, the results reported in table VIII suggest that the firm is more likely to report a poor performance when the CEO is also the chairman of the board (COB). This finding is expected because CEOs who are also COBs enjoy greater discretionary power and this allows them to realize some actions that do not necessarily benefit shareholders.

(Insert Table VIII here)

B. Control for the endogenous aspect of the risk management decision

In section A, we showed that risk management, as measured by the *Delta%* increases the rate of return to the firm's owners. However, there may be an alternative explanation for this finding. Indeed, profitable firms are usually under pressure to sustain their earnings and may have an added incentive to hedge. Therefore, a higher *ROE* for firms managing their risks could simply indicate that profitable firms have a greater incentive to hedge, and not that risk management leads to higher performance. In the previous section, we control for endogeneity by measuring *Delta%* one quarter prior to the one in which the *ROE* is calculated and this could be an insufficient remedy. In this section, we present a modeling strategy based on instrumental variables that controls for the possible endogeneity of the risk management policy. The estimation is done in two stages. In the first stage we calculate the predicted value of the firm's risk management activity (*Delta%**). We include the following variables to control

¹⁴ The relation between risk management and the firm's *ROE* is even stronger when we control for time by including dummies for years and quarters (the coefficient of *Delta%* is significant at the 5% level in these models). The results obtained with these specifications are available from the authors upon request.

for the different aspects of the firm: *CEO_CS*, *ValCEO_op*, *Taxsave*, *Leverage*, *Dum_US* and *%ins*. We drop *Explo* and *CEO_age* from our model because they were hardly significant in previous regressions. Also, we include *govindexbor* and *govindexaud* in the model to capture information about the independence, financial knowledge and education of the board and the audit committee members.

Econometrically speaking, if y is the observed level of risk management and x is the vector of the above mentioned explanatory variables, we need to calculate $E[y/x]$ to get the predicted value of corporate hedging and this is not an easy task to achieve. Indeed, our model in this first stage corresponds to a Tobit specification with individual random effect. In order to calculate the predicted values, we extend the formula presented in Maddala (1986) to the case of a random effect Tobit model. The details of our calculation are provided in Appendix 3. In the second stage, we estimate the same model as in section A, except that we use the predicted value instead of the observed value of *Delta%* as explanatory variable.

Panel A of Table IX reports the results for the first stage regression while Panel B reports the results for the second stage regression. Because we have already focused our attention in the previous sections on models similar to the one used in the first stage, we will limit our discussion to the results obtained in the second stage. Consistent with the findings reported in the previous section, the coefficient of *Delta%** is positive and significant (at the 10% level) confirming that firms managing their risk report a higher performance for their shareholders. Accordingly, the positive relation between hedging and the firm's performance reported earlier in the paper is not the result of an endogeneity problem. Our evidence also confirms that gold mining firms offer a higher return to their shareholders when the gold market is bullish.

(Insert Table IX here)

Overall, the findings reported in Tables III to IX suggest that the presence of independent and financially educated directors on the board and audit committee is beneficial to shareholders because it improves the firm's performance through an increase of its hedging ratio.

VIII. Conclusion and implications

The goal of this research was to study the effect of the board and the audit committee independence and financial knowledge on the firm's risk management activity. Our work is motivated by the new

regulation set by the SOX and the NYSE requiring such characteristics for publicly traded companies. The risk management policy is the perfect laboratory for such investigation because (1) the new regulation obliges the audit committee to discuss and control henceforth this activity, (2) it is well documented in the literature that risk management is beneficial to firms, a conclusion that we confirmed empirically for our sample and, (3) risk management implies dealing with financially sophisticated tools. Therefore, considering corporate hedging allows us to test whether an independent board/audit committee is capable of taking mandatory complicated decisions that are in the interest of shareholders or whether we need to impose financial knowledge on the directors to achieve this goal.

We explore multiple definitions for a director who is financially knowledgeable: a director with any present or former activity or position related to finance, a director who has received an education offering financial literacy and finally a director who has an accounting background to be consistent with the SOX view. For each definition we assess the effect, on the firm's hedging policy, of two requirements set by the SOX (audit committee entirely composed of independent members and at least one member who is financially knowledgeable) and four requirements set by the NYSE (majority of independent directors on the board, audit committee with a minimum of three members, each member of the audit committee must be financially literate, and at least one member of the audit committee must have accounting knowledge). We also investigate the effect of requiring a majority of financially knowledgeable directors on the board as well as the importance of university education for directors sitting on the audit committee and on the board. To conduct our tests, we constructed an original dataset that was hand collected.

We find that the new requirements concerning the audit committee size and independence incite firms to seek more hedging, whereas the requirement of a majority of unrelated directors on the board has no effect on the corporate risk management activity. Likewise, directors with a financial activity and those with an accounting background seem to play no active role in the hedging policy. Interestingly, firms whose audit committees are entirely composed of financially educated directors and those whose boards have a majority of financially educated directors are more active in managing their risks. Therefore, only the directors' financial education affects the risk management policy. Our empirical results also show that the educational level of board members, but not of the audit committee members, is an important determinant of the hedging ratio. Indeed, the hedging level is found to be a decreasing function of the proportion of directors holding only a bachelor degree (*%ba_board*) and an increasing function of the percentage of directors holding a degree superior to a bachelor (*%supba_board*). This

result is the first direct evidence concerning the importance of university education for the board of directors.

