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THE VALUE-RELEVANCE OF ASSET WRITE-DOWN REGULATIONS IN CHINA: THE ROLES OF INFORMATION RELEVANCE AND MEASUREMENT RELIABILITY

by

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ABSTRACT

The Value-relevance of Asset Write-down Regulations in China:
The Roles of Information Relevance and Measurement Reliability

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At the end of the 20th century and beginning of the 21st century, China implemented several new asset write-down regulations. This study addresses the claim that these regulations significantly enhanced the usefulness of financial statements for investors in China. The effect of the regulations on usefulness of financial statements has implications for financial accountants, standard-setters, educators, and auditors. This study derives and tests some of the empirical implications of the claim.

I operationalize usefulness of accounting information in terms of the value-relevance framework, in which information usefulness is construed as a tradeoff between relevance and reliability. These two dimensions are the primary criteria underlying the FASB's Conceptual Framework for choosing alternative accounting rules. Asset write-down, if correctly applied to over-stated assets, should increase the decision relevance to investors; however, measurement errors due to either unintentional mistakes involving professional judgment or intentional misrepresentations involving earnings management may decrease the reliability of reported amounts. While there is substantial value-relevance research, the role of reliability is generally absent. Reliability of regression estimates, also known as measurement error, is often implicitly assumed and not measured. Following non-nested model selection techniques and relative measurement error research, I explicitly measure the relative reliability of asset write-down accounting in various valuation models. Therefore, this study contributes to value-relevance research.

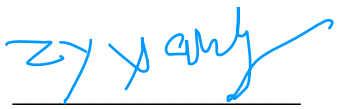
First, I examine the incremental value relevance of asset write-down estimates through their associations with market values: the ability of asset write-down provisions to explain market value of equity; the ability of asset write-down gains

and losses to explain annual market-adjusted return; and the ability of both the above provisions and earnings to explain market value of equity. All the models provide evidence for value relevance of asset write-down estimates, indicating an acceptable level of information usefulness with mixed effects of relevance and reliability. I apply my tests to a balanced panel sample of exchange-listed firms in China over the period 1998-2001. The sample is limited to A shares—the shares subject to the new rules.

Next, the above three valuation models are applied again in a reliability analysis. Model appropriateness tests, i.e. non-nested model tests, are used to answer the question: did asset write-down practices improve reliability in the valuation models? I find that the asset write-down practices are approximately comparable in reliability to historical cost methods in the balance sheet valuation model but somewhat less reliable in the income statement valuation model. The results are ambiguous when both assets and earnings are included in a third valuation model. My relative measurement error tests yield similar results. I conclude that the asset write-down regulations in China have not improved the usefulness of financial statements to investors in terms of reliability.

Because the asset write-down rules are subject to interpretation and judgment, I consider the motivation for write-downs in the final part of the study. The results support a relation between discretionary motivations and the amount of current or cumulative write down. A sub-sample analysis shows that asset write-down rules improve usefulness of financial information in the absence of discretionary motivations.

I declare that this thesis 《The Value-relevance of Asset Write-down Regulations in China: The Roles of Information Relevance and Measurement Reliability》 is the product of my own research and has not been published in any other publications.



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1. Introduction

1.1. Motivations

The accounting system in China has experienced some major changes during the past several years. The market experienced a rapid inflow of new accounting standards, initiated by promulgation of *the accounting regulation for listed companies* in 1998. The implementation of the new *accounting regulation* in 2001 further extended provisions on asset write-down. The rapidity of introduction of these standards and the wide-ranging effect of some of them (especially those related to asset write-down) constitute an accounting reform. My motivation stems from the current debate among standard setters, managers, investors and academic researchers about the effectiveness of asset write-down regulations in improving the usefulness of accounting information. The government believes that the new regulations enhance the truthfulness of reported accounting numbers. However, there appears to be a wide divergence of opinions among professionals and academics. The disagreements mainly focus on asset write-down regulations. This is not surprising given that asset valuation is one of the most contentious issues in accounting. In particular, those who favor this reform claim that it "squeezed the water out of the financial statement" and "obviously improved the quality of accounting information"; while those who are pessimistic about the reform consider it a costless earnings management opportunity. Occasional comments in Chinese professional articles have revealed some pros and cons of the accounting reform, but the evidence presented is not quantitative and the results are not conclusive. The validity of all these claims is subject to empirical scrutiny, and empirical results may resolve issues that otherwise could hinder further development of accounting regulation in China. The potential

implications for a wide range of financial information users have provided incentives for this study.

Consistent with Barth, Beaver and Landsman (2001, hereafter BBL 2001), the usefulness of accounting information is defined in terms of value-relevance. Under this view, accounting information is measured in valuation models and value-relevance is assessed by its ability to be captured or summarized in share values.[1] Relevance and reliability are primary aspects of value-relevance: information is relevant if it supports investment decision-making and information is reliable if it is precise and unbiased; tradeoffs between relevance and reliability are important for investors in judging firms' expected values.

Asset write-down, under various "lower of cost or market" rules, has been practiced for decades in the U.S. market, thus research in this area has focused on decision-making issues rather than value-relevance issues. Because asset write-down has not been addressed by Chinese accounting standards until very recently, whether the new convention succeeds or fails to provide more relevant and reliable information to investors is an important issue. Therefore, the accounting reform in China provides a good opportunity to test the usefulness of asset write-down information, as well as the relevance-reliability tradeoffs—issues that few papers have investigated before. Evidence on any increase or decrease in the usefulness due to these accounting regulations also has important implications for future regulations. Hence, research in this area can make both theoretical and practical contributions.

[1] For example, value-relevant earnings per share data will be reflected in share prices. Many value-relevance studies construct models to capture the relations between equity market values and recognized (disclosed) accounting information. Some studies test whether the coefficients on accounting numbers are significantly different from zero, with the predicted sign; some studies test whether the coefficients are significantly different from the theoretically predicted values; other studies focus on the magnitude of differences among estimated coefficients.

1.2. Objectives

This paper seeks to examine empirically some value-relevance issues of the recently issued asset write-down regulations in China. A broad sample of the exchange-listed companies will be involved. The first objective of this study is to answer the question: is asset write-down value-relevant? Associations between asset write-down information and equity market values will be identified. However, increases in value-relevance do not necessarily mean that asset write-down practice has increased the reliability of reported accounting numbers. Therefore, the second objective is to test the reliability of asset write-down estimates through various valuation models. The third objective is to uncover motivations behind asset write-down decisions, given the fact that asset write-down practice could be the result of either asset impairment or discretionary considerations. In addition, this paper will discuss some emerging econometrics methods in accounting research.

2. Institutional Background

2.1 Stock Markets in China

The government of China organized the Chinese stock market as an initial vehicle to convert the socialist planned economy into a market economy. Since the establishment of stock exchanges in Shanghai and Shenzhen in 1990 and 1991 respectively, the capital market has grown very rapidly. The Chinese stock market has its distinguishing features. First, the market is geographically diversified. The Shanghai Stock Exchange and the Shenzhen Stock Exchange operate independently from each other in two different cities and have their own indexes. However, both

exchanges are subject to the Chinese Securities Regulatory Commission (CSRC), and, more importantly, have almost identical is trading rules or trading costs. Therefore, like previous research, I treat these two stock markets as an integrated market. Second, the Chinese stock market offers a variety of securities with orientations to different investors. For example, Chinese companies can issue A-shares, B-shares, and H-shares, all of which have same rights and obligations but different buyers, trading locations and pricing currencies. Particularly, A-shares are issued to domestic investors and traded domestically in RMB (Renminbi or ¥); B-shares are issued to foreign investors and traded domestically in US dollars (Shanghai Stock Exchange) and HK dollars (Shenzhen Stock Exchange); H-shares are issued to foreign investors and traded only in Hong Kong (HKEx).[2] Third, the stock market has its specific trading rules. 31 December is the statutory fiscal year-end and all financial statements are required to be published within 4 months after the fiscal year-end.[3] The exchanges formerly employed a "T+0" trading method, allowing investors to buy and sell the same shares in a day, and there was no limit on share price fluctuation. Under these rules, the market experienced high volatility in its early stages. Later, the CSRC implemented a "T+1" trading rule and a 10 percent fluctuation limit, aimed at stabilizing the market. Nevertheless, the market is still in its infancy and is politically oriented, resulting in unexpectedly sharp rises and falls.[4]

Most of the listed companies are state-owned. A number of papers document overestimation of net assets in these state-owned companies. Aharony et al. (2000) attribute this kind of overestimation to financial packaging in the initial public

[2] A few Chinese companies are listed in the U.S. now. However, they haven't issued any A-shares yet so I do not include them in my research sample.

[3] Late publication of the annual report is allowed only in specific circumstances, which is rare.

[4] This may help to explain the relatively low levels of value-relevance of accounting information reported in prior Chinese market research.

offering (IPO) period. They report a significant decline in return on assets (ROA) from pre-IPO (protected environment) to post-IPO (unprotected, or competitive, environment). They conclude that the decline in ROA should be imputed to financial packaging—the overestimation of net assets—during the period of IPO. Lee and Cao (2002) suggest there is a strong incentive for managers to over-estimate net assets and earnings in China. They suggest that when state-owned enterprises in China face financial difficulties, one of the ways out of the difficulty is a capital infusion through public listing. But the quotas to be listed are limited. Therefore, companies must queue for listing, and the order is determined by provincial priorities, industry reputation, and most important, financial performance. The management may avail itself of asset over-valuation to win the listing quota.

Another result of vying for listing quotas is that some companies may not have enough time to be restructured to limited-liability companies.[5] Some listed companies share working places and even management with their mother companies, generating even more ambiguous ownership structures. In terms of share structure, traded shares often constitute only a small fraction of total shares, with the majority of non-outstanding shares held by state agencies, various institutions, and employees. All these are latent dangers to the further development of this market.

The CSRC, one of the authorities in the Chinese stock market, maintains the threshold requirements for IPO and stock re-issuance. For example, in the case of initial pubic offering, the regulation requires:

1. raised equity should attain RMB 50 million;

[5] For example, some restructuring activities include capital contribution, company securitization and separation of board and management roles.

2. the company is profitable for the three years prior to IPO, and return on equity (ROE) should equal or exceed 10% in the prior two years;

3. net tangible assets should be at least 35% of total tangible assets.

In the case of re-issuance, the company should attain an average 10% ROE for the prior three years, and at least 6% in each year. In order to protect investors, according to *The Listing Regulation for Shanghai and Shenzhen Stock Exchanges*, stock shares will be specially treated when a listed company experiences two consecutive annual net losses. These shares will be labeled "ST".[6] If loss continues in the next fiscal year, share trading will be suspended and the shares are only particularly transferred.[7] Such shares are labeled "PT". Otherwise, the "ST" label is removed in that year. The "PT" label will be followed by de-listing if the company has another consecutive annual loss.

The IPO regulations and listing rules depend on reliable accounting numbers. CSRC cannot prevent companies from generating unreliable accounting numbers. Unreliability may even be increased by the threshold accounting requirements.[8] The accounting reform is an attempt by regulators to address this problem.

2.2 Accounting Reform

The accounting regulation for listed companies (hereafter, AR1998) was issued in 1998 and is a starting point of the latest accounting reform. Actually, the Chinese accounting system has been continually updated, in step with the booming economy.

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[6] The special treatment includes, among other things, a 5% daily ceiling in price performance and an audited mid-year financial statement. Other situations that could incur "ST": (a) accounting fraud, (b) adverse audit opinion, and (c) net assets fall under the registered capital.

[7] Shares can only be traded on Friday with the assembly open price.

[8] Studies have documented that threshold requirements may become the motivations to conduct earnings manipulation (Burgstahler and Dichev 1997).

Before AR1998, listed companies were subject to numerous regulations and standards of accounting and finance, known as the "two regulations and two standards" system. AR1998 and its affiliated new accounting standards adapt International Accounting Standards (IAS) to the current condition of China, aiming at resolving the overestimation problem and improving the quality of accounting information. AR1998 introduced asset write-down rules. The rules are lower-of-cost-or-market (LCM) rules and not asset revaluation rules, i.e. revaluation downward is required and revaluation upward is not allowed. Although the government urged early adoption, listed companies were not immediately subject to these write-down regulations, except for companies with B or H shares. Most of the domestic A-share companies elected to wait until the issuance of documents No.35 and No.49 in 1999. These two documents mandated asset write-down for all the listed companies beginning in the year 1999. Asset write-down regulations were expanded in 2000. The new regulation, *The Accounting Regulation* (hereafter AR2001 because it is enforced in year 2001), extends the scope of write-down together with other conservative methods.[9] It also regulates accounting for related party transactions. These write-down rules may help in estimating the correct value of net assets.

2.3 Asset write-down regulations

AR1998 requires that four assets (accounts receivables, inventories, short-term and long-term investments) be assessed for impairment. It sets out factors to be considered at each balance sheet date that may indicate impairment. External indications of impairment include a decline in an asset's market value; significant adverse changes in the technological, market, economic or legal environment; and

[9] For example, organization costs must be expensed immediately rather than being capitalized.

increases in market interest rates. Internal indications may be evidence of obsolescence or physical damage of an asset; changes in the way an asset is used; and evidence from internal reporting that the economic performance of an asset is, or will be, worse than expected. If an indicator of impairment is present, these assets should be carried at the lower of historical cost or fair value (LCM) and losses are recognized in income. Different fair values are specified in AR1998, for example, fair value for accounts receivables and long-term investments is the recoverable amount, which is the higher of net selling price (NSP) and value in use (VIU); fair value for short-term investments is market value; and fair value for inventories is NSP. Specifically, write-down provisions are credited and expenses are debited, and the provisions offset the original assets. The expense from accounts receivables provisions and inventories provisions is carried into operating income and the expense from the other two provisions is carried into non-operating income. Application of the write-down regulations in AR1998 was optional for A-share companies in 1998. It became mandatory for all listed companies in 1999. The initial regulations, however, confused many accountants as to how to deal with the impairment losses. A direct charge to current profits was preferred; but some argued that the impairment could have occurred in prior years so the related loss should be charged to accumulated, rather than current profits. Both methods are allowed in 1998. The follow-up regulations, especially documents No.35 and No.49, gave companies the option of a one-time-only charge to accumulated profits in the first year of adoption, i.e. 1999. After adoption, the amounts of provisions are either recognized or disclosed in the balance sheets and the amounts of losses are recognized in the income statements.

Listed companies were asked to provide another four write-down provisions in AR2001 with effect from 2001, namely fixed assets, construction in progress, intangible assets, and commission loans. These four assets are less likely to have market values, rendering impairment assessment more difficult.[10] In particular, commission loans were rarely recognized by companies in their accounts, let alone being subject to loss provisions.[11] Again, the listed companies had the one-time option of charging the losses related to these four assets to accumulated profits rather than to current profits. Write-down losses are not tax deductible except for bad debt allowance. Table 1 summarizes the asset write-down requirements.

[Table 1here]

IAS 36 articulates the impairment of assets. It requires that all assets are subject to the impairment rules of IAS 36 except inventories, construction contract assets, deferred tax assets, financial assets and employee benefit assets. It sets out factors to be considered which may indicate impairment, and its content is much richer than that in AR1998 or AR 2001. In order to operationalize the concept of VIU, IAS 36 defines the concept of cash-generating unit (CGU). When cash flows are not readily identifiable as being specific to a particular asset, the smallest group of related assets should be identified. A CGU generates cash inflows that are largely independent of

[10] Because of this difficulty, the regulation specifies recoverable amount as fair value, but recoverable amount may also be difficult to estimate for these assets.

[11] Commission loans are loans entrusted by the Chinese listed companies to investment companies in the expectation of good returns in the stock market. Theses loans were classified as short-term or long-term investments, depending on the terms. Commission loans emerged in China several years ago when listed companies over-raised funds in the capital market and the stock market was prosperous. Aggressive companies lent idle money to other companies, usually investment companies, to earn promised lucrative returns, which were often realized in the bull market of the period, and became profits to the listed companies. However, China experienced a bear market, and many investment companies suffered heavy losses. The promised return was gone and sometimes the principal was impaired. Despite that, this practice still exists. It is obviously against the interest of minority shareholders if the commission loans are not disclosed clearly and separately in the balance sheet. The CSRC uncovered the situation and required independent disclosure and write-down of commission loans.

the cash inflows from other assets or group of assets. The CGU is a reasonable basis for write-down of goodwill and head office assets and is likely to be incorporated in future write-down regulations in China.

2.4 Sources of noise in asset write-down and related gains and losses

Some observers have expressed concerns about the rapid implementation of asset write-down regulations, claiming that write-down provides an opportunity for earnings management.[12] Healy and Whalen (1999) define earnings management as a situation in which managers use judgment in financial reporting and in structuring transactions to alter financial reports either to mislead some shareholders about the underlying economic performance of the company or to influence contractual outcomes that depend on reported accounting numbers. The asset write-down process involves discretion, both in identification and quantification. Moreover, write-downs and related gains and losses will alter the balance sheet and income statement directly. The possibility of earnings management, therefore, does exist. Earnings management, if it does occur, introduces noise in the accounting signals.

A variety of factors contribute noise to write-down estimations. One of the motivations of earnings management is meeting simple benchmarks such as avoiding losses, reporting increases in profits, and meeting analysts' expectations. However, the last benchmark actually applies only to a small proportion of listed companies in China.[13] The only benchmarks that matter to all listed companies are avoiding losses or reporting growths. Two kinds of earnings manipulation can be observed in the

[12] *China Securities,* one of the leading finance newspapers in China, has published many articles on related topics. For example, *Four assets write-down, not enough yet* (04/08/2000) and *Talk about annual reports: asset write-down is the key to earnings* (30/03/2001).

[13] Because the Chinese market has relatively few analysts, there are not many earning forecasts for listed companies.

Chinese market—big bath and minimum profit. A firm that experiences losses in two successive fiscal years incurs trading and reporting restrictions imposed by the CSRC. Maximum daily stock price change is reduced from 10 percent to 5 percent, and the firm must submit an audited mid-year financial statement. If the firm cannot turn "green" (profitable) in the third year, it will incur further restrictions, such as Friday-only trading. Both restrictions increase the visibility of these firms and reduce their attractiveness to investors, a situation that managers would like to avoid. The big bath can be used to shift losses for two years to losses in one year, thereby avoiding an "ST" or "PT" punishment.[14] The alternative, and more conservative, method is maintenance of marginal profit every year, thereby avoiding the CSRC watch list. The latter strategy becomes more imperative if the firm has experienced two consecutive net loss years. Because the regulations do not formally distinguish size of loss, only the continuation of losses, it would appear that the big bath strategy is preferable. Informally, however, a very large loss will attract market attention with possible political costs and a change in management.[15]

Anecdotal evidence suggests that there are strong incentives to manipulate earnings by manipulating the asset write-down provisions and the related gains and losses. The cost is low for two reasons. First, the write-down regulation is a new regulation to both accountants and auditors. Public accountants may lack sufficient experience in assessing impairment in this early implementation period. Most of the assets subject to impairment do not have ready market prices and fair values must be estimated. VIU estimation involves assumptions and forecasts. Moreover, unlike

[14] For example, taking a big bath in the first loss year increases the possibility of a profit rebound next year, thus avoiding "ST" status. Taking a big bath in the second loss year, although not avoiding "ST" status, could help to avoid falling into "PT" status in the third year.

[15] However, the new regulation was a good excuse to take a big bath, which alleviates the political cost greatly.

other accounts, auditors do not have comparative data on past write-downs. Second, the regulation offers choices to managers, who, in provisions for bad debts, can choose among different estimation methods and different write-down percentages. Finally, the regulation does not mandate detailed disclosure of the write-down.[16] These factors reduce the cost of manipulation. Unsophisticated investors may overlook provision percentages, offset of provisions, and asset swaps.[17] Some firms have been able to achieve amazing paper profits under the regulation.[18]

On the other hand, the monitoring mechanism in the China stock market is still primitive and flawed (Chen et al. 2002). Despite the engagement of the CSRC, investors remain critical of accounting reform. Auditor independence is impaired because of weak corporate governance and rampant intervention by the government, with the result that intended reforms often lead to unintended consequences (Lee and Cao 2002). Despite expansions and mergers among local accounting firms in China, audit quality has been little improved. The monitoring mechanism is further impaired because the majority shareholders can withhold important information.

