Derivatives Recognition and Hedge-Accounting Treatment: an empirical study of the rules prescribed by SFAS 133 and some alternatives

by

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ABSTRACT

Derivatives Recognition and Hedge-Accounting Treatment: an empirical study of the rules prescribed by SFAS 133 and some alternatives

Over the last decade, accountants have faced the increasingly important issue of accounting for derivative securities. SFAS 133, the recently adopted U.S. recognition standard for derivative securities, mandates that all derivatives be accounted for in financial statements at fair value. Accounting rules for hedges of forecasted transactions under SFAS 133 are not consistent with the matching principle: only the derivatives side of the hedge is marked-to-market.

Dechow et al. (1999) argue that value relevance is a necessary, but not a sufficient, condition for the financial-statement recognition of an element of information. In this thesis, it is hypothesized that, when considering whether to recognize derivatives used to hedge forecasted transactions, the matching principle is another necessary condition. Accounting for only the derivatives adds noise to the accounting numbers. SFAS 133 should produce less informative accounting numbers than those based on the matching principle.

The thesis empirical specifications are based on Barth (1994) and Ohlson (1995). Panel samples of 22 gold mining firms between 1992 and 1997 are used to test the thesis hypotheses. Since SFAS 133 does not become mandatory before 2001, "as if" SFAS 133 accounting numbers are generated using voluntary disclosure of derivative securities and no-arbitrage valuation formulas. Two sets of matched accounting numbers are considered as alternatives to SFAS 133 accounting numbers. First, "as if" marked-to-market accounting numbers, which mark-to-market both sides of the hedge, are computed from firm derivatives and reserves disclosures. Reported historical-cost accounting numbers, which keep both sides of the hedge off the balance sheet, are the second alternative.

Results indicate that the two sets of matched balance-sheet numbers show more explanatory power for common-equity market values than the SFAS 133 accounting numbers. Results also indicate that marking both sides of the hedge to market generates accounting numbers that are more informative than keeping both sides of the hedge off the balance sheet. The income statement evidence is mostly inconclusive. The transitory nature of earnings in the gold mining industry is a plausible explanation for these latter results.

The thesis evidence answers the call of standard setters for timely evidence relevant for standard setting decisions. The methodology developed to estimate the fair value of derivatives might also prove useful to CFOs and auditors who will have to comply with SFAS 133. Finally, the thesis contributes to the recognition literature, discussed in Dechow et al. (1999) by indicating that the matching principle appears to be a necessary condition for balance-sheet recognition of derivative securities used to hedge forecasted transactions.

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Chapter 1 - Introduction

Over the last decade, accountants have faced the increasingly important issue of accounting for derivative securities. The focus on this issue has been intensified by the gradual adoption of increasingly stringent reporting standards (Statement of Financial Accounting Standard (SFAS) 52, 80, 105, 107, 119 in the U.S.A., and CICA Handbook Section 3860 in Canada). The standards require extensive footnote disclosures about most of the derivatives held by a firm at the balance-sheet date, but they do not require the recognition of most derivatives in financial statements.[1]

The Financial Accounting Standard Board (FASB) of the U.S.A has recently adopted *SFAS 133 - Accounting for Derivative Instruments and Hedging Activities*, which mandates that all derivatives be recognized in financial statements at market value. The International Accounting Standard Committee has also released its own accounting standard, *IAS 39: Financial Instruments: Recognition and Measurement*, with similar recommendations.[2] In fact, many countries are expected to prescribe their own standards soon.

SFAS 133 has introduced certain hedge-accounting rules for different types of transactions to coordinate the timing of the recognition of the hedged item and of the derivatives used to hedge these items. Perry (1997) defines hedge accounting as "a special accounting treatment,

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[1] Commodity derivatives are not subject to these accounting standards. Also, some complex derivatives, which are also not covered by these standards, have recently been developed. Commodity derivatives as well were not subject to SEC disclosure standards prior to 1997. However, Tufano (1996) indicates that firms from the gold mining industry have had a long history of voluntary disclosure of commodity derivatives. These voluntary disclosures are used to value commodity derivatives in this thesis.

[2] Both standards require derivatives to be recognized on the balance sheet at fair value. Fair-value hedge accounting rules are based on the accelerated recognition of the hedged item gains or losses in both standards. Cash-flow hedging rules mark-to-market the derivatives side of the hedge only in both standards. However, the

based on the matching principle, under which gains and losses on related items should be recognized in the same period". The hedge accounting treatment prescribed in SFAS 133 for anticipated transactions (for example, next year's sales) is not consistent with this definition, because only the derivatives are accounted for in the financial statements.[3] The FASB does not permit the recognition of unrealized gains or losses on the hedged item (i.e. the forecasted transaction). It claims that no transaction or event has yet occurred and that when the transaction or event does occur it will be at the prevailing market price. That is, the forecasted transaction does not give an entity any present rights to future benefits or a present obligation of future sacrifices. In contrast, under proper hedge accounting rules (as defined by Perry (1997), for example), both the gains or losses of the derivatives and the hedged item would be recognized (both the hedged item and the hedging instrument would be adjusted for changes in their market values), or left off-balance-sheet. This thesis examines whether accounting numbers based on the matching principle are more strongly associated with the market value of a firm's common equity (or stock returns) than those produced under SFAS 133 cash flow-hedging rules for anticipated transactions, which recognize only one side of the hedge. Finally, the thesis also investigates whether accelerating the recognition of gains and losses on derivatives and hedged items generates balance-sheet accounting numbers that are more strongly associated to a firm's common equity market value than historical cost accounting numbers, which delay the recognition of both sides of the hedge. These hypotheses are tested on a panel sample of twenty-two gold mining firms between 1992 and 1997, using both a balance sheet and an income statement perspective.

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concept of "comprehensive income" does not exist in IAS 39. Instead, the gains or losses of cash-flow hedges are recognized directly in equity.

If one assumes market efficiency, then this issue may not be important. Users of financial statements are likely to be aware that firms are hedging. They might be able to restate the financial statement numbers, if enough information is available to them to value the hedged item and the derivatives. This paper assumes market efficiency at the aggregate level in the economy in its empirical tests. However, market efficiency at the aggregate level does not preclude intrinsic value assessment errors at the individual investor level (e.g. Hand (1990), Hand (1991)). The argument made for a "superior" accounting standard is consistent with the view of both the SEC and the FASB that protection of the less sophisticated investor is an important objective of the standard setting process.

One interesting aspect of the thesis is that it compares the relative information content of one accounting recognition rule (i.e. SFAS 133) before its application becomes mandatory in the U.S.A. in 2001. Also, other countries, including Canada, are contemplating the adoption of similar accounting standards. In contrast, capital-market research in the past has sometimes compared different recognition rules (for example, historical cost accounting versus current cost accounting, LIFO versus FIFO, etc.) after the relevant accounting standard has become effective and the pertinent accounting numbers are available for analysis. This is an important advance because standard setting bodies in the U.S.A. and Canada have been calling for research which addresses accounting issues prior to the adoption of standards (Beresford (1991), Milburn (1993)). In this thesis, past financial statements are restated to generate different sets of accounting numbers that conform, or that do not conform, to hedge-

[3] There is no such inconsistency for other types of hedges. For example, for fair value hedges (existing asset, liability, or firm commitment), SFAS 133 requires that both the hedged item and the derivative market values be

accounting principles. The potential, *ex-ante*, to offer the standard setters timely evidence is not common in capital market research. Rajgopal's (1998) *ex-ante* study of the SEC new derivatives disclosure rules is one recent example.

However, this approach has some potentially serious shortcomings: the process used to restate the accounting numbers involves estimates which are likely to contain measurement error, thereby reducing the statistical power of empirical tests. Also, all sample firms hold over-the-counter derivatives, which are not actively traded and have to be priced using available footnote disclosures.

The pricing procedure developed in this thesis, which relies on no-arbitrage pricing rules, directly addresses the issue of measurement error. For example, the choice of pricing parameters is one potential source of measurement error. Thus, all parameters have been selected from market-traded instruments. These parameters are likely those used by dealers in over-the-counter derivatives. Second, in interviews with financial managers of a number of sample firms, it was indicated that the proposed estimation procedure should produce reasonably accurate numbers. Ultimately, this is an empirical issue. A comparison of the computed market values of derivatives with voluntarily disclosed market values by a subset of sample firms demonstrates that measurement error of the fair values of derivatives is not a serious problem.[4] Chapter 5 provides a detailed description of the pricing procedure used in

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recognized during the same period.

[4] Following the adoption of SEC Release No. 33-7386 in 1997, firms are required to disclose information about their derivative commodity instruments. Accordingly, the disclosures used for the 1997 sample firms are mandatory.

this thesis and discusses the results of the comparisons between the computed market values of the derivatives and firms' disclosed market values.

The gold mining industry was chosen as the empirical setting. Tufano (1996) notes that this industry is known to make extensive disclosures about both its hedging positions, as well as its hedged asset, namely mineral reserves. The primary sample used in levels regression models is composed of a panel of 22 commodity derivatives users for the six year period 1992 to 1997. It yielded a sample size of 132 firm-year observations in levels regression specifications requiring balance-sheet numbers, and 110 in levels specifications requiring both balance sheet and income statement numbers.[5] The primary sample for "return-earnings" regression specifications is a second panel of 22 commodity users for 5 years (1993 to 1997).[6] These sample sizes are comparable to those used by Tufano (1996, 1998) and Nabar (1997) in their studies of the gold mining industry.

Extant accounting literature involving derivative securities has mainly studied the value and risk relevance of footnote disclosures of derivatives.[7] The two most widely studied industries are the U.S. banking industry and the Oil and Gas industry (*See* among others, Barth et al. (1996); Nelson (1996); Eccher et al. (1996); Venkatachalam (1996); Schrand (1997); and Rajgopal (1998)). Dechow et al. (1999) indicates that value relevance is a necessary but not a sufficient condition to require the recognition of an item in the financial statements. This thesis contributes to research on derivatives accounting by examining whether the "matching"

[5] 31 firm-year observations have no derivatives outstanding at year-end. The panel omits three outliers firms.
[6] Two of the omitted outlier firms are different than those omitted in the levels panels.

principle is another necessary condition that must be met before derivatives can be recognized in the financial statements. Another contribution of this thesis is that it provides "*ex-ante*" evidence of potential implications for the prescribed accounting treatment of hedges of anticipated transactions. While the U.S.A. already has an accounting standard in place, namely SFAS 133, many countries, including Canada, do not. The results of this thesis might be useful in the deliberations of standard setters in countries which are presently contemplating accounting rules for derivative securities. Finally, the use of no-arbitrage valuation models to price both the hedged items and the commodity derivatives from footnote disclosures, and the subsequent comparison of the computed fair values to a firm's voluntary disclosed derivatives fair values, is another contribution of the thesis.

Even though the hypotheses developed in the thesis appear reasonable, their empirical tests might be affected by measurement error problems. Measurement error of independent variables is a difficult challenge in empirical research, because it biases statistical tests of significance toward zero (Greene (1997)). Measurement error has been found to be problematic in a number of recent empirical studies of the relevance of market value disclosurses under SFAS 107. Barth et al. (1996), Nelson (1996) and Eccher et al. (1996) fail to identify an incremental information content for the market value of derivative securities in their study of footnote disclosures under SFAS 107. Venkatachalam (1996) hypothesizes and shows (using derivatives disclosures under SFAS 119) that Barth et al.'s (1996), Nelson's (1996) and Eccher et al.'s (1996) failure to identify incremental information content is due to

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The risk relevance literature refers to studies which examine whether accounting information is associated to measures of firm's risk (stock market beta, stock return sensitivity to a financial price, stock return standard deviation, Value-at-risk, etc.).

measurement error in firms' assessment of derivatives market values.[8] In the context of this thesis, measurement error can arise from the procedure used to estimate fair values of derivative contracts. The valuation of commodity reserves (i.e., the hedged item) is also subject to the same problem. Miller and Upton (1985a, 1985b) find that the fair value of reserves, calculated using the Hotelling's (1931) principle, seems to reflect accurately the market value of oil and gas reserves for a sample of firms for one particular time period (Miller and Upton (1985a)), but not for a subsequent time period (Miller and Upton (1985b)).

Dechow et al. (1999) indicate that questions of recognition should be tested using a relative information content setting. Biddle, Seow and Siegel (1995) define research questions of relative information content as those asking which of two (or more) mutually exclusive measures have greater information content. They also define studies on incremental information content as those which inquire whether one accounting measure provides more information content than given by another, and apply when one measure is viewed as given and an assessment is desired regarding the incremental contribution of another. Recognition questions are those of relative information content rather than incremental information content. An accounting number is prepared based on one recognition rule or another. Dechow et al. (1999) also indicate that relative information content tests mitigate the problems of measurement errors and correlated, omitted variables intrinsic to accounting data. In this thesis, the relative information content of accounting numbers based on the "matching" principle is compared to the information content of accounting numbers not confirming to the matching principle. Fortin and Wirjanto (1999) propose the use of cross-validation to assess

[8] The measurement error in SFAS 107 disclosures arises from the fact that the statement does not require firms to indicate whether the derivatives are an asset or a liability of the firm.

relative information content on panel data. A cross-validation methodology, further described in chapter 6, is used in this thesis to compare relative information content.

Overall, the thesis provides evidence that balance-sheet accounting numbers that are based on the matching principle when recognizing derivatives, whether they accelerate the recognition of both sides of the hedge or delay it, are more strongly associated with the market value of a firm's common equity than balance-sheet accounting numbers that mark only the derivatives to market. The thesis also provides evidence that accelerating the recognition of both sides of the hedge generates balance-sheet accounting numbers which are more strongly associated with a firm's common-equity market value than delaying the recognition of both sides of the hedge. Evidence for the income-statement accounting numbers is less conclusive. This might be due to the transitory nature of earnings in the gold mining industry.

These results have implications for standard setters when considering recognition standards for derivatives. However, a stronger association with stock market prices is only one of many factors that is considered in the standard setting process. The thesis' evidence suggests that if standard setters wish to adopt recognition rules similar to those in SFAS 133, they should support their choice on the basis of practical considerations. These results also contribute to the accounting research literature by providing evidence consistent with the argument of Dechow et al. (1999) that value relevance is a necessary, but not a sufficient condition for financial-statement recognition. This thesis hypothesizes and empirically shows that in the case of the financial-statement recognition of commodity derivatives used to hedge anticipated transactions, consistency with the matching principle is a second necessary

condition. The evidence indicates that violation of the matching principle when recognizing commodity derivatives used to hedge anticipated transactions in the financial statements appears to reduce the strength of the association between a firm's accounting numbers and its common-equity market value.

Chapter 2 of this thesis describes the accounting rules under study. Chapter 3 reviews the relevant accounting research literature. The hypotheses and empirical specifications are developed in Chapter 4. Chapter 5 describes the procedures used in the thesis to generate the accounting numbers per the different derivatives recognition models examined in this thesis. Chapter 6 discusses the sample selection procedure, defines the variables used in the empirical tests, and describes the test of relative information content used in this thesis. Regression results are reported and discussed in Chapter 7. Finally, Chapter 8 concludes the thesis.

Chapter 2 – Accounting rules under study

Chapter 2.1 - Introduction

As indicated in the introduction, this thesis examines the relative information content of accounting numbers produced by the cash flow hedging rules under SFAS 133 vis-a-vis other potential hedge-accounting approaches. The principal objective of chapter two is to describe *SFAS 133 - Accounting for Derivative Instruments and Hedging Activities*, the recently published recognition standard for derivative securities in the U.S.A. First, U.S. recognition and disclosure standards that have preceded SFAS 133 are briefly reviewed in Chapter 2.2 and 2.3. The new SEC disclosure guidelines, which are still mandatory following the adoption of SFAS 133, are described in Chapter 2.4. Chapter 2.5 introduces the new statement of comprehensive income, and discusses the important role of this financial statement in accounting for cash-flow hedges under SFAS 133. SFAS 133 itself is described in chapter 2.6. The following sub-chapter, Chapter 2.7, briefly reviews the International Accounting Standard Committee recognition standard for derivatives, *IAS 39 - Financial Instruments Recognition and Measurement.* Finally, Chapter 2.8 concludes the chapter.

Chapter 2.2 - Recognition and hedge-accounting standards prior to SFAS 133

One difficulty in accounting for derivative securities under historical cost accounting is that many derivative contracts are entered into at no cost (e.g. forwards, swaps and futures). Thus, their initial cost is a poor proxy for the risks and rewards to which the firm is exposed. Derivative securities are often used to hedge some firm's risk exposure. This is another concept that has been considered by standard setters when debating the adoption of recognition rules for derivative securities.

Early U.S. standards addressing the issue of derivative-securities recognition use a case-by-case approach. Few derivative instruments are reported on the balance sheet prior to the adoption of SFAS 133. Recognized derivatives are often measured differently, even though the economics of the reporting problem is similar in many cases. Table 2.1, borrowed from Perry (1997), and up-dated to include the most current developments, lists the different accounting guidelines addressing derivatives recognition.

Table 2.1 - U.S. Published Guidelines for Accounting for Derivatives[9]

Document	Title	Application
Statement of Financial Accounting Standards (SFAS)		
SFAS No. 52	Foreign Currency Translation	Hedge Accounting for foreign currency contracts and currency swaps
SFAS No. 80	Accounting for Futures Contracts	Hedge Accounting for futures contracts
SFAS No. 133	Accounting for Derivative Instruments and Hedging Activities	Recognition of all derivative instruments on balance sheet and hedge accounting treatment.
FASB Interpretation Number (FIN)		
FIN 39	Offsetting of Amounts Related to Certain Contracts	Offsetting receivables and payables arising from derivative transactions
EITF Issues		
EITF No. 84-36	Interest Rate Swap Transactions	General guidance on interest rate swaps
EITF No. 86-25	Offsetting Foreign Currency Swaps	As described in title
EITF No. 87-31	Sales of Put Options on Issuer's Stock	As described in title
EITF No. 88-9	Put Warrants	Warrants that contain the features of a put option and a stock warrant.
EITF No. 90-17	Hedging Foreign Currency Risks with Purchased Options	Hedging anticipated foreign currency transactions with purchased options
EITF No. 91-1	Hedging Intercompany Foreign Currency Risks	As described in title

[9] This summary has been extracted from Perry (1997), pp. 28-29. Note that EITF 96-13 has been reclassified to the correct section when compared to the original version of this table where it appeared last.

Table 2.1 - U.S. Published Guidelines for Accounting for Derivatives[9]

Document	Title	Application
EITF No. 91-4	Hedging Foreign Currency Risks with Complex Options and Similar Transactions	Hedging anticipated foreign currency risk.
EITF No. 94-7	Accounting for Financial Instruments Indexed to, and Potentially settled in, a Company's Own Stock	Derivatives linked to a company's own stock.
EITF No. 95-2	Determination of What Constitutes a Firm Commitment to Foreign Currency Transactions Not Involving Third Parties	Clarification of EITF No. 91-1
EITF No. 95-11	Accounting for Derivative Instruments Containing an Option-Based and a Forward-Based Component	Accounting for compound derivatives such as amortizing swaps and cancelable swaps. No consensus was reached.
EITF No. 96-1	Sale of Put Options on Issuer's Stock that Require or Permit Cash Settlement	As described in title
EITF 96-13	Accounting for Sales of Call Options or Warrants on Issuers Stock with Various Forms of Settlement	As described in title.
SEC Related		
Accounting Series Release No. 268	Presentation in Financial Statements of Redeemable Preferred Stock	Applied by analogy to certain derivatives that settle in a company's own stock.
American Institute of CPAs		
Issues Paper 86-2	Accounting for Options	

Only pronouncements applicable to general classes of derivatives will be discussed in this chapter. Prior to the effective date of SFAS 133, derivatives recognition and hedge accounting for general classes of derivatives are addressed by SFAS 52 - *Foreign Currency Transactions* (hereafter SFAS 52) and SFAS 80 - *Accounting for Futures Contracts* (hereafter SFAS 80). SFAS 52 deals with the treatment of foreign currency hedges, while SFAS 80 is concerned with hedges which use futures exclusively. The American Institute of Certified Public Accountants has published an issue paper on accounting for option contracts, AICPA's Issue Paper 86-2, *Accounting for options*. While not authoritative, it has helped shape pre-SFAS 133 practice, and has been referred to by both the Emerging Issue Committee (hereafter

EIC) of the Financial Accounting Standard Board (hereafter FASB) and the Security and Exchange Commission (hereafter SEC) accounting staff. Table 2.2 summarizes the relevant directives from SFAS 52, SFAS 80 and CPAs 86-2.

SFAS 52 requires that foreign-currency forwards and swaps used as hedging instruments are accounted for on the balance sheet at market value. Thus, the balance sheet is matched at fair value, since monetary assets and liabilities are usually adjusted to reflect changes in exchange rates under SFAS 52. SFAS 80 allows the deferral of realized gains or losses on futures contracts until the losses or gains on the hedged item are recognized. The income statement does not show the impact of either the gains or losses on the futures, or the gains or losses on the hedged item, until the latter are realized. The principal shortcoming of hedge accounting under SFAS 80 is that the deferred gains or losses on the balance sheet do not meet the definition of assets or liabilities. Finally, AICPAs 86-2 suggests the recognition of all options on the balance sheet at their intrinsic value and the recognition and amortization of the time-value over the life of the option. AICPAs 86-2's hedge-accounting rules are based on SFAS 80. The balance sheet is unmatched, because it shows the effect of the derivatives, but not of the hedged transaction.

As a final observation, these standards can also be described in terms of what they do not cover. Prior to SFAS 133, no recognition standard exists for interest rate or commodity forwards and swaps, or for foreign-currency futures. The guidance for option contracts is not mandatory, and may not have been applied consistently across firms. As such, pre-SFAS 133 accounting practice in certain industries is not always based on these existing standards. For

example. current practice in the gold mining industry is to disclose information about outstanding hedging positions in the footnotes of the financial statements. but not to account for unrealized gains or losses on the hedged item or hedging instrument on the balance sheet (Perry (1997)). When gold is produced and the revenue is recognized. the sale is accounted for at the hedging contract price. This approach is consistent with the matching principle. but can be described as off-balance-sheet accounting.

Table 2.2 – U.S. Recognition and hedge accounting standards superseded by SFAS 133

	SFAS No. 52	SFAS No. 80	CPAs 86-2
Scope	Forward contracts, or agreements that are, in substance, essentially the same as forward contracts, such as currency swaps (parag. 17).	Futures contracts, except futures contracts for Foreign Currency (parag. 1)	Option contracts
Hedge Accounting Criteria	1. The transaction to be hedged creates risk. 2. The hedging position reduces the exposure 3. The hedging position is designated as a hedge.	1. The item to be hedged exposes the enterprise to price or interest rate risk 2. The hedged position reduces the exposure (R^2 of at least 0.80 in a regression of gains on hedging instrument and losses on hedged item) 3. The hedge position is designated as a hedge.	Same as SFAS No. 80[10]
Items that can be hedged	Existing assets, liabilities, Firm commitments.	Existing assets, liabilities, Firm commitments, and Anticipated transactions[11].	Existing assets, liabilities, Firm commitments, and Anticipated transactions.
Hedge Accounting treatment	Based on the hedged item accounting treatment.	Based on the hedged item accounting treatment.	• The time value[12] of the option is amortized as an expense over the life of the option. • The intrinsic value[13] is marked-to-market with gains and losses deferred under hedge accounting.

[10] Note that the SEC accounting staff has consistently held the position that the deferral of losses on written options is generally not appropriate because written options do not reduce but rather increase risk (as reported in EITF 91-4, *Hedging Foreign Currency Risk with Complex Options and Similar Transactions*, among others).
[11] An anticipated transaction is a transaction that an entity expects to occur but is not obligated to carry out in the normal course of business (Perry (1997), p. 37).
[12] The time value of an option is the difference between the market value of the option and its intrinsic value. It is an increasing function of the time to maturity.
[13] The intrinsic value of an option is the difference between the current market price of the underlying asset and the strike price of the option multiplied by the notional amount of the option.

Chapter 2.3 - Disclosure rules prior to SFAS 133

U.S. disclosure rules for derivative instruments have been adopted on a piecemeal basis, starting with: SFAS 105, *Disclosure of information about financial instruments with off-balance-sheet risk and financial instruments with concentrations of credit risk* (hereafter SFAS 105); SFAS 107, *Disclosure about Fair Value of Financial Instruments* (hereafter SFAS 107); and SFAS 119, *Disclosure about Derivative Financial Instruments and Fair Value of Financial Instruments* (hereafter SFAS 119). Basically, these statements complement one another because they require that increasingly more information be disclosed about derivative positions. Table 2.3 briefly describes the requirements of these standards.

SFAS 105 requires that the terms of contracts and credit risk information be provided. SFAS 107 mandates the disclosure of the terms of the contracts, plus fair values, or the provision of enough information to calculate fair values (SFAS 107). SFAS 119 mainly requests that the disclosure be separated for instruments held for trading and for those held for other purposes, but special disclosures are also needed for each sub-category. [Note that commodity derivatives are not subject to these standards.] However, gold mining firms have voluntarily complied with SFAS 105 and 107, probably because they extensively use commodity derivatives securities. They have usually provided in the footnotes of their financial statements the notional amount, strike price, and maturity dates of their commodity derivative positions. As well, they sometimes provide a market-value estimate.

The derivatives voluntary disclosures of gold mining firm's are used to price commodity derivatives contracts in this study. Voluntarily disclosed fair-value estimates are used to determine the precision of the pricing procedure used in the thesis.

Canadian disclosures rules for derivatives are prescribed by Section 3860 - Financial Instruments of the CICA Handbook. They are very similar to the rules outlined in SFAS 119. Table 2.4 summarizes the Canadian disclosure requirements. Note that Canadian accounting standards do not address the issue of derivative recognition or hedge accounting.

Table 2.3 : U.S. disclosure rules of outstanding derivative positions superseded by SFAS 133

	SFAS No. 105[14]	SFAS No. 107[15]	SFAS No. 119
General requirement	For financial instruments with off-balance-sheet risk, an entity shall disclose the following, by class of financial instrument: • The face or contract amount (or notional principal amount) • Credit and market risk • Cash requirements • Related accounting policy • Amount of accounting loss if a counterparty to a derivative position defaults. • Entity's policy of requiring collateral or security. • All concentration of credit risk.	An entity should disclose: • Fair value of all derivative financial instruments for which it is practicable to estimate that value. • If it is not practicable to estimate the fair value, the information pertinent to estimating the fair value of that instrument should be provided.	For all derivative financial instruments, an entity should disclose: • Face or contract amount (or notional principal amount) • Credit and market risk • Cash requirements • Related accounting policy distinguishing between instruments held or issued for trading purpose, and for purpose other than trading.
Instruments held for trading	No specific criteria	No specific criteria	• Average fair value during the reporting period and the end-of-period fair value, distinguishing between assets and liabilities. • Net gains and losses arising from trading activities during the reporting period desegregated according to pre-defined categories
Instruments held for purposes other than trading (other than hedges of anticipated transactions)	No specific criteria	No specific criteria	• Objective for holding the instrument • Description of recognition rules, including the accounting treatment of gains and losses

[14] SFAS No. 105 is not limited to derivative financial instruments. The summary presented here is limited to requirements applicable to derivative financial instruments.

[15] SFAS No. 107 applies to all financial instruments. The summary presented here is limited to requirements applicable to derivative financial instruments.

Table 2.3 : U.S. disclosure rules of outstanding derivative positions superseded by SFAS 133

	SFAS No. 105[14]	SFAS No. 107[15]	SFAS No. 119
Hedges of anticipated transactions	No specific criteria	No specific criteria	• Description of the anticipated transaction • Description of derivatives used to hedge this transaction • Amount of hedging gains and losses explicitly deferred. • Description of the transaction or event that will trigger recognition of the deferred amount.

Table 2.4: Disclosure required under section 3860 of the CICA Handbook

Disclosure category	*Information requested*
Accounting policy	• Criteria for the recognition of the financial instrument in the balance sheet • Basis of measurement • Income and expense recognition policy
Terms and conditions	• Principal or notional amount • Date of maturity, expiry or execution • Early settlement options, if any • Amount and timing of scheduled future cash receipts or payments • Stated rate of interest (or dividend or other) • Currency in which receipts or payments are required • Collateral
Interest rate risk	• Contractual repricing date or maturity dates, whichever dates are earlier • Effective interest rate, when applicable
Credit risk	• Amount that best represents its maximum credit exposure at the balance sheet date, without taking account of the fair value of any collateral • Significant concentration of credit risk
Fair value	• Fair value should be disclosed along with the method used to determine it. • Or sufficient information to estimate it.
Other disclosure (Voluntary)	• Recognized gain or loss during the period • Deferred or unrecognized gain or loss at the end of the period. • When different from the end of year value, average aggregate information about the outstanding amount during the year.

Chapter 2.4 - SEC disclosure rules

In addition to the recognition rules prescribed by SFAS 133, firms listing a security on a U.S. Exchange must comply with the SEC disclosure requirements for derivative securities (SEC Release No. 33-7386), issued in January 1997. These disclosure rules are not superseded by SFAS 133, and they will continue to be mandatory after the effective date of SFAS 133. [Note that the directive also applies to derivative commodity instruments.] The directive requires:

1. an enhanced qualitative description, in the notes to the financial statements, of accounting policy for derivative financial instruments and derivative commodity instruments:

2. disclosure, outside the financial statements, of quantitative information about: derivative financial instruments, other financial instruments, and derivative commodity instruments. Three approaches can be used to disclose this information:
   - tabular presentation of fair-value information and contract terms sufficient to determine instruments' fixed and floating future cash flows by expected maturity dates;
   - sensitivity analysis describing the possible effects on earnings, cash flows, or fair values from selected hypothetical changes in market rates and prices;
   - value at risk disclosures expressing the potential loss in earnings, fair value, or cash flows from market movements with a selected likelihood of occurrence;
3. disclosure, outside the financial statements, of additional qualitative information about derivative financial instruments, other financial instruments, and derivative commodity instruments.

A detailed discussion of these requirements is beyond of the scope of this thesis. A summary of the SEC disclosure requirements is available in Linsmeier and Pearson (1997).