The implications of this study are important for the SEC and stock exchanges. Our results suggest that the requirements on the audit committee size and independence are reasonable, although maintaining a majority of unrelated directors on the board and a director with an accounting background on the audit committee may not be necessary. Also, our findings show the need for the SEC and exchanges to provide a narrower definition for the financially knowledgeable term that emphasizes the importance of financial education. More importantly, our research suggests that the SEC and exchanges should not limit their attention to the independence and financial knowledge of the audit committee members when regulating corporate governance. Finally, the results we have reported show that university education for the directors sitting on the board could be considered in future regulation because it is beneficial to the firm.

Holmstrom and Kaplan (2003) claim that the SOX will lead to a better corporate governance system as long as we can avoid overregulation. We also think that over regulating the US corporate governance system will represent a major problem for modern organizations but this does not mean we have to rule out new requirements that could be beneficial to shareholders simply because we fear overregulation.

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Table I: Descriptive statistics

This table reports descriptive statistics for our variables. *Tot_ind_aud* is a dummy equal “1” if the audit committee is entirely composed of unrelated directors, “0” otherwise; *OnefinAct_aud* is a dummy equal “1” if at least one member of the audit committee is financially active, “0” otherwise; *OnefinEdu_aud* is a dummy equal “1” if at least one member of the audit committee is financially educated, “0” otherwise; *OneAcc_aud* is a dummy equal “1” if at least one member of the audit committee has an accounting background, “0” otherwise; *Maj_unr_board* is a dummy equal “1” if the majority of the board is constituted of unrelated directors, “0” otherwise; *Minsize_aud* is a dummy equal “1” if the audit committee has at least three members, “0” otherwise.; *AllfinAct_aud* is a dummy equal one if all the directors sitting on the audit committee are financially active, “0” otherwise; *AllfinEdu_aud* is a dummy equal one if all the directors sitting on the audit committee are financially educated, “0” otherwise; *%Acc_aud* is the proportion of directors with an accounting background sitting on the audit committee; *%unr_board* is the proportion of unrelated directors in the board; *MajfinAct_board* and (*MajfinEdu_board*) are dummy variable equal “1” if the majority of the directors sitting on the board are financially active (educated), “0” Otherwise; *%Acc_board* is the proportion of directors with an accounting background sitting on the board; *OneAcc_board* is a dummy equal “1” if at least one member of the board has an accounting background, “0” otherwise; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm’s common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm’s market value; *Explo* is the firm’s exploration expenditures scaled by its market value. *%ba_board* (*%ba_aud*) is the proportion of directors holding a bachelor degree in the board (audit committee); *%supba_board* (*%supba_aud*) is the proportion of directors holding a degree higher than a bachelor in the board (audit committee); Finally, *Dum_US* is a dummy equal “1” if the firm is US, “0” otherwise.

Variables	N	Mean	Median	Standard deviation
<i>Panel A: General Characteristics</i>				
Leverage	347	0.125	0.086	0.129
Taxsave	347	0.144	0.052	0.260
Explo	347	0.004	0.003	0.010
%inst	347	0.083	0.064	0.093
<i>Panel B: Board Structure</i>				
Maj_unr_board	347	0.761	1.000	0.427
%unr_board	347	0.613	0.615	0.186
MajfinAct_board	347	0.098	0.000	0.298
MajfinEdu_board	347	0.213	0.000	0.410
OneAcc_board	347	0.706	1.000	0.456
%Acc_board	347	0.133	0.125	0.110
%ba_board	324	0.599	0.583	0.175
%supba_board	324	0.335	0.308	0.180
<i>Panel C: Audit Committee Structure</i>				
Tot_ind_aud	347	0.519	1.000	0.500
AllfinEdu_aud	324	0.077	0.000	0.267
OnefinEdu_aud	324	0.870	1.000	0.336
AllfinAct_aud	347	0.078	0.000	0.268
OnefinAct_aud	347	0.882	1.000	0.323
Minsize_aud	347	0.916	1.000	0.277
OneAcc_aud	347	0.473	0.000	0.500
%Acc_aud	347	0.197	0.000	0.240
%ba_aud	324	0.610	0.667	0.270
%supba_aud	324	0.328	0.333	0.269
<i>Panel D: CEO Characteristics</i>				
CEO_CS (millions)	347	1.040	0.060	2.769
ValCEO_op CS (millions)	347	1.690	0.000	6.733
CEO_age	347	54.305	54.000	7.463