This paper reports empirical tests of predictions of the value-relevance of the mandated asset write-down. Measuring the noise in the write-down amounts is a key issue in this paper. Identifying sources of measurement noise will help strengthen the conclusions in this paper. Both results could inform regulators about possible

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[16] AR2001 requires a separate schedule showing write-downs, but not all listed companies prepared such a schedule.

[17] Some listed companies swap assets, mainly with their related companies or mother companies. The swap may be the most efficient way to generate profit in China. The swap works this way: a deeply impaired asset is traded as if no impairment has ever occurred; the write-down provisions are then taken back, increasing the current earnings. The "profit" generated by a swap is against the regulation. Without sufficient disclosure of the write-down provisions, it is hard to trace the source of the profits.

[18] By an asset swap and writing back the provision made in the prior year, ST Shenxinkai, a listed company in China, increased its profits by 2200 percent in fiscal year 2001.

problems of their existing write-down policies, and further, give relief to auditors who are bearing increasing risks nowadays.

3. Literature Review

3.1. The value-relevance research

Reflecting in part the wealth of valuation models, there are many studies on the empirical relation between stock market values (or changes in values) and particular accounting numbers. One purpose of this research is to assess, or provide a basis for assessing, usefulness of those numbers in an accounting standard. [19] With comprehensive analyses of relations between write-down numbers and market values, this study contributes to a line of research that has been called the "value-relevance" literature (Holthausen and Watts 2001, here after HW2001). Three categories of value-relevance research may be identified: relative association studies, incremental association studies, and marginal information content studies. The first two categories are called association studies. The relative and incremental studies both capture associations between stock market values and accounting numbers over relative long windows. The only difference between these two types of studies is that the degree of association is compared relatively between alternative bottom line measures in the relative studies and incrementally among different independent variables in the incremental ones. The third category typically includes event studies using a short window to determine if the release of an accounting number is associated with value changes. Despite its popularity, HW2001 criticize the

[19] There are papers addressing the value-relevance of accounting information without regard to standard setting. For example, the information content research and earnings response coefficient research (Kothari 2001).

usefulness of value-relevance research in standard setting. They conclude that the association criterion is not theoretically rigorous and that the models used in the literature are not well-specified. BBL2001, on the other hand, support the usefulness of value-relevance research in standard setting. The opposing views are not necessarily mutually exclusive. As value-relevance research develops, it is more firmly grounded in theory, and the models employed are better specified. Thus value-relevance research may become more important to standard setting.

3.1.1. Value-relevance research over long-term periods

This area of research examines the time-series behavior of the value-relevance of accounting numbers. A large sample of companies and a long time period are often employed in this kind of research in order to abstract from transitory and individual firm effects. Ely and Waymire (1999) examine earnings' value-relevance under different accounting regimes, namely, CAP (Committee on Accounting), APB (Accounting Principles Board), and FASB (Financial Accounting Standards Board). They examine earnings for yearly samples of NYSE common stocks during 1927-1993 and point out that earnings' value-relevance varies when the accounting regime changes. They measure value-relevance by adjusted R-squares of a cross-sectional regression model of 16-month market-adjusted returns on annual earnings change and level. However, their argument is weakened by a research design that does not permit causal inferences. They do suggest additional research to examine the impact of specific standards on value-relevance of accounting data.

In another paper, Francis and Schipper (1999) investigate the claim that financial accounting information has become less value-relevant over time, specifically over the period 1952-94. They test value-relevance using two measures:

the ability of earnings to explain annual market-adjusted returns and the ability of earnings and book values of assets and liabilities to explain market values of equity. They argue that if value-relevance of financial statement information has declined over time, they should expect to observe a decline in earnings' ability to explain the cross-sectional variation in security returns. Similarly, they expect that, if value-relevance of balance sheet information has declined over time, the ability of these variables to explain market equity values will also decline. The results show that the explanatory power of the book value of equity increased, while that of earnings decreased, during the test periods. Their paper provides measures of value-relevance for both balance sheet and income statement numbers.

There are a few papers that focus on value-relevance issues in the Chinese capital market, such as Chen, Chen, and Su (2001a). They find that accounting information is value-relevant both in price models and income statement models in the period 1992 to 1998. Chen, Chen, and Su (2001b), investigate the institutional setting in China. They find that modified opinions of independent auditors are related with earnings management for meeting the regulatory profitability requirements. Similarly, Lee and Cao (2002) investigate earnings in China and conclude that value-relevant accounting information is related to regulations. All the evidence shows that despite the primitive setting in Chinese capital market, accounting information is value-relevant to some degree.

3.1.2. Fair value accounting research

Another kind of value-relevant research—fair value accounting research—is a primary focus of the FASB and IASB (International Accounting Standards Board). Advocates of fair value accounting believe that it provides more relevant measures of

assets, liabilities and earnings than historical cost accounting (Barth 1994). Fair value accounting involves the recognition or disclosure of current costs or market values of assets and liabilities, as well as earnings derived from fair values. Numerous standards have focused on fair value accounting issues over the past decades.[20] I summarize this sort of value-relevance research here because fair value accounting and LCM accounting are related. Both are mandated by standards, and both provide, in effect, a book value and a fair value.[21] BBL2001 classify several sets of fair value accounting studies.

One set of studies focuses on pension and other postretirement obligations (OPEB). A fundamental question relating to pensions and OPEB is whether pension assets and liabilities and OPEB liabilities are perceived by investors as assets and liabilities of the firm.[22] Findings suggest that these assets and liabilities are perceived by investors as assets and liabilities of the firm but with reduced reliability, causing smaller pricing multiples (Amir 1993, Barth 1991, Barth, Beaver and Landsman 1992).

Another set of studies addresses questions relating to fair values of debt and equity securities. Barth (1994) investigates how disclosed fair value estimates of banks' investment securities and gains and losses based on those estimates are reflected in share prices in comparison with historical costs. She tests the incremental explanatory power of disclosed fair value estimates and gains/losses by adding these

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[20] Great effort has been put on financial instruments, e.g. SFAS Nos. 105, 107, 114, 115, 118, 119, 125, 133, and 138, and Preliminary Views, 1999; IAS Nos. 32 and 39 are among the longest of the international accounting standards.

[21] The accounting reform in China follows the lower of cost or market model rather than fair value accounting. That is, it is more conservative than that of the FASB and IASB and prohibits upward revaluation of assets. Fair values in China are disclosed only if they are lower than book values.

[22] A positive (negative) relation should exist between assets (liabilities) and share prices.

to the balance sheet and income statement models respectively. A coefficient significantly different from zero implies value-relevance. The findings indicate that fair values have explanatory power beyond historical cost, and are robust to several alternative specifications. The relevance of fair value gains and losses differ with different specifications, which implies they are estimated with sufficient error to make value-relevance difficult to establish. Furthermore, Barth discusses the reliability of fair value amounts in several aspects, thereby providing a basis for the measurement error research that I review next. Another paper in this set is Barth, Beaver and Landsman (1996). It provides evidence that fair value estimates of loans, securities and long-term debt disclosed under SFAS No.107 provide significant explanatory power for bank share prices beyond that provided by related book values.

Other studies question the reliability of some fair values, such as those for non-financial intangible assets, derivatives and tangible long-lived assets. A fundamental question these studies address is whether these fair value estimates are reliable. These studies do not consistently find significant value-relevance for fair values. For example, estimates for intangible assets have a significantly positive relation with share prices and this finding holds for a variety of revalued intangible assets and brands (Aboody and Lev 1998, Eccher, Ramesh, and Thiagarajan, 1996), while studies generally fail to find value-relevance for tangible long-lived assets or derivatives (Beaver and Ryan 1985). The finding is usually attributed to biased and unbiased measurement error, where management discretion introduces biased error.

3.2. Reliability and the measurement error research

As I noted in section 3.1.2, although the reliability of fair value numbers is often questioned, a significant incremental association, reflected in a significant coefficient

on fair value accounting data, is found in most of the papers and interpreted as evidence that the accounting number meets the FASB's two prime criteria of relevance and reliability (HW2001). The FASB's Conceptual Framework is set forth in Statements of Financial Accounting Concepts (SFAC) Nos. 1 through 7, which articulate FASB's objectives and criteria in its standard setting decisions. Under SFAC No. 5, an accounting amount is relevant if it is capable of making a difference to financial statement users' decisions; an accounting amount is reliable if it represents what it purports to represent. The accounting amount has a predicted significant relation with share prices only if the amount reflects information that is relevant to investors in valuing the firm and is measured reliably enough to be reflected in share prices. However, results for relevance and reliability are mixed in the incremental value-relevance research. Increased relevance can offset decreased reliability so that the final result is value-relevant. Assuming that an accounting regulation mandates relevant information, reliability becomes a more important issue. For example, both cash flows and earrings are relevant in the decision-making process, and both show value-relevance in the empirical research. However, reliability may well be different for these two measurements, resulting in different levels of observed effect in valuation models.

Recent years have seen emerging studies on reliability. Managements responsible for preparing financial statements have better information than auditors and investors and have an incentive to misrepresent due to, for example, the compensation problem. The reliability studies suggest that management discretion (biased measurement error) and unbiased estimation error—together known as measurement error—play an important role in reducing information usefulness. The measurement error interpretation is especially important to the fair value accounting

debate because critics of the method cite the questionable reliability of fair value estimates as a major reason against using fair value accounting (Barth 1994).

Though some papers attribute insignificant value-relevance to measurement error, they neither quantify the error nor demonstrate the way error affects value-relevance. Measurement error research is an emerging topic (Barth 1991, 1994, Choi et al. 1997, Boone 2002). These studies are based on 1970's econometrics research and attempt to use measurement errors to explain the quality of accounting information. The main idea of measurement error research is that, assuming efficient markets, errors and biases will be reflected in the value-relevance of accounting numbers. For example, if all the accounting numbers are true and unbiased, according to the measurement perspective, they should fit the theoretical models perfectly and have a zero estimated intercept, a theoretically correct estimated slope coefficient, and a zero residual. Actually, accounting numbers have measurement error, and thus the estimated regression model has observed error terms and coefficients that differ from those predicted. The magnitude and sign of the bias is dependent on the correlation structure among the true values of the independent variables and the measurement error (Barth 1991).

One group of papers attempts to quantify and compare the specific errors in balance sheet accounting numbers. I call this measurement error research. This research is distinguished by its "one to one" assumption that one dollar of assets should be priced at one dollar if measured correctly. Barth (1991) investigates measures of pension assets and liabilities disclosed under SFAS 87 to determine which most closely reflect intrinsic values that investors implicitly assign. Measurement errors are investigated through their variances, which are estimated and

further evaluated with chi-square tests in her 1991 paper.[23] The larger the variance is, the bigger the measurement error is. The fair value of plan assets is found to have less measurement error than that disclosed in SFAS 87 and the book value of pension assets. The results also indicate that accumulated benefit obligation exhibits the least measurement error. The study has policy implications for SFAS 87 and is consistent with investors viewing the compromises made in SFAS 87 as rendering the amounts to be recognized less relevant and reliable than disclosed measures. Choi et al. (1997) extend Barth's setting and measure the "noise ratio," defined as the ratio of measurement error variance to the total variance of the accounting measure. Balance sheet items with large noise ratios are interpreted as lacking reliability. Boone (2002) further compares measurement errors in the oil and gas assets and finds that that measurement error in present value measure is on average less than that in the historical cost measure. Plausible assumptions are made under which he estimates the variance of measurement error in a way different from the Barth's approach.

There are limitations to these results. First, the analysis is confined to the balance sheet model, in which the theoretical coefficient for book value of an asset should be one. But the balance sheet does not report all net assets. Internally generated goodwill is specifically excluded from recognition in the accounts. The effect is one of omitted variables. This effect is known to cause bias in coefficients of included variables. Second, the studies require homogenous settings in their sample, with observations of similar size and from the same industry. The results may not be generalizable to a more heterogeneous setting.

[23] Barth (1991) mentions the Gallant and Jorgenson (1979) chi-square statistic, which is used to test significance of the restrictions that measurement error variances are equal.

The other school of research uses more general methods to test measurement error. The non-nested model selection technique is employed. Dechow (1994) uses the income statement model to investigate the relative value-relevance of earnings and cash flows, where value is measured by stock returns. By using the non-nested model selection test of Vuong (1989), Dechow finds that residuals of the operating cash flow regression are larger in magnitude than those from the earnings regression. Since only one independent variable is employed each time, the regression's residual error can be attributed to the measurement error in that independent variable. Hence, earnings appear to be more reliable than operating cash flows. Conditional on value relevance, this kind of model appropriateness test is accepted in the current value-relevance studies as a way of analyzing measurement error. Jennings et al. (1998) investigates the effects of corporate restructurings on the usefulness of the balance sheet model. By using the Vuong test, they find more useful (reliable) information in the book values with restructuring adjustments than that without.

The non-nested model methods are not flawless. If relevance varies across valuation models, a result attributed to reliability could be caused by changes in relevance. In multiple regression, residuals are determined by the fit of all independent variables. With several explanatory variables, the residuals cannot be attributed to measurement error of a particular independent variable.

3.3 Asset write-down and earnings management research

Many papers relate write-down issues with management opportunism. Rees et al. (1996) examine the extent to which discretionary write-offs are value-relevant rather than opportunistic. Unlike most prior studies, they do not equate earnings management with opportunistic behavior. Instead, they consider the possibility that

managers use this discretion to convey signals to investors. The authors find evidence that write-offs tend to occur contemporaneously with large income-decreasing operating accruals. Further, Rees et al. examine the relation between earnings and returns for their sample by regressing the return variable on earnings per share, abnormal operating accruals per share, and per share effect of asset write-down. The significantly positive coefficient on the abnormal operating accruals further strengthens the authors' assumption that these accruals are not opportunistic.

Elliott and Hanna (1996) use a comprehensive data set and innovative tests to document a decline in the information content of earnings for firms with multiple write-offs. They measure earnings information content in two ways: a nonparametric statistic to assess the abnormal price movement on the day of an information event, and an earnings response coefficient (ERC) test. The authors find that firms reporting a sequence of write-offs experience declining levels of earnings as the sequence lengthens. In other words, the poorer the performance is, the more frequently the firm writes off assets. The authors also find that information content of earnings declines for firms with frequent write-offs, as ERCs are lower when the frequency of write-offs increases.

Francis et al. (1996) provide evidence on the causes and shareholder wealth effects of discretionary asset write-offs. They suggest that the absence of explicit guidance for many asset write-offs permit substantial management discretion as to amount and timing of asset write-offs. In order to test their hypotheses, the authors investigate the extent to which proxies for management manipulations and proxies for asset impairments explain write-off decisions. Proxies for asset impairment include stock market return, book-to-market ratios and ROA. They also include variables to proxy for the historical performance of the firm's industry. Proxies for

manipulation include position changes in management, current year's earnings, and other measures.[24] A weighted tobit model is used to test the importance of the proxies on the asset write-off decision. They find that impairment proxies are significant in explaining asset write-offs, and the results are inconsistent with the predictions of big bath and incoming smoothing. An income statement model is employed to test shareholder wealth effects. The authors find significant negative reaction to the announcement of write-offs. They interpret this result as the investors' responses being driven more by impairment perspectives than by a future performance perspective.

Wilson (1996) suggests that future research should view write-off numbers as having three parts: a measurement construct component, a measurement error component, and a manipulation component. The first component is the unbiased amount assessed by experts, the second component captures the dispersion of these hypothetical measures from the consensus estimate, and the third component represents an intentional effort to misrepresent either for personal gain or for signaling. Obviously, measurement error research is prominent in the area of asset write-down.

[24] They claim that management takes write-offs in periods that they experience an unusual income increase. However, it is true that management also could shift future earnings into the current period.

4 Research Design

4.1. Value-relevance test

The empirical investigation of value-relevance reported here is based on three conventional cross-sectional models.[25] One is a balance sheet model in which I investigate the amount of write-down provisions; the second is an income statement model in which write-down gains and losses are investigated through their associations with capital market returns.[26] Both the balance sheet model and income statement model are derived from the so called "capitalization model".[27] Additionally, I use a hybrid "price" model, derived from the "Feltham-Ohlson" model, that incorporates both assets and earnings in one model.

4.1.1 Balance Sheet Model

The incremental explanatory power of write-down provisions is assessed by estimating the relation between the market value of equity and the book value of equity. I calculate the market value of equity from its share price, adjusting any re-issuance effects. The book value of equity is expressed as a combination of reported

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[25] Varieties of valuation models are discussed in Appendix A, part 1, where I discuss valuation theories and model interrelations.

[26] Researchers use numerous approaches to calculate the firm's intrinsic values (Kothari 2001). Two mainstreams of valuation research are the capitalization model and the residual income model. Two perspectives exist in the capitalization model—the balance sheet and the income statement. The balance sheet model measures firm value as the cumulative effect of past operating results. The income statement model measures firm value by earnings capitalization. This model focuses on the expectation of future operating results.

[27] As Easton and Harris (1991) point out, the income statement model is just a first-difference form of the capitalization model. Assume only earnings and dividends affect stock holder's equity, also known as the "clean surplus" condition. We can express the change of price P_t with the following equation: $\Delta P_t = \Delta Asset_t + \Delta Liability_t = \Delta Equity_t = E_t - d_t$, where assets, liabilities, and equity are measured on a per-share basis. Next, divide both sides by last year's price P_{t-1} and obtain the income statement model $Ret_t = (\Delta P_t + d_t)/P_{t-1} = E_t/P_{t-1}$. By the same token, another form of income statement model can be derived from the earnings capitalization model, expressed as $Ret_t = \Delta E_t/P_{t-1}$ (Note $P_t = E_t$ in earnings capitalization model). Both income statement models (level and change) are used in existing papers.

assets and liabilities, as well as balances on write-down provisions.[28] Annual and pooled linear regressions are developed. Because value-relevance of write-down estimates may differ across companies and years in my pooled regression, violating the homogeneity assumption of panel regression, I control both firm effects and year effects in the pooled regression.[29]

The estimation equation is:

$$MVE_{it} = \alpha_0 + \alpha_1 BVA0_{it} + \alpha_2 BVL_{it} + \alpha_3 BVAH_{it} + \alpha_4 PROV_{it} + \upsilon_{it} \qquad (1)$$

where i and t denote firms and years; MVE is market value of common equity three months after the fiscal year-end when most firms have published their financial statements; BVA_0 is book value of assets that are not affected by write-down regulations, namely, cash and cash receivable, prepayments and some other current and non-current assets; BVL is book value of liabilities; BVAC (not used in this equation) is book value of assets subject to write-down regulations as reported on the financial statement, while BVAH is the historical cost amount of those assets.[30] PROV is sum of write-down provisions. All variables are deflated by the number of common shares outstanding adjusted for stock splits and dividends to mitigate effects of heteroskedasticity. In the pooled regression, time and firm specific dummy variables are added to get a robust estimation, summarized in the constant term α_0 in equation (1). Incremental explanatory power of write-down provisions will be observed if the amount is a value-relevant asset.

[28] A similar balance sheet model can be found in, e.g., Landsman (1986).

[29] Known as fixed effect regression. Please see Appendix A, Part III, for a detailed discussion on methodologies of pooled sample regression.

[30] This number is not reported. It is computed by writing back the write-down provisions to BVAC.

A significant t-statistic on PROV in equation (1) will indicate that write-down provisions provide explanatory power incremental to historical costs (Barth, et al. 1996). Auditors tend towards revaluing impaired assets down to reflect the fair values if management fail to do so, lessening book value of equities. This reasoning suggests that the write-down provision will most likely have a negative association with market value of equity. One the other hand, write-down provisions are discretionary accruals through which managements convey information to outsiders. For example, managers could signify future profitability through intensified write-down activities before restructuring or after assigning new management, which could be treated positively by investors. Therefore, the coefficient on PROV could also be positive. Other asset variables are expected to attain positive coefficients and liability variables to be negative.

