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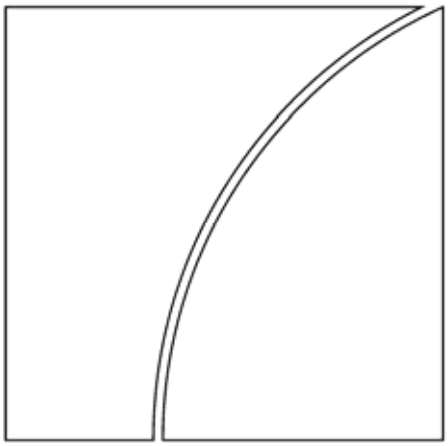

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Fair value accounting for financial instruments: some implications for bank regulation

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Foreword

On 11-12 November 2005, the BIS held a Workshop on “Accounting, risk management and prudential regulation”, which brought together a multi-disciplinary group of around 35 external participants including senior accounting practitioners, standard setters, finance academics, supervisors and central bank officials. The workshop programme is attached. This paper was presented at the workshop. The views expressed are those of the author(s) and not those of the BIS.

Abstract

I identify issues that bank regulators need to consider if fair value accounting is used for determining bank regulatory capital and when making regulatory decisions. In financial reporting, US and international accounting standard setters have issued several disclosure and measurement and recognition standards for financial instruments and all indications are that both standard setters will mandate recognition of all financial instruments at fair value. To help identify important issues for bank regulators, I briefly review capital market studies that examine the usefulness of fair value accounting to investors, and discuss marking-to-market implementation issues of determining financial instruments' fair values. In doing so, I identify several key issues. First, regulators need to consider how to let managers reveal private information in their fair value estimates while minimising strategic manipulation of model inputs to manage income and regulatory capital. Second, regulators need to consider how best to minimise measurement error in fair values to maximise their usefulness to investors and creditors when making investment decisions, and to ensure bank managers have incentives to select investments that maximise economic efficiency of the banking system. Third, cross-country institutional differences are likely to play an important role in determining the effectiveness of using mark-to-market accounting for financial reporting and bank regulation.

Workshop on "Accounting, risk management and prudential regulation"

Room D, Bank for International Settlements
11-12 November 2005, Basel

Friday, 11 November 2005

Welcome by Malcolm Knight, General Manager, BIS

Session 1: **Chairperson: William White, BIS**

Paper 1: "Including estimates of the future in today's financial statements"
by Mary Barth, Professor of Accounting, Stanford University

Discussants: Russell Picot, Group Chief Accounting Officer, HSBC Holdings London
Arnold Schilder, Executive Director of Supervision, Netherlands Bank

Paper 2: "Fair value accounting for financial instruments: some implications for bank regulation"
by Wayne Landsman, Professor of Accounting,
University of North Carolina

Discussants: James O'Brien, Senior Economist, Division of Research and Statistics,
Board of Governors of the Federal Reserve System
Thomas Daula, Chief Risk Officer, Morgan Stanley New York

Session 2: **Chairperson: Sylvie Mathérat, French Banking Commission**

Paper 3: "Institution-specific value"
by Ken Peasnell, Professor of Accounting and Finance,
Lancaster University Management School

Discussants: Philip Lowe, Assistant Governor, Financial System,
Reserve Bank of Australia
David Andrews, Director, Fitch Ratings Ltd

Paper 4: "Do accounting changes affect the economic behaviour of financial firms?"
by Anne Beatty, Professor of Accounting, Ohio State University

Discussants: Patricia Jackson, Enrst and Young, London
Gerard Gil, Group Chief Accountant, BNP Paribas

Saturday, 12 November 2005

Session 3: **Chairperson: José Maria Roldán, Banco de España**

Paper 5: "Implications of marking to market for market/system behaviour"
by Hyun Shin, Professor of Finance, London School of Economics

Discussants: Mauro Grande, Director, Financial Stability and Supervision, European Central Bank
Richard Herring, Professor of Finance, Wharton University of Pennsylvania

Paper 6: "Risk in financial reporting: status, challenges and suggested directions"
by Claudio Borio, Head of Research and Policy Analysis and Kostas Tsatsaronis, Head of Financial Institutions and Infrastructure, Bank for International Settlements

Discussants: Gerald Edwards, Jr, Financial Stability Forum
Philippe Jorion, Professor of Finance, University of California – Irvine

End of Conference

Contents

Fair value accounting for financial instruments: some implications for bank regulation[1]

Wayne R Landsman[2]

Introduction

Accounting standards setters in many jurisdictions around the world, including the United States, the United Kingdom, Australia, and the European Union, have issued standards requiring recognition of balance sheet amounts at fair value, and changes in their fair values in income. For example, in the United States, the Financial Accounting Standards Board requires recognition of some investment securities and derivatives at fair value. In addition, as their accounting rules have evolved, many other balance sheet amounts have been made subject to partial application of fair value rules that depend on various ad hoc circumstances, including impairment (eg goodwill and loans) and whether a derivative is used to hedge changes in fair value (eg inventories, loans, and fixed lease payments). The Financial Accounting Standards Board and the International Accounting Standards Board (hereafter FASB and IASB) are jointly working on projects examining the feasibility of mandating recognition of essentially all financial assets and liabilities at fair value in the financial statements.