Table II: Univariate analysis

This table reports a univariate analysis of the variables used in the regressions. We break down the sample into two groups according to the risk management level adopted by the firm. The first group has a low level of risk management (delta percentage not greater than 50%) and the second group has a high level of risk management (delta percentage strictly greater than 50%). The table reports descriptive statistics for both groups as well as results corresponding to a t-test of the differences in the means and to a non parametric Wilcoxon rank sum test. *Tot_ind_aud* is a dummy equal “1” if the audit committee is entirely composed of unrelated directors, “0” otherwise; *OnefinAct_aud* is a dummy equal “1” if at least one member of the audit committee is financially active, “0” otherwise; *OnefinEdu_aud* is a dummy equal “1” if at least one member of the audit committee is financially educated, “0” otherwise; *OneAcc_aud* is a dummy equal “1” if at least one member of the audit committee has an accounting background, “0” otherwise; *Maj_unr_board* is a dummy equal “1” if the majority of the board is constituted of unrelated directors, “0” otherwise; *Minsize_aud* is a dummy equal “1” if the audit committee has at least three members, “0” otherwise.; *AllfinAct_aud* is a dummy equal one if all the directors sitting on the audit committee are financially active, “0” otherwise; *AllfinEdu_aud* is a dummy equal one if all the directors sitting on the audit committee are financially educated, “0” otherwise; *%Acc_aud* is the proportion of directors with an accounting background sitting on the audit committee; *%unr_board* is the proportion of unrelated directors in the board; *MajfinAct_board* and (*MajfinEdu_board*) are dummy variable equal “1” if the majority of the directors sitting on the board are financially active (educated), “0” Otherwise; *%Acc_board* is the proportion of directors with an accounting background sitting on the board; *OneAcc_board* is a dummy equal “1” if at least one member of the board has an accounting background, “0” otherwise; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm’s common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm’s market value; *Explo* is the firm’s exploration expenditures scaled by its market value. *%ba_board* (*%ba_aud*) is the proportion of directors holding a bachelor degree in the board (audit committee); *%supba_board* (*%supba_aud*) is the proportion of directors holding a degree higher than a bachelor in the board (audit committee); Finally, *Dum_US* is a dummy equal “1” if the firm is US, “0” otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

Variables	Mean			Median		
	High	Low	p-value	High	Low	p-value
Panel A: General Characteristics						
Leverage	0.154	0.118	0.049**	0.106	0.083	0.031**
Taxsave	0.173	0.136	0.479	0.012	0.064	0.000***
Explo	0.006	0.004	0.382	0.002	0.003	0.030**
%inst	0.086	0.082	0.700	0.087	0.055	0.299
Panel B: Board Structure						
Maj_unr_board	0.685	0.781	0.114	1.000	1.000	0.088*
%unr_board	0.541	0.633	0.000***	0.556	0.625	0.001***
MajfinAct_board	0.068	0.106	0.289	0.000	0.000	0.341
MajfinEdu_board	0.164	0.226	0.223	0.000	0.000	0.252
OneAcc_board	0.849	0.668	0.001***	1.000	1.000	0.003***
%Acc_board	0.138	0.131	0.561	0.143	0.125	0.498
%ba_board ⁽¹⁾	0.563	0.609	0.014**	0.600	0.583	0.171
%supba_board	0.384	0.322	0.005***	0.333	0.293	0.002***
Panel C: Audit Committee Structure						
Tot_unr_aud	0.603	0.496	0.105	1.000	0.000	0.107
AllfinEdu_aud ⁽¹⁾	0.043	0.087	0.148	0.000	0.000	0.225
OnefinEdu_aud ⁽¹⁾	0.871	0.870	0.976	1.000	1.000	0.976
AllfinAct_aud	0.014	0.095	0.003***	0.000	0.000	0.022**
OnefinAct_aud	0.890	0.880	0.795	1.000	1.000	0.799
Minsize_aud	1.000	0.894	0.000***	1.000	1.000	0.004***
OneAcc_aud	0.411	0.489	0.235	0.000	0.000	0.236

%Acc_aud	0.137	0.213	0.003***	0.000	0.000	0.061*
%ba_aud ⁽¹⁾	0.479	0.647	0.000***	0.500	0.667	0.000**
%supba_aud ⁽¹⁾	0.475	0.287	0.000***	0.500	0.250	0.000***
Panel D: CEO Characteristics						
CEO_CS CS (millions)	1.543	0.906	0.023**	0.570	0.050	0.000**
ValCEO_op CS (millions)	6.733	0.346	0.000***	0.000	0.010	0.442
CEO_age	56.644	53.682	0.013**	54	54	0.029**
Number of observations for the High group	73					
Number of observations for the Low group	274					

- (1) Statistics for these variables are reported for total number of observations of 70 for the High group and 254 for the Low group.

Table III: Results for financially active directors

In this table we are investigating the effect of the board and audit committee members' independence and financial activity on the risk management policy of the firm. The results are reported for a random effect Tobit specification. Our dependent variable is the delta percentage (Delta%). Panel A reports the results for the audit committee and Panel B reports the results corresponding to the whole board. *Tot_ind_aud* is a dummy equal "1" if the audit committee is entirely composed of unrelated directors, "0" otherwise; *OnefinAct_aud* is a dummy equal "1" if at least one member of the audit committee is financially active, "0" otherwise; *Maj_unr_board* is a dummy equal "1" if the majority of the board is constituted of unrelated directors, "0" otherwise; *Minsize_aud* is a dummy equal "1" if the audit committee has at least three members, "0" otherwise.; *AllfinAct_aud* is a dummy equal one if all the directors sitting on the audit committee are financially active, "0" otherwise; *Tot_ind_aud x OnefinAct_aud* is *Tot_ind_aud* multiplied by *OnefinAct_aud*, *Tot_ind_aud x AllfinAct_aud* is *Tot_ind_aud* multiplied by *AllfinAct_aud*, *%unr_board* is the proportion of unrelated directors in the board; *MajfinAct_board* is a dummy variable equal "1" if the majority of the directors sitting on the board are financially active, "0" Otherwise; *%unr_board x MajfinAct_board* is *%unr_board* multiplied by *MajfinAct_board*; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm's common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm's market value; *Explo* is the firm's exploration expenditures scaled by its market value. Finally, *Dum_US* is a dummy equal "1" if the firm is US, "0" otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