4.1.2 Income Statement Model

Analogously, gains and losses resulting from write-down activities are also investigated in one of the capitalization models, the income statement model. Reported earnings level, earnings change and write-down gains and losses are regressed on market returns. A 12-month holding return is calculated in this study. If the market is complete and perfect, the coefficient on permanent earnings would equal the reciprocal of the cost of capital, while those on transitory earnings would equal one.[31] The coefficient should equal zero when the amount is not treated as

[31] Miller and Modigliani (1966) only use earnings change as the dependant variable. Ohlson (1989) develops a model in which both earnings level and earnings change are relevant. Ohlson uses the symbol ρ to denote the identical theoretical coefficients for earnings level and earnings change, where ρ equals the reciprocal of the required return (ρ =1/r + 1), a constant coefficient across firms and time periods. Ohlson further shows that the theoretical coefficient for earnings change will be kρ while that for earnings level will be (1-k)ρ, k being the weight assigned between earnings change and level, if both level and change are used in the same equation. Easton and Harris (1991) report that, whereas in univariate regressions both level and change of earnings exhibit close relation with returns,

value-relevant (Easton 1999). Both earnings level and earnings change can explain market returns if earnings information is value-relevant. Existing papers use either one or both ones as explanatory variables.

The estimation equation is:

$$R_{it} = \beta_0 + \beta_1 E_{it}^h + \beta_2 \Delta E_{it}^h + \beta_3 WDGL_{it} + \nu_{it} \quad (2)$$

where i and t denote firms and years respectively; R is the 12-month stock return ending three months after fiscal year-end, absorbing most accounting information after companies releasing financial statements; E^h is current earnings before any asset write-down adjustments—current or retrospective; ΔE^h is the change in E^h; WDGL is write-down gains or losses, and equals the changes of write-down provisions after a retrospective adjustment.[32] All independent variables are deflated by the number of common shares outstanding adjusted for stock splits and dividends and by the last fiscal year's ending share prices.

Equation (2) permits assessing whether write-down gains and losses provide explanatory power in explaining stock returns beyond historical earnings and whether they are treated the same as ordinary gains and losses. If the WDGL are considered to be more subject to discretion, they should be less persistent and thus their coefficient, β_3, should be relatively smaller than that of earnings level or earnings change. Reducing assets causes losses and writing back provisions creates gains. Writing back is prohibited by regulations in China but some companies still achieve writing provisions back to equity indirectly, e.g. assets swap. On the whole, the WDGL should appear as a loss in the pooled sample and therefore β_3 should be

in multivariate regression earnings level seems to dominate the whole equation, although the effect of earnings change still exists.

[32] Taking back the write-down provisions may generate income when, for example, an asset swap takes place between related companies. Though Chinese GAAP prohibits this kind of profit generated from non-arm's length transactions, it is difficult to regulate.

negative in equation (2). Occasionally, managements write assets down to convey good news to investors, for example, excessive current year income. I do not exclude the possibility that investors treat these losses positively in valuing firms. Again, I control fixed effects in equation (2) when conducting pooled regressions.

4.1.3 Price Model

The price model examines the ability of write-down provisions and the related gains and losses to explain market equity values in one model. That is:

$$MVE_{it} = \gamma_0 + \gamma_1 BVEH_{it} + \gamma_2 PROV_{it} + \gamma_3 E_{it}^{h} + \gamma_4 WDGL_{it} + \omega_{it} \qquad (3)$$

where i and t denote firms and years; All the variables are described in equations (1) and (2) except BVEH, which is the book value of net assets prior to any write-down. I deflate all the variables in equation (3) with the adjusted outstanding shares and control the fixed effects in pooled regressions.

4.2. Reliability Test

As one of the criteria the FASB uses to choose accounting standards, reliability plays an important part in accounting research. Assume that the write-down provisions and the associated gains and losses are value-relevant in the research period. This does not necessarily imply that lower of cost or market accounting (LCM) is better for investors than historical cost accounting (HCA). LCM could have significantly lower reliability than HCA in that write-down estimations might be misrepresented intentionally or unintentionally. Reliable accounting numbers accurately reflect intrinsic values that market participants have assigned. Unreliable accounting numbers are evidenced by larger residuals in the valuation models, decreasing model explanatory power.

4.2.1. Non-nested Model Selection

Both balance sheet and income information are accessible and important to various market participants in valuing a firm. Therefore, three valuation models will be used to test the relative reliability, interpreted as model appropriateness in this section, of HCA and LCM conventions: the balance sheet model, the income statement model, and the price model.

Estimation equations for the balance sheet models are:

$$MVE_{it} = \phi_0 + \phi_1 BVA0_{it} + \phi_2 BVL_{it} + \phi_3 BVAH_{it} + \eta_{it} \quad (4)$$

$$MVE_{it} = \phi'_0 + \phi'_1 BVA0_{it} + \phi'_2 BVL_{it} + \phi'_3 BVAC_{it} + \eta'_{it} \quad (5)$$

where MVE, BVA_0, BVL and BVAH are defined in equation (1). BVAC is reported amount of assets that are subject to asset write-down regulations. Equation (4) is the balance sheet model under HCA and equation (5) is the same model yet under LCM. The only difference between these two equations is that equation (4) drops the provision item from equation (1) while equation (5) absorbs it into an independent variable BVAC.

Equations for the income statement models are:

$$R_{it} = \varphi_0 + \varphi_1 E^h_{it} + \varphi_2 \Delta E^h_{ig} + \mu_{it} \quad (6)$$

$$R_{it} = \varphi'_0 + \varphi_1' E^c_{it} + \varphi_2' \Delta E^c_{ig} + \mu'_{it} \quad (7)$$

where R, E^h and ΔE^h are defined in equation (2) and equation (3). E^c and ΔE^c are reported earnings level and earnings change under LCM. Therefore, equation (6) is a HCA model, while equation (7) is a LCM model.

Equations (8) and (9) are price models under HCA and LCM respectively:

$$MVE_{it} = \hbar_0 + \hbar_1 BVEH_{it} + \hbar_3 E_{it}^h + \varsigma_{it} \quad (8)$$

$$MVE_{it} = \hbar'_0 + \hbar'_1 BVEC_{it} + \hbar'_3 E_{it}^c + \varsigma'_{it} \quad (9)$$

Note that the only difference between the two accounting conventions, namely LCM and HCA, is the amount of asset write-down provisions or related gains and losses. Because both accounting information from LCM and HCA are relevant to investors, the more reliable these estimates are, the more appropriate the accounting convention will be. Therefore, one could argue that an inferior LCM model is due to unreliable write-down estimates.

Statistically, HCA and LCM models are non-nested. However, they are also not independent, because they share some values, i.e. some asset variable and liability variables. They are overlapping, non-nested models, and testing such models is difficult (see, e.g., Vuoug's (1989) discussion). Because of the shared variables, it is often very hard to discriminate between the models. Three approaches will be used in this study.

The first measure, adjusted R^2 comparison, is used extensively in prior papers. For example, Dechow (1994) tests whether realized cash flow has a higher association (R^2) with stock return than earnings, which is interpreted as more effectively summarizing firm performance. Similarly, adjusted R^2s are compared between HCA regressions and LCM regressions. The equation with a higher R^2 will be favored. This approach is reasonable for non-overlapping models using the same dependent variable.

The second measure uses the J test, described, e.g., in Greene (2003 154f), is based on the "encompassing principle". In test 1, let H_0 (the null) be that HCA is the correct model, and let H_1 (the alternative) be that LCM is the correct model. Obtain

the fitted values from the LCM model. Add these as independent variables in the (augmented) HCA model. If the coefficient on the fitted values in the HCA model is significant, H_0 can be rejected—that is, LCM has explanatory power beyond HCA. If the coefficient is insignificant, H_0 is accepted. Because definition of the hypotheses is arbitrary, the roles of HCA and LCM must be reversed for test 2. There are, in total, four possibilities for the J test. If both hypotheses are rejected, then neither model encompasses the other; if both hypotheses are accepted, then the data are not rich enough to distinguish the models; in the remaining two cases, one model or the other is superior, in the sense that it encompasses the other.

The third measure, derived from the likelihood ratio test, is the Cox test. The Cox test is described, e.g., in Greene (2003 155f). The Cox test is based on the assumption of normally distributed errors in the competing regression models. Although the procedure is similar to the J test, the Cox test examines the increase in error variance in the augmented models. Because of its distributional assumptions, the Cox test is likely to be more powerful than the J test. However, because errors are only asymptotically normal in the models of this paper, the test is also less robust. Details of the J and Cox tests are discussed in Appendix B.

4.2.2. Relative Measurement Error Research

Apart from a mixed effect of relevance and reliability, the J and Cox tests could suffer a mixed effect of measurement errors. It is apparent that all independent variables contain measurement errors, generating a residual in a regression. Conclusions of any decreases in reliability recorded in the J test or Cox test could be a result of an increased variance and covariance structure of measurement errors, rather than an increased measurement error brought by write-down practice. Relative measurement error research is an alternative in testing reliability. Only the semi-log

balance sheet model and the semi-log income statement model are employed in this section, and I give up the price model because of weak theoretical support. A more extensive discussion of relative measurement error research is given in Appendix C.

The balance sheet research is based on equations (4) and (5), the same equations as used for the model appropriateness tests. The main purpose here is to conclude whether LCM asset values contain less measurement error than HCA asset values, that is to say, whether BVAC contains smaller measurement error than that of BVAH, which is the only difference between equation (4) and equation (5). According to the relative measurement error research, measurement error in BVA_0 and BVL also contributes to regression residuals and coefficient biases, so residual comparison is not proper if more than one independent variables are involved. Following the econometric setting outlined in Barth (1991), Choi et al. (1997), and Boone (2002), I estimate the variances of measurement error, $\sigma^2 u_{mvah}$ (for BVAH) and $\sigma^2 u_{mvac}$ (for BVAC), from an errors-in-variables two-stage regression (Appendix equation A-28). A larger variance implies a larger measurement error. The variance comparison is made by an F test in the seemingly unrelated settings.

The two approaches employed in Barth (1991) and Boone (2002) have different assumptions regarding the variance and covariance structure, which is a critical issue in relative measurement error research. Boone (2002) argues that the covariances ignored by Barth (1991) in her computation might weaken her final conclusion. Boone (2002) specifies a compound statistical procedure beyond that of Barth's (Appendix equation A-33). However, the method illustrated in Barth (1991) is direct and easy to implement (Appendix equation A-31). I employ both tests in this study, which might generate conflicting results. Consistent results would add credibility to the conclusion.

Analogous to the balance sheet model, reported earnings also contain measurement error. I separate the earnings level (E) and earnings change (ΔE) from both equations (6) and (7) into independent regressors, keeping only one independent variable each time. Under this setting, the magnitude of measurement error relates directly to the regression residual. A non-nested test proposed by Vuong (1989), is used to assess the magnitude of regression residual for earnings level income statement models and earnings change income statement models under both HCA and LCM conventions. A positive z-statistic implies that the residuals produced by the earnings from LCM convention are larger in magnitude than those from HCA convention. Hence, a positive and significant z-statistic indicates that HCA convention has less measurement error in terms of earnings level or earnings change. I discuss the Vuong test in Appendix B.

4.3. Write-down Motivation Analysis

I characterize write-down provisions as discretionary because limited authoritative guidance provides management with substantial flexibility in determining amounts of current and accumulated write-down. On the other hand, assets are also written down for economic reasons, for example, a loss in value.

In exploring attributes of firms which affect the amount of write-downs, I identify both variables that capture impairment motivations and earnings manipulation motivations. All variables are calculated with no asset write-down effect, i.e. any present asset write-down provisions are added back to assets and related losses are added back to current earnings. A primary motive for asset write-down (and the objective of the regulations) is the impairment of assets. The first proxy for impairment is market-to-book ratio (MTB). MTB equals market value of

equity divided by book value of equity, each measured at the fiscal year-end. I expect that firms with a decreasing MTB ratio (negative ΔMTB) are more likely to recognize impairment losses because the market has devalued their net assets. As a result, firms with relatively low MTB ratios should tend to have larger write-down provisions for economic reasons. Similarly, I predict that the firms with a below industry-average return on assets ratio (IAROA) are more likely to experience decreasing asset efficiency, thus they are more likely to record asset write-down.

I also include variables to proxy for factors associated with managements' incentives to take different amounts of asset write-down. The first such variable is financial distress (FD). FD is a dummy variable, with a value of one for firms classified as "ST" or "PT". FD firms may be motivated either to avoid losses (no or limited impairment) or to take a big bath (excessive write-down) to avoid consecutive years of FD. Clearly, the amounts of current write-down are different for these two purposes. The second dummy variable is the auditor's opinion (AO). AO proxies credibility of the financial statements. Auditors normally assign one of five opinions in China: clean, clean with explanation, qualified, adverse, and disclaimer. The AO variable is zero for a clean opinion (includes clean with explanation) and one otherwise. Most commonly, firms receive a clean opinion. Any other opinion signals reduced confidence in the financial statements on the part of the auditor. A possible source for this reduced confidence is management's use of discretionary asset write-down. The third variable is current year's earnings performance. On the one hand, if management is compensated with earnings-based bonus plans, and if pre-write-down earnings are already short of target, management has an incentive to shift future write-downs into the current year to improve the chance for future bonuses. This is a one form of the big bath hypothesis. However, it is common in

China for management positions to be linked with an earnings-based benchmark, and gross shortfall of the benchmark may result in dismissal. Managers in such a position are motivated to avoid huge losses. Facing a large loss, they may try to shift current write-down to later periods. Facing an adequate profit, on the other hand, they may increase discretionary accruals. This is one form of the income-smoothing hypothesis. To capture these varied effects, I define separate dummy variables for each. I define earnings performance as abnormally good (GOOD) if industry-adjusted ROE is in the top 10 percentile, measured prior to any current write-down amounts. I define earnings performance as abnormally poor (POOR) if industry-adjusted ROE is in the bottom 10 Percentile. The last non-economic dummy variable is TURN, defined as the possibility to turn profitable by earnings manipulation. Companies with small losses in the range of zero to negative ¥0.1 per share are classified into this category.

Finally, I include a measure of firm size (SIZE), defined as the log of total assets per share preceding write-downs. I also include a measure of leverage (LEV), defined as total liabilities divided by total assets. Size and leverage of the firm are general control variables. I do not propose any a priori linkage between these variables and asset write-down, but it is reasonable to assume that the market could treat write-down differentially based on these fundamental financial characteristics.

The multivariate analysis is performed on the current write-down ratio (RDIFPROV), defined as the current write-down amount divided by the related assets subject to write-down (at unadjusted cost), and also on the accumulated write-down ratio (RPROV), defined as the write-down provision divided by the related assets subject to write-down. The regressions are:

$$\begin{aligned} RDIFPROV_{it} = {} & \phi_0 + \phi_1 FD_{it} + \phi_2 AO_{it} + \phi_3 SIZE_{it} + \phi_4 LEV_{it} + \phi_5 \Delta MTB_{it} \\ & + \phi_6 IAROA_{it} + \phi_7 GOOD + \phi_8 POOR_{it} + \phi_9 TURN_{it} + \xi_{it} \end{aligned} \quad (10)$$

$$RPROV_{it} = \varphi_0 + \varphi_1 FD_{it} + \varphi_2 AO_{it} + \varphi_3 SIZE_{it} + \varphi_4 LEV_{it} + \varphi_5 MTB_{it} + \varphi_6 IAROA_{it} + \varphi_7 GOOD + \varphi_8 POOR_{it} + \varphi_9 TURN_{it} + \varsigma_{it} \quad (11)$$

5. Sample Selection and Data Description

5.1. Sample Selection

The sample consists of firms listed on the Shanghai Exchange and Shenzhen Stock Exchange from 1998 to 2001—the period covering the accounting reform and the related asset write-down regulations.[33] Financial data and stock market data are mainly collected from the TEJ (Taiwan Economy Journal) database. Due to limitations in this database, additional data are collected from annual statements.

There are 851 listed companies in the whole market in 1998, and this number increased to 1160 at the end of 2001. Companies were not included in this research unless they met all the following criteria:

1. annual earnings, book value, and share information are available on the 2001 Taiwan Economic Journal Database, supplemented by official stock information obtained from the website of the CSRC;
2. firms issuing B or H shares are excluded, in order to remove the potential impact of foreign investors;
3. the firm is listed before 1997, in order to eliminate any IPO effect;[34]

[33] This four-year period also witnessed a prosperous economy in China. For example, the Shanghai stock market index increased from 1194 in January 1998 to 2230 in June 2001, which is also its historical high. After that, the market declined and the index has not reached this level again (as of early 2003).

[34] IPO packaging is particularly an issue in China, where the stock market is the most precious money resource (Aharony, et al. 2000)

4. firm financial and market data must be available for each year in the period.

[Table 2 here]

These filters produced a sample of 320 firms that survived through the 4-year period, forming a balanced panel of 1280 firm-year observations. Panel data make it possible to control for both cross-sectional and time-series effects, producing more reliable coefficient estimates.[35] Table 2 summarizes sample selection results. Panel A shows the relative scale of the selected sample by listed locations and share types. The sample consists of 31.6% of the existing firm-year observations. There are marginally more firms in Shanghai market than that in Shenzhen market, and cover percentages in both markets are similar. The sample also covers 36.3% of the A shares in the whole market. Panel B presents the sample firms by industry. 320 firms are categorized into 9 main industries according to GICS (Global Industry Classification Standard). The highest sample intensity is the consumer discretionary industry, constituting 25.3% of the sample. The financial industry takes up a percentage of 10.3%, all being real estate companies and not banks.

Table 3 presents evidence on industry differences in asset write-down practice. The number of industries is reduced to seven after merging some industries.[36] PROV is accumulated write-down ratio and equals the provision scaled by the related asset

[35] This is one of the many reasons that panel data models are popular in accounting research. A pooled regression in this study without any year or firm controls may not provide precise estimations, while a fixed effects or a random effects pooled regression may. The fixed effects regression model corrects the omitted variable problem in an uncontrolled regression by incorporating firm-specific and/or year-specific effects. The disadvantage of fixed effects regression is that the model contains a large number of constant terms. The random effects regression model disaggregates the random error term in an ordinary pooled regression into firm-specific and/or year-specific components thus avoiding numerous constant terms. The sample in this paper does not represent a random sample of listed firms, and, thus, a priori, I would expect the fixed effects to be more appropriate. Nevertheless, because the random effects model is more parsimonious, it was considered (and rejected) for this research (see Appendix A for details).

[36] I combine the energy industry with the basic material industry and the consumer staple industry with the consumer discretionary industry.

value before write-down. ΔPROV is current write-down amount scaled by the related asset value. Both PROV and ΔPROV are presented with their four-year-average values. Seven assets are displayed horizontally and eight industries vertically. Because asset write-down is not large relative to asset value, the mean and median ratios for both PROV and ΔPROV are small. Both means and medians for the accounts receivable provision (PROV1) are well over 1% for all industries except utilities and are much larger than those for intangible assets (PROV5), construction in progress (PROV6), and commission loans (PROV7), which are recently required in AR2001. The means and medians in ΔPROV have the same pattern. The summary column for PROV (TOTAL PROV) shows that industry 1 (Oil, Gas and Material) and industry 7 (Utilities) have relatively low accumulated write-down provision ratios. These two industries are characterized by higher quality (i.e. low risk) assets. Industry 5 (Financial), on the other hand, has relatively high ratios for PROV, which may be due to lower quality (i.e. higher risk) assets, such as investments in real estate development and consumer loans. The summary column for ΔPROV (TOTAL ΔPROV) shows that average current write-down ratio is high in industry 4 (Health Care) and industry 6 (Information Technology). It is possible that negative write-down amounts are offset by positive write-backs in industry 5 (Financial), because the current write-down ratio is lower than expected. This could indicate manipulation of the financial result. The last column presents mean total assets for these industries. Utility firms are relatively big (¥2697 million) while information technology firms are the smallest (¥999 million). The absolute amount of total assets probably suggests asset quality because utilities is the biggest, but least impaired, industry.