In the United States, fair value recognition of financial assets and liabilities appears to enjoy the support the Securities and Exchange Commission (hereafter SEC). In a recent report prepared for a Congressional committee (SEC, 2005), the Office of the Chief Accountant of the SEC states two primary benefits of requiring fair value accounting for financial instruments. First, it would mitigate the use of accounting-motivated transaction structures designed to exploit opportunities for earnings management created by the current "mixed-attribute" – part historical cost, part fair values – accounting model. For example, it would eliminate the incentive to use asset securitization as a means to recognise gains on sale of receivables or loans. Second, fair value accounting for all financial instruments would reduce the complexity of financial reporting arising from the mixed attributed model. For example, with all financial instruments measured at fair value, the hedge accounting model employed by the FASB's derivatives standard would all but be eliminated, making it unnecessary for investors to study the choices made by management to determine what basis of accounting is used for particular instruments, as well as the need for management to keep extensive records of hedging relationships.

But, as noted in the SEC report, there are costs as well associated with the application of fair value accounting. One key issue is whether fair values of financial statement items can be measured reliably, especially for those financial instruments for which active markets do not readily exist (eg specialised receivables or privately placed loans). Both the FASB and IASB state in their Concepts statements that they consider the cost/benefit trade-off between relevance and reliability when assessing how best to measure specific accounting amounts, and whether measurement is sufficiently reliable for financial statement recognition. A cost to

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[1] This paper has been prepared for presentation and discussion at the Workshop on Accounting Risk Management and Prudential Regulation, Bank of International Settlement, Basel, Switzerland, 11–12 November 2005. I thank Mary Barth, Bill Beaver, Brad Cornell, and Bruce Miller for helpful comments.

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investors of fair value measurement is that some or even many recognised financial instruments might not be measured with sufficient precision to help them assess adequately the firm's financial position and earnings potential. This reliability cost is compounded by the problem that in the absence of active markets for a particular financial instrument, management must estimate its fair value, which can be subject to discretion or manipulation.

Assessing the costs and benefits of fair value accounting for financial reporting to investors and other financial statement users in particular reporting regimes is difficult. Assessing the costs and benefits of bank regulators mandating fair value accounting for financial institutions for the purpose of assessing a bank's regulatory capital is perhaps even more challenging. The purpose of this paper is to provide some preliminary views on the issues bank regulators face when assessing the costs and benefits of using fair value for determining regulatory capital and making other regulatory decisions. To this end, I begin by reviewing extant capital market studies that examine the usefulness of fair value accounting to investors. I then discuss implementation issues of determining financial instruments' fair values. In doing so, I again look to evidence from the academic literature. Finally, I discuss marking-to-market implementation issues that are of particular relevance to bank regulators as they consider the effects of fair value measurement on bank earnings and capital, and the attendant effects on real managerial decisions.[3]

Background of fair value accounting in standard setting

Definition of fair value

The FASB defines "fair value" as "the price at which an asset or liability could be exchanged in a current transaction between knowledgeable, unrelated willing parties" (FASB, 2004a).[4] As the FASB notes, "the objective of a fair value measurement is to estimate an exchange price for the asset or liability being measured in the absence of an actual transaction for that asset or liability." Implicit in this objective is the notion that fair value is well defined so that an asset or liability's exchange price fully captures its value. That is, the price at which an asset can be exchanged between two entities does not depend on the entities engaged in the exchange and this price also equals the value-in-use to any entity. For example, the value of a swap derivative to a bank equals the price at which it can purchase or sell that derivative, and the swap's value does not depend on the existing assets and liabilities on the bank's balance sheet. For such a bank, Barth and Landsman (1995) notes that this is a strong assumption to make particularly if many of its assets and liabilities cannot readily be traded. I will return to the implications of this problem when discussing implementation of marking-to-market issues below.