<i>Panel A: results for the audit committee members</i>								
Variables	Model 1		Model 2		Model 3		Model 4	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0122	0.002***	0.0114	0.004***	0.0120	0.003***	0.0140	0.001***
ValCEO_op	-0.0051	0.010**	-0.0050	0.010**	-0.0030	0.100**	-0.0078	0.001***
Taxsave	0.1099	0.006***	0.1082	0.006***	0.0764	0.052**	0.1336	0.003***
Leverage	0.7780	0.000***	0.7947	0.000***	1.0354	0.000***	0.7010	0.000***
Explo	-0.6888	0.447	-0.7829	0.381	-1.2028	0.190	-0.4974	0.604
Dum_US	-0.1323	0.000***	-0.1439	0.000***	-0.1036	0.000***	-0.0956	0.002***
Tot_ind_aud	0.1228	0.000***	0.1275	0.000***				
OnefinAct_aud	0.0087	0.789						
AllfinAct_aud			-0.0593	0.254				
Tot_ind_aud x OnefinAct_aud					0.2388	0.000		
Tot_ind_aud x AllfinAct_aud							-0.0154	0.816
Minsize_aud	0.1148	0.007***	0.1070	0.012**	0.2120	0.000***	0.0970	0.040***
%inst	-0.6833	0.000***	-0.6497	0.000***	-0.9024	0.000***	-0.5175	0.000***
CEO_age	0.0001	0.973	-0.0001	0.956	-0.0015	0.407	0.0003	0.851
Intercept	0.0815	0.463	0.1089	0.302	-0.0438	0.661	0.1096	0.337
Log likelihood	33.70		34.30		36.97		19.78	

<i>Panel B: results for the board members</i>						
Variables	Model 1		Model 2		Model 3	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0135	0.001***	0.0120	0.002***	0.0146	0.001***
ValCEO_op	-0.0087	0.000***	-0.0091	0.000***	-0.0080	0.001***
Taxsave	0.1337	0.001***	0.1675	0.000***	0.1362	0.002***
Leverage	0.6960	0.000***	0.8071	0.000***	0.6927	0.000***
Explo	-0.4370	0.646	-1.0156	0.279	-0.4658	0.637
Dum_US	-0.1114	0.001***	-0.1674	0.000***	-0.0877	0.006***
Maj_unr_board	0.0421	0.192				
%unr_board			0.3343	0.000***		
MajfinAct_board	0.0278	0.479	0.0172	0.640		
%unr_board x MajfinAct_board					0.0650	0.325
%inst	-0.5617	0.000***	-0.7466	0.000***	-0.5226	0.000***
CEO_age	0.0011	0.587	-0.0013	0.506	0.0004	0.838
Intercept	0.1403	0.193	0.1313	0.210	0.1889	0.072*
Log likelihood	19.10		24.46		17.76	
Number of Observations : 347						
Uncensored observations: 296						
Censored observations: 51						

Table IV: Results for financially educated directors

In this table we are investigating the effect of the board and audit committee members' independence and financial education on the risk management policy of the firm. The results are reported for a random effect Tobit specification. Our dependent variable is the delta percentage (Delta%). Panel A reports the results for the audit committee and Panel B reports the results corresponding to the whole board. *Tot_ind_aud* is a dummy equal "1" if the audit committee is entirely composed of unrelated directors, "0" otherwise; *OnefinEdu_aud* is a dummy equal "1" if at least one member of the audit committee is financially educated, "0" otherwise; *Maj_unr_board* is a dummy equal "1" if the majority of the board is constituted of unrelated directors, "0" otherwise; *Minsize_aud* is a dummy equal "1" if the audit committee has at least three members, "0" otherwise.; *AllfinEdu_aud* is a dummy equal one if all the directors sitting on the audit committee are financially educated, "0" otherwise; *Tot_ind_aud x OnefinEdu_aud* is *Tot_ind_aud* multiplied by *OnefinEdu_aud*, *Tot_ind_aud x AllfinEdu_aud* is *Tot_ind_aud* multiplied by *AllfinEdu_aud*, *%unr_board* is the proportion of unrelated directors in the board; *MajfinEdu_board* is a dummy variable equal "1" if the majority of the directors sitting on the board are financially educated, "0" Otherwise; *%unr_board x MajfinEdu_board* is *%unr_board* multiplied by *MajfinEdu_board*; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm's common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm's market value; *Explo* is the firm's exploration expenditures scaled by its market value. Finally, *Dum_US* is a dummy equal "1" if the firm is US, "0" otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

<i>Panel A: results for the audit committee members</i>								
Variables	Model 1		Model 2		Model 3		Model 4	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0116	0.003***	0.0082	0.046**	0.0175	0.000***	0.0185	0.000***
ValCEO_op	-0.0052	0.008***	-0.0053	0.006***	-0.0065	0.001***	-0.0043	0.029**
Taxsave	0.1930	0.000***	0.1901	0.000***	0.2367	0.000***	0.1640	0.000***
Leverage	1.2967	0.000***	0.6973	0.000***	0.8514	0.000***	0.6233	0.000***
Explo	-1.3183	0.130	-0.7977	0.354	-0.6738	0.434	-0.3284	0.709
Dum_US	-0.1436	0.000***	-0.2027	0.000***	-0.2779	0.000***	-0.1027	0.000***
Tot_ind_aud	0.3279	0.000***	0.2578	0.000***				
OnefinEdu_aud	0.0216	0.525						
AllfinEdu_aud			0.0625	0.080*				
Tot_ind_aud x OnefinEdu_aud					0.3633	0.000***		
Tot_ind_aud x AllfinEdu_aud							0.2401	0.000***
Minsize_aud	0.3166	0.000***	0.2552	0.000***	0.2326	0.000***	0.0736	0.074*
%inst	-0.8355	0.000***	-1.0355	0.000***	-0.9402	0.000***	-0.6567	0.000***
CEO_age	-0.002	0.240	0.0019	0.319	0.0009	0.692	0.0035	0.050**
Intercept	-0.2720	0.007***	-0.1841	0.072*	-0.0890	0.488	-0.1730	0.862
Log likelihood	50.58		50.38		43.12		41.47	
Number of Observations : 324								