[Table 3 here]

5.2. Descriptive statistics

Descriptive statistics for the value-relevance regression variables are given in Table 4. To control for the effects of extreme values, each variable is ranked separately and winsorized by 1% on both ends. This maintains sample size while minimizing the impact of extreme values. Smaller variances are observed in the winsorized annual data descriptions (not reported in Table 4) with modest changes in mean values, which suggests that the influence of extreme values has been effectively reduced.[37] Both the original numbers and the winsorized numbers are reported in table 4. The following analysis is based on the winsorized data.

[Table 4 here]

The average per share market value of equity (MVE) is ¥10.92, with an annual mean standard deviation of ¥2.77. Investors obtained an average annual 25.2% total market return during this four-year period with an annual mean standard deviation of 43.7%. These two descriptions exhibit a quite unsettled market in China. For the balance sheet amounts, the asset write-down provision (PROV) achieves a mean of ¥0.176 per share with a standard deviation of ¥0.119, roughly a 4.9% reduction in the related assets.[38] The provision creates differences between HCA and LCM asset valuations. For the gain and loss amounts, the mean of annual earnings per share before asset write-down (E^h) is ¥0.110 and declines during the period, with the mean of average earning change (ΔE^h) being –¥0.025. The asset write-down practice results in a ¥0.025 per share loss (WDGL) and makes LCM earnings (E^c) lower than HCA earnings (E^h). However, there are write-down gains (WDGL) if managers

[37] The variances reported in Table 4 are variances of annual mean statistics and thus are not subject to the variance-minimizing effect of the winsorizing procedure.

[38] I record PROV in positive numbers.

revise their earlier estimations and take the provisions back. The result is that LCM could generate higher earnings. The deteriorating profitability of these firms further strengthens arguments that Chinese listed companies are "over-dressed" when initially listed.

6. Empirical Results

6.1. Explanatory power of write-down provisions and related gains and losses

Table 5 presents regression summary of equation (1). The balance sheet model is in semi-log form with equity market value (MVE) being in log form.[39] Panel A reports statistics from two fixed effects regressions. The first row reports results of the four-year fixed effects regression, including 1998, the voluntary write-down year. The adjusted R-square is 70.0% and all the coefficients estimated are significant at the 0.05 level except the coefficient on book value of liabilities (BVL). The coefficient for asset write-down provisions is –0.275 (t= -7.092) and much more significant than that for other assets. The three-year fixed effects regression results are reported below, where I drop the year 1998 to investigate the pure effect of mandatory write-down. The regression shows a 68.10% adjusted R-square, almost unchanged from the 4-year fixed effect model despite losing 320 observations. All the estimates are significant at the 0.05 level and the coefficient for asset write-down provisions is –0.214 (t= -4.426), which is the most significant. The evidence is clear that the asset write-down provision has incremental power in the balance sheet model. However, the coefficients for asset write-down provisions are much bigger than those for assets and liabilities, which is unexpected. Recalling that coefficients in the

[39] Semi-log transformation is used to counter the effect from model misspecification. All valuation models are in their semi-log forms in this study. Please see Appendix A, part 2 for details.

semi-log model are partial elasticities, the -0.275 coefficient on provisions in the four-year model means that a ¥1 per share increase in provisions reduces per share market equity by 27.5 percent. A similar increase in other liabilities reduces per share market equity by only 3.3 percent (8.0 percent in the three-year model).

[Table 5 here]

Panel B of Table 5 presents the annual regression estimates for equation (1). The explanatory power of the annual regressions is relatively low.[40] The adjusted R-square in the 1999 regression is only 1.5%. This may be a reflection of the uncertainty introduced by the onset of mandatory write-downs. There is an insignificantly positive coefficient, α_4, for PROV in 1998 while the coefficients subsequently turn negative. This suggests that some investors treated voluntary asset write-down as a good news signal—either of the quality of management or of the possibility for increased future earnings. α_4 turns negative in 1999 and becomes significantly negative thereafter. With fixed firms in my panel sample, the annual results for the coefficient on provisions suggest the possibility of some learning effect by investors or delayed market response. After four years of experience with the provisions, investors act as if they believe provisions are bad news.

The findings from Table 5 indicate that the write-down provisions are value-relevant to investors, and these provisions provide more information content to investors than other assets and liabilities. Value-relevance, however, does not imply more efficient pricing. Value-relevance could be achieved at the cost of decreased reliability. The result, therefore, should be treated as tentative.

[40] The lack of power of the annual regressions reflects the volatility of the Chinese market and the effects of accounting reforms during this period. The panel regression overcomes much of this volatility by estimating annual effects.

Table 6 presents regression summaries of equation (2), the semi-log form of income statement model. Panel A reports the estimates from fixed effects regressions and Panel B reports annual ones. First I report the four-year fixed effects regression. The adjusted R-square is 55.6%, which is quite powerful for an income statement model. Consistent with Easton et al. (1993), significantly positive coefficients are recorded on both earnings level (E^h) and earnings change ($\triangle E^h$) variables. However, the coefficient for write-down gains and losses (WDGL) is –0.420 (t= -0.819), which is not significant at the conventional level and suggests a transitory loss. The three-year fixed effect regression yields similar results except for a higher adjusted R-square and a significantly negative WDGL coefficient. The magnitude of the WDGL coefficient, however, is lower than that on earnings level. A possible explanation is that these write-down losses might not be as permanent as other gains or losses generated from operations and thus are capitalized at a lower rate. Generally speaking, the mandatory write-down regression yields evidence that WDGL is value-relevant in the income statement model.

[Table 6 here]

Panel B of Table 6 presents annual regression estimates for equation (2). The explanatory power of the annual regressions is relatively low compared with that in the fixed effect regressions, but is, even with fewer independent variables, somewhat better than those in the annual balance sheet model regressions, indicating the possibility that the Chinese equity market is more "earnings-driven" than "assets-driven". Earnings change variables are significant in 3 years while those for level are significant in 2 years. I record a significantly positive coefficient for WDGL in 1998 while all are negative in following periods, which suggests that some voluntary write-down practices are actually signals conveying good news to the investors. For

example, the management could demonstrate their conservatism to lenders by devaluing assets and reducing earnings. Together with the result from the balance sheet model, there is evidence that the market is rewarding the early adopters or equivalently, punishing firms who hide losses by not reporting asset impairments. The mandatory regulations, however, causes write-down practices to become routine and diminishes the signaling effect of WDGL, as we see from the increasing permanence in WDGL.

The findings from Table 6 indicate that write-down practice is value-relevant to investors in terms of its gains and losses, but the information content of write-downs is lower than that of HCA earnings. Again I find that the effect of voluntary write-down practice 1998 is different from that of mandatory write-down in later years, which is subject to less discretion. The noise in these gains and losses could lead them to be viewed as transitory, as can be observed from their small coefficients. Retrospective adjustments taken in 1999 and 2001 are especially likely to contain measurement error. Therefore, the unreliability of these write-down gains and losses could offset their relevance.

[Table 7 here]

Table 7 represents the regression results from the semi-log form of price model, which captures information from both balance sheets and income statements. Panel A reports the combined assets and earnings outcome in the fixed effects regressions. The explanatory power of the price model is higher than either the balance sheet model or the income statement model, related R-squares are 73.4% for the four-year regression and 70.8% for the three-year regression. Coefficients on earnings level (E^h) in both regressions are positive and the ones on write-down gains and losses (WDGL) are negative, with the latter variables being less significant. These results are similar

to those in income statement models. I am surprised in finding insignificant coefficients for book value of net asset (BVEH) and write-down provision (PROV) in these fixed effect regressions. Income statement information is clearly dominating balance sheet information in market valuation in China. Panel B of Table 7 shows that coefficients on earnings are all significant with the predicted signs, while the coefficients on provisions are insignificant or only marginally significant. The marginally significant coefficient is positive, implying an increase in market equity if provisions increase—a counter-intuitive result. A high level of provisions may have been associated with higher expected future return on assets. But the association is not too strong and did not persist in subsequent periods.

The price model tests give a weighted test for write-down provisions and related gains and losses together. The results show evidence that write-down gains and losses are incrementally value-relevant while the write-down provisions are insignificantly value-relevant. These results, however, do not suggest that the provisions are not value-relevant. Instead, it points up that the earnings information might be more important in the valuation processes.

In general, the results presented in 6.1 show evidence that asset write-down practice is value-relevant, providing incremental information beyond historical numbers. The voluntary write down imposes different effects on its value-relevance due to either learning effects or signal effects. However, it does not change the overall results when the observations are pooled. Finally, earnings have priority over assets in valuation processes. In the light of the relevance and reliability theory, asset write-down accounting, although relevant, could cause decreased reliability. The next part of paper is devoted to the reliability analysis.

6.2. The Reliability of Write-down Provisions and Related Gains and Losses

Table 8 reports comparative results based on three valuation models. All these tests are based on the semi-log fixed effects panel regressions. Panel A shows results from the balance sheet model. HCA model, equation (4) and LCM model, equation (5) are regressed independently. LCM model generates marginally higher adjusted R-squares in both fixed effects regressions, with the difference less than 1 percent. In the four-year regression, the J test rejects both null hypotheses in test 1 (t=5.978) and test 2 (t=-4.290), the Cox test rejects both also (t=-30.156 for test 1 and t=9.288 for test 2). However, test 1 generates more significant t values in both J and Cox tests, rejecting the null hypothesis that HCA is appropriate more strongly. The three-year regression shows similar ambiguous results (t=-15.451 for test 1 and t=5.134 for test 2) in the Cox test. The J test, however, rejects HCA but does not reject LCM (t=3.864 for test 1 and t=-1.916 for test 2), indicating that LCM is the appropriate model. In sum, results are ambiguous in balance sheet comparisons: weak evidence is shown that the LCM is more appropriate in the four-year period which includes the voluntary write-down year 1998; these results, however, show stronger, but not conclusive, evidence that LCM is more appropriate in the three-year mandatory write-down period.

[Table 8 here]

Panel B of Table 8 reports results from the income statement model. Both equations, equation (6) and equation (7), are regressed independently. LCM model generates marginally smaller adjusted R-squares in both fixed effects regressions, with the difference less than 1 percent. Both J test and Cox test reject the null hypotheses in test 2 and accept the null hypotheses in test 1 in the four-year

regression, significantly indicating that HCA is appropriate in this setting. Results are ambiguous in the three-year regression, where the J test and Cox test generate close t values for both test 1 and test 2 (for J, t=2.388 for test 1 and t=2.717 for test 2; for Cox, t=-3.919 for test 1 and t=-4.648 for test 2). However, test 2 yields larger t values. In sum, the income statement model comparisons show strong evidence that HCA is more appropriate in the four-year period. In the three-year mandatory write-down period, however, the models are essentially comparable.

Panel C of Table 8 reports marginally higher R-squares in LCM regressions. The J test and Cox test reject the null of both tests in both regressions. In all cases, the HCA model can be rejected at a lower level than LCM model, with rather larger differences in the three-year regressions. In sum, results here provide weak evidence in favor of LCM. This is perhaps somewhat surprising given the results for the income statement model and given that earnings dominated equity in the price model.

Model appropriateness tests, in brief, show some evidence that balance sheet amounts are more reliable under LCM convention, especially after the enforcement of mandatory regulations. The tests, however, show modest evidence that earnings amounts are less reliable under LCM convention, and it is clear that the voluntary write-down brings unreliable estimates into earnings amounts. If both assets and earnings are considered, the results are ambiguous but still there is weak evidence that the LCM convention is more reliable.

Table 9 reports additional reliability evidence from the relative measurement error research. Panel A shows the relative magnitudes of measurement error variances for BVAC after subtracting the measurement error variances for BVAH. The Barth (1991) approach generates significant positive values in both four-year and three-year regression, indicating bigger measurement error variances under the

LCM convention. A bigger measurement error variance, in term, indicates a larger measurement error. The Boone (2002) approach also generates significant positive values in both regressions, showing that the LCM convention contains no less measurement error than the HCA convention. Panel B of Table 9 shows reliability evidence from income statement models. None of the z values are significant, but the direction of the values favors LCM in the mandatory write-down period and HCA in the four-year period.

[Table 9 here]

In general, the reliability tests present ambiguous evidence as to whether the write-down practice has improved the reliability of accounting information or not. The non-nested approach shows weak evidence that LCM contains less measurement error in the balance sheet, while the relative measurement error test comes to an opposite conclusion. Most likely, the magnitude of measurement error in the balance sheet remains unchanged after write-down. There is stronger evidence that voluntary write-down practice brings more measurement error with respects to earnings, which is supported in both non-nested and relative measurement error tests. This earnings effect, however, is not clear in the mandatory period.

6.3. Write-down Motivation Analysis

Panel A of table 10 reports mean and standard deviation values for the variables in equations (10) and (11). The mean for firm size (SIZE) is 1.40, which is the log form of per share total assets. The mean for leverage is 48.5%. The sample firms have an average market-to-book ratio (MTB) of 5.48, with a 0.32 increase (ΔMTB) in sample period. A standard deviation of 7.95, however, suggests the market's unsettled situation. 7.7% of the total sample firms receive qualified auditor's

opinions (AO) and 5.2% have experienced financial distress (FD). As to their performance, the average industry-adjusted return on assets (IAROA) is 0.0% by construction (mean-adjusted value). Also by construction, 10% of the sample firms are in the good performance portfolio (GOOD), and another 10% are in the poor performance portfolio (BAD). 6.8% of the firms have marginal losses (TURN). Finally, the description reports an average 1.8% current write-down ratio (RDIF) and an average 4.5% accumulated write-down ratio (RPROV). Panel B presents the correlation matrix for the regression variables. None of the variables are highly correlated with each other in either Spearman or Pearson tests. The strongest relation is that between LEV and SIZE (0.43).

[Table 10 here]

The multivariate analysis for equation (10) is shown in panel C, which presents numerical relations between different motivations and present asset write-down ratios. The pooled sample regressions show R-squares of 14.6% and 13.9% for the four-year sample and three-year sample respectively. The proxy for impairment motivation, △MTB, has significant negative coefficients in both four-year and three-year regressions, supporting my prediction that firms with declining market-to-book ratio incur more current write-down. Another proxy in this category, IAROA, also has significant negative coefficients in both regressions. It suggests that below-average IAROA can also trigger write-downs. Proxies for discretionary motivations are all significant in both regressions except for POOR. The positive coefficients for AO suggest that current write-down amounts have a positive relation with the incidence of qualified auditor's opinions, which partially represent the quality of financial reports. This in turn suggests that large amounts of current write-down might contain some discretionary motivations. The negative coefficients for FD

suggest that firms write down less if they are in financial distress. The good performance portfolio (GOOD) yields significantly positive coefficients in both regressions, supporting the possibilities of income-smoothing. The poor performance portfolio, however, does not show any relation with current write-down amounts. A possible explanation is that some firms with severe losses take big baths while others minimize their deficits, diversified strategies leading to an insignificant result on the whole. As expected, the TURN variable yields significantly negative coefficients in both regressions, showing management motivation to avoid write-down losses or to record write-back gains when the firm result, before write-down, is a modest loss. The control variable LEV is significantly positive in both regressions while the control variable SIZE is not significant. These results suggest that high leverage is associated with high current write-down, which is contrary to conventional contracting theory. The annual regression results, listed in the right columns, report few significant variables because the motivations are better captured in a relatively long period rather than in a year. The AO, GOOD and TURN variables are significant in most of the annual regressions with the predicted signs, exhibiting strong discretionary motivations in current write-down amounts. The POOR variable, however, shows different signs among the four years, reflecting the diversified strategies among the poor performance portfolio.

The current write-down ratio measures annual effects. Panel D of Table 10 presents the multivariate analysis for accumulated write-down provisions ratios. The accumulated write-down ratio captures multi-period effects. Both three-year and four-year fixed effect regressions yield high adjusted R-squares of 63.11% and 72.32%, respectively. The panel reveals some results that are interesting vis-à-vis the results in panel C for the current write-down ratio. In particular, the result for FD is

significantly positive compared to a significantly negative result for current write-downs. The result suggests that FD (like GOOD firms) engage in smoothing of their write-down losses, but they do not avoid large provisions over the test period. GOOD, on the other hand, is significantly negative compared to a significantly positive result for current write-downs. The result suggests that good firms engage in smoothing only infrequently, but that they do not (or cannot) build up large provisions. The sign on the coefficient for POOR is positive and opposite that of its sign for current write-downs, paralleling the behavior of the GOOD variable. But the coefficient remains insignificant. This is somewhat surprising, because both big bath and smoothing strategies for POOR firms should lead to higher provisions. The result suggests that POOR firms have been successful in avoiding cumulatively large write-downs over the test period. The TURN variable remains significantly negative. This is even stronger evidence that some firms with poor performance have avoided cumulatively large write-downs. These results could be a point of concern for regulators in the Chinese market. The control variable LEV yields a similar result as it does in the previous regression. SIZE goes from insignificantly negative for current write-downs to significantly negative for accumulated write-down provisions, indicating that these firms have persistently low write-downs. The largest firms in the sample are utilities with relatively high-quality assets. However, utilities are only 5 percent of the sample. It is possible that firm size and asset quality are positively related in other industries in China. But the result raises the possibility that large firms have more political power and use that power to avoid large write-downs.

In general, the empirical evidence presented above supports my prediction that both impairment motivations and discretionary motivations can lead to asset write-down, currently and cumulatively. Stronger relations are found between asset write-

down practice and discretionary motivations. Over and under provisions are related with the diversified goals of earnings management. There is evidence that large firms and poorly performing firms are able to avoid large provisions.

7. Further Analysis

Some professional papers attack the practice of periodically excessive write-downs, which they consider unethical.[41] An excessive write-down could either be a result of unexpected asset impairment or be a convenient way to manipulate earnings. Many recent accounting scandals in China involve excessive asset write-down or excessive asset "write-up".[42] This section provides tests for the hypotheses that excessive asset write-down might involve discretionary manipulations and thereby reduce the reliability of LCM values.

I begin by estimating the degree of asset write-down (including write-back), using the absolute amounts of asset write-down ratios.[43] I rank these ratios annually and pick out the top 20% firms as excessive write-down firms. Excessive write-down can have multiple year effects on a firm's performance; for example, a large write-down can reduce losses for several subsequent years. Therefore, firms are categorized into the excessive write-down sample (HIGH) if they take an excessive write-down at least once in the sample period. Otherwise, they are classified as normal write-down firms (LOW).

[Table 11 here]

[41] Case study: Shanxi Fenjiu (listed code 600809), decreasing bad debt allowances and increasing earnings. *China Securities* (12/04/2001).

[42] Write-up here means taking back the provisions and recovering the impaired assets.

[43] Asset write-back ratio is negative. After taking absolute value, this ratio becomes positive.

Table 11 reports the descriptive statistics for both HIGH sample and LOW sample. Panel A reports the composition of the HIGH sample. 166 firms are picked as the aggressive firms that write down assets excessively, leaving 154 firms in the opposite sample. Particularly, 70.6% of the information technology firms are in the HIGH sample while the ratio is only 20.0% for utilities firms, which is attributed to different industry characteristics: a conservative industry like utilities seldom adopts aggressive accounting policies while a liberal industry like IT often adopts aggressive policies. A two-way chi-squared statistic (14.52) rejects the hypothesis that HIGH sample firms are evenly distributed among industries.