Applications to standard setting

In the US, the FASB has issued several standards that mandate disclosure or recognition of accounting amounts using fair values. Among the most significant in terms of relevance to financial institutions are those standards that explicitly relate to financial instruments. Two

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[3] "Marking-to-market" and "fair values" are often used as synonyms. Use of the former implies the existence of active markets with determinable market prices. As described below, "fair value" can have multiple meanings and does not necessarily depend on the existence of active markets. Moreover, even if market prices exist, the instrument's value to the entity need not equal its quoted market price.

[4] The IASB defines fair value similarly.

important disclosure standards are Statement of Financial Accounting Standards (SFAS) no 107, *Disclosures about fair value of financial instruments* (FASB, 1991) and SFAS no 119, *Disclosure about derivative financial instruments and fair value of financial instruments* (FASB, 1994). SFAS no 107 requires disclosure of fair estimates of all recognised assets and liabilities, and as such, was the first standard that provided investors with estimates of the primary balance sheet accounts of banks, including securities, loans, deposits, and long-term debt. In addition, it was the first standard to provide a definition of fair value reflecting the FASB's objective of obtaining quoted market prices wherever possible. SFAS no 119 requires disclosure of fair value estimates of derivative financial instruments, including futures, forward, swap, and option contracts. It also requires disclosure of estimates of holding gains and losses for instruments that are held for trading purposes.

Among the most significant fair value recognition standards the FASB has issued are SFAS no 115, *Accounting for certain investments in debt and equity securities* (FASB, 1993), SFAS no 123 (revised), *Share-based payments* (FASB, 2004), and SFAS no 133, *Accounting for derivative instruments and hedging activities* (FASB, 1998). SFAS no 115 requires recognition at fair value investments in equity and debt securities classified as held for trading or available-for-sale. Fair value changes for the former appear in income, and fair value changes for the latter are included as a component of accumulated other comprehensive income, ie, are excluded from income. Those debt securities classified as held to maturity continue to be recognised at amortised cost. SFAS no 123 (revised) requires the cost of employee stock options grants be recognised in income using grant date fair value by amortising the cost during the employee vesting or service period.[5] This requirement removed election of fair value or intrinsic value cost measurement permitted under the original recognition standard, SFAS no 123, *Accounting for Stock-based Compensation* (FASB, 1995). Until recently, most firms elected to measure the cost of employee stock options using intrinsic value. However, for such firms, SFAS no 123 requires they disclose a *pro forma* income number computed using a fair value cost for employee stock option grants, as well as key model inputs they use to estimate fair values.

SFAS no 133 requires all freestanding derivatives be recognised at fair value. However, SFAS no 133 retains elements of the existing hedge accounting model. In particular, fair value changes in those derivatives employed for purposes of hedging fair value risks (eg interest rate risk and commodity price risk) are shown as a component of income, as are the changes in fair value of the hedged balance sheet item (eg fixed rate loans and inventories) or firm-commitments (ie forward contracts). If the so-called fair value hedge is perfect, the effect on income of the hedging relationship is zero. In contrast, fair value changes in those derivatives employed for purposes of hedging cash flow risks (eg cash flows volatility resulting from interest rate risk and commodity price risk) are shown as a component of accumulated other comprehensive income because there is no recognised off-setting change in fair value of an implicitly hedged balance sheet item or anticipated transaction.[6]

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[5] Although SFAS No 123 (revised) requires the cost of option grants be recognised at fair value, it is not entirely a fair value standard, in that the amortisation of the cost of option grants is based on the grant date fair value - ie the historical cost of the grants. As discussed below, Landsman, Peasnell, Pope and Yeh (2005) advocate also recognising in income changes in fair value of option grants.

[6] The FASB has issued several other standards with elements of fair value recognition or disclosure. For example, SFAS no 87, *Employers' Accounting for Pensions* (FASB, 1985) requires footnote disclosure of the fair value of pension plan assets and the pension obligation associated with defined benefit plans. However, the standard requires balance sheet recognition of only the net of the unrecognised asset, liability, and equity amounts. The SEC report (SEC, 2005) recommends that pension assets and liabilities be recognised at fair value in the body of the financial statements. Evidence in Landsman (1986) and Barth (1991) is consistent with equity prices reflecting pension asset and liability fair values. See the literature review on pricing effects of financial instruments' fair values in the next section.