Uncensored observations: 285

Censored observations: 39

Panel B: results for the board members

Variables	Model 1		Model 2		Model 3	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0143	0.000***	0.0130	0.001***	0.0159	0.000***
ValCEO_op	-0.0122	0.000***	-0.0100	0.000***	-0.0075	0.001***
Taxsave	0.1330	0.001***	0.1568	0.000***	0.1349	0.002***
Leverage	0.7775	0.000***	0.8668	0.000***	0.7163	0.000***
Explo	-0.7623	0.405	-0.9081	0.336	-0.5242	0.579
Dum_US	-0.1492	0.000***	-0.1632	0.000***	-0.0846	0.009***
Maj_unr_board	0.0853	0.002***				
%unr_board			0.3679	0.000***		
MajfinEdu_boad	0.1067	0.000***	0.0850	0.006***		
%unr_board x MajfinEdu_boad					0.0943	0.065*
%inst	-0.7346	0.000***	-0.8570	0.000***	-0.5604	0.000***
CEO_age	0.0024	0.177	-0.0006	0.743	0.0009	0.630
Intercept	0.0652	0.506	0.0712	0.505	0.1510	0.143
Log likelihood	20.68		27.44		19.03	

Number of Observations : 349

Uncensored observations: 296

Censored observations: 51

Table V: Results for directors with an accounting background

In this table we are investigating the effect of the board and audit committee members' independence and accounting background on the risk management policy of the firm. The results are reported for a random effect Tobit specification. Our dependent variable is the delta percentage (Delta%). Panel A reports the results for the audit committee and Panel B and C report the results corresponding to the whole board. *Tot_ind_aud* is a dummy equal "1" if the audit committee is entirely composed of unrelated directors, "0" otherwise; *OneAcc_aud* is a dummy equal "1" if at least one member of the audit committee has an accounting background, "0" otherwise; *Maj_unr_board* is a dummy equal "1" if the majority of the board is constituted of unrelated directors, "0" otherwise; *Minsize_aud* is a dummy equal "1" if the audit committee has at least three members, "0" otherwise.; *%Acc_aud* is the proportion of directors with an accounting background sitting on the audit committee; *Tot_ind_aud x OneAcc_aud* is *Tot_ind_aud* multiplied by *OneAcc_aud*, *Tot_ind_aud x %Acc_aud* is *Tot_ind_aud* multiplied by *%Acc_aud*, *%unr_board* is the proportion of unrelated directors in the board; *%Acc_board* is the proportion of directors with an accounting background sitting on the board; *OneAcc_board* is a dummy equal "1" if at least one member of the board has an accounting background, "0" otherwise; *%unr_board x OneAcc_board* is *%unr_board* multiplied by *OneAcc_board*; *%unr_board x %Acc_board* is *%unr_board* multiplied by *%Acc_board*; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm's common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm's market value; *Explo* is the firm's exploration expenditures scaled by its market value; Finally, *Dum_US* is a dummy equal "1" if the firm is US, "0" otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

<i>Panel A: results for the audit committee members</i>								
Variables	Model 1		Model 2		Model 3		Model 4	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0122	0.002***	0.0125	0.002***	0.0205	0.000***	0.0166	0.000***
ValCEO_op	-0.0052	0.011**	-0.0033	0.071*	-0.0053	0.007***	-0.0030	0.163
Taxsave	0.1094	0.007***	0.0724	0.073*	0.2187	0.000***	0.1061	0.019**
Leverage	0.7763	0.000***	1.0308	0.000***	0.7403	0.000***	0.7571	0.000***
Explo	-0.7171	0.425	-1.1899	0.193	-0.8455	0.332	-0.8093	0.376
Dum_US	-0.1324	0.000***	-0.0996	0.001***	-0.0904	0.002***	-0.1225	0.000***
Tot_ind_aud	0.1228	0.000***	0.2380	0.000***				
OneAcc_aud	-0.0030	0.895						
%Acc_aud			-0.0074	0.878				
Tot_ind_aud x OneAcc_aud					0.3038	0.000***		
Tot_ind_aud x %Acc_aud							0.4462	0.000***
Minsize_aud	0.1180	0.006***	0.2177	0.000***	0.0810	0.047**	0.0786	0.063*
%inst	-0.6724	0.000***	-0.8856	0.000***	-0.6640	0.000***	-0.9565	0.000***
CEO_age	0.0001	0.975	-0.0016	0.376	0.0033	0.062*	0.0031	0.110
Intercept	0.0877	0.417	-0.0473	0.637	-0.1697	0.081*	-0.1053	0.307
Log likelihood	33.67		34.66		39.96		31.86	