Panel B of Table 11 presents the descriptive statistics of the two sub-samples. I use the t test of means and the Wilcoxon signed-rank test of medians to assess statistical differences between the HIGH sample firms and LOW sample firms, where firm performance, discretionary motivations and other controlling factors are compared. Because the underlying distributions of the variables are not normal, the Wilcoxon test may be more powerful than the t test. The accumulated provision ratio (RPROV) shows statistical differences in mean and median with a t value of –15.078 and a z value of –14.150. This shows that the behavior of excessive write-down generally results in relatively more provisions in the accounts. Next, I find that these two sub-samples have significantly different ROA, IAROA and MTB ratios. The HIGH sample firms have smaller ROAs as well IAROAs while achieving larger MTB ratios. Lower IAROA implies under-performing assets for HIGH firms. Such assets are more likely to be impaired. This result supports non-discretionary motivation for write-downs. On the contrary, significantly higher MTB ratios as well as insignificantly higher ΔMTB in the HIGH sample present controversial evidence against the economic motivation hypothesis. Under the economic motivation, it

should be the LOW sample which has lower MTB ratios and experiences greater declines in MTB. The adjusted return (R) is not significantly different between the two sub-samples, although returns to LOW firms are higher than those to HIGH firms. This again supports non-discretionary motivations for write-down; otherwise, investors could discriminate between these sub-samples in terms of risk. Although HIGH and LOW firms are not significantly different in size, they do differ in leverage. HIGH firms are significantly more levered than LOW firms. The results of Table 10 already show that leverage is significantly positively associated with write-downs, both current and cumulative. High leverage firms may be subject to more scrutiny by their creditors (outsiders) than low leverage firms.

Discretionary motivations, however, are more pronounced. The mean and median tests show significant values for all the discretionary-motivation variables. The HIGH sample firms are 4 times more likely to receive qualified auditor's opinions and 6 times more likely to experience financial distress. Also, the likelihood for their presence in the POOR and TURN portfolios is much higher than those for the LOW sample firms. On the contrary, HIGH sample firms are less likely to achieve GOOD status as one of the top 10 percent performers in any year.[44]

In sum, the descriptive statistics show evidence that "excessive" asset write-down is related to both asset impairment and to discretionary motivations. One revealing aspect is that the excessive write-down practice exhibits more discretionary motivations that may involve earnings manipulation.

[Table 12 here]

[44] Although I record a positive relation between current write-down ratio and GOOD in Table 10, this relation was negative for the accumulated write-down ratio, indicating that GOOD firms accumulated relatively low provisions. Excessive write-down firms are in the top 20 percent of write-downs in at least 1 year, and it is likely that GOOD firms never record such high annual write-downs.

Table 12 presents the non-nested model selection results for the two sub-samples, HIGH and LOW. Panel A presents the results from the balance sheet model comparisons. Neither J nor Cox tests can distinguish the two accounting conventions in the LOW sample, where the write-down amounts are normal. Both test 1 and test 2 either jointly reject or jointly accept, leaving an ambiguous result. For the HIGH sample, however, the qualitative results favor the LCM model for both Cox and J tests. In the three-year period model, the J test rejects the null in test 1 and does not reject in test 2, supporting LCM as the appropriate model in the three-year period. Together with other evidence such as marginally improved R-squares, the LCM model shows a slight priority over HCA in terms of reliability.

Panel B of Table 12 presents the results from the income statement model comparisons. The LOW sample sees a small improvement in the R-squares under write-down accounting. Moreover, the null hypothesis that HCA is appropriate is rejected in both J and Cox tests in both regressions, while in the symmetric test the null hypothesis that LCM is appropriate is not rejected in both J and Cox tests in both regressions. Evidence is clear that LCM improves the reliability in the LOW sample. The HIGH sample reports different results for the four- and three-year models. The results tend to favor HCA for the four-year model, but LCM for the three-year model. There is weak evidence that mandatory asset write-down could improve the reliability of earnings information while the voluntary write-down, on the contrary, obviously decreases reliability.

Panel C of Table 12 tests the of the price model, which includes both assets and earnings. As previously seen in Table 7, net earnings dominate net assets in this model. Because of this, the price model can be expected to yield similar results to those reported in panel B. The J test and Cox test strongly support the claim that

LCM is more appropriate in the LOW sample. The results are ambiguous in HIGH sample apparently due to the possible unreliability of voluntary write-down in the first year of the period. Nevertheless, the results qualitatively support LCM even for the HIGH sample. In the three-year model, the J test rejects HCA but cannot reject LCM as the appropriate model.

Additional reliability tests using the relative measurement error approach shows growing dichotomy between the two sub-samples. Panel A of Table 13 reports the measurement error tests for both LOW and HIGH sample. Both Barth (1991) and Boone (2002) approaches generate significant negative values, which are strong evidence that LCM contains less measurement error than HCA. The HIGH sample reports significant positive values under both approaches, indicating a possible increased measurement error in LCM convention. Results from four-year and three-year regressions are consistent. Note that the non-nested test favors LCM slightly in HIGH sample, which is contrary to the result found here. The difference may come from different assumptions on which non-nested and relative measurement error tests are built. Nevertheless, both results in the HIGH sample are not conclusive, which implies that the measurement error or reliability could remain unchanged in the HIGH sample. Panel B reports the measurement error tests from the income statement models. The LOW sample experiences a small improvement in terms of reliability, as suggested by the negative Vuong's z values. This improvement, however, is not statistically significant. Although the HIGH sample also reports insignificant negative z values in the four-year regression, it reports insignificant positive z values in the three-year regression, which show qualitative evidence that voluntary write-down can bring more measurement error in earnings. This finding is consistent with the results from J and Cox tests.

[Table 13 here]

In general, the sub-sample reliability analysis shows that periodically excessive write-down may reduce the reliability of earnings information, especially in the voluntary write-down period. Conversely, non-aggressive write-down practice, which involves less discretionary motivation, appears to increase the reliability of financial information in both assets and earnings. Evidence of decreased reliability in excessive write-down sample, however, is not significant, which suggests some effect from non-discretionary motivations.

8. Conclusion

The objectives of this study are to identify value-relevance characteristics of asset write-down regulations enforced in the recent accounting reform. Both reliability and motivation issues are empirically investigated in this study. There are in total 320 Chinese exchange-listed companies covering a four-year research period (1998-2001) in the sample.

The study shows that provisions and associated gains and losses of asset write-down accounting are priced by the stock market. This result is consistent with the findings of prior value-relevance research. The study also shows that voluntary write-down practice may contain either signaling or learning effects, leading to a value-relevance effect that is opposite that of mandatory write-down practice.

It is possible that LCM numbers, although value-relevant, are measured with greater error than HCA numbers, leading to a loss of reliability. This possibility is investigated using non-nested model comparisons (J and Cox tests) together with

relative measurement error tests. Results for the balance sheet model qualitatively support LCM as the better model in the J and Cox tests, while the relative measurement error tests show that LCM contains no less measurement error than that from HCA. Results from both approaches for the income statement model qualitatively support HCA as the better model. In particular, HCA is weakly supported as the superior model for the four-year period including the voluntary write-down year of 1998. In the price model (which combines return and asset variables), the results from J and Cox tests qualitatively support LCM. There is evidence that voluntary LCM practice decreased reliability of reported earnings, but there is no evidence that mandatory LCM practice has decreased reliability of net earnings or net assets in China.

A potential source of lack of reliability in the LCM numbers is discretionary motivation. Results show that the asset write-down amounts are associated with some discretionary motivations. But the results also show positive association with proxies for asset impairment, supporting non-discretionary motivation for write-down. To further investigate the possible effect of discretionary motivation on reliability of the LCM numbers, I partition the sample based on the magnitude of write-downs, categorizing firms with excessive write-downs or write-backs into one sample (HIGH) and the rest into the other (LOW). The t and Wilcoxon sign-rank tests show that write-down abuse is related to discretionary motivations. For the low write-down/write-back sample, J and Cox tests show that LCM is superior for both the return and price model with mixed results for the balance sheet model. With the same sample, the relative measurement error tests report significantly less measurement error for LCM than that for HCA. Results for the high write-down/write-back sample are generally mixed, indicating that no improvement in

accounting reliability has been achieved in LCM. The fact that HCA is not unambiguously selected as the superior model for the high sample implies that non-discretionary motivations are still an important element of large write-downs/write-backs. Nevertheless, the results support the notion that LCM improves reliability of financial information in the absence of discretionary motivations.

The results in this study have implications for accounting research and practice. The evidence here contributes to the ongoing debate on the usefulness of the asset write-down regulations. Results drawn in this study support the accounting reform. Asset write-down regulations provide more relevant information to investors. If properly used, these regulations can boost reliability of accounting information and thus provide more useful accounting information to investors. Regulators should consider more explicit guidelines to reduce unbiased measurement error and to strengthen the independent auditor's position in opposing biased measurement error. Regulators may also consider incorporating rules prohibiting excessive write-downs.

There are several limitations in this study. First, only 320 firms are covered in the four-year period. The firms represent the "survivors" over the 1998-2001 period. Although this introduces possible survivorship bias in the sample, balancing the panel increases the robustness of the regression models. Furthermore, the use of survivors makes it possible to abstract from heterogeneous effects such as IPO and bankruptcy or de-listing. Nevertheless, it should be possible to increase sample size in future studies.

Second, this study uses relatively simple valuation models that do not fully capture information available in the market. The original models suffer from defective specifications, for example, non-normal residuals. Future work could

examine the value-relevance issue as well as reliability issues using valuation models that are richer and better specified, either empirically or theoretically.

Finally, this study makes an effort in dealing with relevance and reliability issues separately from traditional value-relevance research. Reliability is defined as the difference between intrinsic market value and reported accounting value, known as measurement error. Two approaches were used in testing the magnitude of measurement error: model appropriateness test and relative measurement error test. This study, however, does not fully capture the characteristics of relevance and reliability. Reliability, for example, could be explained from other perspectives than measurement. Even if reliability is well defined in this study, the power of the reliability tests is restricted due to their inherent limitations. Analyses exploring other interpretations of relevance or reliability would add to deeper understanding of usefulness of financial statements to investors, regulators as well as academic researchers.

TABLES

Table 1
Write-downs Regulations Framework in China

Asset	Impairment Method	Identification of Fair Value	Loss Is Charged To	Regulation
Accounts Receivable[a]	LCM[b]	Recoverable Amount[c]	Administration Expense	AR1998 AR2001
Short-term Investment	LCM	Market Value	Investment Gain or Loss[d]	AR1998 AR2001
Long-term Investment	LCM	Recoverable Amount	Investment Gain or Loss	AR1998 AR2001
Inventory	LCM	Net Selling Price	Administration Expense	AR1998 AR2001
Fix Asset	LCM	Recoverable Amount	Non-operating Expense[d]	AR2001
Intangible Asset	LCM	Recoverable Amount	Non-operating Expense	AR2001
Construction In Progress	LCM	Recoverable Amount	Non-operating Expense	AR2001
Commission Loan	LCM	Recoverable Amount	Investment Gain or Loss	AR2001

Notes:

a Including Other Accounts Receivable

b Lower of historical cost or fair market value

c Recoverable Amount is the higher of the Net Selling Price (NSP) and its value in use (VIU)

d Affects non-operating result

Table 2
Sample Selection

Panel A: Comparisons Between Full Sample and Selected Sample

Listing Location

	Full Sample			Selected Sample			Percentage (Selected / Full)		
	Shanghai	Shenzhen	Total	Shanghai	Shenzhen	Total	Shanghai	Shenzhen	Total
1998	438	413	851	184	136	320	42.01%	32.93%	37.60%
1999	484	465	949	184	136	320	38.02%	29.25%	33.72%
2000	572	516	1088	184	136	320	32.17%	26.36%	29.41%
2001	646	514	1160	184	136	320	28.48%	26.46%	27.59%

Share Type

	Full Sample[a]					Selected Sample			
	A	A & B	A & H	B	Total	A	percentage	Other Shares	percentage
1998	727	80	18	26	851	320	44.02%	0	0.00%
1999	822	82	19	26	949	320	38.93%	0	0.00%
2000	955	86	19	28	1088	320	33.51%	0	0.00%
2001	1023	88	25	24	1160	320	31.28%	0	0.00%

Panel B: Selected Sample Firms by Industries[c]

Industry by GICS[b]	N	%
Energy	5	1.56%
Materials	48	15.00%
Industrials	63	19.69%
Consumer Discretionary	81	25.31%
Consumer Staples	11	3.44%
Health Care	30	9.38%
Financials	33	10.31%
Information Technology	34	10.63%
Utilities	15	4.69%
Sum	320	100.00%

Notes:

a A stands for the companies issuing A shares only; A & B stands for the companies issuing both A and B shares; A & H stands for the companies issuing both A and H shares; B stands for the companies issuing B shares only.

b According to the GICS (Global Industry Classification Standard), Sector (10) Energy includes (1010) Energy; Sector (15) Materials includes (1510) Materials; Sector (20) Industrials includes (2010) Capital Goods,(2020) Commercial Service & Supplies, (2030) Transportation; Sector (25) Consumer Discretionary includes (2510) Automobile & Components, (2520) Consumer Durables & Apparel, (2530) Hostels, Restaurants & Leisure, (2540) Media, (2550) Retailing; Sector (30) Consumer Staples includes (3010) Food & Staples Retailing, (3020) Food, Beverage & Tobacco, (3030) Household & Personal Products; Sector (35) Health Care includes (3510) Health Care Equipment & Services, (3520) Pharmaceuticals & Biotechnology; Sector (40) Financials includes (4010) Banks, (4020) Diversified Financials, (4030) Insurance, (4040) Real Estate; Sector (45) Information Technology includes (4510) Software & Services, (4520) Technology Hardware & Equipment, (4530) Semiconductors & Semiconductor Equipment; Sector (50) Telecommunication Services includes (5010) Telecommunication Services; Sector (55) Utilities includes (5510) Utilities;

c Companies are categorized by their main business disclosed publicly. It is assumed that the main business does not change during the research period. However, it is possible that some companies change business after merges or acquisitions. The number of the companies who changed their main business during the research period is small.

Table3

Summary of Asset Write-down Provisions of Different Industries Within Selected Sample: 1998-2001

GICS[a]		Prov1[c]	Prov2	Prov3	Prov4	Prov5	Prov6	Prov7	Total Prov	ΔProv1	ΔProv2	ΔProv3	ΔProv4	ΔProv5	ΔProv6	ΔProv7	ΔTotal Prov	ΓAmillion
1	Mean[b]	0.0299	0.0054	0.0034	0.0136	0.0003	0.0004	0.0000	0.0582	0.0088	0.0020	0.0014	0.0076	0.0003	0.0004	0.0000	0.0221	1308.10
	Median[b]	0.0136	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0310	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0039	
2	Mean	0.0593	0.0129	0.0087	0.0110	0.0003	0.0008	0.0000	0.1042	0.0166	0.0044	0.0037	0.0055	0.0003	0.0008	0.0000	0.0364	1202.43
	Median	0.0177	0.0013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0420	0.0022	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0074	
3	Mean	0.0332	0.0149	0.0059	0.0098	0.0004	0.0002	0.0000	0.0733	0.0106	0.0041	0.0023	0.0054	0.0004	0.0002	0.0000	0.0262	1645.45
	Median	0.0128	0.0022	0.0001	0.0000	0.0000	0.0000	0.0000	0.0348	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0056	
4	Mean	0.0677	0.0146	0.0063	0.0132	0.0015	0.0001	0.0000	0.1096	0.0291	0.0024	0.0007	0.0073	0.0015	0.0001	0.0000	0.0434	1259.69
	Median	0.0262	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0487	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0115	
5	Mean	0.0640	0.0302	0.0147	0.0047	0.0019	0.0009	0.0000	0.1277	0.0142	0.0080	0.0028	0.0023	0.0019	0.0009	0.0000	0.0362	1499.66
	Median	0.0174	0.0041	0.0004	0.0000	0.0000	0.0000	0.0000	0.0482	0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0058	
6	Mean	0.0692	0.0263	0.0078	0.0065	0.0014	0.0005	0.0000	0.1131	0.0226	0.0069	0.0023	0.0045	0.0014	0.0005	0.0000	0.0398	999.04
	Median	0.0217	0.0046	0.0007	0.0000	0.0000	0.0000	0.0000	0.0485	0.0044	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0104	
7	Mean	0.0193	0.0012	0.0045	0.0044	0.0000	0.0003	0.0000	0.0297	0.0067	0.0005	0.0017	0.0025	0.0000	0.0003	0.0000	0.0117	2696.86
	Median	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0146	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022	

Notes:

a GICS is an industry classification system, developed by Standard & Poor+
For purposes of this table, some GICS categories were combined yielding 7 industries : Industry 1=Energy + Materials, 2=Industrials, 3=Consumer Discretionary + Consumer Staples, 4=Health Care, 5=Financials, 6=Information Technology, 7=Utilities.

b Extreme values are winsorized within groups and years.

c These are all ratios of write-down provisions or change of provisions to the historical book value of related assets;
Prov1 is the write-down provision for accounts receivables, including accounts receivable and other accounts receivable;
Prov2 is the write-down provision for inventories;
Prov3 is the write-down provision for investments, including short-term and long-term investments;
Prov4 is the write-down provision for fix assets;
Prov5 is the write-down provision for intangible assets;
Prov6 is the write-down provision for construction in progress;

Prov7 is the write-down provision for commission loans;
Total Prov = Prov1 + Prov2 + Prov3 + Prov4 + Prov5 +Prov6 + Prov7;
ΔProv1 is the changes in write-down provision for accounts receivables, including accounts receivable and other accounts receivable;
ΔProv2 is the changes in write-down provision for inventories;
ΔProv3 is the changes in write-down provision for investments, including short-term and long-term investments;
ΔProv4 is the changes in write-down provision for fix assets;
ΔProv5 is the changes in write-down provision for intangible assets;
ΔProv6 is the changes in write-down provision for construction in progress;
ΔProv7 is the changes in write-down provision for commission loans;
ΔTotal Prov = ΔProv1 + ΔProv2 + ΔProv3 + ΔProv4 + ΔProv5 +ΔProv6 + ΔProv7;
ΔProv = current period provision - last period provision, which is the amount of current write-down if it is positive;
TA is the industry mean total asset.

Table 4
Descriptive Statistics for Regression Variables: 1998-2001

Regressors[a]	Original Data		Winsorized Data	
	Mean	Std.dev of annual means	Mean	Std.dev of annual means
MVE	10.9779	2.7944	10.9188	2.7729
BVA_0	0.7419	0.2381	0.7332	0.2329
BVL	2.3932	0.4762	2.3772	0.4787
BVAH	3.8169	0.5254	3.8007	0.5305
BVAC	3.6361	0.4107	3.6213	0.4164
BVEH	2.1656	0.2890	2.1629	0.2929
BVEC	1.9848	0.1740	1.9860	0.1817
PROV	0.1808	0.1209	0.1755	0.1193
R	0.2591	0.4393	0.2524	0.4374
Eh	0.1092	0.0512	0.1109	0.0491
ΔEh	-0.0254	0.0634	-0.0254	0.0620
Ec	0.0816	0.0460	0.0870	0.0414
ΔEc	-0.0303	0.0406	-0.0307	0.0390
WDGL	0.0275	0.0162	0.025451	0.0152

Notes:

a All the variables are reported in per share amounts, which have been adjusted for stock splits and dividends.