Chapter 2.5 - SFAS 130 - Comprehensive income

According to SFAS 133, the gains or losses on derivatives used to hedge forecasted transactions, net of hedge ineffectiveness, will not be recognized in net income, but instead they will be incorporated into the new statement of comprehensive income. A hedge is ineffective when the gains or losses on the derivative instrument only partially offset the losses or gains on the hedged item. The statement of comprehensive income was first introduced in June 1997 when SFAS 130, *Comprehensive Income* (hereafter SFAS 130), was adopted by the FASB. Although SFAS 130 does not describe the items that must be accounted for under comprehensive income, other FASB statements of accounting standard do. At the time this thesis was written, comprehensive income per SFAS 130 is the sum of:

- net income;
- foreign-currency translation gains and losses from self-sustaining operations;
- adjustments from SFAS 87 - *Accounting for pensions*, which were previously reported directly in shareholders' equity;[16]
- unrealized gains or losses on certain investments in debt and equity securities under SFAS 115; and
- realized and unrealized gains and losses on derivatives used to hedge forecasted transactions and which qualify for hedge accounting treatment under SFAS 133.[17]

This thesis will mainly focus on the last of these elements, derivatives gains or losses used to hedge forecasted transactions.

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[16] The adjustment to be accounted for in other comprehensive income is any pension liability that must be recognized which exceeds unrecognized prior service cost, net of any tax benefits.

[17] Until SFAS 133 is mandatory and supersedes SFAS 80, some hedging gains and losses under SFAS 80 are considered part of comprehensive income.

Items accounted for under comprehensive income are recycled to net income when they meet the normal recognition standards. Recycling is the transfer of the accumulated recognized gains or losses on an item from other comprehensive income to net income when the income statement recognition rules are met. At the time of recycling, the accumulated gains or losses are removed from other comprehensive income and accounted for in net income.

Chapter 2.6 - SFAS 133

The FASB published SFAS 133 - *Accounting for Derivative Instruments and Hedging Activities* in June 1998. The statement will be in effect for fiscal years beginning after June 15, 2000.[18] SFAS 133 will supersede the recognition and disclosure rules found in most of the standards previously mentioned (SFAS 52, 80, 105, 119, and AICPAs 86-2). In the discussion of the need for a new recognition standard for derivative securities, the FASB acknowledged four problems with derivatives accounting under pre-SFAS 133 rules: a) the effects of derivatives are not transparent in the basic financial statements, b) the accounting guidance for derivative instruments and hedging activities is incomplete, c) the accounting guidance for derivative instruments and hedging activities is inconsistent, and finally, d) the accounting guidance for derivatives and hedging is difficult to apply (SFAS 133, paragraphs 234-237).

SFAS 133 requires that all derivatives be recognized on the balance sheet at market value. Hedge-accounting treatment will be available for transactions that meet certain criteria, which are described in Table 2.5. Two types of hedges exist: fair-value hedges and cash-flow

hedges. A fair-value hedge refers to the hedging of an existing asset or liability or of a firm commitment.[19] The asset, liability or firm commitment being hedged will be marked-to-market with the related gains or losses accounted for in earnings to offset the recognition of the derivatives' market value. However, only the change of market value relating to the hedged risk will be recognized. Cash-flow hedges refers to the hedging of the exposure to the variability in expected future cash flows that is attributable to a particular risk. The exposure may be associated with an existent recognized asset or liability, or a forecasted transaction. For cash-flow hedges, and more particularly, for the case of hedges of forecasted transactions, the gain or loss will bypass the income statement and be accounted for in the new statement of comprehensive income, until the forecasted transaction affects earnings.[20] Then, the gain or loss will be recycled into net income, where it will offset the gain or loss being recognized as the previously anticipated transaction is realized.

The resulting set of financial statements is rather unusual. The income statement does not show the impact of the derivatives nor the forecasted transaction. However, the balance sheet, the statement of retained earnings, and the newly introduced comprehensive income statement all show the impact of the derivatives gains or losses, while ignoring the offsetting losses or gains on the transaction being hedged. Noteworthy is the fact that two income numbers are

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[18] The initial effective date was June 15, 1999, but it has recently been changed to June 15, 2000.

[19] SFAS 133 defines a firm commitment as "an agreement with an unrelated party, binding on both parties and usually legally enforceable, with the following characteristics :

1. The agreement specifies all significant terms, including the quantity to be exchanged, the fixed price, and the timing of the transaction. The fixed price may be expressed as a specified amount of an entity's functional currency or of a foreign currency. It may also be expressed as a specified interest rate or specified effective yield.
2. The agreement includes a disincentive for non-performance that is sufficiently large to make performance probable."

shown under SFAS 133: the net income number is prepared under historical-cost accounting rules and conforms to the matching principle: the comprehensive income number follows SFAS 133 recognition rules for cash-flow hedges, and marks only the derivatives to market. Since more information is usually preferable than less, users should be at least as well off following the implementation of SFAS 133. They can always choose to ignore comprehensive income. On the other hand, only one balance sheet is provided under SFAS 133. It is prepared under the recognition rules of SFAS 133 for cash flow hedges and it marks only the derivatives to market. This balance sheet departs from the matching principle. Accordingly, the impact of SFAS 133 on balance-sheet accounting numbers is considered more serious than its impact on the income-statement numbers. This thesis puts more emphasis on balance-sheet tests of relative information content than on income-statement tests for this reason.

[29] SFAS 133 defines a forecasted transaction as "a transaction that is expected to occur for which there is no firm commitment. Because no transaction or event has yet occurred and the transaction or event when it occurs will be at the prevailing market price, a forecasted transaction does not give an entity any present rights to future benefits or a present obligation of future sacrifices."

Table 2.5 : Accounting treatment of derivatives under SFAS 133

	Fair Value Hedge	Cash Flow Hedge
Recognition rules for derivative instruments	• Derivatives shall be recognized on the balance sheet as either assets or liabilities and measured at fair value (parag. 17)	• Idem
Criteria to be designated as a hedge	• Formal documentation at the inception of the hedge about the objective, strategy, identification of the hedging instrument, identification of the hedged item, nature of the risk being hedged, how the effectiveness of the hedge will be assessed should exist (parag. 20). • Both at the inception of the hedge and on an ongoing basis, the hedging relationship is expected to be highly effective (parag. 20). • If a net written option is used, there is as much exposure to gains than to losses (parag. 20).	• Formal documentation at the inception of the hedge about the objective, strategy, identification of the hedging instrument, identification of the forecasted hedged item, nature of the risk being hedged, how the effectiveness of the hedge will be assessed (parag. 28). • Both at the inception of the hedge and on an ongoing basis, the hedging relationship is expected to be highly effective (parag. 28). • If a net written option is used, there is as much exposure to gains than to losses (parag. 28). • If interest rate instrument modifying the interest receipts or payments from one variable rate to another variable rate, the hedging instrument must be a link between a designated asset with variable cash flows and a designated liability with designated cash flows (parag. 28)
Criteria to be eligible as the hedged item	• Hedged item is specifically identified and is a recognized asset or liability or an unrecognized commitment. • Can also be a portfolio of similar assets or liabilities, or a specific portion of an asset or liability. • The hedged item presents an exposure to changes in fair value for the hedged risk that could affect reported earnings. • Certain types of instruments have special designation rules (see parag. 21c, to 21f).	• Forecasted transaction (hereafter, FT) is a single transaction or a series of individual transactions • FT is probable. • FT is with a third party external to the reporting entity and presents an exposure to variations in cash flows that could affect reported earnings. • Certain type of instruments cannot be designated as the hedged item (see parag. 29d, to 29g).

Table 2.5 : Accounting treatment of derivatives under SFAS 133

	Fair Value Hedge	Cash Flow Hedge
Treatment of gains and losses	• Hedging instrument gains and losses shall be recognized currently in earnings (parag. 22) • The losses and gains of the hedged item attributable to the hedged risk shall adjust the carrying amount of the hedged item and be recognized currently in earnings.	• The effective portion of a derivative's gain or loss is reported in other comprehensive income and the ineffective portion is reported in earnings (parag. 30). • Amounts accumulated in other comprehensive income shall be reclassified into earnings in the same period or periods during which the hedged forecasted transaction affects earnings.

The lack of consistency between the basic principles of hedge accounting (Perry (1997)) and the SFAS 133 requirements for cash-flow hedges has been criticized. For example, Bierman (1998) states that "if comprehensive income is a relevant income measure, the prescribed accounting is not hedge accounting." He also predicts that "we can expect increased confusion regarding the interpretation of the differences between the comprehensive income and the period's earnings."

Dechow et al. (1999) indicate that recognition issues in accounting should be examined using a relative information content approach. Biddle, Seow and Siegel (1995) define research questions on relative information content as those asking which of two mutually exclusive measures has greater information content. This thesis examines the relative information content of three sets of accounting numbers produced by three hedge-accounting rules. The recognition rules studied are as follows: i) historical cost acccounting; ii) SFAS 133 cash-flow hedge accounting; and iii) marking-to-market both sides of the hedge. The historical-cost recognition model is based on the realization concept. Hedging gains and losses and hedged item losses and gains are recognized at the time the hedged transaction is realized. The historical-cost recognition model conforms to the matching principle. At the other extreme, the mark-to-market recognition model departs from the realization concept by accelerating the recognition of gains and losses on both sides of the hedge. However, the mark-to-market recognition model still conforms to the matching principle. The SFAS 133 cash-flow-hedges recognition model partly departs from the realization concept by marking derivatives to market, but stops short of marking the other side of the hedge to market. The impact is that the SFAS 133 cash-flow-hedge recognition model strays from both the realization concept

and from the matching principle. Figure 1 summarizes this discussion by comparing the three sets of financial statements under study in this thesis.

Figure 1: A conceptual comparison of historical cost, SFAS 133, and mark-to-market models accounting treatment of a cash flow hedge.

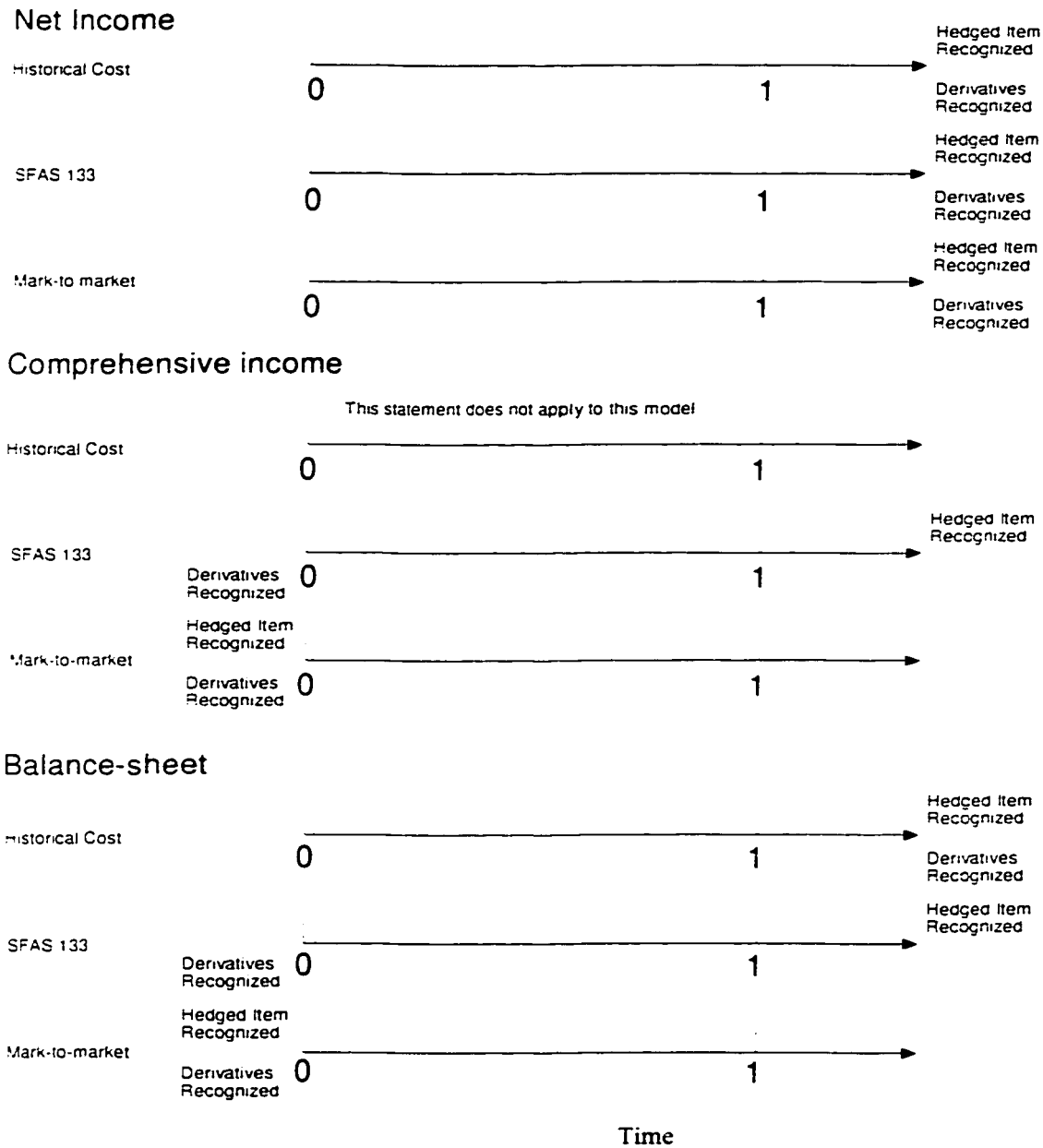


Figure 1 assumes that at time 0 a gain arises on a derivative instrument hedging a transaction forecasted for time 1. Figure 1 compares the timing of the recognition for each of the three cash flow hedges recognition models considered in this thesis.

As can be observed in Figure 1, under historical-cost net income, proper matching of hedged item gains or losses and hedging instrument losses or gains in both net income and on the balance sheet is obtained. Relevant information, namely the gains or losses on the derivative instrument, and the losses or gains on the hedged item, are excluded from the accounting numbers until time 1. Thus, the information does not promptly reach the financial statements.

Under SFAS 133, net income is the same as the amount reported under historical cost.[21] Proper matching is obtained in net income during the period. However, the balance sheet is unmatched at time 0, because gains and losses on the derivative instrument are recognized and accounted for under comprehensive income. However, losses or gains on the hedged item are left off the balance sheet. At the time of recycling (time 1), there is no impact on total comprehensive income, since recycling affects two different components of comprehensive income: namely, other comprehensive income which is reduced and net income which is increased. But the sum of the two components remains the same. This model recognizes gains and losses on derivative positions in a timely manner, but is unmatched and part of the relevant information from the hedging relationship is not included in the balance sheet or comprehensive income.

Finally, under the mark-to-market accounting numbers, all components of the hedging relationship, namely the gains or losses on the hedging instrument as well as the losses or gains on the hedging position, are recognized on the balance-sheet and accounted for under the mark-to-market income at time 0.

Chapter 2.7 - International Accounting Standards

Finally, it is interesting to examine the International Accounting Standards Committee's (IASC) new standard. The IASC adopted *IAS 39 - Financial Instruments: Recognition and Measurement*, in December 1998. The rules proposed are similar to SFAS 133, although the scope of IAS 39 is larger, covering all financial instruments and commodity-based derivative instruments. Table 2.6A and 2.6B describe the requirements of IAS 39.

Many similarities and differences between SFAS 133 and IAS 39 can be outlined. The first similarity is that IAS 39 requires that all derivatives be marked-to-market in the financial statements. Second, both standards introduce two sets of hedge-accounting rules: fair-value hedge accounting rules and cash-flow hedge accounting rules. The accounting treatment of the former is similar under both standards; both sides of the hedge must be marked-to-market and reported in net income. The accounting treatment of the latter type of hedges differs in two main aspects: a) hedges of firm commitments, which are accounted for under fair-value hedges rules under SFAS 133, must be accounted following the rules for cash flow hedges under IAS 39; b) IAS 39 dictates that cash-flow hedge gains or losses flow directly into equity. Third, as previously discussed, IAS 39 mandates that all derivatives be marked-to-market. However, it states that for instruments for which a reliable market-value estimate cannot be obtained, another measurement basis can be used. Fourth, the recycling of gains and losses on cash-flow hedges from comprehensive income (SFAS 133) or equity (IAS 39) to net income is done differently in both standards. Under SFAS 133, these gains or losses remain in comprehensive income until the forecasted transaction affects net income. IAS 39

[21] That is, assuming hedge ineffectiveness is zero. SFAS 133 requires that hedge ineffectiveness be assessed and recognized in earnings as it arises. This was not previously the case. Hence, pre-SFAS 133 historical cost net

requires that the gains or losses previously recognized in equity be added or subtracted from the purchase price of the asset (from the initial value of the liability) when the transaction hedged is the purchase of a long-term asset (issuance of a long term liability). Fifth, a significant departure from the treatment adopted in SFAS 133 is that under IAS 39 non-derivatives are accepted as hedging instruments. Finally, the International Standard will apply to publicly traded firms only, while SFAS 133 applies to all U.S. firms, whether or not publicly traded.

IAS 39 cash-flow-hedging recognition rules have an impact on the balance sheet accounting numbers only. Following the application of the standard, the balance sheet will be unmatched. The income statement will remain matched under historical-cost recognition rules.

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income would be the same as net income post-SFAS 133 only if hedge ineffectiveness is 0.

Table 2.6A : The International Accounting Standard No. 39 - IAS 39

Scope	All financial instruments, excluding : • Participation in consolidated entities • Leases • Insurance contracts • Pension plan assets and liabilities • Financial guarantee contracts • Firm's own equity instruments Commodity-based contracts that give the enterprise the right to settle by cash or some other financial instruments
Balance sheet measurement	Assets Fair value excluding transaction costs, except for : • Held-to-maturity instruments (amortized cost) • Any instrument whose fair value cannot be reliably measured. Liabilities Amortized cost, except for: • Liabilities held for trading purpose (fair value) • Derivative contracts that are liabilities (fair value)
Reporting of gains or losses on Remeasurement at Fair value	Instrument held for trading purpose (note that derivatives are either held for trading purpose of for hedging purpose) • Net Income Assets not held for trading purpose • Net income, **OR** • Directly to equity (with recycling into net income at the time of disposal) Fair value hedges (see Table 3B for more details about fair value hedges): • Net income treatment for both sides of the hedge Cash flow hedges (see Table 3B for more details about fair value hedges): • Recognized directly in equity

Table 2.6B : Hedge accounting treatment under IAS 39

	Fair Value Hedges	Cash flow Hedges
Hedging instruments	Any financial assets or liabilities of the firm, or commodity-based derivatives, except : • A written option, unless it hedges a purchased option • Held-to-maturity investments, unless used to hedge foreign currency risk • A financial asset or liability whose fair value cannot be reliably measured with respect to the risk being hedged	Idem
Hedged item	Recognized asset or liability	• Cash flows from an existing asset or liability • Cash flows from a forecasted transaction (including an unrecognized firm commitment)
Criteria to qualify as a hedge	• Formal documentation at inception of the hedge of the hedging relationship and the enterprise's risk management objective and strategy for undertaking the hedge, including the identification of the hedging instrument, the related hedged item, the nature of the risk being hedged, and how hedge effectiveness will be assessed • The hedge is expected to be highly effective • The fair value of both the hedging instrument and of the hedged item can be reliably measured • The hedge was assessed and determined actually to have been effective throughout the financial reporting period	• Formal documentation at inception of the hedge of the hedging relationship and the enterprise's risk management objective and strategy for undertaking the hedge, including the identification of the hedging instrument, the related hedged item, the nature of the risk being hedged, and how hedge effectiveness will be assessed • The hedge is expected to be highly effective • A forecasted transaction that is the subject of the hedge must be probable and present an exposure to price risk that could produce variation in cash flows that will affect reported income • The cash flow of the hedged item and the fair value of the hedging instrument can be reliably measured • The hedge was assessed and determined actually to have been effective throughout the financial reporting period
Treatment of gains or losses	• Gain or loss from remeasuring the hedging instrument at fair value should be recognized in net income • Gain or loss on the hedged item attributable to the hedged risk should adjust the carrying amount of the hedged item and be recognized in net income.	• Effective portion of the gain or loss should be recognized directly in equity • Ineffective portion should be reported in net income or in equity.

Chapter 2.8 - Conclusion

SFAS 133 requires the recognition of all derivatives on the balance sheet at market value. For derivatives used to hedge anticipated transactions, the financial statements, more particularly the balance-sheet numbers, will not properly match the derivatives gains or losses to the hedged item losses or gains. Other alternatives< rules, based on the matching principle, could have been adopted for the recognition of hedges of anticipated transactions. The historical cost model, which keeps both sides of the hedge off-balance-sheet until realized, and the mark-to-market recognition model, which marks both sides of the hedge to market, are two alternatives examined in this thesis. This thesis compares the relative information content of accounting numbers based on recognition rules for hedges of anticipated transactions which conform to (historical cost and mark-to-market) and do not conform to the matching principle (SFAS 133). Hypotheses regarding the relative information content of each hedge accounting model are more formally developed in Chapter 4.

Chapter 3 - Literature Review

Chapter 3.1 – Introduction

This chapter briefly reviews the accounting research literature relevant to the thesis, and describes the thesis' contribution to this literature, to standard setters and to practitioners. Chapter 3.2 defines association studies in capital-market accounting research. Chapter 3.3 reviews the derivatives accounting literature. The following section, 3.4, discusses the thesis contribution and 3.5 concludes the chapter.

Chapter 3.2 – Association studies

Many recently published accounting studies have used long-window association between accounting numbers and market-based dependent variables to assess the information content of accounting numbers. As opposed to short-window studies that attempt to isolate the cause of a market reaction and to attribute it to the release of accounting information, long-window studies cannot identify direct causation. Rather, they try to determine whether the accounting information released reflects the information used by market participants to assess the value of a firm. Significant associations in long-window studies are consistent with either the accounting information being used to value firms, or the accounting information being correlated with the information used by the market to value firms. Two broad approaches are used in this type of study. The first deals with return-earnings association studies, such as Dechow (1994); Biddle, Seow, and Siegel (1995); Loudder & Behn (1995); Ahmed & Takeda (1995); and Kernstein & Kim (1995). The second approach focuses on levels valuation, for examples, Barth, Beaver and Stinson (1991); Barth (1994); Amir and Lev (1996); and Harris and Ohlson (1987). Return-earnings association studies examine the association between accounting earnings, or other relevant measures of a firm's financial performance for a year

(e.g. cash flows), and stock returns. Stock returns are considered in these studies to be the benchmark measure of a firm's financial performance during the year. Levels studies examine the association between accounting balance-sheet numbers, or between balance-sheet numbers and/or income-statement numbers and a firm's common-equity market value. Most studies examine whether an element of information, such as a footnote disclosure, shows incremental value relevance given the availability of other information, such as recognized balance sheet or income-statement numbers.

Studies relating more specifically to derivatives are reviewed below.

Chapter 3.3 – Derivatives accounting literature

Researchers interested in the issue of derivatives accounting have used two main methodological approaches. The first is a levels-valuation approach, as defined above. The second is a risk-relevance approach. In this method, the relevance of some accounting information (e.g. disclosure of derivatives notional amounts in the footnotes) is assessed by its significant association with a measure of firm's risk, such as the firm's stock market beta, the sensitivity of the firm's stock price to changes in a financial price, its stock return standard deviation. The study by Beaver, Kettler and Scholes (1970) of the accounting determinants of stock market betas is one of the first papers to use this methodology.

Linsmeier et al. (1998) reviews the literature on the usefulness of market values for more general classes of financial instruments. Barth et al. (1996), Eccher et al. (1996)[22] and Nelson

[22] They find that the fair value of derivatives disclosed under SFAS 107 shows incremental information content in some specifications.

(1996) all find that off-balance-sheet instrument market values are not associated significantly with market-to-book ratios of banks. All three studies use fair values disclosed under SFAS 107. According to Venkatachalam (1996), even though SFAS 107 requires disclosure of the market value of off-balance-sheet derivatives, it does not specifically require firms to indicate whether these positions represent an asset or a liability for the firm. He concludes that this ambiguity might explain the potential absence of significant results.

The FASB published SFAS 119, which addresses many of the deficiencies in the disclosure rules of SFAS 107. It specifically requires firms to indicate whether a derivatives position represents an asset or a liability. It also requires firms to separate their disclosures under derivatives used for hedging activities and derivatives used for speculating activities. Using these improved disclosures, Venkatachalam (1996) establishes that the fair-value estimates for derivatives help to explain cross-sectional variation in the share price of banks. He also provides evidence that derivatives fair values have incremental explanatory power for stock price over and above notional amounts.

The risk-relevance methodology normally uses a two-step approach. In the first step, a time-series regression of an extended market model is run to capture the sensitivity of a firm's stock return to a given source of exposure (e.g. interest rate). The second step is a cross-sectional regression relating the sensitivity estimates computed in the first step to accounting disclosures, usually notional amounts of contracts, which are outstanding at year-end. Schrand (1997) argues that such an approach is preferable to a valuation approach, because it does not assume that the derivative portfolio has a first-order effect on a firm's market value,

nor does it assume there is no cross-sectional variation in the effect of derivatives on a firm's value.

Schrand (1997), Ahmed et al. (1997), and Hirtle (1996) study the sensitivity to interest rate changes of the market value of the shares of financial institutions. While Schrand (1997) and Ahmed et al. (1997) conclude that their sample firms used derivatives to reduce risk exposure. Hirtle (1996) finds that for the period 1991-1994, interest-rate derivatives are used by her sample of financial institutions to increase their interest-rate exposure. Schrand and Unal (1998) document that thrifts seem to be using derivatives to reduce certain risks, with the ultimate goal of increasing the total risk of the firm.[23] Schrand and Unal's (1998) sample of thrifts show they are hedging the interest rate and foreign currency risks of their loan portfolio to increase their exposure to credit risk by making more loans. Allayannis and Ofek (1996) and Wong (1997) investigate the impact of derivatives usage on the sensitivity of a manufacturing firm's stock price to foreign currency fluctuations, while Chamberlain et al. (1996) and Cheon et al. (1996) study the same question on a sample of financial institutions. The results for the sample of financial institutions indicate that derivatives usage is associated with a reduction in a firm's foreign-currency exposure. For manufacturing firms, Allayannis and Ofek (1996) conclude that derivatives are used to hedge foreign currency risk. Wong (1997) fails to identify a significant association between notional amounts of foreign currency derivatives and a firm's stock price sensitivity to foreign-exchange movements. Guay (1997) studies the impact of derivatives use on the riskiness of a sample of new derivative users, using different proxies for risk. His results indicate that new derivatives users experience a statistically and economically significant drop in their levels of risk.

Tufano (1998) derives analytically the determinants of commodity exposures for gold mines. He then tests which of these determinants appear to better explain firm's gold exposure. He finds that gold firm exposures are related negatively to hedging activities, to the magnitude of gold prices, and to gold-return volatility. On the other hand, the magnitude of gold firm's commodity exposure seems to be an increasing function of firm leverage. Rajgopal (1998) uses disclosures under SFAS 69 and SFAS 119 to assess *ex-ante* the risk relevance of the recently mandated SEC sensitivity disclosure (SEC Release No. 33-7386). He finds, as predicted, that these measures are associated with oil and gas price sensitivity. They also appear to explain incrementally the level of a firm's oil and gas exposure over and above the notional amounts in tabular disclosures. Rajgopal and Venkatachalam (1998) examine the association between earnings sensitivity to oil prices and stock-price sensitivity to oil prices. Not surprisingly, they report that their earnings-sensitivity measure is associated with the sensitivity of a firm's stock price to changes in oil and gas prices (hereafter, the firm's oil and gas beta). Thornton and Welker (1999) examine whether stock price sensitivity to oil and gas prices, of a sample of oil and gas firms, is affected by SEC VaR or sensitivity disclosures.[24] They find that oil and gas beta of firms shifted significantly following these disclosures. VaR disclosure seems to produce larger shifts than other types of disclosures.

Nabar (1997) studies the question of the usefulness of disclosures of derivatives notional amounts for a sample of gold mining firms. He examines the duration of the relevance of year-end notional values. He finds that the notional amount year-end disclosures show

[23] Thrifts are U.S. financial institutions, often specialized in the mortgage business.

information content for up to nine months following the date of the annual report for the firms included in his sample.

Jorgensen (1998) models the impact of two hedge-accounting policies for futures contracts in an agency setting, under which the manager's compensation is based on net income. He demonstrates that when hedging positions are marked-to-market and hedging gains and losses are recognized immediately, managers do not select the optimal hedging position from the stockholders' perspective. However, when a deferral accounting policy is used, optimal hedging policies are chosen.

Rajgopal and Pincus (1999) investigate whether hedging decisions and accounting policy decisions are independent of each other. They find that for a sample of oil and gas firms, the extent of hedging is negatively associated to the use of the full cost method of accounting for exploration costs. Firms that hedge more also appear to manage earnings through the use of discretionary accruals more.

Chapter 3.4 - Contribution of the thesis

This thesis contributes to the derivatives accounting literature in a number of ways. First, it is possibly one of the few studies so far that have examined the issue of financial-statement recognition of derivative securities. Extant accounting literature, investigating derivative securities from a financial accounting perspective, has demonstrated that derivatives disclosures (notional amounts, market values, sensitivity, or value-at-risk) appear to have

[1] Value at risk is defined in SEC release 33-7386 as the potential loss in earnings, fair value, or cash flows from market movements with a selected likelihood of occurrence.

incremental information content. Dechow and al. (1999) indicate that incremental information content is a necessary, but not a sufficient, condition for the financial-statement recognition of an item. In contrast, this thesis contributes to the deriatives accounting literature by comparing the relative information content of accounting numbers produced by various accounting models (both GAAP and non-GAAP) that might be used to recognize derivative securities that are used to hedge anticipated transactions.

As discussed in chapter 2, three alternatives, suggested by the recent standard-setting effort, are examined in the thesis. The recognition model and hedge-accounting treatment prescribed by SFAS 133 recognizes only the derivatives in the financial statements and produces unmatched accounting numbers. The historical-cost accounting model leaves both sides of the hedge off the balance sheet, but conforms to the matching principle. Finally, the mark-to-market recognition model accounts for both sides of the hedge in the financial statement and conforms to the matching principle. The thesis contributes to the relatively young recognition literature discussed in Dechow et al. (1999), by assessing whether conforming with the matching principle is another necessary condition for the financial-statement recognition of an item.

One factor of interest about this thesis is that the analysis is performed before the application of SFAS 133 becomes mandatory. The results of this thesis provide a potential input into the standard setting process worldwide relating to the adoption of recognition standards for derivative securities. This thesis is also important because it answers the call by standard

setters in the U.S.A. and Canada for research which addresses accounting issues prior to the adoption of accounting standards (Beresford (1991), Milburn (1993)).

The procedure developed in this thesis to generate the "as if" accounting numbers per the different accounting standards is another contribution of the thesis. The procedure developed uses firm's derivatives and annual report disclosures, pricing parameters observed on North American commodity and debt securities markets, and no-arbitrage derivatives valuation formula. Firm CFO's and auditor will likely be using a similar methodology when preparing financial statements under SFAS 133, and they might find the methodology developed in this thesis to be useful.