<i>Panel B: results for the board members</i>												
Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coef	p-value	Coef	p-value	Coef	p-value	Coef	p-value	Coef	p-value	Coef	p-value
CEO_CS	0.0136	0.001***	0.0135	0.001***	0.0117	0.002***	0.0119	0.002***	0.0188	0.000***	0.0148	0.000***
ValCEO_op	-0.0090	0.000***	-0.0090	0.000***	-0.0085	0.000***	-0.0091	0.000***	-0.0052	0.014**	-0.0078	0.001***
Taxsave	0.1326	0.002***	0.1343	0.002***	0.1688	0.000***	0.1670	0.000***	0.1360	0.001***	0.1346	0.003***
Leverage	0.6889	0.000***	0.6897	0.000***	0.8071	0.000***	0.8077	0.000***	0.6345	0.000***	0.7039	0.000***
Explo	-0.4706	0.621	-0.4571	0.631	-1.0806	0.246	-1.0392	0.256	-0.5818	0.549	-0.5627	0.564
Dum_US	-0.1163	0.001***	-0.1172	0.000***	-0.1748	0.000***	-0.1697	0.000***	-0.1204	0.004***	-0.0954	0.002***
Maj_unr_board	0.0472	0.141	0.0462	0.153								
%unr_board					0.3374	0.000***	0.3326	0.000***				
%Acc_board	-0.0049	0.962			-0.0659	0.502						
OneAcc_board			-0.0074	0.785			-0.0055	0.835				
%unr_board x OneAcc_board									0.0028	0.964		
%unr_board x %Acc_board											0.0805	0.591
%inst	-0.5564	0.000***	-0.5510	0.000***	-0.7487	0.000***	-0.7374	0.000***	-0.5896	0.007***	-0.5272	0.000***
CEO_age	0.0010	0.619	0.0011	0.586	-0.0012	0.536	-0.0013	0.487	0.0035	0.097*	0.0002	0.905
Intercept	0.1467	0.180	0.1464	0.177	0.1399	0.173	0.1410	0.171	-0.0597	0.547	0.1983	0.057*
Log likelihood	18.37		18.41		24.97		24.37		20.62		17.95	
Number of Observations : 347												
Uncensored observations: 296												
Censored observations: 51												

Table VI: Results for the education of the directors

In this table we are investigating the effect of the board and audit committee members' education on the risk management policy of the firm. The results are reported for a random effect Tobit specification. Our dependent variable is the delta percentage (*Delta%*). Panel A reports the results for the audit committee and Panel B and C report the results corresponding to the whole board. *Tot_ind_aud* is a dummy equal "1" if the audit committee is entirely composed of unrelated directors, "0" otherwise; *%ba_board* is the proportion of directors holding a bachelor degree in the board; *%supba_board* is the proportion of directors holding a degree higher than a bachelor in the board; *%ba_aud* is the proportion of directors holding a bachelor degree in the audit committee; *%supba_aud* is the proportion of directors holding a degree higher than a bachelor in the audit committee; *Maj_unr_board* is a dummy equal "1" if the majority of the board is constituted of unrelated directors, "0" otherwise; *Minsize_aud* is a dummy equal "1" if the audit committee has at least three members, "0" otherwise.; *%unr_board* is the proportion of unrelated directors in the board; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm's common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm's market value; *Explo* is the firm's exploration expenditures scaled by its market value. Finally, *Dum_US* is a dummy equal "1" if the firm is US, "0" otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

Panel A: results for the audit committee members				
Variables	Model 1		Model2	
	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0085	0.039**	0.0137	0.001***
ValCEO_op	-0.0057	0.003***	-0.0048	0.017**
Taxsave	0.1833	0.000***	0.1645	0.000***
Leverage	0.6884	0.000***	0.7030	0.000***
Explo	-0.8057	0.353	-0.4755	0.599
Dum_US	-0.1995	0.000***	-0.1420	0.000***
Tot_ind_aud	0.2481	0.000***	0.1096	0.000***
%ba_aud	-0.0081	0.854		
%supba_aud			-0.0207	0.675
Minsize_aud	0.2432	0.000***	0.1111	0.007***
%inst	-1.0078	0.000***	-0.6981	0.000***
CEO_age	0.0023	0.207	0.0017	0.465
Intercept	-0.1832	0.097*	0.0249	0.831
Log likelihood	47.78		45.66	
Panel B: results for boards with an independent majority				
Variables	Model 2		Model 2	
	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0118	0.001***	0.0170	0.000***
ValCEO_op	-0.0096	0.000***	-0.0078	0.001***
Taxsave	0.1883	0.000***	0.2061	0.000***
Leverage	0.7749	0.000***	0.6932	0.000***
Explo	-0.9654	0.276	-0.5184	0.621
Dum_US	-0.2016	0.000***	-0.2777	0.000***
Maj_unr_board	0.0189	0.476	0.0749	0.041**
%ba_board	-0.5644	0.000***		
%supba_board			0.5674	0.000***
%inst	-0.3757	0.003***	-0.5846	0.000***
CEO_age	-0.0008	0.666	0.0060	0.017**
Intercept	-0.5685	0.000***	-0.3283	0.011**

Log likelihood	37.09		36.83	
<i>Panel C: results for the board with % of unrelated directors</i>				
Variables	Model 1		Model 2	
	Coefficient	p-value	Coefficient	p-value
CEO_CS	0.0125	0.001***	0.0149	0.000***
ValCEO_op	-0.0078	0.000***	-0.0071	0.001***
Taxsave	0.2789	0.000***	0.2518	0.000***
Leverage	0.8085	0.000***	0.9427	0.000***
Explo	-1.4841	0.354	-1.3475	0.211
Dum_US	-0.2865	0.000***	-0.2794	0.000***
%unr_board	0.5462	0.000***	0.5239	0.000***
%ba_board	-0.2618	0.000***		
%supba_board			0.2683	0.000***
%inst	-0.6419	0.000***	-0.6163	0.000***
CEO_age	0.0032	0.090*	0.0024	0.212
Intercept	-0.0904	0.418	-0.2973	0.004***
Log likelihood	38.56		38.90	
Number of Observations	324			
Uncensored observations	285			
Censored observations	39			