MVE = market value of common equity,

BVA_0 = book value of asset other than those affected by write-down regulation,

BVL = book value of liability,

BVAH = historical book value of asset that are affected by write-down regulation, before providing any provisions

BVAC = reported book value of asset that are affected by write-down regulation,

PROV = reported or disclosed book value of asset write-down provision

BVEH =historical book value of net asset,

BVEC =reported book value of net asset,

R = annual stock return, beginning from three months later after the fiscal year end

Eh = historical number of earnings before any write-down gains and losses,

ΔEh = changes of historical number of earnings before any write-down gains and losses,

Ec = reported earnings

ΔEc = changes of reported number of earnings

WDGL =write-down gains and losses, with a positive number meaning an losses

Table 5
Summary Statistics for Balance Sheet Model Regression

$$MVE_{it} = \alpha_0 + \alpha_1 BVA0_{it} + \alpha_2 BVL_{it} + \alpha_3 BVAH_{it} + \alpha_4 PROV_{it} + \upsilon_{it}$$ [a]

Panel A: Fixed Effects Regression

		α_0	α_1	α_2	α_3	α_4	adj. R2	nobs.
1998-2001	Coef.	-	0.059	-0.033	0.040	-0.275	70.00%	1280
	t[b]	-	2.718***	-1.712*	2.280**	-7.092***		
1999-2001	Coef.	-	0.051	-0.080	0.078	-0.214	68.10%	960
	t	-	2.258**	-4.111***	4.218***	-4.426***		

Panel B: Annual Regression

		α_0	α_1	α_2	α_3	α_4	adj. R2	nobs.
1998	Coef.	1.550	0.314	-0.123	0.138	0.413	15.10%	320
	t	26.458***	4.960***	-3.290***	4.305***	1.201		
1999	Coef.	2.312	0.161	-0.016	0.001	-0.036	1.50%	320
	t	35.104***	2.800***	-0.457	0.048	-0.340		
2000	Coef.	2.577	0.092	0.010	-0.013	-0.149	5.20%	320
	t	55.609***	2.993***	0.498	-0.808	-2.074**		
2001	Coef.	2.257	0.086	0.018	-0.014	-0.186	10.50%	320
	t	45.493***	3.757***	1.044	-0.874	-3.026***		

Notes:

*** significant at 0.01 level

** significant at 0.05 level

* significant at 0.1 level

a MVE = Natural log form of per share market value of common equity, three months after the fiscal year-end,

BVA_0 = Per share book value of asset other than those affected by write-down regulation ,

BVL = Per share book value of liabilities,

BVAH= Per share historical book value of assets that are affected by write-down regulation , before providing any provisions

PROV= per share reported or disclosed book value of asset write-down provision

b t values are reported using White (1980) heteroskedastic-consistent estimates

Table 6
Summary Statistics for Return Model Regression

$$R_{it} = \beta_0 + \beta_1 E^h_{it} + \beta_2 \Delta E^h_{it} + \beta_3 WDGL_{it} + \nu_{it}$$ [a]

Panel A: Fixed Affect Regression

		β_0	β_1	β_2	β_3	adj. R2	nobs.
1998-2001	Coef.	-	2.111	0.979	-0.420	55.57%	1280
	t[b]	-	4.197***	2.707***	-0.918		
1999-2001	Coef.	-	2.289	0.736	-1.530	61.18%	960
	t	-	3.745***	1.767*	3.275***		

Panel B: Annual Regression

		β_0	β_1	β_2	β_3	adj. R2	nobs.
1998	Coef.	0.065	0.529	2.987	5.691	14.85%	320
	t	2.760***	0.721	4.206***	4.070***		
1999	Coef.	0.136	1.945	1.700	-1.627	13.09%	320
	t	7.208***	3.671***	2.824***	1.062		
2000	Coef.	0.559	-0.045	2.539	-1.652	8.20%	320
	t	30.675***	-0.091	3.864***	-2.266**		
2001	Coef.	-0.286	2.290	0.069	-1.220	8.81%	320
	t	-18.890***	3.451***	0.096	-1.916*		

Notes:

*** significant at 0.01 level

** significant at 0.05 level

* significant at 0.1 level

a R = the cumulative market-adjusted return over the 12-month period ending 3 months following fiscal year end
E^h= per share earnings before any write-down accounting adjustments, deflated by the share price at the beginning of the year
ΔE^h= the change in E^h
WDGL= per share write-down gains and losses, deflated by the share price at the beginning of the year

b t values are reported in White (1980) adjusted values

Table 7
Summary Statistics for Price Model Regression

$$MVE_{it} = \gamma_0 + \gamma_1 BVEH_{it} + \gamma_2 PROV_{it} + \gamma_3 E^h_{it} + \gamma_4 WDGL_{it} + \omega_{it}$$ [a]

Panel A: Fixed Affect Regression

		γ_0		γ_1		γ_2		γ_3		γ_4		adj. R2	nobs.
1998-2001	Coef.	-		0.017		-0.079		0.437		-0.188		73.37%	1280
	t[b]	-		1.147		-1.722	*	11.967	***	-3.380	***		
1999-2001	Coef.	-		0.038		0.043		0.359		-0.277		70.79%	960
	t	-		2.045	**	0.771		8.747	***	-5.237	***		

Panel B: Annual Regression

		γ_0		γ_1		γ_2		γ_3		γ_4		adj. R2	nobs.
1998	Coef.	1.575		0.165		0.973		0.247		-0.210		14.98%	320
	t	27.769	***	5.637	***	0.604		1.530	*	-0.146			
1999	Coef.	2.313		-0.020		0.238		0.586		-0.593		6.79%	320
	t	35.644	***	-0.736		1.840	*	5.274	***	-1.941	*		
2000	Coef.	2.601		-0.029		0.081		0.422		-0.521		11.84%	320
	t	60.903	***	-1.616	*	1.013		5.455	***	-3.241	***		
2001	Coef.	2.343		-0.042		0.079		0.605		-0.238		20.65%	320
	t	51.586	***	-2.600	***	1.072		7.461	***	-2.290	**		

Notes:

*** significant at 0.01 level

** significant at 0.05 level

* significant at 0.1 level

a MVE = Natural log form of market value of common equity per share, three months after the fiscal year end,
BVEH = per share book value of net asset before the adjustments of asset write-down regulation
PROV = per share amount of asset write-down provisions
E^h = per share earnings before the adjustments of asset write-down gains and losses
WDGL= per share amount of asset write-down gains and losses

b t values are reported in White (1980) adjusted values

Table 8
Non-nested Models Comparison

Panel A: Balance Sheet Model[a]

	adj.R squares		J Test		Cox Test	
	H[b]	L[c]	Test 1[d]	Test 2[e]	Test 1	Test 2
1998-2001	68.76%	69.31%	5.978 ***	-4.294***	-30.156***	9.288***
1999-2001	67.30%	67.87%	3.864 ***	-1.916	-15.451***	5.134***

Panel B: Return Model[f]

	adj.R squares		J Test		Cox Test	
	H	L	Test 1	Test 2	Test 1	Test 2
1998-2001	55.59%	54.59%	0.892	4.767 ***	-0.823	-5.956***
1999-2001	60.85%	60.75%	2.388 ***	2.717 ***	-3.919***	-4.648***

Panel C: Price Model[g]

	adj.R squares		J Test		Cox Test	
	H	L	Test 1	Test 2	Test 1	Test 2
1998-2001	72.71%	72.95%	4.753 ***	3.668 ***	-4.581***	-3.353***
1999-2001	69.75%	70.52%	4.613 ***	2.182 **	-8.697***	-3.182***

Notes:

** Significant at 0.01 levels

* Significant at 0.05 levels

a Equation (4) and (5)

b Historical cost accounting

c Lower of cost or market accounting

d The null hypothesis in test 1 is that HCA is appropriate, the alternative is that LCM is appropriate

e The null hypothesis in test 2 is LCM is appropriate, the alternative is that HCA is appropriate

f Equation (6) and (7)

g Equation (8) and (9)

Table 9
Relative Measurement Error

Panel A: Balance Sheet Model

	$\sigma^2 u_{mvac} - \sigma^2 u_{mvah}$ [a]			
	Barth (1991)[c]		Boone (2002)	
1998-2001[b]	0.1124		0.0737	
F test	3122.9	***	562.54	***
1999-2001	0.1995		0.1690	
F test	5726.33	***	1753.41	***

Panel B: Return Model

	Vuong's Z value[d]	
	Earnings Level	Earnings Change
1998-2001	0.411	0.372
1999-2001	-0.06	-0.044

Notes:

*,**,*** denote significance in two-tailed tests at the 0.10, 0.05, and 0.01 levels, respectively.

a $\sigma^2 u_{mvah}$ denotes the measurement error variance from asset BVAH, $\sigma^2 u_{mvac}$ denotes that from asset BVAC.

b Regressions are fix-effects controlled.

c Two approaches are from Barth (1991) and Boone (2002). A positive value in Barth (1991) indicates that LCM contains more measurement error while the same value in Boone (2002) only indicates that LCM contains no less measurement error than that in HCA. A negative value in both research shows a decreased measurement error in LCM.

d Vuong test is constructed as HCA versus LCM. A positive Z value indicates that LCM contains more measurement error.

Table 10
Determinants of Write-down Amounts and Accumulated Provisions

Panel A: Variable Description

Description	Variable	Pool Sample		
		Mean	Std dev.	Count (firms)
Log Firm Total Assets	SIZE	1.40	0.48	-
Leverage (%)	LEV	48.45	18.36	-
Market-to-book Ratio	MTB	5.48	3.82	
Change in Market-to-book Ratio	ΔMTB	0.32	7.95	-
Unclean Audit Opinion (% of firm)	AO	7.73	26.72	99
Financial Distress (% of firm)	FD	5.23	22.28	67
Industry Adjusted Return On Asset (%)	IAROA	0.00	6.28	-
Unusually Good Performance (% of firm)	GOOD	10.00	30.01	128
Unusually Poor Performance (% of firm)	POOR	10.00	30.01	128
Small Loss (% of firm)	TURN	6.80	25.18	87
Current Write-down Amounts (%)	RDIFP	1.77	4.75	-
Accumulated Write-down Provisions (%)	RPROV	4.53	7.13	-

Panel B: Pearson (right) and Spearman (left) Correlation Matrix

	AO	ST	SIZE	LEV	MTB	ΔMTB	IROA	GOOD	POOR	TURN
AO		0.103	0.013	0.157	0.081	0.026	-0.357	-0.077	0.293	0.050
Prob > |R|		0.000	0.632	0.000	0.004	0.362	0.000	0.006	0.000	0.076
ST	0.103		-0.076	0.228	0.258	0.085	-0.242	-0.043	0.202	0.048
Prob > |R|	0.000		0.007	0.000	0.000	0.002	0.000	0.122	0.000	0.086
SIZE	0.009	-0.086		0.434	-0.230	-0.082	-0.006	-0.114	-0.078	0.017
Prob > |R|	0.735	0.002		0.000	0.000	0.003	0.833	0.000	0.005	0.540
LEV	0.148	0.199	0.435		0.287	0.101	-0.327	-0.153	0.227	0.010
Prob > |R|	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.728
MTB	0.066	0.201	-0.315	0.285		0.391	-0.083	0.103	0.185	-0.003
Prob > |R|	0.018	0.000	0.000	0.000		0.000	0.003	0.000	0.000	0.926
ΔMTB	0.066	0.062	-0.187	0.120	0.407		-0.111	-0.029	0.128	0.005
Prob > |R|	0.019	0.028	0.000	0.000	0.000		0.000	0.298	0.000	0.849
IROA	-0.289	-0.210	-0.066	-0.321	0.030	-0.146		0.477	-0.760	-0.100
Prob > |R|	0.000	0.000	0.018	0.000	0.288	0.000		0.000	0.000	0.000
GOOD	-0.077	-0.043	-0.096	-0.163	0.142	-0.052	0.518		-0.111	-0.090
Prob > |R|	0.006	0.122	0.001	0.000	0.000	0.062	0.000		0.000	0.001
POOR	0.293	0.202	-0.089	0.212	0.151	0.188	-0.519	-0.111		-0.059
Prob > |R|	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000		0.035
TURN	0.050	0.048	0.011	0.015	0.015	-0.089	-0.222	-0.090	-0.059	
Prob > |R|	0.076	0.086	0.687	0.593	0.597	0.001	0.000	0.001	0.035	

Table 10 Continued

Panel C: Multivariate Analysis of Factors Influencing Current Write-down Amounts

	1998-2001			1999-2001			1998			1999			2000			2001		
	Est.	t		Est.	t		Est.	t		Est.	t		Est.	t		Est.	t	
Intercept	-	-		-	-		0.004	1.228		0.033	3.853	***	0.012	1.028		0.003	0.237	
AO	0.034	4.026	***	0.030	2.626	***	0.015	1.665	*	0.024	1.953	*	0.021	1.555		0.071	2.388	***
FD	-0.033	-3.163	***	-0.036	-2.990	***	0.003	0.431		-0.015	-1.291		-0.005	-0.310		-0.036	-1.580	
SIZE	-0.012	-1.529		-0.008	-0.727		-0.003	-1.785	*	0.001	0.140		0.000	0.051		-0.010	-1.162	*
LEV	0.054	2.276	**	0.068	2.010	**	0.001	0.261		0.003	0.235		-0.002	-0.131		0.055	2.237	**
ΔMTB	-0.001	-2.034	**	-0.001	-1.956	*	0.000	-1.037		-0.001	-1.791	*	0.000	-0.954		-0.001	-0.824	
IAROA	-0.139	-2.240	**	-0.138	-1.926	*	-0.045	-0.885		-0.329	-3.157	***	-0.167	-1.119		-0.286	-1.758	*
GOOD	0.022	3.486	***	0.026	3.287	***	0.003	0.682		0.019	2.017	**	0.027	2.202	**	0.041	2.899	***
POOR	-0.009	-0.889		-0.011	-0.876		0.017	2.140	**	-0.003	-0.190		-0.043	-1.830	*	-0.025	-0.905	
TURN	-0.023	-4.607	***	-0.027	-4.551	***	-0.006	-1.378		-0.002	-0.195		-0.025	-2.393	***	-0.018	-2.727	***
R-square	14.58%			13.68%			24.08%			13.81%			5.33%			21.62%		

Panel D: Multivariate Analysis of Factors Influencing Accumulated Write-down Accumulated Provisions

variable	1998-2001			1999-2001			1998			1999			2000			2001		
	Est.	t		Est.	t		Est.	t		Est.	t		Est.	t		Est.	t	
Intercept	-	-		-	-		0.001	0.304		0.033	3.726	***	0.071	4.554	***	0.101	3.949	***
AO	0.030	3.794	***	0.019	2.239	**	0.011	1.234		0.028	2.384	***	0.069	4.047	***	0.086	2.718	***
FD	0.034	3.171	***	0.033	3.258	***	0.004	0.540		0.008	0.694		0.068	2.975	***	0.073	2.424	***
SIZE	-0.079	-7.224	***	-0.083	-6.904	***	-0.001	-0.309		-0.003	-0.488		-0.018	-2.134	**	-0.044	-2.823	***
LEV	0.130	4.132	***	0.156	4.615	***	-0.001	-0.139		0.016	0.895		0.021	0.878		0.104	2.797	***
MTB	-0.004	-2.597	***	-0.005	-3.517	***	0.001	0.848		0.001	0.629		-0.002	-2.229	**	-0.006	-2.229	**
IAROA	-0.172	-2.656	**	-0.151	-2.319	**	-0.051	-0.989		-0.437	-4.010	***	-0.266	-1.358		-0.490	-2.763	***

continued

GOOD	-0.024	3.796	***	0.024	3.347	***	0.002	0.548		0.025	2.656	***	0.030	1.871	*	0.042	2.644	***
POOR	0.014	1.459		0.022	2.120	**	0.017	1.895	*	-0.008	-0.416		0.005	0.211		0.042	1.335	
TURN	-0.013	-2.557	**	-0.018	-3.260	***	-0.003	-0.590		0.005	0.433		-0.008	-0.441		-0.001	-0.066	
R-square	63.11%			72.32%			25.46%			23.38%			34.14%			49.16%		

Notes:

*,**,*** denote significance in two-tailed tests at the 0.10, 0.05, and 0.01 levels, respectively.

a Following variables are computed with historical data:

SIZE = Ln (per share total asset);

LEV = total liability / total asset;

MTB = market value of equity/book value of equity;

$\Delta MTB = MTB_t - MTB_{t-1;}$

$IAROA = ROA - ROA_{mean,}$ where ROA = earning / total asset and ROA_{mean} is the industry mean ROA

b FD,AO,GOOD, POOR and TURN are binary dummy variables. FD stands for finance distress, FD=1 if a company is in "ST" or "PT"; AO stands for audit opinion, AO=1 if a company receives an qualified opinion that year; GOOD stands for good performance, GOOD=1 if a company's industry adjusted ROA achieves a top 10%; POOR stands for poor performance, POOR=1 if its ROA is in bottom 10%; TURN stands for the possibility to turn profit, TURN=1if a company's current earnings per share is within the area of -0.1 to 0.

Table 11
Descriptions for Sub Samples

Panel A: Firm distribution

Industry by GICS	Full Sample	High[a,b]	%
Energy & Materials	53	24	45.28%
Industrials	63	28	44.44%
Consumer Discretionary & Staples	92	53	57.61%
Health Care	30	16	53.33%
Financials	33	18	54.55%
Information Technology	34	24	70.59%
Utilities	15	3	20.00%
Sum	320	166	51.88%

Panel B: Firm Profile

	Mean			Median		
	Low	High	T test	Low	High	Wilcoxon Z test
RPROV[c]	0.017	0.071	-15.078***	0.013	0.045	-14.150***
ROA	0.046	0.008	11.180***	0.044	0.022	10.452***
IAROA	0.019	-0.018	11.151***	0.020	-0.005	10.401***
MTB	5.111	5.828	-3.396***	4.213	4.689	-3.444***
ΔMTB	-0.003	0.628	-1.461	-0.109	0.231	-2.509**
AO	0.023	0.128	-7.363***	0.000	0.000	-7.042***
FD	0.013	0.089	-6.345***	0.000	0.000	-6.087***
GOOD	0.125	0.077	2.879***	0.000	0.000	2.870***
POOR	0.016	0.178	-10.288***	0.000	0.000	-9.618***
TURN	0.044	0.090	-3.316***	0.000	0.000	-3.303***
R	0.255	0.250	1.314	0.120	0.132	0.860
SIZE	1.386	1.407	-0.783	1.400	1.395	-0.162
LEV	0.459	0.509	-4.913***	0.460	0.514	-4.689***

Notes:

*** Significant at the level of 0.01

** Significant at the level of 0.05

* Significant at the level of 0.1

a I rank the annual sample by absolutes value of current write-down ratio and mark the top 20% portfolio as the high written down firms. If the firms were marked as "high" in one of the sample years, they will be categorized in HIGH sample. Otherwise, they will be categorized in LOW sample.

b 2-way table chi-squared statistic is 14.52, significant at the 0.05 level

c see Table 10 for definitions other than RET

see Table 4 for definitions for R.

Table 12

Non-nested Model Comparisons in Sub Samples

Panel A: Balance Sheet Model

	Low						High					
	adj.R squares		J Test[a]		Cox Test		adj.R squares		J Test		Cox Test	
	H	W	Test 1	Test 2	Test 1	Test 2	H	W	Test 1	Test 2	Test 1	Test 2
1998-2001	69.09%	69.07%	-2.072**	2.137**	93.359***	-281.4***	69.97%	70.75%	4.306***	-2.298**	-17.88***	5.004***
1999-2001	66.89%	66.91%	0.469	-0.29	-15.45***	8.943***	68.35%	69.13%	3.103***	-1.125	-12.86***	3.121***

Panel B: Return Model

	Low						High					
	adj.R squares		J Test		Cox Test		adj.R squares		J Test		Cox Test	
	H	W	Test 1	Test 2	Test 1	Test 2	H	W	Test 1	Test 2	Test 1	Test 2
1998-2001	60.19%	60.66%	2.406***	0.572	-4.076***	-0.888	54.93%	54.42%	1.001	2.555***	-1.648*	-5.2***
1999-2001	64.36%	64.92%	2.269**	0.533	-4.79***	-0.932	60.37%	60.68%	2.006**	1.186	-6.665***	-3.17***

Panel C: Price Model

	Low						High					
	adj.R squares		J Test		Cox Test		adj.R squares		J Test		Cox Test	
	H	W	Test 1	Test 2	Test 1	Test 2	H	W	Test 1	Test 2	Test 1	Test 2
1998-2001	73.51%	73.86%	9.156***	0.47	-4.938***	-0.82	73.50%	74.05%	4.213***	2.692***	-5.627***	-3.2***
1999-2001	70.56%	71.21%	2.631***	0.244	-7.318***	-0.524	70.06%	71.31%	3.96***	1.239	-11.01***	-2.29**

Notes:

*** Significant at the level of 0.01

** Significant at the level of 0.05

a Tests are defined in Table 8.