Chapter 3.5 – Conclusion

This chapter has reviewed the relevant literature pertaining to the development of the thesis hypotheses. The potential contribution of this thesis to the accounting research literature, to the standard setting debate and to practitioners has also been described. The next chapter formally develops the thesis hypotheses.

Chapter 4 - Theory, hypotheses, and empirical models

Chapter 4.1 – Introduction

Earlier in the thesis, it was discussed how derivatives market values disclosures under SFAS 119 have been shown to be value relevant by Venkatachalam (1996). Harris and Ohlson (1987) and Miller and Upton (1985a) have shown that reserves fair-value estimates based on Hotelling (1931) appear to be value relevant, at least in the oil and gas industry. This thesis examines different recognition models for these items in the context of hedge-accounting rules for anticipated transactions. Dechow et al. (1999) argue that value relevance is a necessary, but not sufficient, condition for the financial-statement recognition of an element of information. The thesis argues that when considering recognition rules for hedges of anticipated transactions, consistency with the matching principle is another condition that should be achieved. Chapter 4.2 formally develops the thesis hypotheses. Chapter 4.3 describes the levels specifications of the empirical models used to test the thesis hypotheses from the balance sheet perspective. The return-earnings specifications used to test the thesis hypotheses from an income statement perspective are developed in Chapter 4.4. Finally, chapter 4.5 concludes the chapter.

Chapter 4.2 - Hypotheses development

Section 4.2.1 - An example

The following example, based on figure 1, is intended to summarize the development of the thesis hypotheses. It is assumed that a firm has been hedging 75 per cent of its risk exposure on an anticipated transaction scheduled for t=1. At time t=0, the firm has made a hedging gain of $75 (it holds a derivatives asset of $75), that partially offsets an expected loss of $100

on the anticipated transaction scheduled for time t=1 (the firm has a highly probable future loss of $100). For simplicity, assume the firm does not hold other assets or liabilities at t=0. Without loss of generality, the effect of discounting is ignored. The market value of the company at time t=0 should be ($25). Accounting numbers showing a net liability (a net loss) of ($25) would explain perfectly the market value of the firm. Accounting numbers showing any figure other than ($25) would measure the firm's market value with noise.

Mark-to-market accounting numbers would show a net book value of ($25) at time t=0, and would appear to explain satisfactorily the market value of the firm. SFAS 133 recognition rules require that a derivatives asset of $75 be recognized at time t=0. The accounting numbers would show a net book value of $75, while the firm value is ($25). Finally, the historical cost recognition model keeps both sides of the hedge off-balance-sheet at time t=0 and shows a net asset of $0, while the firm value is ($25). Let's define the explanatory power of a model as the difference between firm's market value and its book value under a recognition rule.[25] The first conclusion is that the mark-to-market model measures the value of the firm exactly, and should dominate both the historical cost and SFAS 133 recognition models.

The second conclusion is that historical cost accounting numbers always measure the firm's value with less noise than the SFAS 133 accounting numbers. By definition, a hedging gain is always associated with a net economic loss for a partially hedged firm, and vice-versa. Accounting for a gain when the firm suffers a loss means that the historical cost accounting

numbers have been adjusted in the wrong direction. The following is always true in cases where hedging gains are observed:

Firm's market value ≤ Historical cost book value ≤ SFAS 133 book value

Inspection of this inequality indicates that the noise in the measurement of the firm's market value, defined as the difference between the accounting number per a recognition rule and the firm's market value, is always smaller for historical cost numbers than for SFAS 133 numbers. The example is generalized below.

Section 4.2.2 - Definitions

Let us generalize the example by considering a firm that owns a forward contract used to hedge a very probable anticipated transaction of period 1. This transaction might be the sale of the firm's proven and probable reserves. For simplicity, assume that the other net assets (OA) of the firm are marked-to-market and that their value is independent of the value of the forward contract and the anticipated transaction. Let's define the hedging ratio of a firm (H) as the percentage of the gain/loss exposure on the anticipated transaction that is hedged. H must be comprised in the following interval to be consistent with hedging:

$$0 < H \leq 1 \qquad (4.1)$$

Hedging requires that the gains and losses on an hedging instrument be inversely correlated to the losses or gains on the hedged transaction. Further assume that there is no hedge

[25] This definition of explanatory power is consistent with the definition used in the empirical section of the thesis, where the out-of-sample variances of the forecast errors of each model are compared. Further details are provided in chapter 6.

ineffectiveness. This implies that the value of a forward contract used to hedge (DER) can be expressed as a percentage of the expected gain/loss on the anticipated transaction:

$$DER = -H * AT \tag{4.2}$$

Where:

AT is the expected gain/loss on the anticipated transaction.

The market value of the firm (MV) is given by the sum of the market value of its assets and liabilities:

$$MV = AT + DER + OA \tag{4.3}$$

Using 4.2 in 4.3:

$$MV = AT - H * AT + OA \tag{4.4}$$

Regrouping terms:

$$MV = (1 - H)AT + OA \tag{4.5}$$

Equation 4.5 states that the market value of a firm is equal to the market value of its other assets and liabilities (OA), plus the gain or loss net of hedging expected on the anticipated transaction.

Note that under mark-to-market accounting, both sides of the hedge are recognized on the balance sheet at their market value. It follows that the book value of the firm's common equity under mark-to-market accounting (BVMTOM) is:

$$BVMTOM = AT - DER + OA \tag{4.6}$$

Using 4.2 in 4.6 yields:

$$BVMTOM = (1 - H)AT + OA \tag{4.7}$$

Remember that under SFAS 133 accounting, only the derivatives are recognized on the balance sheet at their market value. It follows that the book value of the firm's common equity under SFAS 133 accounting (BVSFAS) is:

$$BVSFAS = DER + OA \tag{4.8}$$

Using 4.2 in 4.8 yields:

$$BVSFAS = -H * AT + OA \tag{4.9}$$

Finally, recall that under historical cost accounting, both sides of the hedge are kept off-balance-sheet. It follows that the book value of the firm's common equity under historical cost accounting (BV) is:

$$BV = OA \tag{4.10}$$

The "explanatory power" of the mark-to-market accounting numbers can be defined as the valuation error (VE) as follows:[26]

$$VE_{MTOM} = |MV - BVMTOM| \tag{4.11}$$

Using the definition of MV (4.5) and BVMTOM (4.8) in 4.11 yields:

$$VE_{MTOM} = |(1-H)AT + OA - (1-H)AT - OA| = 0 \qquad (4.12)$$

Intuitively, the mark-to-market model measures all of the firm's assets and liabilities at their market value, such that the book value of the firm's equity is always equal to its market value.

Similarly, the valuation error of the SFAS 133 model is:

$$VE_{SFAS} = |MV - BVSFAS| \qquad (4.13)$$

$$VE_{SFAS} = |(1-H)AT + OA - (-H * AT) - OA| \qquad (4.14)$$

Grouping terms:

$$VE_{SFAS} = |AT| \qquad (4.15)$$

Intuitively, recognition of the expected gain or loss on the anticipated transaction is omitted from the SFAS 133 accounting model, and constitutes the valuation error.

Finally, the valuation error for the historical cost model is:

$$VE_{HC} = |MV - BV| \qquad (4.16)$$

$$VE_{HC} = |(1-H)AT + OA - OA| = |(1-H)AT| \qquad (4.17)$$

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[2] This definition of explanatory power is consistent with the definition used in the cross-validation methodology described in Chapter 6.

Since the historical cost model does not account for either side of the hedge, the net gain or loss expected on the anticipated transaction is omitted from the historical cost accounting model, and constitutes the valuation error.

Section 4.2.3 - Development of hypothesis 1

The mark-to-market model shows more explanatory power than the SFAS 133 model if and only if the valuation error of the mark-to-market model is smaller than the valuation error of the SFAS 133 model:

$$VE_{MTOM} < VE_{SFAS} \tag{4.18}$$

or,

$$VE_{MTOM} - VE_{SFAS} < 0 \tag{4.19}$$

Replacing terms:

$$VE_{MTOM} - VE_{SFAS} = 0 - |AT| \tag{4.20}$$

If AT > 0, we get : $0 - AT = -AT < 0$

If AT < 0, we get: $0 - (-AT) = AT < 0$, Q.E.D.

In other words, since the absolute value of AT in (4.20) is by definition positive, $VE_{MTOM} - VE_{SFAS}$ is negative for any value of AT. Thus, the valuation error for the SFAS 133 model is always larger than the valuation error for the mark-to-market model. This leads to hypothesis H_1, expressed in alternate form:

H_1: The mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers.

Because they measure firm value perfectly (unless there is measurement error), mark-to-market accounting numbers should be more strongly associated with a firm's common-equity market value than SFAS 133 accounting numbers. Many anticipated transactions, even if they do not qualify as firm commitments, have probabilities of occurrence close to certainty. For example, there is little uncertainty that a gold mining firm that is not a going concern will be selling gold next year. On the other hand, the FASB claims that anticipated transactions are not part of the accounting model and that, as of the balance-sheet date, no event warranting the recognition of the anticipated transaction has occurred.

Section 4.2.4 - Development of hypothesis 2

The historical cost model shows more explanatory power than the SFAS 133 model if and only if the valuation error of the historical cost model is smaller than the valuation error of the SFAS 133 model :

$$VE_{HC} < VE_{SFAS} \tag{4.21}$$

or, $$VE_{HC} - VE_{SFAS} < 0 \tag{4.22}$$

Replacing terms:

$$VE_{HC} - VE_{SFAS} = |(1-H)AT| - |AT| \tag{4.23}$$

Note that (1 – H) is always positive by definition, and included in the interval 0 to 1.

If AT > 0, we get : $(1-H)AT - AT = -H * AT < 0$, since H is positive, and AT is positive.

If AT < 0, we get: $(1-H)(-AT) - (-AT) = H * AT < 0$, since H is positive and AT is negative, Q.E.D.

In other words, since the absolute value of AT in (4.23) is by definition positive, and since (1-H) is always in the interval between 0 and 1, (1-H) AT is always smaller than AT. Accordingly, $VE_{HC} - VE_{SFAS}$ is negative for any value of AT. Thus, the valuation error for the SFAS 133 model is always larger than the valuation error for the historical cost model. This leads to hypothesis H_2, expressed in alternate form:

H_2: The historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers.

Under SFAS 133, because only one side of the hedge is recognized, the accounting numbers measure firm's market-value with more noise than when keeping both sides of the hedge off-balance-sheet under historical cost accounting. The historical cost accounting numbers should be more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. However, the FASB claims that the SFAS 133 accounting numbers will be more informative than the historical cost accounting numbers. The FASB also states that the market value of the derivatives is the best measure for these instruments, and that accounting numbers that fail to reflect this value are less informative than the SFAS 133 accounting numbers. It argues that from an accounting perspective, no hedging relationship exists, since the anticipated transaction does not meet financial-statement recognition criteria. Marking only the derivatives sides of the hedge to market is accounting for all the relevant information at the balance-sheet date, and that is why the FASB claims that SFAS 133 accounting numbers should be more relevant.

Section 4.2.4 - Development of hypothesis 3

Finally, the mark-to-market model shows more explanatory power than the historical cost recognition model if and only if the valuation error of the mark-to-market model is smaller than the valuation error of the historical cost model:

$$VE_{MTOM} < VE_{HC} \tag{4.24}$$

or. $$VE_{MTOM} - VE_{HC} < 0 \tag{4.25}$$

Replacing terms:

$$VE_{MTOM} - VE_{HC} = 0 - |(1 - H).AT| \tag{4.26}$$

If AT > 0, we get : $0 - (1 - H).AT < 0$, since (1-H) is positive, and AT is positive. That is, unless H=1 (the firm is fully hedged).

If AT < 0, we get: $0 - (-(1 - H).AT) = -(H - 1).AT < 0$, since H is less or equal than 1, (H -1) is negative and since AT is negative, $-(H - 1).AT$ is negative. That is, unless H=1 (the firm is fully hedged), Q.E.D.

In other words, since the absolute value of (1-H) AT in (4.26) is by definition positive, $VE_{MTOM} - VE_{HC}$ is negative for any value of AT. Thus, the valuation error for the historical cost model is always larger than the valuation error for the mark-to-market model, unless the firm is fully hedged. Note that none of the sample firms are fully hedged. This leads to hypothesis H_3, expressed in alternate form:

H_3: The mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers.

H_3 holds only for partially hedged firms. This is intuitively appealing. A fully hedged firm is not affected by expected gains or losses on the anticipated transaction, because those gains or losses are fully offset by losses or gains on the derivatives. Since both the historical cost model and the mark-to-market model show a net gain/loss of zero, neither model dominates.

For a partially hedged firm, marking-to-market both sides of the hedge at time t=0 generates accounting numbers that are equal to the firm's market value under ideal conditions. The mark-to-market financial statements show the net gain/loss (after hedging) realized on the anticipated transaction. On the other hand, historical cost accounting numbers fail to reflect this net gain/loss, because its recognition is delayed under historical cost accounting rules until the anticipated transaction is realized.

Chapter 4.3 - Empirical models

Hypotheses H_1 to H_3 are tested by comparing the relative information content for common-equity market values of the balance-sheet accounting numbers produced by applying three different recognition rules for hedges of anticipated transactions. As discussed in Chapter 2, the balance-sheet impact of SFAS 133 is the most significant. SFAS 133 requires the presentation of both historical cost and SFAS 133 income numbers. Individuals who use financial statements, because they can ignore the SFAS 133 income number if they choose to, should be at least be as well off after the application of SFAS 133 from an income-statement perspective. However, only one balance sheet is provided under SFAS 133, and it is prepared under SFAS 133 cash-flow hedge recognition rules, which are not consistent with the

matching principle. Because the balance-sheet impact of SFAS 133 appears to be the most significant, tests of association between a firm's common-equity market value and balance-sheet numbers represent the most important empirical tests of the hypotheses derived in this thesis. A firm's common-equity market value is the benchmark to which accounting numbers are compared; a perfectly measured balance sheet should produce book value accounting numbers that are equal to the market value of the firm. Two main empirical approaches are used. In the first one, a valuation perspective based on Ohlson (1995) is used to assess the relative association of balance-sheet accounting numbers per the different recognition rules described above and a firm's common-equity market value.[27] Ohlson (1995)-based specifications are described more formally in chapter 4.3.1. In the second approach, a valuation perspective used by Barth (1994), and others, is considered. Empirical specifications based on Barth (1994) are more formally described in chapter 4.3.2.

Chapter 4.3.1 - The Ohlson (1995) valuation model

The Ohlson (1995) framework is a powerful valuation model that relates a firm value to basic accounting constructs and other value relevant information. The strength of the model relies on its very general assumptions: it is based on the dividend discounting principle, and it holds under fairly unrestrictive conditions.[28] The model is as follows:

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[27] Ohlson (1995) based specifications also include income-statement numbers.

[28] The Ohlson (1995) model assumes that the market value of the firm is equal to the discounted value of its future dividends. Based on this valuation principle, and further assuming that :

- $BV_{t-1} = BV_t + d_t - X_t$, or namely, the clean surplus relation.
- dividends directly reduce book value
- earnings are not affected by current dividends
- interest rates are deterministic and the term structure is flat
- and the following information dynamic:

$$MV_t = BV_t + a_1 X_t^a + a_2 v_t \qquad (4.27)$$

where:

MV_t is the market value of the firm's common equity at time t

BV_t is the book value of the firm's common equity at time t

X^a_t is the abnormal earnings of the firm at time t

v_t is other value relevant information, and

X_t is the earnings of the firm at time t

α_1 and α_2 are valuation weights

κ is the cost of equity capital

$$X_t^a = X_t - \kappa BV_{t-1} \qquad (4.28)$$

Assuming market efficiency and the availability of contemporaneous accounting information only, Ohlson's (1995) valuation model is used to compare the relative explanatory power for a firm's common-equity market value of three alternative accounting measurement rules for hedging relationships. These are the historical cost accounting model, SFAS 133 cash-flow hedging rules, and marking-to-market of both sides of the hedge. Bandyopadhyay et al. (1998) have recently used the model in a similar study which compared the information content of Canadian-GAAP-based and U.S.-GAAP-based accounting numbers.

$$\tilde{x}^a_{t+1} = \omega X_t^a + v_t - \tilde{\varepsilon}_{1t+1} \quad . \qquad 0 \le \omega \le 1,\ E(\tilde{\varepsilon}_{1t+1}) = 0$$

$$\tilde{v}_{t+1} = \qquad + \gamma v_t - \tilde{\varepsilon}_{2t+1} \qquad 0 \le \gamma \le 1,\ E(\tilde{\varepsilon}_{2t+1}) = 0$$

One gets Ohlson's (1995) valuation model (equation 4.28). Note that these assumptions implies that accounting is unbiased. Feltham and Ohlson (1995) have considered the case of conservative accounting numbers. Under conservative accounting, the Feltham and Ohlson (1995) valuation equation becomes:

$$MV_t = BV_t + a_1 X_t^a + BV_{t-1} + a_2 v_t$$

The mark-to-market Ohlson (1995)-based specification, where both the hedged asset (gold reserves) and the derivatives are marked-to-market, is derived first. Under the marked-to-market model, book value of equity, $MTOMBV_t$ is defined as:

$$MTOMBV_t = BV_t + DER_t - NOPD_t + RES_t - BVRES_t \qquad (4.29)$$

Where:

$MTOMBV_t$ is the book value of the firm under mark-to-market accounting

BV_t is the book value of the firm's common equity under historical cost accounting.

DER_t is the unrealized market value of commodity derivative positions outstanding at year-end

$NOPD_t$ is the total of the net commodity option premium paid or received at year-end. It is the book value of commodity derivatives.

RES_t is the unrealized market value of mineral reserves at year-end.

$BVRES_t$ is the book value of the firm commodity reserves at year-end.

Similarly, the marked-to-market income for the year is defined as:

$$XMTOM_t = XC_t + \Delta DER_t + \Delta RES_t \qquad (4.30)$$

Where:

$XMTOM_t$ is the marked-to-market income of the firm

XC_t is the net income number before adjustments for derivative market values and reserves market values. It is net income under historical cost accounting.

However, because BV_t tends to be very highly correlated to BV_{t-1}, the latter term is dropped from the a Feltham and Ohlson (1995) empirical specification to avoid multicollinearity. The result is that the empirical versions of Ohlson (1995) and Feltham and Ohlson (1995) are similar.

ΔDER_t is the change between t-1 and t of the unrealized market value of the derivatives outstanding.

ΔRES_t is the change between t-1 and t of the unrealized market value of the mineral reserves.

Remember that the realization from reserves and derivatives are included in XC_t.

The same identities hold at all time. Using these identities at t and t-1, substituting in equation 4.27, adding a constant term and regression coefficients, and assuming that the other information, v_t, is not correlated to the variable included in the specification, yields the Ohlson (1995)-based empirical specification under mark-to-market hedge accounting:

$$MV_t = \beta_0 + \beta_1 MTOMBV_t + \beta_2 MTOMAE_t + \mu_{1t} \qquad (4.31)$$

where:

$MTOMAE_t = XMTOM_t - \kappa(MTOMBV_{t-1})$ = mark - to - market abnormal earnings

Similarly, defining :

$$SFASBV_t = BV_t + DER_t - NOPD_t \qquad (4.32)$$

where:

$SFASBV_t$ is the book value of the firm's equity under SFAS 133.

and:

$$XSFAS_t = XC_t + \Delta DER_t \qquad (4.33)$$

where:

$XSFAS_t$ is the comprehensive income of the firm under SFAS 133.

$$SFASAE_t = XSFAS_t - \kappa(SFASBV_t) = \text{SFAS 133 abnormal earnings}$$

yields the Ohlson (1995)-based SFAS 133 empirical specification:

$$MV_t = \gamma_0 + \gamma_1 SFASBV_t + \gamma_2 SFASAE_t + \mu_{2t} \qquad (4.34)$$

Finally, the Ohlson (1995)-based historical cost specification is:

$$MV_t = \varphi_0 + \varphi_1 BV_t + \varphi_2 AE + \mu_{3t} \qquad (4.35)$$

Where: BV_t is the book value of the firm's equity under historical cost accounting.

$$AE_t = XC_t - \kappa(BV_t) = \text{historical cost abnormal earnings}$$

Predictions with respect to the sign and magnitude of the regression coefficients in equations 4.31, 4.34 and 4.35 are as follows. Feltham and Ohlson (1997) discuss the notion of mark-to-market accounting more specifically. Under mark-to-market accounting, the coefficients of the book-value component and of the abnormal earning-component of their model should be respectively 1 for book value and 0 for abnormal earnings. Since assets and liabilities are measured at their market values, there is no information content in regard to the future in the realization of abnormal earnings. In other words, abnormal earnings are not expected to persist, and their coefficient, which is a function of the persistence parameter, will tend toward 0. If the mark-to-market accounting model used in this thesis is properly specified, the coefficient estimate of MTOMBV should be indistinguishable from 1, and the coefficient estimate of MTOMAE should be 0. Olhson's (1995) theoretical work indicates that the coefficient estimates for the SFAS 133 and historical cost specifications should be positive and significant, but it is not possible to predict their magnitude.

Hypothesis 1 is tested by comparing the explanatory power of the mark-to-market accounting numbers for a firm's common-equity market values (equation 4.31) versus the explanatory power of the SFAS 133 accounting numbers (Equation 4.34).

Hypothesis 2 is tested by comparing the explanatory power of the historical cost accounting numbers for a firm's common-equity market value (equation 4.35) versus the explanatory power of the SFAS 133 accounting numbers (equation 4.34).

Finally, hypothesis 3 is tested by comparing the explanatory power of the mark-to-market accounting numbers for a firm's common-equity market value (equation 4.31) versus the explanatory power of the historical cost accounting numbers (equation 4.35).

Chapter 6 describes the econometrics methods used to perform the comparison of the models explanatory power.

Chapter 4.3.2 - The Barth (1994) approach

Another empirical setting that has been used widely to study the valuation relevance of accounting numbers from a balance-sheet perspective is based on a valuation model employed by Barth (1994) and others. In this valuation model, the market value of the firm's common equity is hypothesized to be equal to its book value (*See* for example, Barth (1994)) (hereafter Barth (1994)-based specifications):

$$MV_t = BV_t + e_t \tag{4.36}$$

Hypotheses H_1, H_2, and H_3 can also be studied using Barth's (1994) valuation setting. The empirical models are univariate, which simplifies the econometric analysis. Under the mark-to-market accounting model, the Barth (1994) empirical specification becomes:

$$MV_t = \beta_0 + \beta_1 MTOMBV_t + \mu_{4t} \tag{4.37}$$

The SFAS 133 specification is:

$$MV_t = \gamma_0 + \gamma_1 SFASBV_t + \mu_{5t} \tag{4.38}$$

And finally, the historical cost specification is:

$$MV_t = \varphi_0 + \varphi_1 BV_t + \mu_{6t} \tag{4.39}$$

The regression coefficient should be positive and significant in each specification, but it is not possible to make a prediction regarding its magnitude.

Chapter 4.4 - Return specifications

Even though both historical cost and SFAS 133 earnings are provided under SFAS 133, the thesis hypothesis could also be explored from the income-statement perspective. It is necessary to make the assumption that only one income number would be supplied under SFAS 133, and that this number would be comprehensive income. Each recognition model

for cash-flow hedges of anticipated transactions produces a different income number. The relative information contents of each income number for stock-market returns are compared.

Return-earnings specifications require an assessment of the proper return horizon to consider. Long-window tests are preferred to short-window, because the object of the thesis is not to determine whether the accounting numbers convey new information to the market, but to assess whether the accounting numbers seem to reflect the information that is assessed as being relevant by market participants.

From a theoretical perspective, hypotheses H_1 to H_3 are also expected to hold under return-earnings specifications. More specifically, it is expected that the mark-to-market income number (XMTOM) will be more strongly associated with stock returns than the SFAS 133 income number (XSFAS) (H_1) or than the historical cost income number (XC) (H_3). Similarly, comprehensive income under SFAS 133 (XSFAS) is not properly matched and is assumed to measure the true change in the value of the firm with more error than historical cost income. The latter should be more strongly associated to stock returns than SFAS 133 comprehensive income (H_2).

A source of concern for Return-earnings tests is that one of the most robust findings of the ERC literature is the low explanatory power of accounting earnings for returns. Many explanations have been brought to explain this lack of power. Lev (1989) reviews this literature comprehensively. Briefly:

1. The model relating stock returns to accounting earnings as an explanatory variable lacks theoretical support. While Ohlson (1995)'s valuation setting is shown to hold under very general assumptions, the Return - Earnings specification is known to hold only in aggregation over the entire life of the firm. Its main justification as an explanatory variable for stock returns for a given period is ad-hoc, and mainly based on the vast interest in the earnings number in practice. Olhson and Schroff (1992) propose an econometrics argument to support the return-earnings specification.
2. It appears that stock returns react to information captured by earnings well before earnings numbers are released (*See* among others, Ball and Brown (1968)). This leads to the use of proxies for earnings expectations (Lev (1989)), which suffer from noise in measurement problems, or to the use of non-contemporaneous return windows which might be difficult to justify other than based on their empirical performance (Collins and Kothari (1989)).
3. The ERCs are not stable over time. Using observations that span more than one time-period will result in a test of little power.
4. Losses have a much lower ERCs than profits, due to limited liability (Hayn (1995)).

The second observation above is particularly problematic for the purpose of this thesis. If market participants value mining firms based on earnings forecasts, then firms that systematically hedge are likely to have their earnings forecasts known by the market several periods prior to the current period. The determination of the proper return window to use is

particularly difficult. Many sample firm-year observations show losses, which as noticed by Hayn (1995) reduces the statistical power of the specification.

Given the observations above, the empirical power of the return specifications is expected to be low, and results from these specifications should be interpreted with caution.

The return-earnings models that correspond to each Ohlson (1995)-based valuation equation presented in chapter 4.3.1 are developed first. For the purpose of this sub-chapter, assume that:

K = 1 + κ= 1 + cost of equity capital as previously described in this paper.

The development of the return specification is demonstrated using the historical cost model. Since the Ohlson (1995) valuation model holds under any accounting policy that conforms to the clean surplus relationship, the return equations corresponding to the mark-to-market and to the SFAS models can be developed using the same procedure. The return expression is developed following Appendix 2 of Ohlson (1995). [Note that all variables in the remainder of this chapter are understood to be deflated by the number of common shares outstanding.] We know that:

$$P_t = BV_t + \alpha_1 AE_t \tag{4.40}$$

First, develop the expression for $P_t + d_t - KP_{t-1}$

$$P_t + d_t - KP_{t-1} = BV_t + d_t - KBV_{t-1} + \alpha_1 \left(AE_t - KAE_{t-1} \right) \tag{4.41}$$

Note that:

$$BV_t = BV_{t-1} + XC_t - d_t \tag{4.42}$$

Using this identity in (4.41):

$$P_t + d_t - KP_{t-1} = BV_{t-1} + XC_t - KBV_{t-1} + \alpha_1\left(AE_t - KAE_{t-1}\right) \tag{4.43}$$

Remember that:

$$XC_t = (K-1)BV_{t-1} + XC_t^a \tag{4.44}$$

Using this identity in (4.43):

$$P_t + d_t - KP_{t-1} = BV_{t-1} + KBV_{t-1} - BV_{t-1} + XC_t^a - KBV_{t-1} + \alpha_1\left(AE_t - KAE_{t-1}\right) \tag{4.45}$$

From the information dynamic of Ohlson (1995), we know that:

$$AE_t = \omega AE_{t-1} + \varepsilon_t \tag{4.46}$$

Replacing in (4.45)

$$P_t + d_t - KP_{t-1} = \omega AE_{t-1} + \varepsilon_t + \alpha_1\left(\omega AE_{t-1} + \varepsilon_t - KAE_{t-1}\right) \tag{4.47}$$

Grouping terms

$$P_t + d_t - KP_{t-1} = (1+\alpha)\varepsilon_t + (\omega + \alpha\omega - \omega K)AE_{t-1} \tag{4.48}$$

Analyze the coefficient of abnormal earnings under historical cost. Remember that:

$$\alpha = \frac{\omega}{K-\omega} \tag{4.49}$$

Replacing in the second bracket of (4.48):

$$P_t + d_t - KP_{t-1} = (1+\alpha)\varepsilon_t + \left(\omega + \frac{\omega^2}{K-\omega} - \frac{\omega K}{K-\omega}\right)AE_{t-1} \tag{4.50}$$

Using a common denominator

$$P_t + d_t - KP_{t-1} = (1+\alpha)\varepsilon_t + \left(\frac{\omega K - \omega^2 + \omega^2 - \omega K}{K-\omega}\right)AE_{t-1} \tag{4.51}$$

Hence, the abnormal-earnings term drops off the equation. Dividing both sides by P_{t-1}

$$\frac{P_t + d_t - KP_{t-1}}{P_{t-1}} = (1+\alpha)\frac{\varepsilon_t}{P_{t-1}} \tag{4.52}$$

Isolating for return on the left-hand side yields:

$$\frac{P_t + d_t}{P_{t-1}} = K + (1+\alpha)\frac{\varepsilon_t}{P_{t-1}} \tag{4.53}$$

This equation is presented in term of the gross return on the firm's equity. The net return is:

$$\frac{P_t + d_t}{P_{t-1}} - \frac{P_{t-1}}{P_{t-1}} = K - \frac{P_{t-1}}{P_{t-1}} + (1+\alpha)\frac{\varepsilon_t}{P_{t-1}} \tag{4.54}$$

Or:

$$\frac{P_t + d_t - P_{t-1}}{P_{t-1}} = \kappa + (1+\alpha)\frac{\varepsilon_t}{P_{t-1}} \tag{4.55}$$

Adding a regression-error term, letting κ be captured by the constant term, and adding a regression coefficient yields the correct return model corresponding to Ohlson (1995):

$$R_t = const + \beta_1 \frac{\varepsilon_t}{P_{t-1}} + \xi_{1t} \tag{4.56}$$

Note that in these specifications, ε_t is the surprise in abnormal earnings. It is unobservable. Ohlson & Schroff (1992) discuss the best proxy for the right-hand side of this return equation. They argue that the most likely proxy ex-ante for the surprise in abnormal earnings is the level of the firm's earnings.[29] Easton & Harris (1991)'s empirical tests also come to the same conclusion. The historical cost return equation thus simplifies to:

[29] In some cases, it is possible that the change in earnings be the best proxy. Their argument for the superiority of the levels of earnings is statistical rather than theoretical. Only empirical evidence can answer this question, given that many of the conditions indicated in Ohlson & Schroff (1992) are sample specific.

$$R_t = const + \beta_1 \frac{XC_t}{P_{t-1}} + +\xi_{1t} \tag{4.57}$$

SFAS 133 specification:

$$R_t = const + \gamma_1 \frac{XSFAS_t}{P_{t-1}} + \xi_{2t} \tag{4.58}$$

And finally, the mark-to-market specification

$$R_t = const + \varphi_1 \frac{XMTOM_t}{P_{t-1}} + \xi_{3t} \tag{4.59}$$

Interestingly, these return equations are also the return models directly implied by the valuation model in Barth (1994).[30] Note that return-earnings specifications, including changes in earnings terms, are also considered in a sensitivity analysis.