Table VII: Results with the governance scores

In this table we are investigating the effect of the board and audit committee members' characteristics, when they are put together, on the risk management policy of the firm. The results are reported for a random effect Tobit specification. Our dependent variable is the delta percentage (*Delta%*). *Govindexbor* *govindexaud* are scores measuring respectively the quality of the board and the audit committee and *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm's common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *CEO_age* is the CEO age; *Leverage* is the book value of the long-term debt divided by the firm's market value; *Explo* is the firm's exploration expenditures scaled by its market value. Finally, *Dum_US* is a dummy equal "1" if the firm is US, "0" otherwise. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

Variables	Coefficient	p-value
CEO_CS	0.0166	0.000***
ValCEO_op	-0.0072	0.000***
Taxsave	0.2973	0.000***
Leverage	0.9538	0.000***
Explo	-1.5377	0.094*
Dum_US	-0.2746	0.000***
Govindexbor	0.0383	0.001***
Govindexaud	0.0742	0.000***
%inst	-1.0303	0.000***
CEO_age	0.0039	0.044**
Intercept	-0.3280	0.002***
Log likelihood		38.24
Number of Observations		324
Uncensored observations		285
Censored observations		39

Table VIII: Results for the firm performance with the observed level of risk management

In this table we are investigating the effect of the firm's risk management activities on its performance as measured by the return on equity (*ROE*). The results are reported for a random effect specification. Our dependent variable is the ROE calculated as the income before extraordinary items divided by common equity. *Delta%* is the delta of the risk management portfolio held by the firm divided by its production during the same period; *Lnsales* is the natural logarithm of the firm's sales; *Leverage* is the long term debt divided by the firm's market value; *Cost* is the operating cost of producing one ounce of gold, excluding all non-cash items such as depreciation, amortization and other financial costs; *Explo* is the ratio of exploration expenditures to the firm's value, *%unr_board* is the proportion of unrelated directors in the board; *CEO_COB* is a dummy equal one if the CEO of the firm is also the chairman of the board, 0 otherwise; *%inst* is the percentage of shares held by institutions; *Dum_US* is a dummy variable equal one if the firm is US, 0 otherwise; *Gold_price* is the price of an ounce of gold in the sport market expressed in thousands of USD and finally, *CEO_change* is a dummy variable equal one if the CEO of the firm changed during the past year, 0 otherwise. All independent variables are measured one quarter prior to the one in which the ROE is calculated in order to avoid endogeneity problems. The significant values at the 1%, 5% and 10% level are respectively marked with three, two and one asterisks.

Variables	Coefficient	p-value
Delta%	0.1092	0.069*
Lnsales	0.0004	0.979
Leverage	-0.0952	0.458
Cost	0.0036	0.991
Explo	0.2448	0.874
%unr_board	0.1337	0.187
CEO_COB	-0.0629	0.099*
%inst	-0.0613	0.741
Dum_US	-0.051	0.215
Gold_price	0.0016	0.000***
CEO_Change	-0.051	0.282
Intercept	-0.6119	0.001***
Log likelihood		-56.82
Number of observations		343

Table IX: Results for the firm performance with the predicted level of risk management

In this table we are investigating the effect of the firm’s risk management activities on its performance as measured by the return on equity. The results are reported for random effect specifications (a random effect Tobit model in the first stage and a random effect model in the second stage). Panel A reports the results for the first stage of our estimation procedure. Our dependent variable is the Delta%. *Govindexbor* *govindexaud* are scores measuring respectively the quality of the board and the audit committee; *%inst* is the percentage of shares held by institutions; *Taxsave* is a measure of the convexity-based tax advantage of hedging; *CEO_CS* is the number of the firm’s common shares held by the CEO; *ValCEO_op* is the value of options held by the CEO; *Leverage* is the book value of the long-term debt divided by the firm’s market value; Finally, *Dum_US* is a dummy equal “1” if the firm is US, “0” otherwise. Panel B reports the results for the second stage of our estimation procedure where we investigate the effect of risk management on the firm performance. Our dependent variable is the ROE calculated as the income before extraordinary items divided by the firm’s common equity. *Delta%** is the predicted level of risk management obtained from the model in the first step; *Lnsales* is the natural logarithm of the firm’s sales; *Cost* is the operating cost of producing one ounce of gold, excluding all non-cash items such as depreciation, amortization and other financial costs; *Explo* is the ratio of exploration expenditures to the firm’s value, *%unr_board* is the proportion of unrelated directors in the board; *CEO_COB* is a dummy equal one if the CEO of the firm is also the chairman of the board, 0 otherwise; *Gold_price* is the price of an ounce of gold in the sport market expressed in thousands of USD and finally, *CEO_change* is a dummy variable equal one if the CEO of the firm changed during the past year, 0 otherwise. The significant values at the 1%, 5% and 1% level are respectively marked with three, two and one asterisks.