Table 13
Relative Measurement Error in Sub Samples

Panel A: Balance Sheet Model

	$\sigma^2 u_{mvac} - \sigma^2 u_{mvach}$							
	Low				High			
	Barth (1991)		Boone (2002)		Barth (1991)		Boone (2002)	
1998-2001	-0.0525		-0.0709		0.2109		0.1723	
F test	4377.22	***	5373.85	***	3377.31	***	895.88	***
1999-2001	-0.0320		-0.0471		0.2394		0.1975	
F test	1099.54	***	1662.56	***	2010.71	***	601.90	***

Panel B: Return Model

	Vuong's Z value			
	Low		High	
	Earnings Level	Earnings Change	Earnings Level	Earnings Change
1998-2001	-0.162	-0.414	0.138	0.182
1999-2001	-0.465	-0.660	-0.474	-0.232

Notes:

*,**,*** denote significance in two-tailed tests at the 0.10, 0.05, and 0.01 levels, respectively.

a Tests are defined in Table 9

Appendix A: Model Specification[45]

I. Model Derivation

Various parties such as shareholders, investors or lenders will have explicit interests in valuing firms. Modern accounting and finance research began with ideas of finding mis-priced securities. During the past several decades, researchers devised numerous models to estimate firms' intrinsic values. Three major models were developed: dividend-discounting, capitalization, and residual income valuation.

I - 1. Discounting models

The discounting model is often referred to as dividend discounting. The model defines share price as the present value of expected future dividends discounted at their risk-adjusted expected rate of return. Formally,

$$P_t = \sum_{k=1 to \infty} \{E_t[D_{t+k}]\} / \prod_{j=1 to k} (1 + r_{t+j}) \qquad \text{(A-1)}$$

where P_t is share price at time t, $E_t[D_{t+k}]$ is market's expectation of dividends in period t+k, and R_{t+j} is risk-adjusted discount rate that reflects the systematic risk of dividends in period t+j.

As seen from (A-1), price depends on forecasts of future dividends and discount rates for future periods. The Gordon growth model makes simplifying assumptions. Specifically, if the discount rate, r, is constant through time and dividends are

[45] Some contents are based on existing review papers, for example, Kothari (2001).

expected to grow at a constant rate g (g<r), then the value of a firm can be expressed in terms of expected dividends, discount rate and constant growth rate:

$$P_t = E_t[D_{t+1}]/(r-g) \qquad \text{(A-2)}$$

Though the discounting model has theoretical foundations, it is not often employed in empirical research because of its restrictive assumptions. Finance researchers soon simplified this model. Later research points out, the dividend policy per se does not affect firm value, instead, it is the firm's investment policy that matters. The growth rate also depends on reinvestment, which can increase future market value. This approach led to models laying stress on investment and its capitalization process.

I-2. The capitalization models

The idea of the capitalization models is that a firm's value is either the sum of past operating results or the expectations of future operating results. The first approach is the equity model: the value of a firm is the result of investments and reinvestments transformed into equity. The share price in this model is:

$$P_t = MVE_t + u_t \qquad \text{(A-3)}$$

where P_t is share price at time t, MVE_t is market value of equity at time t, and u_t is error term caused by unrecognized accounting information or conservatism.

(A-3) can be decomposed as:

$$P_t = MVA_t + MVL_t + u_t \qquad \text{(A-4)}$$

where MVA_t is market value of assets at time t, MVL_t is market value of liability at time t, and u_t is error term. Here the firm's market value is a weighted combination of asset and liability market value (Landsman 1986). Book value of assets and liabilities

are often used as proxies for market value of assets and liabilities, because the market values are seldom available. That is,

$$P_t = BVE_t + u_t = BVA_t + BVL_t + u_t \qquad \text{(A-5)}$$

where BVE_t is book value of equity at time t, BVA_t is book value of asset at time t, BVL_t is book value of liability at time t, and u_t is error term.

(A-5) is referred to as the "balance sheet model", and its format varies with different research objects. The balance sheet model was first used by Beaver et al (1989) in research on non-performing loans and later used by Barth et al (1991). Since then, this model has been frequently used in accounting research because of its conceptual basis and ease of application in accounting setting. Moreover, it is suitable for research that focuses on measurement error in reported accounting numbers (Barth 1991, 1994, Choi, et al. 1997, Boone 2002).

The second view is that firm value is the expectation of future operating results, which is closely related to the discounting models. If the expected return on investment in all future periods is r, then the share price P_t can be expressed as:

$$P_t = \frac{E(X_{t+1})}{r} + v_t \qquad \text{(A-6)}$$

where $E(X_{t+1})$ is forecasted earnings for the next period at the time *t*, *r* is return rate that supposed to be constant over periods, and v_t is an error term.

Equation (A-6) can be explained as the "capitalized value of the earnings stream produced by the assets that the firm currently holds." Earnings capitalization models are popular in accounting research, especially in earnings response coefficient research. $E(X_{t+1})$ is replaced with X_t , which is the current income, when incomes are assumed to be constant in future periods.

Despite apparent differences between the balance sheet model and the income capitalization model, they both reduce to the income statement model mathematically.

Take first differences in the balance sheet model, (A-5), obtaining,

$$\Delta P_t = \Delta BVE_t + \Delta u_t \qquad \text{(A-7)}$$

Next, $\Delta BVE_t = X_t - d_t$, which means the current year's change in net worth is caused only by the change in the income statement, current earnings X_t, and the current dividend d_t. (A-7) can be transformed into the income statement model,

$$\mathrm{Re}t_t = (\Delta P_t + d_t)/P_{t-1} = X_t/P_{t-1} + u'_t \qquad \text{(A-8)}$$

where, Ret_t is the holding return from time t-1 to time t, including price increase and dividend, X_t is current earnings as of t, P_{t-1} is share price at t-1, and u'_t is the error.

One can, by the same token, derive the income statement model from (A-6). Suppose that the current share price is cum-dividend, and this relation holds constantly. (A-9) is the earnings capitalization model for time t-1:

$$P_{t-1} = \frac{X_{t-1}}{r} + v_{t-1} \qquad \text{(A-9)}$$

Subtracting (A-9) from (A-6) gives an alternative expression of the income statement model in change of earnings:

$$\mathrm{Re}t_t = (P_t - P_{t-1})/P_{t-1} = \frac{1}{r}(\Delta X_t/P_{t-1}) + v'_t \qquad \text{(A-10)}$$

It is an empirical issue whether level of earnings or change of earnings better explains security returns. Ball and Brown (1968), as well as Beaver (1968), have set the basic theoretical work for the income statement model in the 1960s. They define the information content of earnings in terms of abnormal earnings, measured by the

difference between actual and expected earnings, with expected earnings estimated as last year's actual earnings. The reason to use abnormal earnings is testing the market reaction to so-called "good news" or "bad news" within a specific window rather than the change of earnings in reaction tests. However, others use the level of earnings. Therefore, there are two competing constructs for measuring information content in earnings. Efficient securities market theory predicts that security prices will react quickly and in an unbiased manner to new information and there should be no abnormal returns under both methods. When the assumption of efficient markets is relaxed, however, matters become less clear. Ball and Brown (1968) believe that the return in their model is better explained by abnormal earnings. Easton and Harris (1991) further develop the model of Ball and Brown (1986) and suggest that both the level model (A-8) and change model (A-10) proxy for abnormal earnings and can be used to account for market return. They suggest use of a mixed level and change model:

$$\mathrm{Re}t_t = X_t / P_{t-1} + \Delta X_{t-1} / P_{t-1} + v_t^{''} \qquad \text{(A-11)}$$

The explanatory power of the income statement model is generally lower than that of the balance sheet or capitalization models. Market volatility can also reduce explanatory power, which effect is conspicuous in China (Lee and Cao 2002).

I-3. The residual income models

The Ohlson (1995) and Feltham and Ohlson (1995) residual income valuation model has become popular in the literature. Starting with a dividend-discounting model, the residual income valuation model expresses firm value as the sum of current book value and the discounted present value of expected abnormal earnings,

which combines the previous two capitalization views. The standard residual income model is expressed as:

$$P_t = BVE_t + \sum_{k=1}^{\infty} \frac{E_t[X_{t+k} - r * BVE_{t+k-1}]}{(1+r)^k} \quad \text{(A-12)}$$

where BVE_t is book value of equity at time t, E_t is the expectation operator where the expectation is based on information available at time t, X_t is current earnings for period t, and r is risk-adjusted discount rate .

Olhson (1995) imposes a time-series structure on the abnormal earnings (X_t^a) in (A-12). The linear information dynamics in the model specifies an autoregressive, time-series decay in the current period's abnormal earnings (A-13), and models "information other than abnormal earnings" into prices (A-14).

$$X_{t+1}^a = \omega X_t^a + v_t + \varepsilon_{1,t+1} \quad \text{(A-13)}$$

$$v_{t+1} = \gamma v_t + \varepsilon_{2,t+1} \quad \text{(A-14)}$$

where v_t is the correlated residual in time t and ε_t is the uncorrelated residual in time t. The two equations above are known as the Olhson (1995) model.

The economic intuition for the autoregressive process in abnormal earnings is that competition will sooner or later erode above-normal returns and that firms who are experiencing below-normal rates of returns eventually exit the market. The other information in the Ohlson model formalized the idea that prices reflect a richer information set than transaction-based, historical-cost earnings. The Feltham and Ohlson (1995) model (hereafter, F-O model) retains much of the structure of the Ohlson(1995) except the autoregressive time-series process. As one of the few

attempts in accounting theory to address empirical finance issues, the F-O model is often used in empirical research (Burgstahler and Dichev 1997).

The F-O model is superior to the dividend-discounting model in its ease of implementation. First, the assumptions are more common and make the work easier. Second, it provides a role for many important features of the accounting system, covering areas like clean surplus, book value as well as earnings, transitory components of earnings, conservatism, and delayed recognition. However, some aspects of this model are unsupported by the empirical data, such as linearity properties. It should be pointed out that most of the F-O models are conducted in "reduced forms", rather than the original residual income model. Often, abnormal earnings are replaced with current year earnings, which form the "price model", where market equity value becomes a function of book value of equity and current earnings. This model is:

$$P_t = BVE_t + X_t + \varepsilon_t \qquad \text{(A-15)}$$

where P_t is share price in time t, BVE_t is book value of equity per share in time t, and X_t is reported net income per share in time t.

Each model may be able to explain share prices in some aspects. It is not wise to criticize one model on the grounds that its assumptions are too restrictive to represent the real world. Model efficiency should be examined empirically.

II. The Discussion on Model Inappropriateness and Possible Remedy

It is expected that stock price does not have a linear association with accounting information in China. The U.S. market saw an escalating gap between the book and market value during the last 20 years of the 20th century. There is some doubt

whether the linear model used pervasively in accounting research could capture the market-book relation that could actually be nonlinear. Also, researchers are less likely to uncover a one to one relation between market and book value, the theoretical assumption still held by many researchers. If I use conventional models in this study, results could be biased due to model mis-specification.

First, a nonlinear relation between market and book value could exist in China, where resources are not evenly distributed. Listed companies are more or less controlling scare resources that bring extra profits, which could either be a privilege, a technology advantage, or a monopoly. HW 2001 note that, if the firm has some competitive advantage, for example, proprietary technology that may not be separable and saleable, that allows it to earn a positive abnormal return (economic rents), then (A-5), the balance sheet model, might not hold. In such a case, total equity value exceeds the combined value of net assets, even if the assets are valued at market. Then equity value is a weighted average of operations value (value from continuing operations plus value of future expansion) and abandonment value (net asset value) (Burgstahler and Dichev 1997). If agency costs are low, the firm will liquidate when the value of net assets value exceeds the operations value of the firm. It is especially important to consider the abandonment option, without which the value of net assets is not associated with the value of the firm except to the extent it affects future operating cash flows. Although some investors in China can sell shares if the price has reached the abandonment point, it is difficult for the State government, who is the major investor in china, to liquidate. Considering that the majority shareholder in China is the State rather than individual investors, the effect of abandonment value is relatively small. Therefore, the relation between firm value and value of net assets value is neither zero nor a one-to-one linearity in China. If

operations value exceeds net assets but there is a likelihood of abandonment then equity value could has a nonlinear relation with net assets (Wysocki 1999).

Second, existing models by no means incorporate all the variables reflected in market price because of information asymmetry. The information that investors rely on might be quite different from reported accounting information. For example, political information and rumor are important in China. Therefore stock prices incorporate some information that is not explained by accounting numbers. Model inappropriateness leads to biased results even if the market-book relation is linear.

Remedies against model inappropriateness vary in practice. Many value-relevance studies using the balance sheet model allow the possibility that firms have a competitive advantage. To eliminate the economic rent effect, some researchers convert it to an identity by including a goodwill term, defined as the difference between market value of equity and net asset value:

$$MVE = BVA + BVL + GW \tag{A-16}$$

where MVE is the security market value, BVA is the book value of equity, BVL is the book value of liability, and GW = goodwill = MVE - MVA -MVL. Sometimes, researchers incorporate variables in their model to proxy non-accounting information, for example, an indicator variable for bull or bear market.

Variable adding is one remedy, equation transformation is the other. As proposed by many researchers, it is difficult to construct a non-linear model, especially in accounting. Transformation is used in most applications, in the belief that many complex functional relations are intrinsically linear and can be linearized by transformation, e.g. logarithms, exponentials, reciprocals and polynomials.

The relation between equity market values and accounting numbers will not be purely linear in reality, which can be seen from a simple market-book line drawn in X-Y bars. The non-linearity draws a concave shape line, suggesting an exponential relation between market and book value. A hybrid of the linear and log-linear models, the semi-log equation would be a good candidate.

$$LnY = \beta_1 + \beta_2 X + \varepsilon \qquad \text{(A-17)}$$

where Y is the market value and X is the book value. Ln denotes the natural log function. The coefficient in a semi-log model has a special meaning. A one-unit increase in net asset causes a β-percent increase in stock price. By the same token, a one-unit increase in earning could trigger a β-percent increase in return. The effect of the semi-log transformation can only be examined empirically.

I perform balance sheet model (equation 1) regressions on both the untransformed and the semi-log transformed data. Annual data is used so I drop the survival criterion from my previous sample criteria. 542 firms are picked in 1998, 655 firms in 1999, 780 firms in 2000 and 884 firms in 2001. Results (not reported in detail here) give sufficient evidence that the semi-log model fits better. First, three out of four adjusted R squares are higher in semi-log models than in untransformed models. Second, as expected, all the coefficients in semi-log models are significant at least at 0.1 levels. However, several coefficients in the untransformed models are unexpectedly insignificant, for example, the coefficient on BVL is -0.609 (t=-1.627) in 1998 and that on BVAH is 0.0237 (t=0.103) in 1999. Third, residual analysis also supports the semi-log model. The residuals of the semi-log regressions appear approximately normal, while the residuals of the untransformed models exhibit a quadratic pattern. Normality is tested by skewness and kurtosis tests and a joint Wald test of both skewness and kurtosis. All three tests reject the hypothesis that the

residuals are normal for the untransformed models. The results are much better in the semi-log models, with skewness and kurtosis much closer to normal distribution values. In some cases, normality cannot be rejected despite the high power of the test due to large sample sizes. Fourth, the distribution of residuals against fitted values indicates a serious heteroskedasticity problem in the untransformed models.[46] For the semi-log model, heteroskedasticity is not visually apparent. Finally, the histogram of standardized residuals presents further evidence that the distribution is much more asymmetric for the untransformed models than for the semi-log models. Descriptive statistics also indicate that the semi-log model is better in capturing the market-book relation. Average net assets increased from 1.81 to 2.19 during the four-year period, achieving a 20.99% growth. The average untransformed market value, however, achieves a 39.92% growth. The growth rate is for log market value is 18.58%, much closer to the one to one book-market theoretical relation. Based on the above discussion, the semi-log model should be favored in balance sheet model regression.

Further comparisons done using the return and price models again favor the semi-log models. It is clear that the semi-log transformation is a practical way to improve the model fitness in this paper, even if the untransformed balance sheet model is appropriate. Therefore, I will use semi-log transformations of equity market value and market return. To avoid infinite logarithmic transformations of returns, I add 1 to all returns prior to transformation:

$$Ln(1+\mathrm{Ret}_t) \quad \text{where} 1+\mathrm{Ret}_t > 0 \tag{A-17}$$

[46] The White (1980) t test could solve this problem in both models.

III. Fixed Effects and Random Effects

Data sets can comprise either time series or cross sections. The data sets that combine both are called longitudinal or panel data sets. This paper employs a panel in the multivariate regressions. Greene (2003) points out that "the fundamental advantage of a panel data set over a cross section is that it will allow the researcher great flexibility in modeling differences in behavior across individuals." A pooled regression cannot fully capture the heterogeneity, or individual effects, among different firms and years. It is especially important to control the firm and year effects in stock market research in China. Firms' different backgrounds determine their different sensitivities to regulations and rules. These specific firm attributes should be controlled in market research. For example, the share price of the listed companies in western China out-performed the rest of the market when the government announced the "Western China Development" Program.

Fixed effects and random effects are often used to improve estimation of regression coefficients by avoiding the omitted variable problem. The fixed effects approach takes one "fixed" term as a group-specific constant and assigns each of the firm-year observations an independent constant. If the unobserved individual year and firm effects are correlated with the regressors, omitting the effects will bias estimation of the regressors. The fixed effects regression model is:

$$Y_{it} = \alpha_i + \gamma_t + \boldsymbol{\beta}' \mathbf{x}_{it} + \varepsilon_{it} \qquad \text{(A-18)}$$

where Y_{it} is the dependent variable, $\boldsymbol{\beta}$ and $\mathbf{x}_{it}$ are vectors of parameters and independent variables, respectively, α_i is the firm-specific effect that is fixed across years, γ_t is the year-specific effect that is fixed across firms, and ε_{it} is the remaining residual (capturing the effect of all omitted variables). The fixed effects are dummy

variables that each sum to 1, hence one of the time and one of the firm effects must be omitted (and an overall constant permitted) in order to avoid perfect collinearity.

Results for these dummy variables are not reported in the tables, as they serve only a control function to improve estimation of the regressors of interest in this research.

The random effects regression model is based on a random sample from the target population. If the sample is random, individual effects are uncorrelated with the regressors and randomly distributed across cross-sectional units. That is,

$$Y_{it} = \alpha + \boldsymbol{\beta}' \mathbf{x}_{it} + v_i + u_t + \varepsilon_{it} \qquad \text{(A- 19)}$$

where v_i is the random disturbance characterizing the ith observation and is constant through time, and u_t is the random disturbance characterizing year t, and ε_{it} is the remaining residual.

An important of advantage of the random effects model is increased degrees of freedom over the fixed effects model. The sample used in this study, however, is not random. A priori, then, I assume the fixed effects model is more appropriate for purposes of this study. Nevertheless, as Greene (2003) notes, the distinction is not theoretically clear-cut, and it is possible for the assumptions of the random effects model to be met in non-random samples. The Hausman specification test (Greene 2003, 301) assesses the propriety of the random effects assumption. For the panel data used in this study, the Hausman test rejects the assumptions of orthogonality between the random effects and regressors at less than the 0.01 level for all models. Therefore, I employ the fixed effects model in the study. I note, nevertheless, that the results using the random effects model on this panel data set are qualitatively similar to the fixed effects results reported here.

Appendix B: Non-nested Model Test

I. J Test

The J test addresses the problem of choosing between two possible sets of regressors, where the sets are overlapping but non-nested. That is, the two sets share some, but not all, regressors, and there are distinctive regressors in both sets. I illustrate the J test in the balance sheet model as an example.