Chapter 4.5 – Conclusion

This chapter develops the thesis hypotheses. As discussed in Chapter 2.6, the impact of SFAS 133 on the balance sheet is more significant than its impact on the income statement. SFAS 133 require that both the historical cost income number and SFAS 133 income numbers be provided in financial statements. Users can choose to ignore the SFAS 133 income number. However, only one balance-sheet, prepared under SFAS 133 rules, is provided. For this reason, tests of this thesis' hypotheses from a balance-sheet perspective are considered the main empirical setting. Three hypotheses are developed. H_1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. H_2 (in alternate form) predicts

[30] If one develops the expression for $(P_t - P_{t-1} + d_t)$ using the valuation model $P_t = BV_t + e_t$, one easily obtains the return equations above.

that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Finally, H_3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers.[31]

Two sets of levels-empirical specifications are developed. The first set is based on a valuation model developed by Ohlson (1995). Empirical specifications based on Ohlson (1995) are referred to as "Ohlson (1995)-based specifications" in the remainder of the thesis. The second set of empirical specifications is based on the valuation model that has been used by Barth (1994), among others. Levels-specifications based on Barth's (1994) work are referred to as Barth (1994)-based specifications in the remainder of the thesis.

Finally, a return-earnings setting has been defined for exploratory tests of the thesis hypotheses from an income-statement perspective.

[31] Note that hypothesis H_3 holds for the case of partially hedged firms only. If firms were fully hedged, both the historical cost and mark-to-market accounting numbers would show the same net accounting numbers at t=0, and none would dominate in terms of explanatory power.

Chapter 5 – Pricing for gold and other commodity derivative contracts and reserves[32]

Chapter 5.1 - Introduction

As discussed in chapter 2, SFAS 133 requires that derivatives be marked-to-market and recognized on the balance sheet. The mark-to-market model requires the recognition of both derivatives and gold reserves. SFAS 133 will not be mandatory before the fiscal year 2001 for calendar-year firms. To test the hypotheses developed in chapter 4, derivatives and commodity reserves must be valued and accounting numbers generated for the different models. This chapter discusses the valuation models used for calculating fair values of derivatives and commodity reserves.

The FASB indicates in SFAS 107 that the best estimate of fair value is a traded market value (SFAS 107, paragraph. 5). When an instrument is not traded actively, such as over-the-counter derivatives, pricing models must be used to value commodity derivatives and gold reserves. In this thesis, commodity derivatives values are computed using footnotes disclosures, no-arbitrage pricing models, and some general market data. Many assumptions are required to complete the process. This chapter describes these assumptions. Gold reserves are valued using the Hotelling principle as modified by Miller and Upton (1985a, 1985b).

Chapter 5.2 describes the assumptions that have been made in this thesis when interpreting a firm's derivatives disclosures for valuation purpose. Chapter 5.3 summarizes the derivatives

[32] Although gold is the most important commodity produced by gold firms, many other commodities, such as

pricing assumptions. Chapter 5.4 describes the pricing procedure for commodity reserves and Chapter 5.5 provides a pricing example of derivatives and reserves fair values. Chapter 5.6 details tests that have been performed to assess the validity of the fair value numbers generated. Finally, chapter 5.7 concludes this chapter.

Chapter 5.2 - Assumptions concerning the interpretation of derivative disclosures

Most sample firms provide aggregate information about their derivative contracts to reduce the volume of information disclosed in the footnotes of their financial statements. Disclosures are normally made for each maturity year. Usually, the total of the notional amount for a type of contract (for example, gold forwards) is disclosed, along with the average strike price of those contracts. In some cases, a range of strike prices is provided. Contracts are priced as if they were a single contract using the total notional amount, the average strike price (or the middle of the range of strike prices disclosed), and the exact maturity date. If the exact maturity date is not provided, an expiry date of June 30 is assumed. This assumption is reasonable because gold mines are usually in production year round, with the production being distributed fairly evenly over the year. Accordingly, it is assumed that sales also would be distributed evenly, as well as the hedging program. In fact, this procedure assumes that the contracts mature equally around June 30 every year. It also assumes that the average strike price disclosed by firms is the weighted average of the strike prices of all their outstanding contracts for the maturity year. If a firm disclosed a range of strike prices instead of an average, the mid-point of that range has been used to price the contracts. These assumptions have been discussed with the CFO's of a sub-sample of firms. They indicated that the assumptions appear realistic.

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silver and copper, are also extracted by these firms.

Chapter 5.3 – Derivatives-pricing assumptions

Derivative contracts are priced assuming no-arbitrage conditions. A detailed discussion of no-arbitrage pricing is found in Hull (1997) and Jarrow and Turnbull (1996). Table 5.1 summarizes pricing data parameters that are collected, as well as the sources of the data. Table 5.2 reports the pricing parameters used.

Table 5.1: Derivatives pricing data and data sources

Type of data	Data item collected	Data source
Interest rate data (risk-free rate proxy)	Implied yield on zero coupon U.S. treasury bills or U.S. treasury strips	Wall Street Journal
Commodity spot prices	COMEX cash prices	CSI Database
Commodity Futures prices	COMEX traded futures for all available duration	CSI Database
Cost of carry/Convenience yield	As implied by the term structure of futures prices	CSI Database
Gold price volatility	Implied volatility from short term COMEX futures options	Wall Street Journal

The continuously compounded risk-free rate of interest is proxied by the implied interest rate on U.S. Treasury Bills or on U.S. Treasury Strips for a longer duration. Gold prices (spot and futures) were collected from The Commodity Exchange (hereafter COMEX), a division of the New-York Mercantile Exchange, as reported on the CSI Database. The cost-of-carry-and-convenience-yields are estimated from the term structure of futures prices. Futures prices usually grow at a rate equal to the risk-free rate **plus** the cost of carrying the position **plus or minus** any convenience yield pertaining to the physical ownership of the commodity. An estimate of the cost of carrying the position **minus** the convenience yield is required for pricing commodity options. The term structure of futures prices has been used to estimate

this parameter. The convenience yield **minus** the cost of carrying the position calculated for gold ranges from 0.53 per cent (1997 – 6 months forward) to 2.60 per cent (1996 – 6 months forward), with an average of 1.52 per cent. McDonald and Shimko (1998) relate this convenience yield to the existence of a lending market for gold. Physical ownership of the commodity may be used to generate a return on investment, and prices of commodity derivatives must reflect this opportunity cost. McDonald and Shimko (1998) document convenience yields over the period 1979 to 1998 that are similar to the convenience yields calculated in this thesis.

Gold mining firms often use forward and spot deferred contracts to hedge; these contracts are priced using the quoted futures price as the estimate of the forward price for a given maturity. Theoretical research has shown that forward and futures prices are equal only when interest rates are deterministic (Cox et al. (1981), Jarrow and Oldfield (1981)). Empirical research on forward and futures price differences indeed determined that these prices are statistically different for many commodities, but also shows that this difference is of little economic significance for the objectives of this thesis (French (1983), Park and Chen (1985)). From the results of these studies, it seems that the difference is in the range of less than 1 per cent. The small magnitude of this difference leads to the use of futures prices as the estimate of forward prices in the thesis. Chapter 5.5 shows an example of the pricing of a forward contract using the methodology developed here.

Spot deferred contracts are similar to forward contracts, but they embed the option of rolling the contract forward at expiration, instead of settlement. According to the chief financial

officers (CFOs) of some mining firms' and a risk manager working for a derivatives dealer. this option does not affect the valuation of the contract. The price of a spot-deferred contract should always equal the price of a fixed-forward contract. Chapter 5.5 explains in greater detail the terms of a spot-deferred contract and provides an example of the pricing of such a contract using the methodology developed in this thesis.

Commodity options are priced in this thesis assuming they are European options. A European option can be exercised only on its maturity date. This is a simplifying assumption, since some sample firms have exercised their options early, indicating their options are American. The European price of an American option is a lower bound of its true market value, and can be considered a conservative accounting estimate when dealing with short commodity positions. The advantage of using European contracts is that closed-form-solution pricing formulas exist, and are readily implemented. Other characteristics of option contracts, such as barriers, are considered when necessary. Closed form pricing formula have been used to value barrier options. These formulas assumed a continuous assessment of whether the barrier has been crossed. However, many contracts used in practice make this assessment on a discrete basis. Firms do not disclose the frequency of the assessment per their option contract.[33]

The implied volatilities of commodity futures options traded on COMEX are used as the estimate of volatility for all commodity options priced in this thesis. Only very short-term option quotations are provided by the *Wall Street Journal*. Up to 36 different options trade at

[33] A pricing error may result from the use of these formulas. However, the pricing errors for puts and calls go in opposite directions, and would tend to cancel each other.

any given date. Moreover, there is a clear evidence of a "volatility smile", namely that options deep in or out-of-the-money trade under an implied volatility that is much larger than that of their at-the-money counterparts. The choice of the proper estimate to use is a matter of individual judgement. One estimate of volatility for a given year has been chosen, from the range of possible values. The volatility estimates used for gold each year range from 9 per cent (1996) to 18 per cent (1993 and 1997), with an average of 13 per cent. Again, chapter 5.5 provides an example of the pricing of a commodity option using the procedure developed in this thesis. Pricing parameters are summarized in table 5.2.

Table 5.2 : Derivatives pricing parameters

Gold, silver, copper, and interest rate

as of December 31, 1992, 1993, 1994, 1995, 1996, 1997

	1992	**1993**	**1994**	**1995**	**1996**	**1997**
1. Gold parameters						
Spot price (US $)	$ 333.30	$ 391.70	$ 382.40	$ 386.90	$ 369.00	$ 287.00
Volatility (%)	12%	18%	12%	10%	9%	18%
Drift rate : 0 -60 months	4.42	4.06	6.30	3.21	3.72	3.87
Convenience yield (%)						
0-6 months	1.85	1.11	0.81	1.76	2.60	0.53
0-18 months	1.24	1.03	0.60	1.88	2.03	1.13
0-30 months	1.2	1.05	0.97	1.96	2.10	1.32
0-42 months	1.25	1.09	1.16	2.05	2.19	1.55
0-48 months	1.3	1.11	1.21	2.08	2.27	1.62
0-54 months	1.44	1.10	1.28	2.06	2.30	1.66
0-60 months	N/A	0.99	1.32	2.06	2.36	1.66
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
2. Silver parameters						
Spot price (US $)	$ 3.67	$ 5.08	$ 4.87	$ 5.11	$ 4.73	$ 5.95
Volatility (%)	22%	33%	27%	24%	23%	39%
Drift rate : 0 -60 months	5.25	4.69	7.71	5.49	5.79	2.33
Convenience yield (%)						
0-6 months	-0.15	-0.26	0.11	-1.66	-0.13	3.30
0-18 months	-0.56	-0.10	-0.23	-0.24	-0.11	4.68
0-30 months	-0.28	-0.04	-0.06	-0.05	-0.12	5.02
0-42 months	-0.21	0.32	-0.10	-0.01	-0.21	4.45
0-48 months	-0.44	0.27	-0.11	-0.07	-0.25	4.00
0-54 months	-0.61	0.04	-0.22	-0.11	-0.27	3.62
0-60 months	N/A	0.36	-0.09	-0.22	-0.29	3.20

Table 5.2 : Derivatives pricing parameters

Gold, silver, copper, and interest rate

as of December 31. 1992. 1993, 1994, 1995, 1996, 1997

	1992	1993	1994	1995	1996	1997
3. Copper parameters						
Spot price (US $)	$ 1.065	$ 0.875	$ 1.435	$ 1.325	$ 1.075	$ 0.794
Volatility (%)	12%	16%	25%	17%	28%	28%
Drift rate : 0-24 months	-1.11	-0.53	-16.00	-8.93	-7.24	3.74
Convenience yield (%)						
0-6 months	7.84	12.11	32.03	29.76	25.83	4.55
0-18 months	5.18	4.74	24.48	15.67	14.64	1.81
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
4. U.S. Interest rates (%)						
0-6 months	3.24	3.16	6.12	4.5	5.21	5.11
0-18 months	3.95	3.87	7.08	4.92	5.47	5.35
0-30 months	4.71	4.28	7.49	5.04	5.75	5.43
0-42 months	5.32	4.69	7.6	5.16	5.9	5.54
0-48 months	5.56	4.86	7.6	5.22	5.98	5.56
0-54 months	5.86	5.02	7.63	5.23	6.03	5.56
0-60 months	6.04	5.05	7.62	5.27	6.08	5.53
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
5. Gold futures prices (estimate of forward prices - $US)						
6 months	335.60	395.70	392.60	392.20	373.80	293.60
18 months	347.10	408.70	421.30	404.90	388.50	305.70
30 months	363.80	424.60	450.10	417.90	404.20	318.00
42 months	384.30	444.20	479.10	431.40	420.10	330.00
48 months	395.20	455.10	493.80	438.70	428.20	336.00
54 months	406.60	467.20	508.90	446.30	436.40	342.10
60 months	N/A	479.80	524.00	454.20	444.50	343.80
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
6. Silver futures prices (estimate of forward prices - $US)						
6 months	3.743	5.182	5.043	5.296	4.879	6.008
18 months	3.941	5.409	5.467	5.544	5.166	6.008
30 months	4.174	5.679	5.917	5.828	5.470	6.008
42 months	4.407	5.942	6.420	6.150	5.799	6.181
48 months	4.505	6.104	6.631	6.314	5.949	6.318
54 months	4.668	6.384	6.979	6.528	6.159	6.497
60 months		6.424	7.161	6.725	6.319	6.678
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
7. Copper futures prices (estimate of forward prices - $US)						
6 months	1.041	0.837	1.294	1.169	0.9705	0.7965
18 months	1.0445	0.863	1.09	1.118	0.93	0.843

Chapter 5.4 – Pricing Commodity Reserves

The reserves of firms are priced using a formula introduced by Miller and Upton (1985a, 1985b) that is based on the work of Hotelling (1931). The Hotelling (1931) principle states that commodity reserves are expected to earn their owner a return over time in equilibrium. Miller and Upton (1985a, 1985b) developed a pricing model for the market value of a firm's commodity reserves. In their model, the forecasting of the schedule of future production is not needed, since the expected return on holding the reserves cancels out the impact of discounting the future benefits. The market value of the reserves can be estimated using current spot price and current cash costs of production. Miller and Upton (1985a) determine that the formula holds for a sample of oil and gas firms facing a high volatility in oil prices. However, the results of their second paper (Miller and Upton (1985b)) are less conclusive. Nabar (1997) also used the Miller and Upton (1985a, 1985b) valuation model in his gold mining study.

The market value of a firm's commodity reserves is given by:

$$RES_t = (P_t - CC_t) * PPR_t \qquad (5.1)$$

Where

RES_t is the market value of the firm's commodity reserves at time t

P_t is the spot price of the commodity at time t

CC_t is the current cash costs of extraction of the commodity at time t

PPR_t is the firm's Proven and Probable commodity reserves at time t

Chapter 5.5 provides an example of the pricing of commodity reserves using the methodology developed by Miller and Upton (1985a, 1985b).

Chapter 5.5 Pricing examples using the methodology described in this chapter

The case of Hecla Mining, 1996, was chosen to demonstrate the application of the pricing methodology developed in this thesis. The firm has only a limited involvement with derivatives, and provides market-value estimates for each class of instruments.

Chapter 5.5.1 – Details of the positions outstanding

The annual report of Hecla Mining for the year ending December 31, 1996 indicates the following derivative positions outstanding:

Table 5.3 – Hecla mining gold derivative positions as of December 31, 1996

Type	Notional Amount	Strike Price	Expiry date	Disclosed Market Value
Forwards	25 000	S 381.00	January 15, 1997	S 299,000
Spot deferred contract	1 000	S 412.00	January 1997	S 43,000
Put options purchased	34 400	S 396.00	1997	S 772,000
Call options sold	34 400	S 461.00	1997	S (2,000)

Chapter 5.5.2 – Pricing of a forward contract

Hull (1997) indicates that the value of any forward contracts can be calculated using the following formula:

$$f(t) = (F(t) - K)e^{-r_c(T-t)} \qquad (5.2)$$

where:

$f(t)$: Forward contract value at time t

$F(t)$: Forward price at time t

K: Contract price

r_f: Risk-free rate of interest

$(T-t)$: Duration of the contract (in years).

For Hecla Mining in 1996, the relevant parameters are:

$F(t)$: $369.20 (Futures price for delivery in January 1997)

K: $381.00

r_f: 5.21% (*Wall Street Journal*)

$(T-t)$: 0.5/12

Using equation 5.2, the value of the forward contracts for one ounce of gold is $11.77, for a total value of $294,360 for 25,000 ounces. Hecla Mining disclosed a market value of $299,000 for this position.

Chapter 5.5.3 – Pricing of a spot-deferred contract

As discussed in this chapter, the value of a spot-deferred contract should always be equal to the value of a forward contract. The logic is as follows. Assume that a firm enters in a spot-deferred contract at time 0, which matures at time t=1, with the firm having the option to roll the contract forward into a new contract expiring at time t=2. Also assume that at t=1, the firm has a realized loss on the spot-deferred contract of $10.00/ounce. The firm decides to exercise the option of rolling the contract forward. A new forward price for delivery at t=2 is calculated such that the market value of the new contract is equal to $(10.00). Under very

stable market conditions, the new price calculated would be the initial delivery price of the contract at t=0.[34]

Since the value of a spot-deferred contract is equal to the value of a forward contract, the methodology proposed in this chapter can be used directly. For Hecla Mining in 1996, the relevant parameters are:

$F(t)$: S 369.20 (Futures price for delivery in January 1997)

K: S 412.00

r_f: 5.21% (*Wall Street Journal*)

$(T-t)$: 1/12

Hence, the value of the spot-deferred contract for one ounce of gold is S42.61, for a total value of S42,615 for 1,000 ounces. Hecla Mining disclosed a market value of S43,000 for this position.

Chapter 5.5.4 – Pricing of commodity options

Commodity options are priced using Black & Scholes pricing formulas. These formulas, for a put and a call, are (Hull (1997) and Jarrow & Turnbull (1996)):

$$put = Ke^{-r_f(T-t)}N(-d_2) - G(t)e^{(u-y)(T-t)}N(-d_1) \qquad (5.3)$$

$$call = G(t)e^{(u-y)(T-t)}N(d_1) - Ke^{-r_f(T-t)}N(d_2) \qquad (5.4)$$

and :

[34] This is true only if interest rates and the contango on gold have not changed between t=0 and t=1. If this is not the case, the new forward price for delivery will be different from the initial price, but the market value of the new contract at inception will be equal to the cash settlement that would have occurred at time t=1.

$$d_1 = \frac{\ln(G(t)/X) + (r_f + u - y + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}} \quad (5.5)$$

$$d_2 = d_1 - \sigma\sqrt{T-t} \quad (5.6)$$

where:

K : Strike price of the option

G (t): Spot price of the commodity

r_f : Risk-free rate of interest

$(u-y)$: Cost of storage minus the convenience yield. As discussed earlier, this rate has been estimated from the term structure of futures prices.

$(T-t)$: Duration of the option, in years

σ : Volatility of the commodity price, estimated using the implied volatility from traded futures options.

For Hecla Mining put options outstanding in 1996, the relevant parameters are :

K : $396.00

G (t): $369.00

r_f : 5.12%

$(u-y)$: 2.60%

$(T-t)$: 0.5 year, since no precise expiry date in 1997 is indicated.

σ : 9%.

The price of a put option for 1 ounce of gold is $23.86. Hence, the market value of the position of 34,400 ounces of gold is $820,820. Hecla Mining disclosed a market value of

S772.000 for their put position.

Finally, for Hecla Mining's call options in 1996, the relevant parameters are :

K : S461.00

G : S369.00

r_f : 5.12%

$(u-y)$: 2.60%

$(T-t)$: 0.5 year, since no precise expiry date in 1997 is indicated.

σ : 9%.

The price of a call option for 1 ounce of gold is S0.003227. The total market value of the position of 34,400 ounces of gold is S(111). Note that a call option sold always has a negative market value for the seller. Hecla Mining disclosed a market value of S(2,000) for the call position.

Chapter 5.5.5 – Valuation of commodity reserves

The market value of commodity reserves, based on Hotelling's (1931) principle as adapted by Miller and Upton (1985a, 1985b), is given by:

$$RES_t = (P_t - CC_t) * PPR_t \qquad (5.7)$$

Where

RES_t is the market value of the firm's commodity reserves at time t

P_t is the spot price of the commodity at time t

CC_t is the current cash costs of extraction of the commodity at time t

PPR_t is the firm's Proven and Probable commodity reserves at time t.

For Hecla Mining in 1996, the relevant parameters for the valuation of the firm's gold reserves are :

P_t : $369.00

CC_t : $276.00

PPR_t : 787,249 ounces.

The market value of the firm's gold reserves is $73,214,157 as at December 31, 1996.

Chapter 5.6 – Validation of computed fair values

Some firms voluntarily disclose the fair value of their commodity derivatives. To assess the measurement error of the derivatives fair values computed, the disclosed fair values have been compared to the computed fair values for the sub-sample of firms providing disclosures. It was possible to obtain 53 firm-year paired observations. Of these pairs, six are outliers. The valuation method described by the firm holding the derivatives is not consistent with a fair value computation, and the fair values disclosed are very different from the fair values computed.[35] The results discussed in this chapter are not sensitive to the inclusion or exclusion of these six pairs.

A paired t-test of the difference between computed and disclosed fair values fails to reject the null of no difference between the two numbers. As a second step, the correlation between observed and computed fair value is 0.99, indicating that the two numbers are strongly

associated. A linear regression model of disclosed fair values on computed fair values has also been estimated. The adjusted R^2 from this regression is 0.98. The coefficient of computed fair value is positive and is highly significant, and the constant is positive. The positive constant indicates that computed derivatives values are slightly upward biased. These results demonstrate that the pricing procedure used seems to generate reliable estimates of derivatives fair values for the purpose of this thesis.

Chapter 5.7 – Conclusion

This chapter has described the assumptions and procedures used in the calculation of the fair values of commodity derivatives and reserves. These fair values are central to the computation of the "as if" accounting numbers per the SFAS 133 and mark-to-market recognition models for cash-flow hedges of anticipated transactions. Tests were performed comparing the derivatives fair values computed using the methodology described in this chapter to firms' voluntary disclosed commodity derivatives fair values. They reveal that the pricing procedures used appear to generate reliable estimates of derivatives fair value.

[35] For example, one firm indicated that because its contract prices were equal to the current spot price, the market value of its derivative position is zero.

Chapter 6 - Sample selection, variable definitions, and methodology

Chapter 6.1 – Introduction

The gold mining industry is chosen as the empirical setting to test the hypotheses developed in chapter 4. This chapter describes the sample selection procedures and defines the variables and econometric procedures used in the empirical tests of the thesis hypotheses.

This chapter is organized as follows. Chapter 6.2 describes the sample selection procedures. Chapter 6.3 defines the variables used in the empirical specifications. An example of the calculation of the variables used in these empirical specifications is provided in chapter 6.4. The econometric-estimation procedure for panel data employed in this thesis is described in chapter 6.5. Chapter 6.6 describes theoretically the cross-validation methodology applied to compare the relative information content of the regression models. Chapter 6.7 shows how the cross-validation methodology is specifically applied to the thesis data and chapter 6.8 concludes the chapter.

Chapter 6.2 - Sample selection

This paper concentrates on the gold mining industry as the empirical setting in which the hypotheses developed in Chapter 4 are tested. The gold mining industry is an interesting setting because firms in this sector are relatively homogenous and use derivatives extensively. Tufano (1996) explains that this industry has a long history of commodity derivatives voluntary disclosure.[36] The homogeneity of these companies contributes to the internal validity of this study by reducing the number of potentially confounding factors. In addition,

derivatives positions outstanding are usually material and gold price volatility is an important issue faced by the management of these organizations. This should ensure that the independent variables span a reasonable range and provide econometric power. Finally, industry membership is large enough to ensure a fair power of tests in the empirical setting.

Sample selection procedures are summarized in Table 6.1. The Access Lexis/Nexis disclosure database indicates that the gold mining industry, as of July 31, 1998, comprised 216 firms. Of these 216 firms, six were not actively involved in gold mining during the years spanned by this study. Five firms are subsidiaries of another of the 216 firms.[37] Eight firms did not release an annual report or a 10-K during the study period. Further, annual reports or 10-K's could not be obtained from 33 firms. The initial sample size is therefore 164 firms. Of these remaining firms, 108 were involved in exploration activities only and two were only collecting royalties. These firms cannot use commodity derivative securities for hedging purposes, because they do not have reserves that can be hedged. This leaves only 54 potential derivatives users. Unfortunately, the disclosures of one derivatives user are incomplete and derivative positions could not be valued. Of the remaining potential derivatives users, 19 firms are not using commodity derivative securities, and 34 firms have chosen to use commodity derivatives. Of the thirty-four derivatives users, 25 have a full panel of data available for the six years of the sample period.[38,39]

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[36] As discussed in chapter 2, commodity derivatives are not subject to pre-SFAS 133 FASB disclosure rules. Firms from this industry have used derivatives very heavily, which may explain why they choose to voluntarily disclose the positions.

[37] One of the two firms involved in the parent-subsidiary relation has been kept in the sample. The firm the most closely involved in gold mining has usually been chosen.

[38] 31 firm-year observations have no derivatives outstanding at year-end.

[39] The 9 firms with a partial panel of data available represent 31 firm-year observations in levels specifications (20 firm-year observations in specifications including income statement elements). Descriptive statistics for these 31 firm-year observations (not reported) show that on average these firms are about 4 times smaller than

Table 6.1: Sample selection

Total number of firms listed on Access disclosure database with their primary or secondary SIC listed as 1041 – Gold mining, as of July 1998	216
Less : Firms that do not have gold related activities over the sample period[40]	(6)
Less : Firms that are subsidiaries or parent company of a firm already in the sample	(5)
Less : Firms that did not publish Annual Report over the study period[41]	(8)
Less : Firms for which Annual Reports or 10-Ks could not be obtained[42]	(33)
Firms for which information could be gathered	164
Less : Firms with exploration activities only	(108)
Less : Royalty company	(2)
Firms with Reserves outstanding at year-end	54
Less : Firms with sub-standard disclosures (not enough to price)	(1)
Less : Firms that are not using derivatives	(19)
Firms with derivatives outstanding at year-end	34
Minus: firms with a partial panel of data available from 1992 to 1997	9
Minus: outliers firms[43]	3
Sample firms with a full panel of data available from 1992 to 1997	22

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the firms from the panel sample (both in terms of market value and book value of common stockholders equity). They produce 5 times less gold yearly, and have 3 times less gold reserves than the panel firms. Like the panel firms, they hedge about 10% of their commodity reserves.

[40] Firms who are listing the SIC code 1041 as one of their secondary activity, mainly because of exploration activities they are or were pursuing.

[41] Firms that are listed on the Access disclosure database, but that did not file with the SEC between 1992 and 1997 (For example, some firms were taken over prior to 1992, or were created after December 31, 1997).

[42] Includes 12 South African firms, 9 Australian firms, and 12 from diverse locations.

[43] One firm is mainly involved in copper production, and accounts for gold sales as a by-product of its copper activities. When included in the sample, this firm is an influential observation that greatly affects the regression results. When included, the explanatory power of the mark-to-market regression model tends to zero. Levels regression analysis further revealed two firms who show residuals larger than 2.5 standard deviations. Changes regression analysis also revealed two firms who show residuals larger than 2.5 standard deviations. The changes analysis outliers are not the same as the levels analysis outliers.

One firm in particular is an influential observation. It is mainly involved in copper mining, and it accounts for gold sales as a by-product of its copper activities. In this sense, it is different from the other sample firms, for which gold mining is the principal activity. When included in the sample, the explanatory power of the mark-to-market model tends to zero. Therefore, it is removed from the sample. During residuals analysis of levels specifications, two firms show large residual observations (i.e. larger than 2.5 standard deviations). These outliers are also omitted. The final sample for levels specifications is a panel of 22 firms for 6 years (5 years in specifications which include income-statement numbers), yielding 132 firm-year observations (110 firm-year observations in specifications including income-statement numbers). Note that all sample firms have a December 31 year-end.

Outlier analysis of the changes specification revealed two outliers (i.e. larger than 2.5 standard deviations). These outliers are not the same as those identified in the levels analysis. One of these firms is so influential that it produces regression results inconsistent with the results observed in the capital-market financial accounting literature (Lev (1989) reviews this literature).[44] The final sample for changes specifications is a second panel of 22 firms for 5 years, yielding 110 firm-year observations. Finally, in specifications including changes-in-earnings terms, the sample is a panel of 22 firms for 4 years, yielding 88 firm-year observations.

The sample size described in the paragraphs above is comparable to sample sizes used by

[44] More particularly, the estimated regression coefficients for the earnings variables are negative and significant when the outlier firms are included in the data. Positive and significant coefficients are observed when the outliers are omitted, which is consistent with the results reported in the capital-market financial accounting literature (Lev (1989)).

Tufano (1996, 1998) and Nabar (1997) in their studies about the gold mining industry.

Chapter 6.3 Definition of variables

The following is the description of the variables used in the empirical tests.