Variables	Coefficient	p-value
<i>Panel A: results for the first stage estimation: getting the predicted values of RM</i>		
CEO_CS	0.0096	0.011**
ValCEO_op	-0.0055	0.003***
Taxsave	0.2202	0.000***
Leverage	0.6339	0.000***
Dum_US	-0.1187	0.000***
Govindexbor	0.0271	0.020**
Govindexaud	0.0964	0.000***
%inst	-1.1382	0.000***
Intercept	-0.1274	0.051*
Log likelihood		34.25
Number of Observations		324
Uncensored observations		285
Censored observations		39
<i>Panel B: results for the second stage estimation: the effect of RM on the firm ROE</i>		
Delta%*	0.4563	0.057*
Lnsales	0.0094	0.631
Leverage	-0.1932	0.284
Cost	-0.0847	0.831
Explo	0.5552	0.756
%unr_board	0.0867	0.560
CEO_COB	-0.0311	0.504
%inst	0.2107	0.417
Dum_US	-0.0394	0.486
Gold_price	0.0015	0.002***
CEO_Change	-0.0244	0.635
Intercept	-0.6816	0.001***
Log likelihood		-46.55
Number of observations		320

Appendix 1: Data sources checked for biographical information concerning the directors sitting on the board and on the audit committee

Publications

- 1- The international who's who
- 2- Canadian who's who
- 3- Who's who in America
- 4- S&P register of corporations, directors and executives
- 5- Who's who in Canada
- 6- Who's who in America
- 7- Who's who in Canadian business
- 8- Who's who in Finance
- 9- The Northern Miner
- 10- Who's who in finance and industry
- 11- The Financial Post directory of directors
- 12- Who's who in Canadian finance
- 13- The blue book of Canadian businesses
- 14- Who's who in Ontario
- 15- Encyclopedia of British Columbia
- 16- Who's who in British Columbia
- 17- Who's who in Australia
- 18- Who's who in the West
- 19- Who's who in the South and Southwest

Electronic sources

- 1- Firms websites available in the internet and google search engine
- 2- Proquest ABI/Inform
- 3- Factiva provided by Reuters
- 4- EDGAR Online
- 5- Lexis-Nexis
- 6- EUREKA.CC

Appendix 2: Details concerning the construction of the board and the audit committee governance scores

In order to construct the governance score for the board, we construct the following dummy variables:

- 1) $D_1=1$ if the majority of the board is composed of unrelated directors, 0 Otherwise
- 2) $D_2=1$ if the majority of the board is financially active, 0 Otherwise
- 3) $D_3=1$ if the majority of the board is financially educated, 0 Otherwise
- 4) $D_4=1$ if there is at least one director with an accounting background in the board, 0 Otherwise
- 5) $D_5=1$ if the CEO and COB positions are held by the same person, 0 Otherwise
- 6) $D_6=1$ if the average tenure in the board for directors is superior to 10 years, 0 Otherwise
- 7) $D_7=1$ if the majority of the board holds a degree superior to a bachelor, 0 Otherwise

$$govindexbor = D_1 + D_2 + D_3 + D_4 - D_5 - D_6 + D_7$$

In order to construct the governance score for the audit committee, we construct the following dummy variables:

- 1) $D_1=1$ if the audit committee is entirely composed of unrelated directors, 0 Otherwise
- 2) $D_2=1$ if there is at least one director in the audit committee who is financially active, 0 Otherwise
- 3) $D_3=1$ if there is at least one director in the audit committee who is financially educated, 0 Otherwise
- 4) $D_4=1$ if there is at least one director in the audit committee who has an accounting background, 0 Otherwise
- 5) $D_5=1$ if the audit committee is composed of at least three members, 0 Otherwise
- 6) $D_6=1$ if the audit committee is entirely composed of financially active directors, 0 Otherwise
- 7) $D_7=1$ if the audit committee is entirely composed of financially educated directors, 0 Otherwise
- 8) $D_8=1$ if the majority of the audit committee holds a degree superior to a bachelor, 0, Otherwise
- 9) $D_9=1$ if the average tenure in the audit committee for directors is superior to 10 years, 0 Otherwise

$$govindexaud = D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 - D_9$$

Appendix 3: Formula used to compute the predicted value of risk management

The model is:

$$y_{it} = y_{it}^* \quad \text{If } y_{it}^* > 0 \quad \text{where } y_{it}^* = X'_{it}\beta + u_i + \varepsilon_{it}$$

$$y_{it} = 0 \quad \text{Otherwise}$$

Let's call $\eta_{it} = u_i + \varepsilon_{it}$. Because u_i and ε_{it} are independently normally distributed we can show that $\eta_{it} \sim N(0, \sigma_u^2 + \sigma_\varepsilon^2)$. This leads to:

$$E(y_{it}) = P[y_{it} > 0]E[y_{it} / y_{it} > 0] + \underbrace{P[y_{it} = 0]E[y_{it} / y_{it} = 0]}_{=0}$$

$$P[y_{it} > 0] = P[X'_{it}\beta + \eta_{it} > 0] = P[\eta_{it} > -X'_{it}\beta] = F\left[\frac{X'_{it}\beta}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}\right]$$

$$E[y_{it} / y_{it} > 0] = X'_{it}\beta + \left[\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}\right] \frac{f\left(\frac{X'_{it}\beta}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}\right)}{F\left(\frac{X'_{it}\beta}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}\right)}$$

This leads to:

$$E(y_{it}) = F\left[\frac{X'_{it}\beta}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}\right] X'_{it}\beta + \left[\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}\right] f\left(\frac{X'_{it}\beta}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}\right)$$