The null hypothesis H_0 is that HCA is the correct model; the alternative H_1 is that LCM is the correct model. Run the following regressions:

$$MVE_{it} = \psi_0 + \psi_1 BVA0_{it} + \psi_2 BVL_{it} + \psi_3 BVAH_{it} + \psi_4 M\hat{V}E^{c}_{it} + \rho_{it} \qquad \text{(A-20)}$$

where $M\hat{V}E^{c}_{it}$ is the fitted market value of equity from equation (5), i.e. from the LCM balance sheet model. This LCM fitted value is added into equation (4) to form equation (A-20). In this equation, a test of $\psi_4 = 0$ would be a test of null hypothesis H_0. A significant ψ_4 would reject the null and accept the alternative that LCM is the better model. The idea of the J test (which is relatively non-parametric and intuitively plausible) is that, if HCA is the correct model and LCM is not the correct model, the fitted values from the LCM regression cannot be useful in fitting the HCA regression.

The J test is symmetric, however, and one can interchange the models and repeat the test. That is, run the following regression:

$$MVE_{it} = \psi'_0 + \psi'_1 BVA0_{it} + \psi'_2 BVL_{it} + \psi'_3 BVAC_{it} + \psi'_4 M\hat{V}E^{h}_{it} + \rho'_{it} \qquad \text{(A-21)}$$

where $M\hat{V}E^{h}_{it}$ is the fitted market value of equity from equation (4), i.e. from the HCA balance sheet model.

The J test can have four possible outcomes: reject HCA only, reject LCM only, reject both HCA and LCM, reject neither HCA nor LCM. In most empirically tests, models are advanced only as approximately correct for the data analyzed. In this situation, and because of shared variables, the J test often rejects both models, but rejection can occur at a level considerably lower for one model than the other. Such a result qualitatively favors the lower level.

II. Cox Test

This likelihood ratio test is an extension of a general test of Cox (1961, 1962). Here I illustrate it with the income statement model. Like the J test, the Cox test is symmetric, and two tests are performed, in which the LCM and HCA models are interchanged. The following does the first test that H_0: HCA model is correct; H_1: LCM model is correct.

Step 1, regress R on E^h and ΔE^h and compute $\widehat{R}_h$ and residual e_h, and $S_h^2 = e_h' e_h / n$.

Step 2, regress R on E^c and ΔE^c and compute $\widehat{R}_h$ and residual e_c, and $S_c^2 = e_c' e_c / n$.

Step 3, regress $\widehat{R}_h$ on E^c and ΔE^c, then compute the residual e_{ch}.

Step 4, regress e_{ch} on E^h and ΔE^h, then compute the residual e_{hch}.

Step 5, compute $S_{ch}^2 = S_h^2 + e'_{ch}\, e_{ch} / n,\ c_{01} = \frac{n}{2} \log \frac{S_c^2}{S_{ch}^2},\ v_{01} = S_h^2 * \left(\frac{e'_{hch}\, e_{hch}}{S_{ch}^2} \right)^2$.

Step 6, $q = \frac{c_{01}}{\sqrt{v_{01}}}$ and check the q value against the critical standard normal value, for example, the 5 percent critical value of 1.96.

Reverse the HCA and LCM roles and repeat the above steps to complete the two-way tests. The Cox test is generally more powerful than the J test, but is essentially parametric, relying on the assumption that the residuals are normally distributed (the likelihood ratio is that of the normal distribution). Thus the Cox test is less robust than J test.

III. Vuong Test

Vuong has provided a likelihood ratio test for model selection to test the null hypothesis that the two models are equally close to explaining the "true data generating process" against the alternative that one model is closer. For example, if we test whether earnings A is closer to true earnings than earnings B, we could construct the following equation specified in Dechow (1994):

$$m_i = \frac{1}{2}\log\left[\frac{RSS_B}{RSS_A}\right] + \frac{n}{2}\left[\frac{e_{Bi}}{RSS_B} - \frac{e_{Ai}}{RSS_A}\right] \qquad \text{(A-22)}$$

Equation (A-22) is a simplification obtained from the Vuoung's original procedures. We can obtain the Vuong's z-statistic by regressing m_i on unity. The coefficient in this regression will equal ½ Log[RSSb/RSSa] and tells us the mean difference in explanatory power between earnings B and earnings A. The standard error from the regression tells us whether the relationship is unusual, i.e. if the difference is significant. The z-statistic can be obtained by multiplying the t-statistic from the regression by $((n-1)/n)^{1/2}$. Note that a positive z-statistic implies that the residuals produced by the earnings B are larger in magnitude than those from earnings A. Hence, a positive and significant z-statistic indicates that earnings A has less measurement error. Dechow (1994) clearly illustrates the above procedures.

Appendix C: Relative Measurement Error Research

This appendix illustrates the theory and practical computation for the relative measurement error. Measurement error is defined as the difference between book value and its corresponding market value, which comprise their intrinsic market values and measurement errors. I start this research from the balance sheet model.

$$BVA_0 = MVA_0 + \upsilon_{mva0} \tag{A-23}$$

$$BVL = MVL + \upsilon_{mvl}$$

$$BVA = MVA + \upsilon_{mva}$$

(A-23) shows the book-to-market relations in the balance sheet model, where MVA_0, MVL and MVA denote market values, and u_{mva0}, u_{mvl} and u_{mva} denote measurement errors. These measurement errors become the statistical residual.

$$\text{residual} = -\gamma_1 * u_{mva0} - \gamma_2 * u_{mvl} - \gamma_3 * u_{mva} \tag{A-24}$$

where γ_i are estimated coefficients for BVA_0, BVL and BVA, respectively (i=1,2,3).

Absent measurement error, accounting data fit the balance sheet model perfectly, leaving no intercept or residual and capitalizing assets and liabilities at the rate of 1. If measurement error does exit, we would observe intercepts, residuals and biased coefficients in almost all regressions. The measurement error could be either positive or negative, depending on its attributes. E.g., fixed assets or contingent liabilities might be underestimated, producing a positive measurement error. Measurement error causes bias in coefficient estimations, as shown in equation (A-25):

$$MVE = \gamma_0 + (1 - B_1)BVA0 + (1 - B_2)BVL + (1 - B_3)BVA + \upsilon \tag{A-25}$$

B_k is the proxy for biases in the coefficients (k = 1, 2, 3). The relative measurement error is computed as the relative magnitude of measurement error variance from

these coefficients biases, i.e. σ^2_{umva0}, σ^2_{umvl} and σ^2_{umva}.[47] Barth (1991) uses proxies for assessing the variance and covariance structures of the measurement error. The coefficient biases are expressed with Y_i and other variables:

$$B_1 = -[(\frac{\beta_{31}}{\sigma^2_{e3}})Y_3 + (\frac{\beta_{21}}{\sigma^2_{e2}})Y_2 - (\frac{1}{\sigma^2_{e1}})Y_1)] \quad \text{(A-26)}$$

$$B_2 = -[(\frac{\beta_{32}}{\sigma^2_{e3}})Y_3 + (\frac{\beta_{12}}{\sigma^2_{e1}})Y_1 - (\frac{1}{\sigma^2_{e2}})Y_2]$$

$$B_3 = -[(\frac{\beta_{23}}{\sigma^2_{e2}})Y_2 + (\frac{\beta_{13}}{\sigma^2_{e1}})Y_1 - (\frac{1}{\sigma^2_{e3}})Y_3)]$$

Y_i denotes the variance-covariance structures of particular measurement errors, β_{ij} and σ^2_{ei} are operationally defined as the slope coefficients and residual variance obtained from the auxiliary regression specified in equation (A-27): [48]

$$BVA_0 = \beta_{10} + \beta_{12}BVL + \beta_{13}BVA + e_1 \quad \text{(A-27)}$$

$$BVL = \beta_{20} + \beta_{21}BVA_0 + \beta_{23}BVA + e_2$$

$$BVA = \beta_{30} + \beta_{31}BVA_0 + \beta_{32}BVL + e_3$$

Barth (1991) estimates the magnitude of Y_i through the matrixes in (A-26) and (A-27). Choi, et al (1997) further simplifies this procedure in a 2-stage regression. The Y_i are assessed by the coefficient ϕ_i in the following equation:[49]

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[47] Unfortunately, these variances are interact with other variances, forming complex variance-covariance constructs.

[48] No restrictions are posed in Y_i except that there is no relation between two market value variables. Different restrictions lead to different computations of relative measurement error. For example, Boone (2002) assumes that each measurement error and its underlying market value should exert effects on all measurement errors. Barth (1991), however, poses more rigid restrictions.

[49] Seemingly related regression method is used in estimation for HCA and LCM data because they are actually related.

$$MVE^{error} = \phi_0 + \phi_1 Z_{bva0} + \phi_2 Z_{bvl} + \phi_3 Z_{bva} + \omega \quad \text{(A-28)}$$

where:

$$Z_{bva0} = -\left[\frac{BVA_0 - \beta_{12} BVL + \beta_{13} BVA}{\sigma_{e1}^2}\right]$$

$$Z_{bvl} = -\left[\frac{BVl - \beta_{21} BVA_0 + \beta_{23} BVA}{\sigma_{e2}^2}\right]$$

$$Z_{bva} = -\left[\frac{BVA - \beta_{31} BVA_0 + \beta_{32} BVL}{\sigma_{e3}^2}\right]$$

$$MVEh^{error} = MVE - (BVA_0 + BVL + BVAh)$$

$$MVEc^{error} = MVE - (BVA_0 + BVL + Sh/Sc * BVAc)$$

MVE, BVA_0, BVL, BVA_h, BVA_c, β_{ij} and σ_{ei}^2 are defined in equation (A-26), and S_h/S_c is a scale factor: S_h as the mean value of BVA_h and Sc of BVAc.[50]

After the magnitude of the variance and covariance structure is estimated, it is possible to estimate the magnitude of measurement error variance. However, different assumptions lead to different interpretations of the variance and covariance structure, and, therefore, different measurement error variance. For this reason, I first explore the variance and covariance structure.

Consider (A-25) without BVA_0. Now let BVA_0 enter (A-25). Its market value MVA_0 will interact with its measurement error u_{mva0} and other existing measurement errors from assets and liabilities. MVA_0 does not interact with other market values.[51] The new measurement error, $u_{mva0,}$ will interact with all the market values and

[50] Scale differences between BVAH and BVAC, though not large (around 1.04), confound comparisons of measurement error variance because variance is a function of scale (i.e. $Var(sx)=s^2Var(x)$). Following Barth (1991) and Boone (2002), I multiply the factors in my models.

[51] Market values are assumed to be uncorrelated.

measurement errors.[52] It is the same for BVL and BVA, so the variance-covariance structure could be expressed as (A-29):

$$Y_1 = \sigma\ mva0,\ u_{mva0} + \sigma\ mva0,\ u_{mvl} + \sigma\ mva0,\ u_{mva} + \sigma\ u_{mvl},\ u_{mva0} + \sigma\ u_{mva},\ u_{mva0} + \sigma^2 u_{mva0}$$

$$Y_2 = \sigma\ mvl,\ u_{mva0} + \sigma\ mvl,\ u_{mvl} + \sigma\ mvl,\ u_{mva} + \sigma\ u_{mvl},\ u_{mva0} + \sigma\ u_{mva},\ u_{mvl} + \sigma^2 u_{mvl}$$

$$Y_3 = \sigma\ mva,\ u_{mva0} + \sigma\ mva,\ u_{mvl} + \sigma\ mva,\ u_{mva} + \sigma\ u_{mva0},\ u_{mva} + \sigma\ u_{mvl},\ u_{mva} + \sigma^2 u_{mva}$$

Y_1 is the variance and covariance structure for BVA_0 and $\sigma^2 u_{mva0}$ is the measurement error variance for BVA_0; Y_2 is the structure for BVL and $\sigma^2 u_{mvl}$ is the measurement error variance for BVL; Y_3 is the structure for BVA while the $\sigma^2 u_{mva}$ is the measurement error variance for BVA. Consider that BVA could either be BVAH under the HCA or be BVAC under the LCM; the research question is whether their measurement error variances, $\sigma^2 u_{mvah}$ and $\sigma^2 u_{mvac}$, are equal.

Barth (1991) assumes that measurement errors in MVA are uncorrelated with other variables. That is to say, the value of some covariances are zero; in Y_3, e.g., $\sigma\ mva,\ u_{mva}$, $\sigma\ u_{mva0},\ u_{mva}$ and $\sigma\ u_{mvl},\ u_{mva}$. In this setting, the variance-covariance structure Y_i can be reduced to equation (A-30):

$$Y_1 = \sigma\ mva0,\ u_{mva0} + \sigma\ mva0,\ u_{mvl} + \sigma\ u_{mvl},\ u_{mva0} + \sigma^2 u_{mva0} \qquad \text{(A-30)}$$

$$Y_2 = \sigma\ mvl,\ u_{mva0} + \sigma\ mvl,\ u_{mvl} + \sigma\ u_{mvl},\ u_{mva0} + \sigma^2 u_{mvl}$$

$$Y_3 = \sigma\ mva,\ u_{mva0} + \sigma\ mva,\ u_{mvl} + \sigma^2 u_{mva}$$

[52] The variance of u_{mva} is the focus of this paper because it captures measurement error effects in net assets.

There is no difference in Y_1 and Y_2 no matter which accounting convention is taken, HCA or LCM. Furthermore, MVA, the market value of write-down assets, together with U_{mva0} and U_{mvl} are constant in both accounting conventions. The only difference brought by asset write-down practice is in $\sigma^2 u_{mva}$, which is $\sigma^2 u_{mvah}$ under HCA (BVA_h) and $\sigma^2 u_{mvac}$ under LCM (BVA_c); U_{mvaj} is either U_{mvah} or U_{mvac}, depending on accounting convention. I can assess the relative magnitudes of asset write-down measurement errors by comparing Y_3 values. An F test is conducted to test whether $\sigma^2 u_{mvac}$ and $\sigma^2 u_{mvah}$ are equal in statistically.[53] If the write-down practice produces more measurement error in LCM than in HCA, $\sigma^2 u_{mvac}$ should be bigger, significantly or insignificantly. Barth's approach is expressed as:

$$Y3c - Y3h = \sigma^2 u_{mvac} - \sigma^2 u_{mvah} \qquad \text{(A-31)}$$

Another view of measurement error imposes no restrictions on equation (A-29) and focuses on the integrated effects of measurement error, as in Boone (2002). Boone argues that the covariances ignored by Barth (1991) could influence the computation of measurement error and the final conclusion. Therefore, he includes the covariances omitted in Barth (1991). In Boone's method, there are two sets of variance-covariance structures, Y_{ih} from HCA and Y_{ic} from LCM. Subtracting Y_{ic} from Y_{ih} yields the following expression:

$$Y_{1h} - Y_{1c} = \sigma\, mva0, u_{mvah} + \sigma\, u_{mvah}, u_{mva0} - (\sigma\, mva0, u_{mvac} + \sigma\, u_{mvac}, u_{mva0}) \qquad \text{(A-32)}$$

$$Y_{2h} - Y_{2c} = \sigma\, mvl, u_{mvah} + \sigma\, u_{mvah}, u_{mvl} - (\sigma\, mvl, u_{mvac} + \sigma\, u_{mvac}, u_{mvl})$$

[53] This test is done in the seemingly unrelated regression model, where SAS reports an F test while LIMDEP reports a $\chi 2$ test. The degree of freedom is one in this test. This effect of the F and $\chi 2$ should be approximately same here because the F distribution and Chi-square distribution are essentially identical with one degree of freedom.

$$Y_{3h} - Y_{3c} = \sigma\ mva,\ u_{mvah} + \sigma\ u_{mva0},\ u_{mvah} + \sigma\ u_{mvl},\ u_{mvah} + \sigma^2 u_{mvah} - (\sigma\ mva,$$

$$u_{mvac} + \sigma\ u_{mva0},\ u_{mvac} + \sigma\ u_{mvl},\ u_{mvac} + \sigma^2 u_{mvac})$$

Re-arranging (A-32) yields (A-33) as follows:

$$Y_{1h} + Y_{2h} - Y_{3h} - (Y_{1c} + Y_{2c} - Y_{3c}) \qquad \text{(A-33)}$$

$$= \sigma^2 u_{mvac} - \sigma^2 u_{mvah} + (\sigma\ mva0,\ u_{mvah} - \sigma\ mva0,\ u_{mvac}) + (\sigma\ mvl,\ u_{mvah} - \sigma\ mvl,\ u_{mvac}) +$$

$$(\sigma\ mva,\ u_{mvac} - \sigma mva,\ u_{mvach}) = \sigma^2 u_{mvac} - \sigma^2 u_{mvah} + \xi\ (\xi >= 0)^{54}$$

The null hypothesis that function $Y_{1h} + Y_{2h} - Y_{3h} - (Y_{1c} + Y_{2c} - Y_{3c}) >= 0$ will be rejected only if $\sigma^2 u_{mvac}$ is significantly smaller than $\sigma^2 u_{mvah}$, indicating that the asset write-down practice has reduced measurement error effectively. In other situations, the function is biased towards a positive value under.

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[54] $\xi = (\sigma\ mva0,\ u_{mvah} - \sigma\ mva0,\ u_{mvac}) + (\sigma\ mvl,\ u_{mvah} - \sigma\ mvl,\ u_{mvac}) + (\sigma\ mva,\ u_{mvac} - \sigma\ mva,\ u_{mvah})$. Here I prove that $\xi >= 0$:

[i] $\sigma\ mva0,\ u_{mvah} - \sigma\ mva0,\ u_{mvac}$ = Cov (mva0, Umvah) - Cov (mva0, Umvac) = Corr (mva0, Umvah) [Var(mva0)Var(Umvah)]1/2 - Corr (mva0, Umvac) [Var(mva0)Var(Umvac)]1/2

- Corr (mva0, Umvac) [Var(mva0)Var(Umvac)]1/2

Because Cov(mva, Umvah) = Cov (mva, Umvac) <0 , Cov (mva, mva0) >0, and Umvah > Umvac. Cov (mva, mva0) > 0 , so Corr (mva0, Umvah) = Corr(mva0, Umvac) <0 and Umvah > Umvac, then Corr (mva0, Umvah) = Corr(mva0, Umvac) <0, [Var(mva0)Var(Umvah)]1/2 > [Var(mva0)Var(Umvac)]1/2, and $\sigma\ mva0,\ u_{mvah} - \sigma\ mva0,\ u_{mvac} < 0$;

[ii] $\sigma\ mvl,\ u_{mvah} - \sigma\ mvl,\ u_{mvac}$ = Cov (mvl, Umvah) - Cov (mvl, Umvac) = Corr (mvl, Umvah) [Var(mvl)Var(Umvah)]1/2 - Corr (mvl, Umvac) [Var(mvl)Var(Umvac)]1/2

Because, Cov(mva, Umvah) = Cov (mva, Umvac)<0, Cov(mva, mvl) <0, Umvah > Umvac,

So Corr (mvl, Umvah) = Corr (mvl, Umvac) > 0, [Var(mvl)Var(Umvah)]1/2 > [Var(mvl)Var(Umvac)]1/2. Then $\sigma\ mvl,\ u_{mvah} - \sigma\ mvl,\ u_{mvac} > 0$

[iii] $\sigma\ mva,\ u_{mvac} - \sigma\ mva,\ u_{mvah}$ = Cov (mva, Umvac)- Cov(mva, Umvah) = Corr (mva, Umvac) [Var(mva)Var(Umvac)]1/2 -Corr (mva, Umvah) [Var(mva)Var(Umvah)]1/2

Because Corr (mva, Umvac) = Corr (mva, Umvah) <0 and Umvah > Umvac, so, $\sigma_{mva,\ umvac} - \sigma\ mva,\ u_{mvah} > 0$

Combine [i], [ii] and [iii] together to get ξ in equation (A-33). Though [i] is negative, the absolute value is much smaller compared with that of [ii] and [iii], because the magnitude of MVA_0 (assets not affected by the write-down regulation) is much smaller than that of MVL and MVA, and because covariance is a magnitude-sensitive metric, I expect the negative part [i] to be smaller in absolute value than the positive part [ii]+[iii]. As a result, I expect ξ to net to a positive signed value.

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[The following abbreviations are used in the bibliography: *CAR = Contemporary Accounting Research, JAE = Journal of Accounting and Economics, JAR = Journal of Accounting Research, TAR = The Accounting Review*]

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