Variable	Description
MV:	The market value of the firm's common equity measured using stock price as of December 31, net of the book value of non-participative preferred shares outstanding. Participative preferred shares are considered common equity.
BV:	Book value of the firm's common equity as of December 31 under historical cost accounting, net of the book value of non-participative preferred shares outstanding.
SFASBV:	Book value of the firm common equity as of December 31, restated under cash flow hedges accounting rules under SFAS 133. It is : SFASBV = BV – NOPD + DER Where : NOPD : Net option premium paid or received as of December 31 deferred under historical cost accounting. DER : Unrealized market value of derivatives outstanding, calculated using pricing parameters as of December 31, as described in Chapter 5.[45]
MTOMBV:	Book value of the firm's common equity as of December 31, restated under the rules of mark-to-market accounting. It is :

[45] The analysis concentrates only on commodity derivatives used to sell the firm's output. This thesis' hypotheses require that the hedged item be known and priced. Wong (1997) notices that accounting disclosures of hedged items are often deficient. For example, firms usually do not disclose the total amount of their future foreign-currency cash flows, or their future commodity inputs. Accordingly, all derivatives other than those related to the firm's output are omitted from the calculation of SFAS 133 and mark-to-market accounting numbers. Fifty-nine firm-year observations report foreign-currency derivatives outstanding at year-end, and 33 firm-year observations report interest rate contracts. Using market value estimates disclosed by firm, the mean market value of foreign currency derivatives contracts outstanding is about US $5 million (mean notional amount of US $130 million). The mean market value of interest rate contracts outstanding is US $(201,000) (mean notional amount of 76 million). These means are small when compared to the means of commodity contracts outstanding.

Variable	Description
	MTOMBV = SFASBV – BVRES + RES Where: BVRES : Book value of the firm commodity reserves as of December 31 under historical cost accounting. It is proxied for by the sum of the book value of mineral properties, fixed assets, and deferred exploration costs. RES: Hotelling's (1931) unrealized reserves value, calculated using pricing parameters as of December 31, as described in chapter 5. It is based on the proven and probable commodity reserves of the firm at year-end and realized cash costs of extraction.[46]
AE:	Abnormal earnings of the firm for the year ending December 31 under historical cost accounting. It is: $AE_t = XC_t - 0.10 * BV_{t-1}$ Where : XC_t: Net income for the year ending December 31 under historical cost accounting. Claus and Thomas (1999) estimate the discount rate observed in financial markets between 1985 and 1996 to be 11%. Given that interest rates between 1992 and 1997 have been lower than the rates observed prior to 1992, the rate of 11% has been arbitrarily adjusted down to 10%. The results are not sensitive to the estimate of the expected rate of return used.[47] Note that the same expected rate of return is used for all firms.
SFASAE:	Abnormal earnings of the firm for the year ending December 31 under SFAS 133 cash-flow hedge accounting rules. It is : $SFASAE_t = XSFAS_t - 0.10 * SFASBV_{t-1}$ Where : $XSFAS_t$: Net income of the firm for the year ending December 31 under SFAS 133 cash flow hedging rules

[46] For firms that are not producing at year-end, an estimate of the cash cost of production was used instead.
[47] Expected rates of return of 11% and 15% have also been used without effect on the results.

Variable	Description
	$XSFAS_t = XC_t + \Delta DER_t$
MTOMAE:	Abnormal earnings of the firm for the year ending December 31 under mark-to-market accounting rules. It is :
	$MTOMAE_t = XMTOM_t - 0.10 * MTOMBV_{t-1}$
	Where :
	$XMTOM_t$: Net income of the firm for the year ending December 31 under mark-to-market accounting rules:
	$XMTOM_t = XSFAS_t + \Delta RES_t$
RETURN	Stock return of the firm for the year, calculated as follows:
	$RETURN = \frac{P_t - P_{t-1} + D_t}{P_{t-1}}$
	Where:
	P_t: Stock price as of January 1st P_{t-1}: Stock price as of December 31st D_t: Dividend per share paid during the year
EPS	Earnings per share under historical cost accounting:
	$EPS_t = \frac{XC^s_t}{P_{t-1}}$
	Where :
	XC^s_t : the historical cost earnings of the firm per common share outstanding for the year ending December 31 (the superscript "s" stands for "per share") P_{t-1}: Common stock price as of January 1st
ΔEPS	Changes in historical cost earnings per share:
	$\Delta EPS_t = \frac{XC^s_t - XC^s_{t-1}}{P_{t-1}}$
SFAS133	SFAS 133 earnings per share under SFAS 133 cash flow hedging rules:

Variable	Description
	$$SFAS133_t = \frac{XSFAS^s}{P_{t-1}}$$
	Where :
	$XSFAS^s_t$: SFAS 133 income per share under SFAS 133 cash flow hedging rules for the year ending December 31 (the superscript "s" stands for "per share")
	P_{t-1}: Common stock price as of January 1st
ΔSFAS133	Changes in SFAS133 earnings per share:
	$$\Delta SFAS133_t = \frac{XSFAS^s_t - XSFAS^s_{t-1}}{P_{t-1}}$$
MTOM	Mark-to-market earnings per share:
	$$MTOM_t = \frac{XMTOM^s_t}{P_{t-1}}$$
	Where :
	$XMTOM_t$: Mark-to-market income per share under mark-to-market accounting for the year ending December 31 (the superscript "s" stands for "per share")
	P_{t-1}: Common stock price as of January 1st
ΔMTOM	Changes in mark-to-market earnings per share:
	$$\Delta MTOM_t = \frac{XMTOM^s_t - XMTOM^s_{t-1}}{P_{t-1}}$$

Chapter 6.4 – Example of the calculation of the variables used in the empirical specifications

This section provides an example of the calculation of the variables used in the empirical tests. The case of Barrick Gold, the largest firm in the sample, for 1997, has been chosen to illustrate the calculation.

Chapter 6.4.1 – Some financial statement data

The following information has been extracted from Barrick Gold's annual reports for 1997, 1996 and 1995.

1997

Book Value of common equity (BV) (x US $1,000,000):	3,324
Book value of fixed assets (BVRES) (x US $1,000,000):	3,824
Net option premium deferred (NOPD) (x US $1,000,000):	0
Net income (XC) (x US $1,000,000):	(123)
Number of common shares outstanding:	373,000,000
Dividend per share (US $):	0.16
Gold reserves (ounces):	50,318,000
Cash cost of production (CC_{1997}) (US $):	182

1996

Book Value of common equity (x US $1,000,000):	3,501
Book value of fixed assets (x US $1,000,000):	3,991
Net option premium deferred (x US $1,000,000):	0
Net income (x US $1,000,000):	218
Number of common shares outstanding:	373,000,000
Dividend per share (US $):	0.14
Gold reserves (ounces):	51,117,000
Cash cost of production (CC_{1996}) (US $):	193

1995

Gold reserves (ounces):	36,539,000
Cash costs of production (CC_{1995}):	183

Chapter 6.4.2 – Commodity and stock market information

Barrick Gold's stock price as of December 31, 1997 (US $):	18.63
Barrick Gold's stock price as of December 31, 1996 (US $):	28.75
Gold spot price as of December 31, 1997 ($Spot_{1997}$) (US $):	287.00
Gold spot price as of December 31, 1996 ($Spot_{1996}$) (US $):	369.00
Gold spot price as of December 31, 1995 ($Spot_{1995}$) (US $):	386.90

Chapter 6.4.3 – Commodity Derivatives fair values

The fair values of Barrick Gold's commodity derivatives estimated following the procedure described in Chapter 5 are as follows:

DER_{1997} (x US $1,000,000):	$825
DER_{1996} (x US $1,000,000):	$270
DER_{1995} (x US $1,000,000):	$150

Chapter 6.4.4 – Commodity reserves fair values

The fair value of Barrick Gold's commodity reserves is estimated following the procedure described in chapter 5. More particularly, it is given by:

$$RES_t = \text{Proven and probable reserves}_t * (\text{Spot price of gold}_t - \text{Cash cost}_t)$$

For 1997, we get :

$RES_{1997} = 50.318.000 * (287 - 182)$

$RES_{1997} = \$5.283$ million

For 1996, we get:

$RES_{1996} = 51,117.000 * (369 - 193)$

$RES_{1996} = \$8,997$ million

For 1995, we get:

$RES_{1995} = 36.539.000 * (386.90 - 183)$

$RES_{1996} = \$7.450$ million

Chapter 6.4.5 – Dependent variables

In raw Barth (1994)-based and Ohlson (1995)-based specifications, the dependent variable is the market value of the firm's common equity:

MV_{1997} = common shares outstanding x stock price as of December 31, 1997

$MV_{1997} = 373.000.000 \times \$18.63$

$MV_{1997} = \$6.949$ million

In return-earnings specifications, the dependent variable is the common stock return between January 1st and December 31 of 1997. It is :

$Return_{1997} = (P_{1997} - P_{1996} + \text{Dividend per share})/P_{1996}$

$Return_{1997} = (18.63 - 28.75 + 0.14)/28.75$

$Return_{1997} = (0.35)$

Chapter 6.4.6 – Historical-cost accounting numbers

Barth (1994)-based specification:

The book value of common stockholder's equity (BV_{1997}) is obtained directly from the financial statements and is $3,324 million.

Ohlson (1995)-based specification:

The book value of common stockholder's equity (BV_{1997}) is obtained directly from the financial statements and is $3,324 million.

Historical-cost abnormal earnings (AE) are:

$$AE_{1997} = XC_{1997} - 0.10 * BV_{1996}$$

$$AE_{1997} = (123) - 0.10 * 3,501$$

$$AE_{1997} = (\$473) \text{ million}$$

Return-Earnings specifications:

Earnings per share deflated by price at the beginning (EPS_{1997}) are:

$$EPS_{1997} = XC_{1997}/(\text{number of common shares oustanding} * P_{1996})$$

$$EPS_{1997} = (123)/(373 * 28.75)$$

$$EPS_{1997} = (0.01)$$

Changes in earnings-per-share deflated by price at the beginning (ΔEPS_{1997})

$$\Delta EPS_{1997} = (XC^{s}_{1997} - XC^{s}_{1996})/P_{1996}$$

$$\Delta EPS_{1997} = [(-123/373) - (218/373)]/28.75$$

$$\Delta EPS_{1997} = -0.03$$

Chapter 6.4.7 – SFAS 133 accounting numbers

Barth (1994)-based specification:

The book value of common stockholder's equity ($SFASBV_{1997}$) is:

$$SFASBV_{1997} = BV_{1997} - NOPD_{1997} + DER_{1997}$$

$$SFASBV_{1997} = 3.324 - 0 + 825$$

$$SFASBV_{1997} = \$4.149 \text{ million}$$

Ohlson (1995)-based specification:

The book value of common stockholder's equity ($SFASBV_{1997}$) is the same as in Barth (1994)-based specifications and is $4,149 million.

Using the same calculation formula and 1996 accounting numbers, $SFASBV_{1996}$ is $3,771 million.

SFAS 133 abnormal earnings (SFASAE) are:

$$SFASAE_{1997} = XSFAS_{1997} - 0.10 * SFASBV_{1996}$$

$$SFASAE_{1997} = (XC_{1997} + \Delta DER_{1997}) - 0.10 * SFASBV_{1996}$$

$$SFASAE_{1997} = (XC_{1997} + DER_{1997} - DER_{1996}) - 0.10 * SFASBV_{1996}$$

$$SFASAE_{1997} = (-123 + 825 - 270) - 0.10 * 3.771$$

$$SFASAE_{1997} = 432 - 0.10 * 3.771$$

$SFASAE_{1997}$ = 54.9 million

Return-Earnings specifications:

SFAS 133 Earnings per share deflated by price at the beginning ($SFAS133_{1997}$) is:

$SFAS133_{1997} = XSFAS_{1997}$/(number of common shares oustanding * P_{1996})

$SFAS133_{1997} = (XC_{1997} + \Delta DER_{1997})$ /(# of common shares oustanding * P_{1996})

$SFAS133_{1997}$ = (-123 + 825 - 270)/(373 * 28.75)

$SFAS133_{1997}$ = 432/(373 * 28.75)

$SFAS133_{1997}$ = 0.06

Changes in earnings-per-share deflated by price at the beginning ($\Delta SFAS133_{1997}$)

$\Delta SFAS133_{1997} = (XSFAS^{s}_{1997} - XSFAS^{s}_{1996})/P_{1996}$

$\Delta SFAS133_{1997}$ = [(-123 + 825 – 270)/373 – (218 + 270 – 150)/373]/28.75

$\Delta SFAS133_{1997}$ = 0.04

Chapter 6.4.8 – Mark-to-market accounting numbers

Barth (1994)-based specification:

The book value of common stockholder's equity ($MTOMBV_{1997}$) is:

$MTOMBV_{1997} = BVSFAS_{1997} - BVRES_{1997} + RES_{1997}$

$MTOMBV_{1997}$ = 4,149 – 3,824 + 5,283

$MTOMBV_{1997}$ = $5,608 million

Ohlson (1995)-based specification:

The book value of common stockholder's equity ($MTOMBV_{1997}$) is the same as in Barth (1994)-based specifications and is $5.608 million.

Using the same calculation formula and 1996 accounting numbers, $MTOMBV_{1996}$ is $8.777 million.

Mark-to-market abnormal earnings (MTOMAE) are:

$$MTOMAE_{1997} = XMTOM_{1997} - 0.10 * MTOMBV_{1996}$$

$$MTOMAE_{1997} = (XSFAS_{1997} + \Delta RES_{1997}) - 0.10 * MTOMBV_{1996}$$

$$MTOMAE_{1997} = (XSFAS_{1997} + RES_{1997} - RES_{1996}) - 0.10 * MTOMBV_{1996}$$

$$MTOMAE_{1997} = (432 + 5.283 - 8.997) - 0.10 * (8.777)$$

$$MTOMAE_{1997} = (\$4.160) \text{ million}$$

Return-Earnings specifications:

Mark-to-market earnings per share deflated by price at the beginning ($MTOM_{1997}$) are:

$$MTOM_{1997} = XMTOM_{1997}/(\text{number of common shares oustanding} * P_{1996})$$

$$MTOM_{1997} = (XSFAS_{1997} + \Delta RES_{1997}) /(\# \text{ of com. shares oustanding} * P_{1996})$$

$$MTOM_{1997} = (432 + 5.283 - 8.997)/(373 * 28.75)$$

$$MTOM_{1997} = (0.31)$$

Changes in earnings-per-share deflated by price at the beginning ($\Delta MTOM_{1997}$):

$$\Delta MTOM_{1997} = (XMTOM^{s}_{1997} - XMTOM^{s}_{1996})/P_{1996}$$

$$\Delta MTOM_{1997} = [(432 + 5.283 - 8.997)/373 - (338 + 8.997 - 7.450)/373]/28.75$$

$$\Delta MTOM_{1997} = -65.87$$

Chapter 6.5 – Estimation procedure for panel data

The data used to test the thesis hypotheses are a panel of 22 firms spanning six years (five years for empirical specifications derived from Ohlson (1995)). A second panel of 22 firms is used for changes specifications. Panel data usually violate two of the classical Ordinary Least Square (OLS) assumptions: the data are usually heteroskedastic (different firms have residuals distributed under unequal variances) and serially correlated (for a given firm, the residuals are not independently distributed over time). Analysis of the data used in this thesis (not reported) reveals that the assumptions of homoskedasticity and no-serial-correlation are violated.

Kmenta (1986) describes an estimation procedure that accounts for heteroskedasticity and for first-order serial correlation of data. An appealing way to explain this procedure is to describe the three steps involved in the computation of the regression equation. A more rigourous description of the methodology can be found in Kmenta (1986), Chapter 12. The steps are:

1. Remove the first-order serial correlation from the data

   A regression equation is estimated by OLS on the pooled sample. The residuals from this equation are computed and used to estimate the first order autoregressive parameter. The data are then transformed using the Prais-Winsten (1954) estimator.

2. Remove the heteroskedasticity

   The data transformed in step 1 are used to estimate a second regression equation, using OLS. The residuals from this second regression are used to calculate the variance of the error terms for each cross-sectional unit. The data are then re-weighted using these variance estimates.

3. Estimate the regression equation on the twice-transformed data using OLS and report the results.[48]

This procedure produces a regression equation that has been corrected for cross-sectional heteroskedasticity and for time-wise serial-correlation.

Buse (1973) describes a measure of goodness-of-fit for this type of model, which is a modified version of the well-known R^2 statistic. The Buse R^2 is expressed in terms of the weighted GLS variables. The statistic is given by :

$$\text{Buse (1973) } R^2 = 1 - \frac{e'\Omega^{-1}e}{(Y - DY)'\Omega^{-1}(Y - DY)}$$

Where

Y is the dependent variable;

e is the vector of regression residuals;

Ω^{-1} is the inverse of variance-covariance matrix of the error terms;

$$D = \frac{jj'\Omega^{-1}}{j'\Omega^{-1}j};$$

and j is a vector of 1.

Note that the variance-covariance matrix of the error terms used to weight the observations in the Buse (1973) R^2 formula is different for each model (mark-to-market, SFAS 133 and historical cost models) estimated in this thesis empirical tests. The resulting effect is that Buse (1973) R^2 are not directly comparable between different Kmenta (1986) specifications. Buse (1973) R^2 rankings are inconclusive as tests of the thesis hypotheses.

Chapter 6.6 – Test of relative information content – theoretical description

The thesis hypotheses are tested by comparing the relative information content of accounting numbers that are based on three different recognition rules for derivatives used to hedge anticipated transactions. Several econometric tests have been developed for model selection. These tests, and their appropriateness for this thesis, are discussed below.

Davidson and MacKinnon's (1981) J-test makes the assumption that one of the two empirical models is the true data generating process. This is not the case in this thesis since the models considered include only accounting variables and are not fully specified. Accordingly, the J-test is not appropriate for the empirical tests of this thesis.

Vuong's (1989) likelihood ratio test has often been used in accounting research, mainly in return-earnings empirical settings (*See*, among others, Dechow (1994), Dechow et al. (1999)). This test assumes that the error terms of each model are identically and independently distributed (the i.i.d. assumption). Hoewever, the panel data used in this thesis violate the i.i.d. assumption. Biddle, Seow and Siegel (1995) indicate that Vuong's (1989) test is very

[1] Note that other estimation procedures, more specifically generalized least squares, can be used at this step.

sensitive to violation of this assumption. Simulation results, reported in the Appendix of this thesis, support their argument. Vuong's (1989) test applied to a panel of data with the same characteristics as the panel used in the thesis fails to reject the null hypothesis of equal explanatory power between models. This occurs even when the simulation procedure generates a variable much noisier than the other one. Since the panel data violate the assumptions of Vuong (1989), this methodology cannot be used to test the thesis hypotheses.

Biddle, Seow and Siegel (1995) develop a test based on a comparison of the sum of squares across models. Because Kmenta's (1986) pooling technique transforms the dependent variable used in each model, the sum of squares are not comparable. Accordingly, this methodology also cannot be used to examine the thesis hypotheses.

Fortin and Wirjanto (1999) propose the use of cross-validation to test relative-information-content hypotheses on panel data.[49] Cross-validation is a technique that has been widely used in time-series analysis (*See*, among others, Diebold and Mariano (1985)). With this technique, a small number of the observations, randomly selected, are kept as a holdout sample. The two regression models considered are estimated on the remainder of the data. The regression equations estimated on the in-sample data are then used to forecast the dependent variable for the holdout sample. Forecast errors for each model are calculated. This procedure is repeated many times, selecting a new random holdout sample each time the procedure is run.

[49] I would like to acknowledge the contribution of Tony Wirjanto for his theoretical development of this test. For this reason, this work constitutes a separate paper from this thesis. The paper is available upon request.

This technique produces two vectors of forecast errors, one for each model studied. These vectors are then used to determine which of the two models studied shows the smallest forecast errors. Specifically, the following assumptions are made:

1. The loss associated with forecast errors is quadratic (in particular symmetric). This implies that positive forecast errors are as costly as negative forecast errors. This is a reasonable assumption when assessing which of two models seems to best "fit" a data set.
2. Forecast errors are unbiased. In other words, the forecast error expectation is zero.
3. Forecast errors have Gaussian (normal) distributions.
4. Forecast errors are distributed independently across the cross-sectional units (i.e. the are not contemporaneously correlated). This assumption is relaxed below in the development of the cross-validation methodology.
5. Forecast errors are distributed independently across time periods (i.e. they are not serially correlated).

Under these assumptions, the null hypothesis of equal forecast accuracy between the two models corresponds to equal forecast error variances between the two models. Further relaxing the assumption of independence across the cross-sectional unit, the null hypothesis of equal forecast accuracy can be conveniently parameterized by forming a panel-data artificial regression. In its simplest description, the sum of the forecast errors for the two models under study (S_{it}) is regressed on the difference of their forecast errors (D_{it}) [omitting the constant term from the regression].

The intuition from the test is similar to that underlying a paired t-test. A paired t-test is usually used when the independence assumption of the t-test is violated. A paired t-test is ordinarily computed by forming a third variable (usually the difference between the two initial variables) which by construction does not violate the independence assumption. The statistical procedures are then applied to this third variable. In the thesis, the intuition for the cross-validation test is similar. However, the cross-validation test is based on the comparison of the variances of two variables, and thus the methodolody is somewhat more complicated. Note also that since the out-of-sample observations are drawn independently from the cross-sectional sample population, the observed forecast errors should also be cross-sectionally independent.

The decision rule following the estimation of the artificial regression is based on a two-step procedure. First, the p-value of the t-ratio testing the null hypothesis that the coefficient of D_{it} is different from zero determines if the null hypothesis of equal forecast error variances can be rejected by the cross-validation test. Note that the sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio should be reported. If a significant t-ratio is observed, the direction of the relation is determined by inspection of the forecast error-variance estimates. The model showing the smallest forecast error variance dominates the other. Note the cross-validation methodology is used to evaluate empirical models. As with Vuong (1989), it does not assume that either model is the true model under the null.

The conclusions from the cross-validation method have the same implication for the tests of

this thesis' hypotheses, since it is expected that the model which performs better out-of-sample, should also perform better in-sample. For example, hypothesis 1 of this thesis (in alternate form) predicts that the mark-to-market model accounting numbers are more strongly associated to a firm's common-equity market value than the SFAS 133 accounting numbers. The null hypothesis states that the mark-to-market earnings are not more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. The cross-validation method can draw three different conclusions:

1. If the cross-validation method cannot reject the null of equal forecast error variances, it has the same implication as failing to reject the null hypothesis of H_1.
2. If the cross-validation method rejects the null hypothesis of equal forecast error variances, but concludes that the variance of the forecast errors of the SFAS 133 model is smaller than the variance of the forecast errors of the mark-to-market model, it has the same implication as failing to reject the null hypothesis of H_1
3. Finally, if the cross-validation method rejects the null hypothesis of equal forecast error variances and concludes that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null hypothesis of H_1.

The third outcome is the desired one in this thesis. Conclusions for H_2 and H_3 are reached following the same procedure.

A Monte-Carlo simulation of the cross-validation method revealed that this test has adequate

power in panel data conditions.[50] However, when the cross-validation method is used in conjunction with Kmenta's (1986) estimation procedure for panel data (simulation work reported in Appendix 1), the test tends to over-reject the null hypothesis in situations when it should not. Also, in instances when differences in explanatory power are small, this test sometimes rejects the null hypothesis in the wrong direction when it is used in conjunction with Kmenta's (1986) estimation procedure. As is further evidenced in chapter 7, differences in explanatory power observed in this thesis are rather large. In such situations, the simulation demonstrates that the cross-validation methodology is expected to perform well.

Chapter 6.7 – Test of relative information content – operational description of the test in this thesis.

Even though the econometric properties and the general computation of the cross-validation method for panel data are described in the previous section, it should be noted that for each data set, the specific application of this method is unique. This section will describe the application used in this thesis. A step-by-step description of how the method has been applied is detailed below.

First step

The regression model is estimated on the full sample using the Kmenta (1986) pooling technique described earlier in this chapter. Estimates of the first-order autocorrelation coefficients for each cross-sectional unit are saved.[51] Regression parameters from these

[50] This Monte-Carlo simulation generates forecast errors with panel data characteristics directly, instead of estimating the forecast errors using a Kmenta (1986) regression model.
[51] The computation of forecasts for an autoregressive regression model requires an estimate of the residuals correlation coefficient. In typical time-series data, this coefficient is estimated from the historical data and used

regressions are reported in Chapter 7.

Second step

Two firms are randomly selected from the 22 sample firms and are kept as a holdout sample. The model is re-estimated using Kmenta (1986) on the first 20 firms. The regression parameters are saved.

Third step

Using the regression parameters from step 2 and the autocorrelation coefficient estimates from step 1, the forecasts and the forecast errors are computed for each firm in the holdout sample. The forecast errors are saved for each model estimated in a different vector.

Fourth step

One particularity of serially correlated forecasts is that they are adjusted by the observed forecast error from the previous period. Obviously, the forecast for the first year cannot be adjusted in this way. Three options exist on how to deal with this issue:

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in the computation of the forecast. In panel data, the holdout sample is composed of all time-series observations for the selected cross-sections. An estimate of the autoregressive parameter is not available. Different options exist, with different shortcomings:

1. Use the parameter estimated from the data. It is the exact parameter to use for this cross-sectional unit and it would not favor one model over another. A shortcoming is that it uses "hindsight", namely, the knowledge of information that would not be known at the time of the forecast.
2. Ignore the autocorrelation factor. This would theoretically be the most honest method, because it does not use hindsight. However, it would bias the results toward the regression model that is less subject to serial correlation: not a desirable property.
3. Use the pooled autocorrelation factor estimated for the in-sample firms. Again, this would not use hindsight. However, it would bias the results toward the regression model with the narrower distribution of autocorrelation factor across firms. Again, this is not a desirable property.
4. Use an autocorrelation factor that minimizes observed forecast errors. Again, this procedure requires hindsight and might actually result in over-fitting.

Given the observation above, it has been decided to follow approach one.

1. Do not adjust the forecast error for t=1. This would potentially bias the cross-validation test toward the model with the less serious serial-correlation problem, which is an undesirable end product. Therefore, this procedure was not adopted.
2. Consistent with Prais-Winsten (1954), transform the forecast for the first year using the following formula:

   $newforecast_{t=1} = \sqrt{(1-\rho^2)} \times oldforecast_{t=1}$

   and compute the new forecast error.
3. Consistent with Cochrane-Orcutt (1949), drop forecast errors for t=1. This approach, however, might prove to be problematic if the time-series component of the panel is short, as is the case in this thesis.

Options 2 and 3 above have been considered. Tests reported in Chapter 7 are based on the Prais-Winsten (1954) transformation. Tests based on Cochrane-Orcutt (1949) yield similar conclusions.

Fifth step

Steps 2 to 4 are repeated one hundred times, randomly selecting a new holdout sample, consisting of two firms, each time the test is run. This procedure yields 1,200 forecast errors for each model in levels specifications based on Barth (1994) (1,000 of these forecast errors are used in the Cochrane-Orcutt (1949)-inspired test, since the first year of forecast is dropped). The number of forecast errors is 1,000 for levels specification based on Ohlson (1995), or for changes specifications (800 of those are used in Cochrane-Orcutt (1949)-inspired test).

Sixth step

Compute the forecast error variance for each model.

Seventh step

Form the new data vectors:

$$D_{12} = \text{Forecast error}_1 - \text{Forecast error}_2$$

And

$$S_{12} = \text{Forecast error}_1 + \text{Forecast error}_2$$

Eighth step

Run the regression (without a constant term):

$$S_{12} = \delta D_{12} + \mu \qquad (6.1)$$

The intuition behind the artificial regression (6.1) is that the variances of the forecast errors generated from the two models are equal only if S_{12} and D_{12} are not correlated. If δ in equation (6.1) is not significantly different from zero, it implies that S_{12} and D_{12} are not correlated.

Ninth step

As described in the previous section, conclusions from the cross-validation method are made using a two-step procedure.

1. If the coefficient δ in equation 6.1 is significantly different from zero, reject the null hypothesis of equal forecast-error variances. If δ is not different from zero,

conclude that the null hypothesis of equal forecast-error variances cannot be rejected.

2. If δ is different from zero, the conclusion regarding the direction of the relation is given by inspection of the forecast-error variances calculated during the sixth step described above. The model with the smallest forecast-error variance is considered to be superior, since we expect that the model which performs better out-of-sample would perform better in-sample.

Tenth step

Recall that H_1 predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation test described in steps one to nine above rejects the null hypothesis of equal forecast-error variances and concludes that the variance of the mark-to-market forecast errors is smaller, it has the same implication as rejecting the null hypothesis of H_1. Conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation test fails to reject the null of equal forecast-error variances, or rejects the null hypothesis and concludes that the variance of the SFAS 133 forecast errors is smaller, it has the same implication as failing to reject the null hypothesis of H_1.

Conclusions with respect to H_2 and H_3 are made similarly.

Chapter 6.8 – Conclusion

The hypotheses developed in Chapter 4 are tested on a panel sample of 22 firms (a second panel of 22 firms is used for return-earnings specifications). The variables used in the thesis empirical tests have been described in this chapter, and an example of their calculation has been provided. The empirical specifications developed in Chapter 4 are estimated using the Kmenta (1986) pooling technique, because the data violates the assumptions of heteroskedasticity and no serial-correlation required for pooled OLS estimation. A cross-validation methodology, often used in time-series analysis, is proposed to test the hypotheses developed in Chapter 4.

Chapter 7 – Regression results

Chapter 7.1 - Introduction

It is stated in Chapter 4 that three hypotheses are tested in this thesis. Hypothesis 1 predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Mark-to-market accounting numbers conform to the matching principle and mark-to-market both sides of the hedge. SFAS 133 accounting numbers mark only the derivatives to market. Accounting numbers conforming to the matching principles are expected to dominate in terms of association to a firm's common-equity market value. Hypothesis 2 predicts that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Because SFAS 133 derivatives recognition rules ignore the matching principle, it is hypothesized that they are noisier than the historical cost accounting numbers, even though the historical figures keep both sides of the hedge off the balance sheet. Finally, hypothesis 3 predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. Because mark-to-market numbers accelerate the recognition of value relevant information and conform to the matching principle, mark-to-market accounting numbers are hypothesized to dominate in terms of association with common-equity market value. These three hypotheses are referred to as H_1, H_2 and H_3 in the remainder of this chapter.

Two sets of empirical specifications are used in the balance-sheet tests of H_1, H_2 and H_3. The first set of specifications, based on Barth (1994), hypothesizes that the market value of a

firm's common-equity is explained by the book value of its common equity. This is a valuation model that has little theoretical support. However, this model has been widely used in capital-market, financial-accounting research (*See* among others, Barth et al. (1991)). The specifications based on Barth (1994) and used in this thesis are developed in Chapter 4.3.2. They are to be referred to as Barth (1994)-based specifications in the remainder of this chapter.

The second set of empirical specifications is based on the theoretical work of Ohlson (1995). Ohlson (1995) hypothesizes that the market value of a firm's common-equity is explained by the book value of its common-equity, plus an abnormal earnings term. Abnormal earnings are the realized earnings of a firm, minus a normal return on the opening book value. An expected rate of return of 10 per cent is used to calculate abnormal earnings in this thesis, but results do not appear to be sensitive to the estimate of the expected rate of return used. Ohlson's (1995) theoretical model also requires the linear introduction of "other-value-relevant" information in the valuation equation. Following the practice observed in the capital-market, financial-accounting literature (*See* among others Bandyopadhyay et al. (1998)), "other-value-relevant" information is omitted from the empirical specification. This is accomplished by making the assumption that this information does not correlate with the book value or abnormal earnings terms. Empirical specifications, based on Ohlson (1995), developed in Chapter 4.3.1 are referred to as Ohlson (1995)-based specifications in the remainder of this chapter.

Simple "Return-Earnings" regressions are used to compare the relative information content of income-statement numbers. They are shown to be consistent with both Barth (1994)-based and Ohlson (1995)-based levels specifications.

As discussed in Chapter 6, the primary sample used to estimate balance-sheet specifications is a panel of 22 firms. A second panel of 22 firms is used to estimate the return-earnings specifications. The remainder of this chapter is organized as follows. Chapter 7.2 discusses descriptive statistics for the balance-sheet specification variables. Chapter 7.3 reports regression results for Barth (1994)-based and Ohlson (1995)-based balance-sheet regressions. Chapter 7.4 reports on descriptive statistics for the variables used in return-earnings specifications. Chapter 7.5 describes the regression results for return-earnings specifications and Chapter 7.6 details the results of several sensitivity analyses of the balance-sheet specifications. The next section, Chapter 7.7, recapitulates the sensitivity analyses applied to the return-earnings specifications and Chapter 7.8 summarizes the regression evidence and concludes the chapter.

Chapter 7.2 – Descriptive statistics of variables used in the levels specifications

Descriptive statistics for the derivative positions outstanding at fiscal year-end for the sample firms are presented in Table 7.1. Table 7.1 is based on the levels-panel data. Statistics for the changes panels are qualitatively similar. Fixed-forward contracts are the most commonly used gold derivative security in terms of the number of users: they were reported by 67 firm-year observations. A common hedging strategy in the gold mining sector is to buy put options that are funded by selling call options. The prevalence of this hedging strategy could

explain why short calls and short puts seem to be used by a similar number of firm-year observations (around 60).

The most heavily used gold-derivative instrument in terms of mean number of ounces under contract is the spot-deferred contract. This gold-derivative instrument has on average 1,510,000 ounces under contract. For fair-value estimates, fixed forwards represent the most valuable positions outstanding at year-end, with an observed mean (median) fair value of $16,951,000 ($1,855,000). Also, spot deferred and short puts and short calls have relatively large fair values, with mean (median) calculated fair values of $10,201,000 ($294,000), $5,877,000 ($2,175,000), and $(5,540,000) ($(704,000)) respectively. [Note that forwards and spot- deferred contracts can have a positive or negative fair value at year-end, while purchase puts and written-calls fair values must respectively be positive and negative.] Only five firms use gold swaps, but they are relatively large positions for these companies, with a mean (median) swap-market value of $2,203,000 ($1,068,000). Long gold derivative positions are observed in less than 10 firm-year observations and both their mean and median fair values are less than $1,100,000.

It can be observed in Table 7.1 that relative to gold contracts outstanding, silver contracts are used by fewer firms and are in total less valuable. Less than 24 firm-year observations report using silver derivative contracts. The mean contract-values for silver range from $(5,843,000) to $3,367,000 (median ranging from $(2,991,000) to $2,481,000), while gold mean contract values range from $(5,540,000) to $16,951,000 (median ranging from $(812,000) to $2,175,000).

Table 7.1 : Derivative positions outstanding at year-end and estimated fair values

Levels panel

Panel A : Gold derivatives

Instruments used	Notional amounts (x 1,000 ounces of gold)						Fair values (x U.S. $1,000)				
	n	Mean	Std. Dev.	Median	Min.	Max.	Mean	Std. Dev.	Median	Min.	Max.
Short forwards	67	382	615	164	1	3,264	16,951	46,685	1,855	-15,846	308,558
Spot deferred	36	1,510	2,692	326	2	10,100	10,201	37,558	294	-37,132	178,578
Puts bought	61	252	324	132	3	1,426	5,877	12,436	2,175	26	85,047
Calls sold	56	339	508	107	3	2,481	-5,540	12,259	-704	-76,616	-1^
Swaps	5	420	128	425	218	544	2,203	21,722	1,068	-33,978	28,673
Long forwards	1	48	-	48	48	48	-1,094	-	-1,094	-1,094	-1,094
Puts sold	10	123	117	71	24	412	-1,088	874	-812	-2,571	-234^
Calls bought	9	154	166	58	15	455	492	323	506	78	1,106

Panel B : Silver derivatives

Instruments used	Notional amounts (x 1,000 ounces of silver)						Fair values (x U.S. $1,000)				
	n	Mean	Std. Dev.	Median	Min.	Max.	Mean	Std. Dev.	Median	Min.	Max.
Short forwards	24	5,586	4,803	3,903	13	19,600	854	3,979	360	-60,000	9,510
Spot deferred	4	9,960	13,226	5,375	91	29,000	-442	2,687	72	-3,348	1,951
Puts bought	16	5,336	6,324	3,616	720	27,678	3,367	2,967	2,481	321	9,834
Calls sold	18	10,026	12,865	6,350	120	55,568	-5,843	13,451	-1,750	-58,842	-988^
Long forwards	4	5,958	2,972	5,437	2,960	10,000	-2,492	5,508	-2,991	-8,603	4,614
Puts sold	1	1,000	-	1,000	1,000	1,000	-256	-	-256	-256	-256^

Panel C : Copper derivatives

Instruments used	Notional amounts (x 1,000,000 pounds of copper)						Fair values (x U.S. $1,000)				
	n	Mean	Std. Dev.	Median	Min.	Max.	Mean	Std. Dev.	Median	Min.	Max.
Short forwards	17	29	39	16	1	150	926	3,508	64	-4,407	11,451
Puts bought	5	37	35	23	19	100	2,100	1,826	1,542	-84	4,140
Calls sold	4	21	8	23	9	26	-276	210	-378	-521	-84^
Calls bought	1	8	-	8	8	8	117	-	117	117	117

^ The market value of these contracts is negative by definition.

Short-forward contracts and short puts and short calls are the most frequently used silver instruments, with respectively 24, 16, and 18 firm-years reporting positions outstanding at year-end. The most heavily employed silver instrument is the short call, with a mean (median) of 10,026,000 (6,350,000) ounces under contract. Spot-deferred contracts are the second most used silver derivatives, with a mean (median) of 9,960,000 (5,375,000) ounces under contract. Short puts and calls are the most valuable silver positions, with mean (median) calculated fair values of $3,367,000 ($2,481,000) and $(5,843,000) ($(1,750,000)) respectively.

Panel C of Table 7.1 presents descriptive statistics on copper-derivative contracts outstanding for the levels panel. Very few firm-year observations report using copper contracts (less than 17 for any given contract) and the mean fair-values of these contracts are quite small, ranging from $(276,000) to $2,100,000 (median ranging from ($(378,000) to $1,542,000).

Table 7.2 provides descriptive statistics for the level of gold production, the proven and probable reserves of firms at year-end, the number of ounces of gold equivalent under derivative contracts and some hedging ratios. All data are reported in gold equivalents. Silver and copper data were converted to gold equivalents using spot prices in effect at year-end. The average firm has a mean (median) annual production level of 647,000 ounces (211,000 ounces) of gold equivalent. The mean (median) level of reserves is 8,557,000 ounces (4,000,000 ounces) of gold equivalent. Five firm-year observations did not have proven and probable reserves outstanding at year-end and eleven firm-year observations were not producing. Accordingly, the hedging ratios discussed below are for the 127 firm-year

observations in which reserves are the denominator and 121 firm-year observations in which production is the denominator (to avoid division by zero).

Table 7.2 : Production, Reserves, and hedging data
Levels panel
(x 1,000 ounces of gold equivalent[52])

Variable	N	Mean	Std. Dev.	Median	Min.	Max.
Production[53]	132	647	1,063	211	0	6,705
Reserves[54]	132	8,557	11,968	4,000	0	52,679
Ounces under contracts[55]	132	977	1,936	157	0	10,770
Ratio Ounces under contracts Reserves	127	0.10	0.11	0.08	0	0.52
Ratio Ounces under Contracts Production	121	6.22	44.03	0.97	0	483.87[56]

The mean (median) total number of ounces under derivative contracts is 977,000 ounces (157,000 ounces) of gold equivalent. This statistic should be interpreted very carefully. The mean (median) number of ounces does not directly represent the number of ounces of future production hedged, since some hedging strategies require that firms enter into more than one contract for any ounce of gold hedged (for example, put-call strategies). Therefore, inferences about firms' level of hedging should be made carefully. Typically, firms have a mean (median) of about 6 years (about one year) of gold equivalent production covered by derivative contracts. When the number of ounces under contract is compared to the proven and probable reserves of the firm, the mean (median) indicates that about 10 per cent (8 per

[52] Silver and Copper reserves, production, and ounces under derivatives contracts were converted in gold equivalents using spot prices at year end.
[53] Eleven firm-year observations were not producing during the year.
[54] Five firm-year observations have no reserves outstanding at year-end.
[55] This statistic represents the number of ounces of gold equivalent under derivatives contracts at year-end. This statistic should be interpreted carefully. The total number of ounces hedged is different from the total number of ounces under contracts, since some hedging strategies require that the firm enters into more than one contract for any ounce of gold hedged.
[56] One firm is producing just a few ounces of gold in a mine it is abandoning, while it has hedged a significant portion of its proven and probable reserves at another mine under development. This explains the rather large ratio of 484 years of production hedged.

cent) of firms' reserves are covered by derivative contracts. The minimum observed is 0 per cent and the maximum is 52 per cent.

Panels A and B of Table 7.3 report descriptive statistics for the dependent and explanatory variables used in the levels specifications examined in this thesis. Panel A reports descriptive statistics for the variables used in Barth (1994)-based specifications. Barth (1994)-based specifications use six years of data for each cross-sectional unit. Panel B reports statistics for variables used in Ohlson (1995)-based specification. Because Ohlson (1995)-based specifications include an abnormal earnings term, they are limited to five years of data per cross-sectional unit. Since descriptive statistics for the balance-sheet variables are very similar in both panels, only panel B is further described below.

The mean (median) MV is $1.19 billion ($0.31 billion), which is similar to the mean (median) BVMTOM of $1.25 billion ($0.35 billion). The similar order of magnitude of BVMTOM and MV indicates that mining is the principal activity of the sample firms, at least from a market-value perspective. BVSFAS is much smaller than MV or BVMTOM. BVSFAS ranges from $(156) million to $4.15 billion, with a mean (median) value of $438 million ($183 million). BV shows a mean (median) value of $414 million ($178 million).

The descriptive statistics for the abnormal earnings terms, which are explanatory variables in Ohlson (1995)-based empirical specifications, are reported in the last part of Table 7.3, panel B. Note that Barth (1994)-based specifications do not include abnormal earnings terms. All abnormal earnings variables have a negative mean and median, reflecting the negative trend

for the price of gold observed over the sample period (*See* Figure 2). AE and SFASAE have means (medians) of the same magnitude, respectively S(44) million and S(34) million (median of S(16) and S(10) million). The slightly less negative values for SFASAE, when compared to AE, is consistent with firms using derivatives to hedge. Finally, Table 7.4 reports Pearson and Spearman pairwise correlation for the variables used in the levels specifications. [Note that these correlations do not account for the serial-correlation and heteroskedasticity observed in the data.]

Table 7.3 – Descriptive statistics for the variables used in levels empirical specifications

Panel A : Variables used in Barth (1994)-based specifications, as described in chapter 4.3.2

(x U.S. $1,000,000)

Variable	N	Mean	Std. Dev.	Median	Min.	Max.
MV	132	1,098	2,002	296	1	10,724
BV	132	391	624	177	-156	3,501
BVSFAS	132	414	690	181	-156	4,150
BVMTOM	132	1,166	1,925	357	-727	8,777

Variable definitions :

MV: Market value of the firm's common equity calculated using stock prices as of December 31 of each year.
BV: The book value of common shareholders' equity as of December 31 under historical cost accounting
BVSFAS: The book value of common shareholders' equity as of December 31 under SFAS 133 accounting rules
BVMTOM: The book value of common shareholders' equity as of December 31 under mark-to-market accounting

Panel B : Variables used in Ohlson (1995)-based specifications, as described in chapter 4.3.1

(x U.S. $1,000,000)

Variable	N	Mean	Std. Dev.	Median	Min.	Max.
MV	110	1,185	2,125	307	7	10,724
BV	110	414	662	178	-156	3,501
BVSFAS	110	438	733	183	-156	4,149
BVMTOM	110	1,246	2,045	352	-727	8,777
AE	110	-44	101	-16	-549	131
SFASAE	110	-34	733	-10	-576	304
MTOMAE	110	-152	819	-26	-4,160	2,216

Variable definitions:

$MTOMAE_{it}$: The abnormal mark-to-market earnings for the year ended December 31, calculated as : $XMTOM_{it} - 0.10*BVMTOM_{it-1}$
where $XMTOM_{it}$ are the mark-to-market earnings of the firm for the year ended December 31.

$SFASAE_{it}$: The abnormal SFAS 133 earnings, for the year ended December 31, calculated as : $XSFAS_{it} - 0.10*BVSFAS_{it-1}$
where $XSFAS_{it}$ are the SFAS 133 earnings of the firm for the year ended December 31.

AE_{it}: The historical cost abnormal earnings of the firm for the year ended December 31, calculated as : $XC_{it} - 0.10*BV_{it-1}$
where XC_{it} are the historical cost earnings of the firm for the year ended December 31.

Table 7.4 : Pearson[A] (above the diagonal) and Spearman[B] (below) Cross-Correlation
Levels panel

Variables used in Barth (1994)-based specifications

Variables	n	MV	BV	BVSFAS	BVMTOM
MV	132		0.93***	0.91***	0.96***
BV	132	0.96***		0.99***	0.90***
BVSFAS	132	0.95***	1.00***		0.87***
BVMTOM	132	0.86***	0.84***	0.83***	

Variable definition :

MV: Market value of the firm's common equity at year-end, calculated using stock price as of December 31.
BV: The book value of common shareholders' equity as of December 31 under historical cost accounting
BVSFAS: The book value of common shareholders' equity as of December 31 under SFAS 133 accounting rules
BVMTOM: The book value of common shareholders' equity as of December 31 under mark-to-market accounting

Variables used in Ohlson (1995)-based specifications

Variables	N	MV	BV	BVSFAS	BVMTOM	AE	SFASAE	MTOMAE
MV	110		0.93***	0.91***	0.96***	-0.05	0.16**	0.01
BV	110	0.96***		0.99***	0.90***	-0.21**	0.19**	-0.21**
BVSFAS	110	0.95***	1.00***		0.87***	-0.26**	0.18**	-0.28***
BVMTOM	110	0.85***	0.82***	0.82***		-0.03	0.20	0.05
AE	110	-0.30**	-0.38***	-0.39***	-0.14**		0.71***	0.67***
SFASAE	110	-0.11	-0.14	-0.15	0.06	0.71***		0.25
MTOMAE	110	-0.05	-0.12	-0.14	0.10	0.42***	0.25***	

Variable definition :

$MTOMAE_{it}$: The abnormal mark-to-market earnings of the firm for the year ended December 31, calculated as : $XMTOM_{it} - 0.10*BVMTOM_{it-1}$
where $XMTOM_{it}$ are the mark-to-market earnings of the firm for the year ended December 31
$SFASAE_{it}$: The abnormal SFAS 133 earnings of the firm for the year ended December 31, calculated as : $XSFAS_{it} - 0.10*BVSFAS_{it-1}$
where $XSFAS_{it}$ are the SFAS 133 earnings of the firm for the year ended December 31
AE_{it}: The abnormal historical cost abnormal earnings of the firm for the year ended December 31, calculated as : $XC_{it} - 0.10*BV_{it-1}$
where XC_{it} are the historical cost earnings of the firm for the year ended December 31

[A] The Pearson correlation coefficient (ρ_{XY}) is a measure of the closeness of a linear relationship between two variables. It is estimated using the following formula:

$$\rho_{XY} = \frac{cov(X,Y)}{\sqrt{var(X)var(Y)}}$$

Where :
X, Y are the two variables of interest.

[B] The Spearman correlation coefficient (θ_{XY}) is a measure of the correlation of the ranks of the variables. It is calculated using the following formula:

$$\theta_{XY} = \frac{\sum (R_i - \overline{R})(S_i - \overline{S})}{\sqrt{\left(\sum (R_i - \overline{R})^2 \sum (S_i - \overline{S})^2\right)}}$$

Where:

R_i is the rank of the ith X value

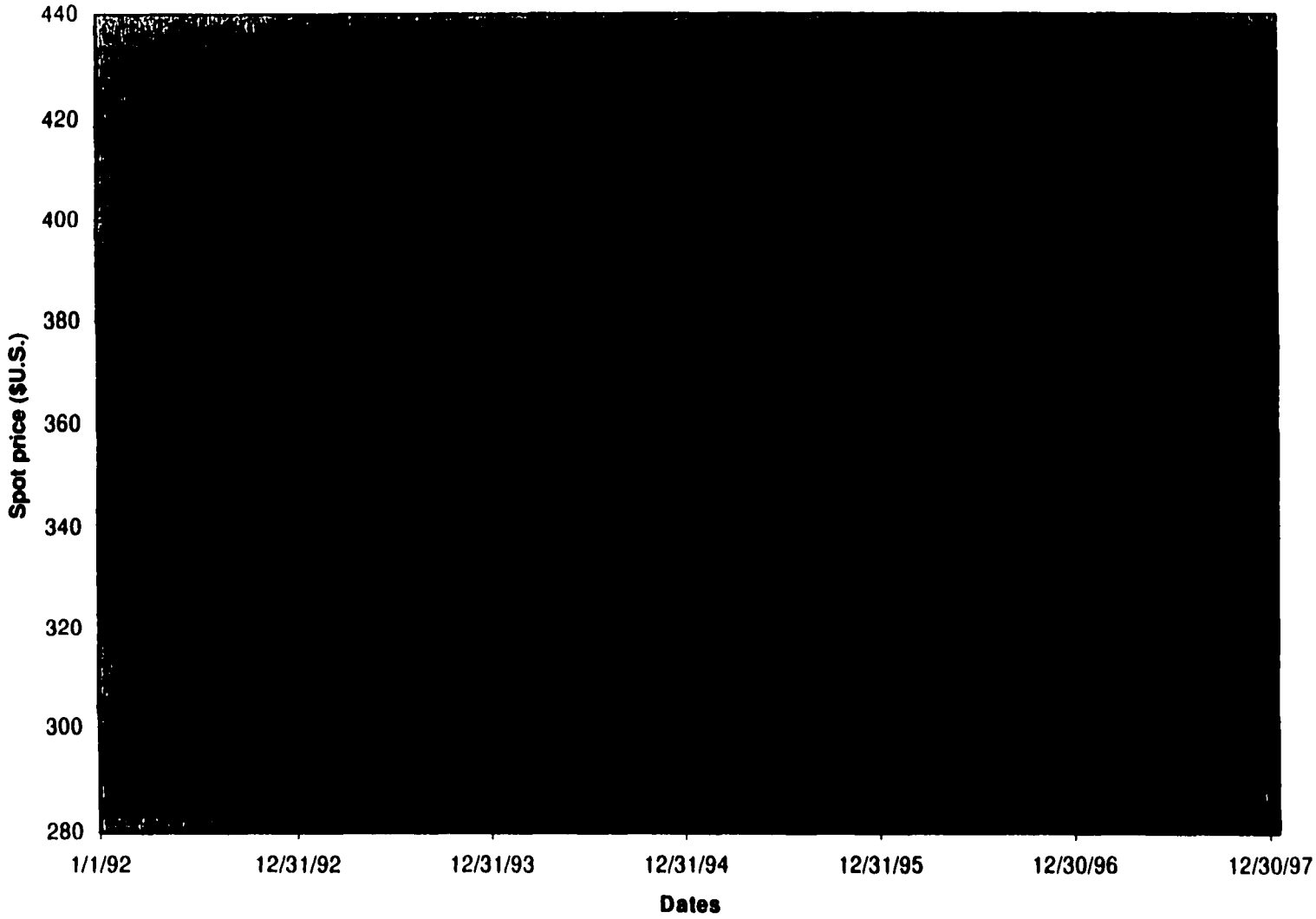
S_i is the rank of the ith Y value

$\overline{R}$ and $\overline{S}$ are the means of the R_i and S_i values

Levels of significance for the test of the null hypothesis that the correlation coefficient is equal to zero:

*** less than 1%, ** less than 5%

Figure 2 :Gold Spot Price between January 1992 and December 1997



Section 7.3 – Results of levels regressions

As discussed in Chapter 6, the panel data used in this thesis violate pooled OLS assumptions, and regression equations have been estimated using the Kmenta (1986) estimation methodology. The Kmenta (1986) estimation methodology employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and time-wise first-order auto-regressive model. This econometric technique further assumes cross-sectional independence. More specifically, the model assumes a different error term for each cross-sectional unit and a first order auto-regressive process for each firm's specific time-series. Kmenta's (1986) assumption of cross-sectional independence might not hold in the data, since all of the sample firms are from the gold mining industry. This does not appear problematic, because the cross-validation methodology used to test the thesis hypotheses is robust to cross-sectional dependence. The coefficient's t-ratios are also very large, and their significance could probably not be accounted for by the unique impact of cross-sectional dependence.

Table 7.5 reports the results for Barth (1994)-based empirical specifications. [Note that results from Barth (1994)-based regression models, deflated by the number of common shares outstanding, are presented in Table 7.10 and discussed in section 7.6.] The coefficient estimate of 0.81 observed for MTOMBV in the mark-to-market specification is significantly different from zero (p-value less than 1 per cent), as expected. The coefficient estimates of 2.45 observed for BV and 2.19 observed for SFASBV are also positive and significantly different from zero (p-values less than 1 per cent). The larger coefficients observed for SFASBV and BV probably reflect the conservative recognition rules for commodity reserves adopted under the historical cost and SFAS 133 accounting models.

The cross validation method described in Chapter 6 rejects the null hypothesis of H_1. The cross-validation t-test is significantly different from zero ($|t_{MTOM\ versus\ SFAS}|$ of 24.18, p-value less than 1 per cent) and the forecast-error variance estimate of 0.23×10^{12} for the mark-to-market model is smaller than the estimate of 0.57×10^{12} for the SFAS 133 model.[57] It appears that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Similarly for H_2, the cross validation t-test is significantly different from zero ($|t_{HC\ versus\ SFAS}|$ of 21.35, p-value less than 1 per cent). As well, the forecast-error variance estimate of 0.49×10^{12} for the historical cost model is smaller than the estimate of 0.57×10^{12} for the SFAS 133 model. The null hypothesis of H_2 is rejected. It appears that the historical-cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Finally, the cross-validation t-test of H_3 is also significantly different from zero ($|t_{MTOM\ versus\ HC}|$ of 22.15, p-value less than 1 per cent). The inspection of the forecast-error variance estimates also indicates that the estimate for the mark-to-market model of 0.23×10^{12} is smaller than the estimate for the historical cost model of 0.49×10^{12}. Therefore, the null hypothesis of H_3 is also rejected. It appears that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical-cost accounting numbers.

[57] The forecast-error variance estimates may appear large at first glance. By taking the square root of the variance estimates, we convert these numbers into US dollars. The forecast error standard-deviation (square root of the variance) for the mark-to-market model is US $866 million, which is comparable in magnitude to the mean of US $1,098 million and standard deviation of US $2,002 million reported for MV in Table 7.3, panel A.

As discussed in this chapter introduction, the Barth (1994) valuation model is "ad-hoc". The lack of a theoretical basis raises some concern about the validity of the results observed for the Barth (1994)-based empirical specifications. Ohlson's (1995) valuation model has stronger theoretical support. The regression results for the Ohlson (1995)-based empirical specifications are presented in Table 7.6. [Note that results for Ohlson (1995)-based regression models deflated by the number of common shares outstanding are presented in table 7.11 and discussed in section 7.6.] The estimated regression coefficients of the mark-to-market model differ from the expected values. As discussed in chapter 4, a properly specified Ohlson (1995) specification should show a coefficient of 1 for book value, and a positive and significant coefficient for abnormal earnings. The positive and significant coefficient of 0.84 observed for MTOMBV (p-value less than 1 per cent) is close to the expected value of 1, but the negative and significant coefficient of -0.19 for MTOMAE (p-value less than 1 per cent) is puzzling.[58] It is possible that the market be expecting a long-term mean reversion in the price of gold, and that this expectation is taken into account when valuing gold mining firms. The negative sign observed for MTOMAE smoothes the impact of re-measuring all accounting numbers using current spot price, consistent with the expectation that gold prices may mean revert in the long run. Discussion with gold firms indicate that they use a long-term gold price forecast for internal decision making, consistent with an expectation of long-term mean reversion.

It is also possible that the negative sign observed for MTOMAE and the coefficient of less than 1 observed for MTOMBV are due to omitted variable bias. For example, management

[58] The coefficient of 0.84 for MTOMBV is statistically significantly different from 1 at less than 1% (t-statistic of -4.55, p-value less than 1%).

expertise or the expected benefits from exploration expenses are not included in the empirical models used. If these elements are correlated with the variables in the equations, they may explain the unexpected coefficient estimates observed. Another potential explanation relates to the fact that MTOMAE is a component of MTOMBV. Since the variable is indirectly included twice in the regressions, Collins, Pincus and Xie (1999) argue that the true coefficient for the MTOMAE variable is given by the sum of the MTOMBV and MTOMAE coefficients. If this is the case, then a positive coefficient in Table 7.6 is observed for MTOMAE since the sum of the coefficient of MTOMBV and MTOMAE is positive.

The regression coefficients of the SFAS 133 specification also show an inconsistent coefficient estimate for the abnormal earnings term. The positive and significant (p-value less than 0.01) coefficient of 2.22 observed for SFASBV is similar in magnitude to the coefficient of 2.19 observed for SFASBV in Barth (1994)-based specifications which are reported in Table 7.5. The coefficient estimate of SFASAE is negative and significant. This is likely due to the inherent bias in the measurement of SFAS 133 earnings brought about by the recognition of derivatives without the recognition of the hedged item (only one side of the hedge is marked-to-market). As discussed above for the mark-to-market specification, omitted variable bias and the indirect duplicate inclusion of SFASAE in the regression models (as argued by Collins, Pincus and Xie (1999)) are also potential explanations for this result. Finally, the regression coefficients of the historical cost specification (2.75 for BV and 1.35 for AE) are both positive and significant (p-values less than 1 percent).

The cross-validation method rejects the null hypotheses of H_1 and H_3, but fails to reject the null of H_2. For H_1, the cross-validation t-test is significantly different from zero ($|t_{MTOM\ versus\ SFAS}|$ of 7.08, p-value less than 1 per cent). The inspection of the forecast-error variance estimates indicates that the estimate of 0.51×10^{12} for the mark-to-market model is smaller than the estimate of 0.84×10^{12} for the SFAS 133 model. It appears that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than are the SFAS 133 accounting numbers are. The null of H_3 can similarly be rejected using the cross-validation test. The cross-validation t-test is significantly different from zero ($|t_{MTOM\ versus\ HC}|$ of 9.90, p-value less than 1 per cent) and the variance of the forecast errors of 0.51×10^{12} for the mark-to-market model is smaller than the estimate of 0.87×10^{12} for the historical cost model. It appears that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. Finally, the cross-validation t-test for H_2 is not significant ($|t_{HC\ versus\ SFAS}|$ of 1.03). The cross-validation test fails to reject the null hypothesis of H_2: the historical-cost accounting numbers are not more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers.

[Note that Barth (1994)-based specification shows support for H_2, while Ohlson (1995)-based specifications fail to do so.] Sensitivity analyses, discussed in greater detail in chapter 7.6, show that if the market value of a firm's common equity is measured as of April 30, the null of H_2 is rejected by the data in Ohlson (1995)-based specifications. Stock prices may not reflect all the information included in the financial statements before their release date. This appears to be a plausible explanation for the negative results observed with respect to H_2.

Table 7.5 : Pooled Barth (1994)-based levels specifications estimated by the Kmenta (1986) pooling technique

This table reports the results of regressions relating the explanatory variables below to the dependent variable, market value of the firm's common equity measured as of December 31 each year. The results are based on the Kmenta (1986) pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-market specification (MTOM):

$$MV_{it} = const + \beta_1 MTOMBV_{it} + \eta_{1it}. \qquad i=1..22; \quad t=1..6$$

SFAS 133 specification (SFAS):

$$MV_{it} = const + \gamma_1 SFASBV_{it} + \eta_{2it} \qquad i=1..22; \quad t=1..6$$

Historical cost specification (HC):

$$MV_{it} = const + \phi_1 BV_{it} + \eta_{3it} \qquad i=1..22; \quad t=1..6$$

where i stands for the firm cross section number, and t for the year

	Mark-to-Market[B]	**SFAS 133**[B]	**Historical Cost**[B]
Constant	Coeff. : 8.359 t^A : 0.41	Coeff. : 6.214 t^A : 0.48	Coeff. : -21.425 t^A : -1.70
MTOMBV	Coeff. : 0.81 t^A : 24.12***	NA	NA
SFASBV	NA	Coeff. : 2.19 t^A : 21.40***	NA
BV	NA	NA	Coeff. : 2.45 t^A : 22.19***
Number of firm-year observations	22	22	22
Number of observations	132	132	132
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	0.23×10^{12}	0.57×10^{12}	0.49×10^{12}
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS} \rvert = 24.18$*** Test direction[C]: $Var(FE_{SFAS}) = 0.57 \times 10^{12} > 0.23 \times 10^{12} = Var(FE_{MTOM})$		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS} \rvert = 21.35$*** Test direction[C]: $Var(FE_{SFAS}) = 0.57 \times 10^{12} > 0.49 \times 10^{12} = Var(FE_{HC})$		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC} \rvert = 22.15$*** Test direction[C]: $Var(FE_{HC}) = 0.49 \times 10^{12} > 0.23 \times 10^{12} = Var(FE_{MTOM})$		

Variable definitions:

MV_{it}: Market Value of the firm's common equity at year-end, calculated using the December 31 stock price
BV_{it}: Book value of common shareholders' equity as of December 31 under historical cost accounting
$SFASBV_{it}$: Book value of common shareholders' equity as of December 31 under SFAS 133 accounting
$MTOMBV_{it}$: Book value of common shareholders' equity as of December 31 under mark-to-market accounting

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student distribution with 130 degrees of freedom. Barth (1994) predicts that the coefficients on MTOMBV, SFASBV and BV are positive, but it is not possible to make a prediction with respect to the coefficient magnitude. Under Ohlson (1995) specification, this model is not properly specified. Abnormal earnings are not included. Also, the specification abstracts from conservatism and growth opportunities. No predictions are made about the sign or the magnitude of the constant term.

[B] Some Kmenta (1986) estimation parameters

1. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.14 to 0.98
   SFAS 133 model: from -0.81 to 0.96
   Historical cost model: from -0.75 to 0.97

2. Range of the cross-sectional estimates of residual variances (x $1,000^2)

   Mark-to-market model : from 0.22×10^{9} to 0.33×10^{13}
   SFAS 133 model: from 0.23×10^{9} to 0.11×10^{14}
   Historical cost model: from 0.17×10^{9} to 0.76×10^{13}

[C] Description and interpretation of the cross-validation method described in chapter 6:

The cross-validation method described in chapter 6 tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported; the related subscripts indicate which two models are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

1. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
2. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated to a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implications as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

Table 7.6 : Pooled Ohlson (1995)-based levels specifications estimated by the Kmenta (1986) pooling technique

This table reports the results of regressions relating the explanatory variables below to the dependent variable, market value of the firm's common equity measured as of December 31 each year. The results are based on the Kmenta (1986) pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-market specification (MTOM):

$$MV_{it} = const + \beta_1 MTOMBV_{it} + \beta_2 MTOMAE_{it} + \eta_{1it} \qquad i=1..22;\ t=2..6$$

SFAS 133 specification (SFAS):

$$MV_{it} = const + \gamma_1 SFASBV_{it} + \gamma_2 SFASAE_{it} + \eta_{2it} \qquad i=1..22;\ t=2..6$$

Historical cost specification (HC):

$$MV_{it} = const + \phi_1 BV_{it} + \phi_2 AE_{it} + \eta_{3it} \qquad i=1..22;\ t=2..6$$

where i stands for the firm cross section number, and t for the year.

	Mark-to-Market[B]	**SFAS 133**[B]	**Historical Cost**[B]
Constant	Coeff. : -14.688 t^A: -0.73***	Coeff. : 4.646 t^A 0.26	Coeff. : -577 t^A : -0.03
MTOMBV	Coeff. : 0.84 t^A: 23.24***	NA	NA
SFASBV	NA	Coeff. : 2.22 t^A: 19.60***	NA
BV	NA	NA	Coeff. : 2.75 t^A : 25.43***
MTOMAE	Coeff. : -0.19 t^A: -4.32***	NA	NA
SFASAE	NA	Coeff. : -0.60 t^A: -2.74***	NA
AE	NA	NA	Coeff. : 1.35 t^A : 3.29***
Number of firms	22	22	22
Number of firm-year observations	110	110	110
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	0.51×10^{12}	0.84×10^{12}	0.87×10^{12}
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS}\rvert = 7.08$*** Test direction[C] : $Var(FE_{SFAS}) = 0.84 \times 10^{12} > 0.51 \times 10^{12} = Var(FE_{MTOM})$		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS}\rvert = 1.03$ Test direction[C]: N.A		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC}\rvert = 9.90$*** Test direction[C]: $Var(FE_{HC}) = 0.87 \times 10^{12} > 0.51 \times 10^{12} = Var(FE_{MTOM})$		

Variable definitions:

MV_{it}: Market Value of the firm's common equity at year-end, calculated using December 31 stock price.
BV_{it}: Book value of common shareholders' equity as of December 31 under historical cost accounting.
$SFASBV_{it}$: Book value of common shareholders' equity as of December 31 under SFAS 133 accounting
$MTOMBV_{it}$: Book value of common shareholders' equity as of December 31 under mark-to-market accounting.
$MTOMAE_{it}$: The abnormal mark-to-market earnings of the firm for the year ended December 31, calculated as : $XMTOM_{it} - 0.10*BVMTOM_{it-1}$
where $XMTOM_{it}$ are the mark-to-market earnings of the firm for the year ended December 31.
$SFASAE_{it}$: The abnormal SFAS 133 earnings of the firm for the year ended December 31, calculated as : $XSFAS_{it} - 0.10*BVSFAS_{it-1}$
where $XSFAS_{it}$ are the SFAS 133 earnings of the firm for the year ended December 31.
AE_{it}: The abnormal historical cost earnings of the firm for the year ended December 31, calculated as : $XC_{it} - 0.10*BV_{it-1}$
where XC_{it} are the historical cost earnings of the firm for the year ended December 31

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student "t" distribution with 107 degrees of freedom. Ohlson (1995) predicts a positive sign on the coefficients of MTOMBV, MTOMAE, SFASBV, SFASAE, BV, and AE. It is not possible to make a prediction with respect to the coefficient magnitude in the case of SFASBV, SFASAE, BV and AE. However, if the mark-to-market regression is properly specified, the coefficient of MTOMBV should be 1 (Ohlson (1995)). If the mark-to-market regression is properly specified, the coefficient of abnormal earnings should not be distinguishable from zero (Feltham and Ohlson (1997)). It is not possible to predict the sign or the magnitude of the constant term.

[B] Some Kmenta (1986) estimation parameters

1. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.66 to 0.98
   SFAS 133 model: from -0.93 to 0.99
   Historical cost model: from -0.67 to 0.99

2. Range of the cross-sectional estimates of residual variances (x 1.000^2)

   Mark-to-market model : from 0.27×10^9 to 0.65×10^{13}
   SFAS 133 model: from 0.21×10^9 to 0.21×10^{14}
   Historical cost model: from 0.70×10^9 to 0.89×10^{13}

[C] Description and interpretation of the cross-validation method described in chapter 6:

The cross-validation method described in chapter 6 tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported; the related subscripts indicate which two models that are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

1. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
2. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implications as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implication as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

Chapter 7.4 – Descriptive statistics of variables used in the changes specifications

Table 7.7 reports the descriptive statistics for the variables used in changes specifications. It is interesting to note that a downward sloping trend has been observed for gold price from 1992 to 1997 (*See* Figure 2). This effect can be illustrated by the negative mean for each of the earnings variables, respectively –0.04 for EPS, -0.04 for SFAS133 and –0.06 for MTOM. RETURN shows a positive mean of 14 per cent. The rather large minimum value observed for MTOM is consistent with the drop of U.S. $82.00 observed in the price of gold between December 1996 and 1997. The large maximum is observed for a firm discovering new reserves in a given year. The data is well distributed between these two extremes.

Table 7.8 shows the Pearson and Spearman correlation coefficients between the changes specification variables. [Note that these correlation coefficients do not consider potential serial correlation or heteroskedasticity in the data.] It appears that EPS is the variable most correlated with RETURN, with a pair-wise correlation of 0.23 (significantly different from zero, p-value less than 5 per cent). The Spearman correlation coefficients yield interesting results. Recall that a Spearman correlation is non-parametric. The variable that is most highly correlated with RETURN appears to be MTOM with a pair-wise correlation of 0.58 (significantly different from zero, p-value less than 1 per cent). The Pearson correlation between both variables is only 0.13 (not significantly different from zero). This suggests that a non-parametric regression could prove useful in identifying the effect hypothesized in Chapter 4. This is explored in a sensitivity analysis.

Table 7.7 – Descriptive statistics for the variables used in return-earnings specifications

Changes Panel (/share)

Variable	N	Mean	Std. Dev.	Median	Min.	Max.
RETURN	110	0.14	0.67	0.00	-0.92	2.48
EPS	110	-0.04	0.19	0.00	-1.62	0.19
SFAS133	110	-0.04	0.19	0.00	-1.70	0.19
MTOM	110	-0.06	2.13	0.01	-7.39	13.13

Variable definitions :

RETURN: The stock return of the firm, measured between January 1 and December 31 of the year
EPS: Historical cost earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
SFAS133: SFAS 133 earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
MTOM: Mark-to-market earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st

Table 7.8 : Pearson[A] (above the diagonal) and Spearman[B] (below) cross correlation for the return-earnings specification variables

Changes Panel

Variables	n	RETURN	EPS	SFAS133	MTOM
RETURN	110		0.23**	0.14	0.13
EPS	110	0.36***		0.98***	0.25***
SFAS133	110	0.10	0.79***		0.23**
MTOM	110	0.58***	0.46***	0.28***	

[A] The Pearson correlation coefficient (ρ_{XY}) is a measure of the closeness of a linear relationship between two variables. It is estimated using the following formula:

$$\rho_{XY} = \frac{cov(X,Y)}{\sqrt{var(X)var(Y)}}$$

Where :

X, Y are the two variables of interest.

[B] The Spearman correlation coefficient (θ_{XY}) is a measure of the correlation of the ranks of the variables. It is calculated using the following formula:

$$\theta_{XY} = \frac{\sum(R_i - \overline{R})(S_i - \overline{S})}{\sqrt{\left(\sum(R_i - \overline{R})^2 \sum(S_i - \overline{S})^2\right)}}$$

Where:

R_i is the rank of the ith X value

S_i is the rank of the ith Y value

$\overline{R}$ and $\overline{S}$ are the means of the R_i and S_i values

Variable definitions :

RETURN: The stock return of the firm, measured between January 1 and December 31 of the year.

EPS: Historical cost earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st

SFAS133: SFAS 133 earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st

MTOM: Mark-to-market earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st

Levels of significance for the test of the null hypothesis that the correlation coefficient is equal to zero:

*** less than 1%, ** less than 5%

Chapter 7.5 - Results of changes regressions

Table 7.9 reports the regression results for the levels specifications, estimated using the Kmenta (1986) estimation methodology. [Note that regression results for specifications including earnings and changes in earnings independent variables are included in Table 7.12 and discussed in chapter 7.7.]

The coefficient estimate of MTOM in the mark-to-market specification in Table 7.9 is small (0.08), but nonetheless significantly different from zero (p-value less than 1 per cent). This small coefficient observed is consistent with the argument made in Chapter 7.3 that the market may expect mean reversion of gold prices in the long run. The small coefficient for MTOM smoothes the impact of the MTOM earnings, which are measured using this year and last year gold prices. The coefficients of SFAS133 (0.71) and EPS (1.02) are both positive and significant (p-values less than 0.01). The magnitude of about one indicates that earnings are considered transitory in the gold mining industry.

Cross-validation tests fail to reject the null of H_1, H_2 and H_3. In the cases of H_1 and H_2, the cross-validation t-tests are not significant (respectively $|t_{MTOM \text{ versus } SFAS}|$ of 0.98 for H_1, $|t_{HC \text{ versus } SFAS}|$ of 0.29 for H_2). The cross-validation t-test of H_3 is significant ($|t_{HC \text{ versus } SFAS}|$ of 4.12, p-value less than 1 per cent), but inspection of the forecast error variance estimates reveals that the estimate of 0.49 for the historical cost model is larger than the estimate of 0.43 for the SFAS 133 model. Since the cross-validation tests indicate that the relations are in the wrong direction, it is not possible to reject the null of H_2.

Table 7.9: Return-Earnings specifications estimated using the Kmenta (1986) pooling technique

This table reports the results of regressions relating the explanatory variables below to the dependent variable, common stock return measured between January 1st and December 31. The results are based on the Kmenta pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-Market specification (MTOM):

$$RETURN_{it} = const + \beta_1 MTOM_{it} + \eta_{1it} \qquad i=1..22,\ t=2..6$$

SFAS 133 specification (SFAS):

$$RETURN_{it} = const + \gamma_1 SFAS133_{it} + \eta_{2it} \qquad i=1..22,\ t=2..6$$

Historical cost specification (HC):

$$RETURN_{it} = const + \phi_1 EPS_{it} + \eta_{3it} \qquad i=1..22,\ t=2..6$$

where i stands for the firm cross section number, and t for the year.

	Mark-to-Market[B]	SFAS 133[B]	Historical cost[B]
Constant	Coeff.: 0.09 t^A: 2.79***	Coeff.: 0.09 t^A: 2.49**	Coeff.: 0.10 t^A: 2.75**
EPS	NA	NA	Coeff.: 1.02 t^A: 4.96***
SFAS133	NA	Coeff.: 0.71 t^A: 3.46***	NA
MTOM	Coeff.: 0.08 t^A: 4.00***	NA	NA
Number of firms	22	22	22
Number of firm-year observations	110	110	110
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	0.49	0.45	0.43
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS}\rvert = 0.98$ Test direction[C]: N/A		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS}\rvert = 0.29$ Test direction[C]: N/A		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC}\rvert = 4.12$*** Test direction[C]: $Var(FE_{MTOM}) = 0.49 > 0.43 = Var(FE_{HC})$		

Variable definitions :

RETURN: The stock return of the firm, measured between January 1 and December 31 of the year.
EPS: Historical cost earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
SFAS133: SFAS 133 earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
MTOM: Mark-to-market earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student distribution with 108 degrees of freedom. Based on results from the accounting research literature (see among other Lev (1989)), a positive sign should be observed for the coefficients of MTOM, SFAS133 and EPS, but it is not possible to make a prediction with respect to the coefficient magnitude. It is not possible to predict the sign or the magnitude of the constant term.

[B] Some Kmenta (1986) estimation parameters

1. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.81 to 0.64
   SFAS 133 model: from -0.74 to 0.60
   Historical cost model: from -0.75 to 0.58

2. Range of the cross-sectional estimates of residual variances

   Mark-to-market model : from 0.09 to 3.28
   SFAS 133 model: from 0.10 to 2.71
   Historical cost model: from 0.09 to 2.71

[C] Description and interpretation of the cross-validation method described in chapter 6 (1999):

The cross-validation method tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported; the related subscripts indicate which two models are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

1. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
2. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implication as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

The transitory nature of earnings in the gold mining industry, evidenced by the coefficient estimates of about one observed in the historical cost and SFAS 133 return-earnings specifications, may explain the lack of findings regarding the income-statement numbers. Market participants may be using a balance-sheet perspective when valuing gold firms, and they may not give much weight to signals from the income statement. The small valuation coefficients observed for the abnormal earnings terms in Ohlson (1995)-based balance-sheet specifications are also evidence that the market appears to place little weight on the signals from the income statement in the gold mining industry. The question of the relative information content of income-statement numbers per different hedge-accounting recognition policies should possibly be addressed in an industry where earnings are more persistent before definite conclusions could be drawn.

Chapter 7.6 - Sensitivity analyses of the levels specifications

Chapter 7.6.1 Introduction

Several sensitivity analyses are performed to assess the robustness of the results to the specification choices. First, empirical variables have been deflated by the number of shares outstanding to assess potential bias that could be due to scaling differences. Second, the impact of measuring the dependent variable (market value of the firm's common equity) as of April 30 instead of December 31, is assessed. Third, the deflation of all variables by book value of common stockholder's equity in levels regressions is considered. Fourth, the impact of using a different expected rate of return to measure abnormal earnings variables in Ohlson (1995)-based specifications is explored. Fifth, the impact of imposing a floor of zero for

book-value variables in levels specifications has been assessed. Finally, yearly OLS regressions have been estimated. Results of these analyses are discussed below.

Chapter 7.6.2 – Deflation by the number of common shares outstanding

The results observed in Chapter 7 are not affected by the deflation of all variables by the number of common shares outstanding. Results from Barth (1994)-specifications, reported in Table 7.10, are qualitatively similar to the results observed in Table 7.5. The main difference is that regression coefficients are smaller in Table 7.10 than in Table 7.5. The coefficient of MTOMBV is 0.69 in Table 7.10, compared to 0.81 in Table 7.5. The coefficient of SFASBV is 1.58 in Table 7.10, compared to 2.19 in Table 7.5. Finally, the coefficient of BV is 1.69 in Table 7.10, compared to 2.45 in Table 7.5. Levels of significance remain unchanged. The cross-validation method yields the same inferences when applied to deflated data. The null hypotheses of H_1, H_2 and H_3 are all rejected.

Results for Ohlson (1995)-based specifications deflated by the number of common shares outstanding are presented in Table 7.11. As for Barth (1994)-based deflated specifications, the coefficient estimates of the book-value variables are smaller, but still highly significant. The coefficient estimates of the SFAS 133 abnormal earnings and of the historical cost abnormal earnings show the same signs in Tables 7.6 and 7.11, but both are not significantly different from zero. Deflated Ohlson (1995)-based specifications reject the null of H_1 and H_3, but fail to reject the null of H_2. The same conclusions were reached when using raw variables.

Table 7.10: Pooled Barth (1994)-based levels specifications estimated by the Kmenta (1986) pooling technique on per share data

This table reports the results of regressions relating the explanatory variables below to the dependent variable, market value of the firm's common equity measured as of December 31 each year. The results are based on the Kmenta (1986) pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-market specification (MTOM):

$$Price_{it} = const + \beta_1 MTOMBV_{it} / Shares + \eta_{1it}, \qquad i=1..22;\ t=1..6$$

SFAS 133 specification (SFAS):

$$Price_{it} = const + \gamma_1 SFASBV_{it} / Shares + \eta_{2it} \qquad I=1..22;\ t=1..6$$

Historical cost specification (HC):

$$Price_{it} = const + \phi_1 BV_{it} / Shares + \eta_{3it} \qquad i=1..22;\ t=1..6$$

where i stands for the firm cross section number, and t for the year

	Mark-to-Market[B]	SFAS 133[B]	Historical Cost[B]
Constant	Coeff.: 0.72 t^A: 3.24***	Coeff.: 1.55 t^A: 6.14***	Coeff.: 1.38 t^A: 5.56***
MTOMBV/Shares	Coeff.: 0.69 t^A: 28.00***	NA	NA
SFASBV/Shares	NA	Coeff.: 1.58 t^A: 19.00***	NA
BV/Shares	NA	NA	Coeff.: 1.69 t^A: 19.17***
Number of firm-year observations	22	22	22
Number of observations	132	132	132
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	33.21	67.05	65.79
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS}\rvert = 14.35$*** Test direction[C]: $Var(FE_{SFAS}) = 67.05 > 33.21 = Var(FE_{MTOM})$		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS}\rvert = 2.45$** Test direction[C]: $Var(FE_{SFAS}) = 67.05 > 65.79 = Var(FE_{HC})$		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC}\rvert = 14.05$*** Test direction[C]: $Var(FE_{HC}) = 65.79 > 33.21 = Var(FE_{MTOM})$		

Variable definitions:

$Price_{it}$:	Firm's common stock price as of December 31
BV_{it}:	Book value of common shareholders' equity as of December 31 under historical cost accounting
$SFASBV_{it}$:	Book value of common shareholders' equity as of December 31 under SFAS 133 accounting
$MTOMBV_{it}$:	Book value of common shareholders' equity as of December 31 under mark-to-market accounting
Shares:	Number of common shares outstanding at year-end

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student distribution with 130 degrees of freedom. Barth (1994) predicts that the coefficients on MTOMBV, SFASBV and BV are positive, but it is not possible to make a prediction with respect to the coefficient magnitude. Under Ohlson (1995) specification, this model is not properly specified. Abnormal earnings are not included. Also, the specification abstracts from conservatism and growth opportunities. No predictions are made about the sign or the magnitude of the constant term.

[B] Some Kmenta (1986) estimation parameters

3. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.38 to 0.90
   SFAS 133 model: from -0.78 to 0.99
   Historical cost model: from -0.78 to 0.99

4. Range of the cross-sectional estimates of residual variances (x $1,000^2)

   Mark-to-market model : from 0.47 to 102.92
   SFAS 133 model: from 0.13 to 301.20
   Historical cost model: from 0.13 to 298.12

[C] Description and interpretation of the cross-validation method described in chapter 6:

The cross-validation method described in chapter 6 tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported: the related subscripts indicate which two models are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

3. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
4. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated to a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implications as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

Table 7.11: Pooled Ohlson (1995)-based levels specifications estimated by the Kmenta (1986) pooling technique on per share data

This table reports the results of regressions relating the explanatory variables below to the dependent variable, common stock price as of December 31 each year. The results are based on the Kmenta (1986) pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-market specification (MTOM):

$$Price_{it} = const + \beta_1 MTOMBV / Shares_{it} + \beta_2 MTOMAE / Shares_{it} + \eta_{1it} \qquad i=1..22;\ t=2..6$$

SFAS 133 specification (SFAS):

$$Price_{it} = const + \gamma_1 SFASBV / Shares_{it} + \gamma_2 SFASAE / Shares_{it} + \eta_{2it} \qquad i=1..22;\ t=2..6$$

Historical cost specification (HC):

$$Price_{it} = const + \phi_1 BV / Shares_{it} + \phi_2 AE / Shares_{it} + \eta_{3it} \qquad i=1..22;\ t=2..6$$

where i stands for the firm cross section number, and t for the year.

	Mark-to-Market[B]	SFAS 133[B]	Historical Cost[B]
Constant	Coeff. : 0.39 t^A: 8.67***	Coeff. : 1.72 t^A 4.79***	Coeff. : 1.79 t^A : 4.90***
MTOMBV/Shares	Coeff. : 0.77 t^A: 41.70***	NA	NA
SFASBV/Shares	NA	Coeff. : 1.67 t^A: 15.21***	NA
BV/Shares	NA	NA	Coeff. : 1.74 t^A : 15.80***
MTOMAE/Shares	Coeff. : -0.16 t^A: -4.70**	NA	NA
SFASAE/Shares	NA	Coeff. : -0.04 t^A: -0.21	NA
AE/Shares	NA	NA	Coeff. : 0.22 t^A : 1.15
Number of firms	22	22	22
Number of firm-year observations	110	110	110
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	23.27	47.65	49.15
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS}\rvert = 16.08$*** Test direction[C] : $Var(FE_{SFAS}) = 47.65 > 23.27 = Var(FE_{MTOM})$		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS}\rvert = 0.09$ Test direction[C]: N/A		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC}\rvert = 18.10$*** Test direction[C]: $Var(FE_{HC}) = 49.15 > 23.27 = Var(FE_{MTOM})$		

Variable definitions:

$Price_{it}$: Firm's common stock price as of December 31.
BV_{it}: Book value of common shareholders' equity as of December 31 under historical cost accounting.
$SFASBV_{it}$: Book value of common shareholders' equity as of December 31 under SFAS 133 accounting
$MTOMBV_{it}$: Book value of common shareholders' equity as of December 31 under mark-to-market accounting.
$MTOMAE_{it}$: The abnormal mark-to-market earnings of the firm for the year ended December 31, calculated as : $XMTOM_{it} - 0.10*BVMTOM_{it-1}$
where $XMTOM_{it}$ are the mark-to-market earnings of the firm for the year ended December 31.
$SFASAE_{it}$: The abnormal SFAS 133 earnings of the firm for the year ended December 31, calculated as : $XSFAS_{it} - 0.10*BVSFAS_{it-1}$
where $XSFAS_{it}$ are the SFAS 133 earnings of the firm for the year ended December 31.
AE_{it}: The abnormal historical cost earnings of the firm for the year ended December 31, calculated as : $XC_{it} - 0.10*BV_{it-1}$
where XC_{it} are the historical cost earnings of the firm for the year ended December 31
Shares: Number of common shares outstanding

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student "t" distribution with 107 degrees of freedom. Ohlson (1995) predicts a positive sign on the coefficients of MTOMBV, MTOMAE, SFASBV, SFASAE, BV, and AE. It is not possible to make a prediction with respect to the coefficient magnitude in the case of SFASBV, SFASAE, BV and AE. However, if the mark-to-market regression is properly specified, the coefficient of MTOMBV should be 1 (Ohlson (1995)). If the mark-to-market regression is properly specified, the coefficient of abnormal earnings should not be distinguishable from zero (Feltham and Ohlson (1997)). It is not possible to predict the sign or the magnitude of the constant term.

[B] Some Kmenta (1986) estimation parameters

3. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.60 to 0.94
   SFAS 133 model: from -0.90 to 0.99
   Historical cost model: from -0.81 to 0.99

4. Range of the cross-sectional estimates of residual variances (x $1,000^2$)

   Mark-to-market model : from 0.05 to 153.69
   SFAS 133 model: from 0.11 to 519.63
   Historical cost model: from 0.12 to 509.49

[C] Description and interpretation of the cross-validation method described in chapter 6:

The cross-validation method described in chapter 6 tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported; the related subscripts indicate which two models that are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

3. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
4. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implications as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implication as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

Overall, comparisons of the results for deflated and raw specifications indicates that scaling differences do not appear to be the cause of the results observed in Tables 7.5 and 7.6.

Chapter 7.6.3 – Using stock prices as of April 30

The analysis is repeated using stock prices as of April 30 instead of stock prices as of December 31 to measure the market value of the firm's common equity. Measuring the dependent variable at a later date should ensure that all the firm's earnings announcements have reached the market and are being incorporated in stock prices. Be aware that two of the 22 firms in the panel must be dropped from this analysis because they stop trading shortly after December 31, 1997. Ohlson (1995)-based specifications appear robust to this specification change. H_1 and H_3 are still rejected by the data, and contrary to the evidence reported in Table 7.6, the cross-validation method also rejects the null hypothesis of H_2.

Barth (1994)-based specifications are different when stock prices as of April 30 are used to measure the market value of the firm's common equity. The cross-validation evidence fails to reject the null of H_1 and H_3. Only the conclusions with respect to H_2 appear robust. Recall that the Hotelling (1931) value of commodity reserves is given by :

$$RES_t = (P_t - CC_t) * PPR_t \qquad (7.1)$$

Where

RES_t is the market value of the firm's commodity reserves at time t (December 31)

P_t is the spot price of the commodity at time t (December 31)

CC_t is the current cash costs of extraction of the commodity at time t (December 31)

PPR_t is the firm's Proven and Probable commodity reserves at time t (December 31)

Tufano (1998) indicates that stock returns are strongly correlated with contemporaneous gold-holding returns. This implies that the stock price at time t+4 (April 30) reflects the price of gold at time t+4 (April 30). Stock prices at time t+4 (April 30) might not be correlated strongly with gold prices at time t (December 31). In this thesis, the mark-to-market accounting numbers are based on Hotelling's (1931) reserve value at time t (December 31). It is possible that stock market values as of April 30 show a weak correlation to mark-to-market accounting numbers as of December 31 because of this measurement issue.

There exists another non-mutually exclusive possibility that could explain the failure to reject the null hypotheses of H_1 and H_3 when using stock prices as of t + 4 (April 30) to measure MV. The information conveyed by the December 31 accounting numbers may not be fully reflected in stock prices as of December 31. If this were the case, then the evidence presented in Tables 7.5 and 7.6 would have to be discounted.

Anecdotal evidence based on conversations with analysts in the gold mining industry reveal that conference calls are held on a regular basis with firms in this sector. Earnings forecasts are normally discussed during these calls. This would indicate that reliable estimates of accounting numbers are available to market participants before their final release. Based on this anecdotal evidence, December 31 would appear to be the theoretically correct date at which to measure the market value of the firm's equity.

This issue is also examined empirically using the following methodology. The firm's common-equity market value has been adjusted to remove changes to the firm's market value caused by changes in the price of gold between January 1 and April 30, as follows:

$$MVtrans_{t+4} = MV_{t+4} - PPR_t * (spot_{t+4} - spot_t) \qquad (7.2)$$

Where :

$MVtrans_{t+4}$: Market value of the firm's common equity as of April 30 of the subsequent year, adjusted to remove value created by changes in the price of gold.

MV_{t+4} : Market value of the firm's common equity, calculated using the firm's stock price as of April 30.

PPR_t : Proven and probable reserves of the firm as of December 31.

$Spot_{t+4}$: Gold spot price as of April 30

$Spot_t$: Gold spot price as of December 31

Using this formula should generate a dependent variable that reflects the information conveyed by accounting numbers as of December 31. At the same time, the dependent variable would not reflect changes in the firm's market value due to information that subsequently became available. Recall that information that becomes available subsequent to year-end is not accounted for in the financial statements. This transformation of the dependent variable is based on a restrictive set of assumptions. The first assumption is that all value-relevant events between January 1 and April 30, excluding the release of the year-end accounting numbers, are captured by changes in commodity prices. The second assumption is

that the market value of the firm changes by $1 for any change in the fair value of proven and probable reserves. This assumption might not hold, given the regression coefficients observed in Tables 5 and 6, or the gold beta's (around 2) observed in Tufano (1998). Third, it assumes that all firms will have released their accounting numbers by April 30, which appears reasonable.

The mark-to-market, SFAS 133 and historical-cost empirical equations have been re-estimated using $MVtrans_{t+4}$ as the dependent variable. Results (not reported) of cross-validation tests reject the null hypotheses of H_1, H_2 and H_3. The mark-to-market model shows the lowest forecast-error variance, followed by the historical cost model and the SFAS 133 model. It appears that the failure to reject the null hypotheses of H_1 and H_3 in Barth (1994)-based specifications, when measuring stock market values as of April 30, is due to changes in the price of gold observed between January 1 and April 30 that are not reflected in mark-to-market accounting numbers. Ohlson (1995)-based specifications have also been re-estimated using $MVtrans_{t+4}$ as the dependent variables. The null hypotheses of H_1, H_2 and H_3 are all rejected by the data.

Overall, it appears that the results are not affected by measuring the dependent variables at a later date, if adjustments are made to remove information that cannot be reflected in the December 31 financial statements because it became known after this date. Moreover, results from this analysis suggest that stock prices as of December 31 may not reflect all the information included in the financial statements until they have been released. This appears to be a plausible explanation for the negative results observed with respect to H_2 in Table 7.6.

Chapter 7.6.4 – Deflation by book value

Book value of equity has been widely used in the accounting research literature as a deflator to control scaling differences (*See* among others Barth (1994), Barth et al. (1991)). It does not appear possible to use variables deflated by the book value of equity in this thesis. Dechow et al. (1999) indicate that tests of relative information content are designed to assess which of two candidate specifications better explain a benchmark. The benchmark chosen in this thesis for levels specifications is the market value of the firm's common equity. Regression equations deflated by the book value of common stockholders' equity would be of the form:

$$\frac{MV_t}{BVMTOM_t} = \beta_1 \frac{1}{BVMTOM_t} + \beta_2 \frac{BVMTOM_t}{BVMTOM_t} + \eta_1 \qquad (7.3)$$

$$\frac{MV_t}{BVSFAS_t} = \alpha_1 \frac{1}{BVSFAS_t} + \alpha_2 \frac{BVSFAS_t}{BVSFAS_t} + \eta_2 \qquad (7.4)$$

The benchmark for equation 7.3 is $\frac{MV_t}{BVMTOM_t}$, while it is $\frac{MV_t}{BVSFAS_t}$ in equation 7.4.

Forecast errors from equation 7.3 cannot be compared to forecast errors from equation 7.4 using the cross-validation test described in Fortin and Wirjanto (1999). Vuong (1989) also requires the benchmark to be the same for both models, as discussed in Dechow et al. (1999).

Chapter 7.6.5 – Expected rate of return

Recall that abnormal earnings are calculated using the following formula:

$$AE_t = XC_t - k * BV_{t-1}$$

Where:

AE_t are the abnormal earnings of the firm

XC_t are the earnings of the firm

BV_{t-1} is the book value of the firm at the beginning of the fiscal year

k is the expected rate of return on the firm's equity.

As discussed in Chapter 6, a rate of return of 10% has been used in Ohlson (1995)-based tests [note that the same rate of return is used for all firms]. Measuring the abnormal earnings variables using a rate of 11 per cent or 15 per cent instead of the rate of 10 per cent used does not affect the results.

Chapter 7.6.6 – Negative book value numbers

As can be observed in Table 7.3, some firms show negative book values. Under limited liability, stockholders cannot lose more than their investment in the firm in case of bankruptcy. The analysis has been repeated replacing negative book value numbers by 0. Results (not reported) are qualitatively similar to those discussed above.

Chapter 7.6.7 – Yearly regressions

Finally, the analysis has been repeated on a year-by-year basis (22 observations for each year between 1992 and 1997). Yearly regressions are estimated using ordinary least squares, and

their relative explanatory power is assessed using Vuong's (1989) test, as described in Dechow (1994). Vuong's (1989) test is usually not significant for most comparisons, probably due to the small sample size used.

Chapter 7.7 - Sensitivity analyses of the return-earnings specification

Chapter 7.7.1 - Introduction

Several sensitivity analyses were performed to assess the robustness of results from return-earnings models to specification changes. First, the length of the return window has been modified to assess the robustness of the results to the choice of the return window. Second, ranked regressions are explored to assess the sensitivity of the results to the cardinal assumptions imposed by the Kmenta (1986)'s estimation procedure. Third, changes specifications relating the levels of earnings and the changes-in-earnings to stock returns are estimated. Finally, yearly regressions have been estimated. Results of these sensitivity analyses are discussed below.

Chapter 7.7.2 – Changing the return windows

Different assumptions with respect to the return window have been explored. Return-earnings specification require the identification of the proper return window to use, because the market may be incorporating value-relevant information into stock prices before the information is recognized in accounting earnings (Lev (1989), Easton and Harris (1991)). For example, the market probably incorporates a firm's reserve values into stock prices at the time of their discovery (Harris and Ohlson (1987)). Historical-cost accounting rules, however, delay the recognition of reserve values until the actual production and sale of the reserves. If firms

have hedged a large proportion of their production, such that there is little uncertainty with respect to the sale price, there may be no contemporaneous association between returns and accounting earnings.

Easton and Harris (1991) have determined that the best return window to use for tests of the association between accounting earnings and stock returns is a 15-month return window starting five months before the beginning of the accounting year and ending at month ten. Regression results using stock returns between August of the previous year and October of the current year (the 15-month return window of Easton and Harris (1991)) indicate that the earnings variables do not explain stock returns over this period. The mark-to-market earnings show a negative coefficient. A negative coefficient is not consistent with results observed in the literature (Lev (1989)). The SFAS 133 and historical-cost earnings show insignificant regression coefficients.

Other return windows have also been considered. A return window for the year preceding and a return window for a 17-month period starting 5 months before the beginning of the accounting year and stopping with the last month of the year, have also been used as the dependent variable in changes regression. None of these specifications appear to fit the data. They either show a negative coefficient for the earnings variable, or a coefficient not significantly different from zero.

When using a twenty-four-month return window starting in January of the previous year, only the MTOM earnings show a positive and significant coefficient. The SFAS 133 and historical cost earnings have coefficients that are positive but not significantly different from zero.

Finally, using a sixteen-month return window, starting in January of the fiscal year and ending in April of the subsequent year, show results that are consistent with H_2, but the data fail to reject the null hypotheses of H_1 or H_3. Removing from the firm's stock return the return observed on gold between January and April of the subsequent year does not appear to affect this result.

Overall, the results observed when modifying the return window are not conclusive. The only noticeable change in the results is observed when the return window is extended to April 30 of the subsequent year. In this case, the data appear to reject the null hypothesis of H_2, and indicates that the historical cost accounting numbers are more strongly associated with stock returns than the SFAS 133 accounting numbers.

Chapter 7.7.3 – Ranked regressions

Analysis of the Spearman correlation coefficients between the variables used in the changes specifications suggest that the return-earnings data set may violate the parametric assumptions associated with pooled regression. The Spearman correlation coefficient of 0.58 between XMTOM and RETURN is much larger than the Pearson correlation coefficient between the same two variables (0.13). Ranked regressions are not subject to parametric assumptions pertaining to the relation between variables in their cardinal form. For example, they do not

suggest that a dollar of earnings is equal to a given number of dollars of return, and that this relation is constant over the range covered by the variables. Instead, ranked regressions assess whether firms with the largest earnings show the largest returns and vice-versa. The variables have been reordered in increasing order. Their relative rank is used in pooled OLS regressions of the firm's rank with respect to RETURN with the firm's rank with respect to each of the earnings variables. The regressions R^2 ranking (not reported) is consistent with H_1, H_2, and H_3.

Chapter 7.7.4 – Return specifications including a change-in-earnings variable

Ohlson and Schroff (1992) and Easton and Harris (1991) propose the following changes specification to assess the information content of accounting earnings:

$$RETURN = Const + \beta_1 EPS + B_2 \Delta EPS + \varepsilon \qquad (7.5)$$

Where :

RETURN is the firm stock return over the time period considered

EPS is the earnings per share of the firm, divided by price at the beginning of the return window.

ΔEPS is the change in earnings per share, defined as this year's EPS minus last year's EPS, divided by price at the beginning of the return window.

Equation 7.5 has been estimated using respectively the mark-to-market earnings plus the change in mark-to-market earnings, the SFAS 133 earnings plus the change in SFAS 133 earnings and the historical cost earnings plus the change in historical cost earnings as the independent variables. Return is measured between January 1 and December 31. Results are

reported in Table 7.12. The change-in-earnings variable coefficients are not significantly associated with stock returns in any of the specifications. This is intuitive, given that earnings appear to be transitory in the gold mining industry, as evidenced by the coefficient estimates of about 1 observed in Table 7.9. A change-in-earnings variables usually captures how persistent the market views the recently observed trend in earnings to be. Since earnings in the gold mining industry do not appear to show persistence, it is consistent to observe insignificant coefficients for the change-in-earnings variables. When applying the cross-validation methodology to these specifications, the null hypotheses of H_1, H_2 and H_3 are not rejected by the data.

Chapter 7.7.5.

Finally, the analysis has been repeated on a year-by-year basis (22 observations for each year from 1993 to 1997). The return equations are estimated with OLS, and their relative explanatory power is assessed using Vuong (1989). The null of H_1, H_2 and H_3 cannot be rejected at normal levels of significance in any of the five yearly regressions.

Table 7.12: Return-Earnings specifications estimated using the Kmenta (1986) pooling technique which includes changes-in-earnings variables.

This table reports the results of regressions relating the explanatory variables below to the dependent variable, common stock return measured between January 1st and December 31. The results are based on the Kmenta pooling technique. This technique employs a set of assumptions on the disturbance covariance matrix that gives a cross-sectionally heteroskedastic and timewise autoregressive model.

Mark-to-Market specification (MTOM):

$$RETURN_{it} = const + \beta_1 MTOM_{it} + \eta_{7it} \qquad i=1..22,\ t=3..6$$

SFAS 133 specification (SFAS):

$$RETURN_{it} = const + \gamma_1 SFAS133_{it} + \eta_{8it} \qquad i=1..22,\ t=3..6$$

Historical cost specification (HC):

$$RETURN_{it} = const + \phi_1 EPS_{it} + \eta_{9it} \qquad i=1..22,\ t=3..6$$

where i stands for the firm cross section number, and t for the year.

	Mark-to-Market[B]	**SFAS 133[B]**	**Historical cost[B]**
Constant	Coeff. : -0.09 t^{A}: -4.09***	Coeff. : -0.08 t^{A} : -4.15***	Coeff. : -0.07 t^{A} : -3.41***
EPS	NA	NA	Coeff. : 0.90 t^{A} : 8.07***
ΔEPS	NA	NA	Coeff. : 0.11 t^{A} : 0.93
SFAS133	NA	Coeff. : 0.79 t^{A} : 8.40***	NA
ΔSFAS133	NA	Coeff. : 0.05 t^{A} : 0.53	NA
MTOM	Coeff. : 0.07 t^{A}: 4.27***	NA	NA
ΔMTOM	Coeff. : -0.005 t^{A} : -0.65	NA	NA
Number of firms	22	22	22
Number of firm-year observations	88	88	88
Variance of the forecast errors (Var(FE)) calculated using the cross-validation method[C]	0.20	0.17	0.16
Test of H_1[D]	Test parameter[C]: $\lvert t_{MTOM\ versus\ SFAS}\rvert = 6.58$ Test direction[C]: Var (FE_{MTOM}) = 0.20 > 0.17 = Var (FE_{SFAS})		
Test of H_2[E]	Test parameter[C]: $\lvert t_{HC\ versus\ SFAS}\rvert = 12.92$ Test direction[C]: Var (FE_{SFAS}) = 0.17 > 0.16 = Var (FE_{HC})		
Test of H_3[F]	Test parameter[C]: $\lvert t_{MTOM\ versus\ HC}\rvert = 5.29$*** Test direction[C]: Var (FE_{MTOM}) = 0.20 > 0.16 = Var (FE_{HC})		

Variable definitions :

RETURN: The stock return of the firm, measured between January 1 and December 31 of the year.
EPS: Historical cost earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
ΔEPS: Change in historical cost earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st:
$\Delta EPS_t = EPS_t - EPS_{t-1}$
SFAS133: SFAS 133 earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
ΔSFAS133: Change in SFAS 133 earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st:
$\Delta SFAS133_t = SFAS133_t - SFAS133_{t-1}$
MTOM: Mark-to-market earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st
ΔMOTM: Change in mark-to-market earnings per share of the firm for the year ended December 31, deflated by common stock price as of January 1st:
$\Delta MTOM_t = MTOM_t - MTOM_{t-1}$

[A] Regression coefficient t-tests

The t-ratio of a regression coefficient tests the null hypothesis that the coefficient is equal to zero against the alternate hypothesis that the coefficient is not equal to zero. The p-value reported is based on a two-tail Student distribution with 108 degrees of freedom. Based on results from the accounting research literature (see among other Lev (1989)), a positive sign should be observed for the coefficients of MTOM, SFAS133 and EPS, but it is not possible to make a prediction with respect to the coefficient magnitude. It is not possible to predict the sign or the magnitude of the changes-in-earnings variables, nor the constant terms.

[B] Some Kmenta (1986) estimation parameters

3. Range of the estimated coefficients of autocorrelation:

   Mark-to-market model : from -0.46 to 0.65
   SFAS 133 model: from -0.98 to 0.41
   Historical cost model: from -0.97 to 0.23

4. Range of the cross-sectional estimates of residual variances

   Mark-to-market model : from 0.06 to 4.62
   SFAS 133 model: from 0.06 to 4.39
   Historical cost model: from 0.07 to 4.35

[C] Description and interpretation of the cross-validation method described in chapter 6 (1999):

The cross-validation method tests the null hypothesis that two nested or non-nested regression models have the same forecast error variance (Var (FE)) when the regression parameters are used to forecast the dependent variable for a randomly selected holdout sample, since we expect that the model which performs better out-of-sample should perform better in-sample. The t-statistic reported tests the null hypothesis that in an artificial regression of the sum of the forecast errors from the two models (S_{it}) on the difference of their forecast errors (D_{it}) (hereafter, the artificial regression), the coefficient of D_{it} is zero, against the alternative that it is different from zero. The sign of the t-ratio is inconclusive with respect to the direction of the relation. The absolute value of the t-ratio is reported; the related subscripts indicate which two models are being compared. The p-value is based on a Student "t" distribution. Conclusions are made using a two-step procedure:

3. Determine if the coefficient of D_{it} in the artificial regression is different from zero by observing the p-value of the t-ratio. If the t-ratio is not significantly different from zero, conclude that the null hypothesis that the forecast error variances are equal cannot be rejected. If the coefficient is different from zero, go to step 2.
4. Compare the magnitude of the forecast error variances. Conclude that the model with the lowest forecast error variance is the most precise model.

[D,E,F] Description of the thesis hypotheses, and decision rules.

[D] H_1: Hypothesis 1 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_1. Therefore, we can conclude that the mark-to-market accounting numbers are more highly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_1.

[E] H_2: Hypothesis 2 (in alternate form) predicts that the historical cost accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the historical cost model is smaller than the variance of the forecast errors of the SFAS 133 model, it has the same implication as rejecting the null of H_2. Therefore, we can conclude that the historical cost accounting numbers are more strongly associated with a firm's stock return than the SFAS 133 accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the SFAS 133 model forecast error variance is smaller, it has the same implication as not rejecting the null of H_2.

[F] H_3: Hypothesis 3 (in alternate form) predicts that the mark-to-market accounting numbers are more strongly associated with a firm's stock return than the historical cost accounting numbers. If the cross-validation method described above indicates that the variance of the forecast errors of the mark-to-market model is smaller than the variance of the forecast errors of the historical cost model, it has the same implication as rejecting the null of H_3. Therefore, we can conclude that the mark-to-market accounting numbers are more highly associated with a firm's stock return than the historical cost accounting numbers. If the cross-validation method cannot reject the null hypothesis of equal forecast error variances, or concludes that the historical cost model forecast error variance is smaller, it has the same implication as not rejecting the null of H_3.

Levels of significance :

*** less than 1%, ** less than 5%

Chapter 7.8 - Summary of regression results and conclusion

The following table provides a summary of the regression results discussed in chapter 7.

Table 7.13 - Summary of regression results

Description	Test	H_1[59]	H_2[60]	H_3[61]
Table 7.5 : Barth (1994)-based levels specifications	Cross-validation test	Rejects the null hypothesis	Rejects the null hypothesis	Rejects the null hypothesis
Table 7.6 : Ohlson (1995)-based levels specifications	Cross-validation test	Rejects the null hypothesis	Fails to reject the null hypothesis[62]	Rejects the null hypothesis
Table 7.9 : Changes specifications	Cross-validation test	Fails to reject the null hypothesis	Fails to reject the null hypothesis	Fails to reject the null hypothesis

The null hypotheses of H_1 and H_3 appear to be consistently rejected by the data in levels specifications. A firm's common-equity value is more strongly associated with the mark-to-market accounting numbers than with SFAS 133 accounting numbers, or than with historical-cost accounting numbers. The evidence is mixed with respect to H_2. When using Barth (1994)-based empirical specifications, the historical-cost recognition rules produce accounting numbers that are more strongly associated to a firm's common-equity market value than SFAS 133 accounting numbers. This does not appear to be the case when employing Ohlson (1995)-based specification. Further analyses of the data discussed in the sensitivity analyses reveal a potential explanation for this result. Measuring a firm's common equity market value as of December 31 may reduce the power of the test. Financial statements are usually

[59] H_1 predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market value than the historical-cost accounting numbers.
[60] H_2 predicts that the historical-cost accounting numbers are more strongly associated with a firm's common-equity market value than the SFAS 133 accounting numbers.
[61] H_3 predicts that the mark-to-market accounting numbers are more strongly associated with a firm's common-equity market values than the historical-cost accounting numbers.
[62] Note that results from a sensitivity analysis in which the market value of the firm's common equity is measured as of April 30 rejects this null hypothesis.

released to the public a few months following year-end. Stock prices as of December 31 may not reflect all of the information included in the financial statements. When using stock prices as of April 30 to measure the market value of a firm's common equity, the null hypotheses of H_1, H_2 and H_3 are rejected by the data in both Barth (1994)-based and Ohlson (1995)-based specifications. Results based on levels specifications appear robust to specification changes.

As can be observed in the table above, the return-earnings specifications appear to show results that are inconsistent with the results observed for the levels specifications. Sensitivity analyses of these specifications fail to reach different conclusions.[63] Evidence from the return-earnings specifications indicates that earnings appear to be transitory in the gold mining industry. This implies that little weight is given to earnings signals when performing equity valuation. This implication is consistent with the small coefficients observed for abnormal earnings variables in Ohlson (1995)-based levels specifications. Given these concerns, it is probably preferable to discount the evidence from return-earnings specifications in the evaluation of the thesis evidence. An avenue for future research would be to examine the relative information content of earnings numbers per the three recognition rules examined in this thesis for a sample of firms demonstrating a high level of earnings persistence.

[63] Ranked regressions are consistent with H_1, H_2 and H_3. However, ranked regressions are difficult to interpret and have not been used very often in capital-market financial-accounting research.

Chapter 8 - Conclusions, limitations, and future research directions

The recently released U.S. recognition standard for derivative securities, *SFAS 133 - Accounting for Derivative Instruments and Hedging Activities*, requires that only the derivatives side of a hedging relationship be recognized on the balance-sheet for hedges of anticipated transactions. The evidence presented in this thesis is not consistent with the claim of the FASB that the application of SFAS 133 will produce more relevant balance-sheet accounting numbers, at least from the stock market perspective. The evidence here indicates that marking-to-market both sides of the hedging relationship, or keeping both sides of the hedge off-balance-sheet, generates balance-sheet accounting numbers that appear more relevant than the SFAS 133 accounting numbers. The thesis also provides evidence with respect to the accelerated recognition issue. It appears that accelerating the recognition of both sides of the hedge (mark-to-market accounting numbers) results in balance-sheet accounting numbers that are more relevant than accounting numbers based on the delayed recognition of both sides of the hedge (historical-cost accounting numbers). Barth (1994)-based and Ohlson (1995)-based regression specifications both yield evidence consistent with these conclusions.[84] Overall, the evidence generated from levels regressions is a potentially useful input for standard setters world-wide that are contemplating the adoption of a recognition standard for derivative securities.

The evidence in the thesis is inconclusive with respect to the income-statement accounting numbers. It has not been possible to show that marking-to-market both sides of the hedge, or keeping both sides off-balance-sheet, generates earnings numbers that are more relevant than

the SFAS 133 earnings numbers. It is hypothesized that the transitory nature of earnings numbers in the gold mining industry affects the validity of the test. An avenue for future research would be to assess the relative explanatory power of earnings numbers per the three recognition policies studied in this thesis on a sample of firms showing more persistent earnings numbers. The lack of conclusive evidence regarding income statement numbers makes the FASB's decision to require the presentation of both historical-cost income numbers and SFAS 133 (comprehensive income) income numbers appear sensible.

The thesis also contributes to the capital-market financial-accounting literature by examining the issue of financial-statement recognition. Dechow et al. (1999) indicate that few studies have addressed this issue. As discussed in Dechow et al.(1999), value relevance is a necessary, but not sufficient condition to recognize an element in the financial statements. This thesis supports their argument and indicates that the matching principle is an important concept to consider when studying whether an item should be recognized in the financial statement (at least for the case of hedges of anticipated transactions).

The valuation methodology developed in Chapter 5 may prove to be useful to CFOs and auditors who will have to apply SFAS 133.

Conclusions from the thesis evidence are subject to some caveats. First, the empirical analysis looks at commodity positions (derivatives and reserves) of firms involved in gold mining. Further research is necessary before conclusions made from this analysis can be

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[84] When measuring the firm's common-equity market value as of December 31, specifications based on Ohlson (1995) fail to reject the null of H_2. However, a sensitivity analysis measuring market value of the firm's

generalized to other positions (foreign currency, interest rate, credit risk, etc.) or other industries. Second, this thesis uses the market value of a firm's common equity as the benchmark to which the accounting numbers per the different hedge-accounting rules are compared. Stronger association to market traded data is not the only factor on which the standard setting process is based. Results from this thesis may not indicate that society would be better served by the adoption of a different hedge-accounting standard. However, the evidence does suggest that the adoption of SFAS 133 rules cannot be made on the basis of value relevance. Third, the analysis is performed on "as if" data, which are computed from voluntary disclosures of commodity derivatives. It is possible that the estimates of derivatives fair values calculated are too noisy to show the true level of association between SFAS 133 accounting numbers and a firm's common-equity market value. Fourth, the valuation models used in this thesis are likely to be under-specified, in the sense that they do not include all of the variables that market participants use when they value gold mining firms. It is always possible in empirical research that some omitted variables be correlated with the variables included in the regression equations. Inferences might be different if these variables were included in the valuation model.

As discussed above, an avenue for future research would be the assessment of the relative explanatory power of earnings numbers per the three recognition policies studied in this thesis on a sample of firms showing persistent earnings numbers. A second interesting research avenue would be to use the design developed in this thesis to address the issue of financial recognition of other footnote information. For example, the question of whether debt-financial instruments should be marked-to-market could be analyzed. Third, the thesis

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common equity as of April 30 of the subsequent year rejects the null of H_2.

evidence is based on "as if" accounting numbers. Another research direction would be to examine fair-value hedges. SFAS 133 will require that both sides of a fair-value hedge be marked-to-market. When SFAS 133 becomes mandatory, accounting numbers marking both sides of a hedging relationship to market will be directly available from a firm's financial statements. It would be interesting to compare the relative information content of pre- and post-SFAS 133 accounting numbers in this setting to determine whether marking-to-market both sides of the hedge would result in more informative accounting numbers. Finally, under SFAS 133, no footnote disclosure of derivative positions is required. It would be interesting to assess whether this results in a loss of information for market participants.

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Appendix 1: Monte Carlo simulation results

Appendix 1.1 Description of the simulation setting under classical assumptions

The following steps describe the Monte Carlo simulation setting. The classical assumption simulation setting is presented as a starting point. It demonstrates the well-known performance of Vuong's (1989) test in classical conditions. It is used to assess whether the Monte-Carlo simulation is designed properly.

Step 1

Randomly select 150 observations between 0 and 100 from a uniform distribution. Call this vector X_1.

Step 2

Randomly select 150 observations from a normal distribution, with mean 0 and standard deviation 12. Call this vector μ_1.

Step 3

Compute the variable Y, using the following data generating process:

$$Y = 0 + 1 * X_1 + \mu_1 \qquad \text{(A1.1)}$$

Step 4

Select two vectors of error terms, e_1 and e_2, from two normal distributions with mean zero and standard deviation σ_1 and σ_2. Form the following two variables:

$$X_2 = X_1 + e_1 \quad , e_1 \approx N(0, \sigma_1^2) \qquad \text{(A1.2)}$$

and

$$X_3 = X_1 + e_2 \ , e_2 \approx N(0, \sigma_2^2) \qquad \text{(A1.3)}$$

Note that X_2 measures X_1 with error, and that X_3 measures X_1 with error.

Step 5

Estimate the following two regression models using OLS:

$$Y = \alpha_0 + \alpha_1 X_2 \qquad \text{(A1.4)}$$

and

$$Y = \gamma_0 + \gamma_1 X_3 \qquad \text{(A1.5)}$$

If σ_1 is smaller than σ_2, then by construction (A1.4) should have a larger explanatory power than (A1.5).

Step 6

Test the hypothesis stated in step 5 above using Vuong (1989) (See Dechow (1994) for a complete description of the test). Note the decision (reject the null of equal explanatory power in favor of (A1.4), or reject the null of equal explanatory power in favor of (A1.5), or fail to reject the null).

Step 7

Repeat steps 1 to 6 one hundred times and compare the rejection rate with expectations.

Appendix 1.2 Simulation results under classical assumptions – Vuong's (1989) test

The following table summarizes the Monte Carlo simulation results for the performance of Vuong (1989) under classical assumptions, for a finite sample similar in size to the thesis sample.

σ_1	σ_2	Expectation	Results (100 loops)		Comments
			X_2 best	X_3 best	
10	10	Do not reject the null	1	1	Less than 5 rejections, while with α=5%, we would expect 5.
10	11	Reject in favor of X_2	8	3	Not enough power to identify the relationship. Should reject 95 times.
10	12	Reject in favor of X_2	19	0	Not enough power to identify the relationship. Should reject 95 times.
10	13	Reject in favor of X_2	24	0	Not enough power to identify the relationship. Should reject 95 times.
10	14	Reject in favor of X_2	35	0	Not enough power to identify the relationship. Should reject 95 times.
10	15	Reject in favor of X_2	55	0	Not enough power to identify the relationship. Should reject 95 times.
10	16	Reject in favor of X_2	73	0	Not enough power to identify the relationship. Should reject 95 times.
10	17	Reject in favor of X_2	80	0	Not enough power to identify the relationship. Should reject 95 times.
10	18	Reject in favor of X_2	92	0	Weakly reject the null hypothesis at this level
10	19	Reject in favor of X_2	96	0	Reject the null hypothesis at conventional levels
10	20	Reject in favor of X_2	98	0	Reject the null hypothesis at conventional levels

Conclusion

Vuong's (1989) test demonstrates enough power to reject a null hypotheses of equal explanatory power under small sample size when one of the candidates is at least twice as noisy as the other candidate.

Appendix 1.3 Description of the simulation setting under Kmenta (1986) data set conditions – Vuong's (1989) test

The following steps describe the Monte Carlo simulation setting.

Step 1

Randomly select 150 observations between 0 and 100 from a uniform distribution. Call this vector X_1.

Step 2

Generates a serially correlated and heteroskedastic error term for each cross-sectional unit. Randomly select an autocorrelation coefficient between 0 and 1 from a uniform distribution and call this coefficient ρ_i , where i represent a cross-sectional unit. Randomly select an error term between 0 and 20 from a uniform distribution. Call this error term ϕ_i , where i represent a cross-sectional unit.

For each cross-sectional unit, randomly select six error terms from a normal distribution with mean 0 and variance ϕ_i^2 . Call these error terms e_{it}, where t represent time unit, and i stands for the cross-section number. Generate the vector μ_i as follow:

$$\begin{aligned} \mu_{it} &= e_{it} && \text{for t = 1} \\ \mu_{it} &= \rho_i \mu_{it-1} + e_{it} && \text{for t = 2 to t = 6} \end{aligned} \qquad \text{(A1.6)}$$

Repeat the procedure 25 times to generate a pooled sample of 25 cross-sectional unit with a time-series component of 6 years, for a total of 150 firm year observations.

Step 3

Compute the variable Y, using the following data generating process:

$$Y_{it} = 0 + 1 * X_1 + \mu_{it} \qquad \text{for i} = 1 \text{ to } 25, \text{ t} = 1 \text{ to } 6 \qquad \text{(A1.7)}$$

Step 4

Select two vectors of error terms, a_1 and a_2, from two normal distributions with mean zero and standard deviation σ_1 and σ_2. Form the following two variables:

$$X_2 = X_1 + a_1 \ , a_1 \approx N(0, \sigma_1^2) \qquad \text{(A1.8)}$$

and

$$X_3 = X_1 + a_2 \ , a_2 \approx N(0, \sigma_2^2) \qquad \text{(A1.9)}$$

Note that X_2 measures X_1 with error, and that X_3 measures X_1 with error.

Step 5

Estimate the following two regression models using Kmenta (1986):

$$Y_{it} = \alpha_0 + \alpha_1 X_{2it} \qquad \text{(A1.10)}$$

and

$$Y_{it} = \gamma_0 + \gamma_1 X_{3it} \qquad \text{(A1.11)}$$

If σ_1 is smaller than σ_2, then by construction (A1.10) should have a larger explanatory power than (A1.11).

Step 6

Test the hypothesis stated in step 5 above using Vuong (1989) (See Dechow (1994) for a complete description of the test). Note the decision (reject the null of equal explanatory power in favor of (A1.10), or reject the null of equal explanatory power in favor of (A1.11), or fail to reject the null).

Step 7

Repeat steps 1 to 6 one hundred times and compare the rejection rate with expectations.

Appendix 1.4 Simulation results under Kmenta (1986) assumptions – Vuong's (1989) test

The following table summarizes the Monte Carlo simulation results for the performance of Vuong (1989) under Kmenta (1986) assumptions, for a finite sample similar in size to the thesis sample.

σ_1	σ_2	Expectation	Results (100 loops)		Comments
			X_2 best	X_3 best	
10	10	Do not reject the null	0	0	Less than 5 rejections, while with α=5%, we would expect 5.
10	15	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.
10	20	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.
10	50	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.
10	100	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.
10	250	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.
10	1000	Reject in favor of X_2	0	0	Not enough power to identify the relationship. Should reject 95 times.

Conclusion

Vuong (1989) does not have enough power to reject the null hypothesis of equal explanatory power under small sample size that are serially correlated and heteroskedastic, even if the estimation procedure controls for these classical assumptions violations.

Appendix 1.5 Description of the simulation setting under Kmenta (1986) data set conditions – Cross-validation test

Steps 1 to 5 are exactly the same as those described in Appendix 1.3. Step 6 and 7 are modified. The cross-validation test developed by Fortin & Wirjanto (1999) is used.

Step 6

Test the hypothesis stated in step 5 above using the cross-validation methodology described in Chapter 6 of this thesis. Note the decision (reject the null of equal explanatory power in favor of (A1.10), or reject the null of equal explanatory power in favor of (A1.11), or fail to reject the null).

Step 7

Repeat steps 1 to 6 ten times and compare the rejection rate with expectations. Only ten loops are used, since the test is computer-time intensive.

Appendix 1.6 Simulation results under Kmenta (1986) assumptions – Cross-validation test

The following table summarizes the Monte Carlo simulation results for the performance of the cross-validation test under Kmenta (1986) assumptions, for a finite sample similar in size to the thesis sample.

σ_1	σ_2	Expectation	Results (10 loops)		Comments
			X_2 best	X_3 best	
10	10	Do not reject the null	5	2	Over-rejects. It should not be rejecting the null hypothesis more than once in this setting.
10	11	Reject in favor of X_2	4	2	Does not show enough power. It should reject 9/10 times. It rejects twice in the wrong direction.
10	12	Reject in favor of X_2	6	1	Does not show enough power. It should reject 9/10 times. It rejects once in the wrong direction.
10	13	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance
10	14	Reject in favor of X_2	9	1	Rejects the null at conventional level of significance. It rejects once in the wrong direction.
10	15	Reject in favor of X_2	9	0	Rejects the null at conventional level of significance.
10	16	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance
10	17	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance
10	18	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance
10	19	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance
10	20	Reject in favor of X_2	10	0	Rejects the null at conventional level of significance.

Conclusion

The Monte-Carlo simulation reveals that the cross-validation test has adequate power in panel data conditions. However, this test tends to over-reject the null hypothesis in situation when it should not be. Also, this test sometimes rejects the null in the wrong direction, when known differences in explanatory power are known to be small.