Outside of the US, standards issued by the IASB are often accepted or required as generally accepted accounting principles (GAAP) in many countries. For example, the European Union generally requires member country firms to issue financial statements prepared in accordance with IASB GAAP beginning in 2005. IASB GAAP comprises standards issued by its predecessor body, the International Accounting Standards Committee (IASC), as well as those it has issued since its inception in 2001. The IASC issued two key fair value standards, both of which have been adopted by the IASB, IAS 32: *Financial Instruments: Disclosure and Presentation* (IASB, 2003a), IAS 39, *Financial Instruments: Recognition and Measurement* (IASB, 2003b). The former standard is primarily a disclosure standard, and is similar to its US GAAP counterparts, SFAS no's 107 and 119. IAS 39 describes how particular financial assets and liabilities are measured (ie amortised cost or fair value), and how changes in their values are recognised in the financial statements. The scope of IAS 39 roughly encompasses accounting for investment securities and derivatives, which are covered under SFAS no's 115 and 133, although there are some minor differences between IAS and US GAAP.

The IASB has also issued a key fair value standard, *International Financial Reporting Standard 2, Accounting for Share-based Payment* (IASB, 2004). *IFRS 2* is very similar to SFAS no 123 (revised) (FASB, 2004) in requiring firms to recognise the cost of employee stock option grants using grant date fair value.[7]

As part of their efforts to harmonise US and international accounting standards, the IASB and FASB recently issued related proposed or finished standards pertaining to disclosure of financial instruments fair values, *Exposure Draft: Fair Value Measurements* (FASB, 2004a) and *International Financial Reporting Standard 7, Financial Instruments: Disclosures* (IASB, 2005). The US *Exposure Draft* describes a hierarchy of preferred approaches to fair value measurement for all assets and liabilities measured at fair value under other FASB pronouncements, ranging from quoted market prices for the specific asset or liability to use of models to estimate fair values.[8] Both the *Exposure Draft* and *IFRS 7* require disclosure of fair value amounts at the end of each accounting period (year, quarter), how the fair values are determined, and the effect on income arising from each particular class of assets or liabilities (ie separate disclosure of recognised and unrecognised gains and losses). *IFRS 7* is more comprehensive than the *Exposure Draft* in that it requires disclosure of detailed information for recognised financial instruments, both those measured at fair value and those that are not, as well as qualitative information relating to financial instruments' liquidity, credit, and market risks.

Valuation techniques

As noted above, in its *Exposure Draft: Fair value measurements*, the FASB describes a hierarchy of preferences for measurement of fair value. The preferred *level 1* fair value estimates are those based on quoted prices for identical assets and liabilities, and are most applicable to those assets or liabilities that are actively traded (eg trading investment securities). *Level 2* estimates are those based on quoted market prices of similar or related assets and liabilities. *Level 3* estimates, the least preferred, are those based on company estimates, and should only be used if level 1 or 2 estimates are not available. With the emphasis on market prices, the FASB emphasises that firms should base their estimates on market prices as model inputs wherever possible (eg use of equity market volatility estimates when employing the Black-Scholes valuation model to estimate the fair value of employee

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7 The comment in footnote 5 relating to SFAS no 123 (revised) applies also to IFRS 2.

8 The IASB adopts a similar hierarchy in IAS 39.

stock options). Fair value estimates can be constructed using entity-supplied inputs (eg discounted cash flow estimates) if other models employing market inputs are not available.

Are fair values useful to investors? Evidence from research

US-based research

A natural question to ask is whether bank fair value information is useful to investors. For example, when it was deliberating SFAS no 107, the FASB was concerned with policy questions relating to the relevance and reliability of disclosed amounts. Regarding relevance, the FASB was interested in whether SFAS no 107 disclosures would be incrementally useful to financial statement users relative to items already in financial statements, including recognised book values and disclosed amounts. Regarding reliability, the FASB was concerned with whether fair values estimates, especially those relating to loans, would be too noisy to disclose.[9]

As Barth, Beaver, and Landsman (2001) note, policy-based accounting research cannot directly address these questions, but can provide evidence that helps standard setters assess relevance and reliability questions. A common way to assess the so-called value relevance of a recognised or disclosed accounting amount is to assess its incremental association with share prices or share returns after controlling for other accounting or market information. Several studies address the value relevance of banks' disclosed investment securities fair values before issuance of SFAS no 115, mandating recognition of investment securities' fair values and effects of their changes on the balance sheet and the income statement. For a sample of US banks with data from 1971–90, Barth (1994) finds that investment securities' fair values are incrementally associated with bank share prices after controlling for investment securities' book values. When examined in an annual returns context, the study finds mixed results for whether unrecognised securities' gains and losses provide incremental explanatory power relative to other components of income. One leading candidate for the ambiguous finding is that securities' gains and losses estimates contain too much measurement error relative to the true underlying changes in their market values.[10] Using essentially the same data base, Barth, Landsman, and Wahlen (1995) confirm the Barth's (1994) findings and lend support to the measurement error explanation by showing that fair value-based measures of net income are more volatile than historical cost-based measures, but that the incremental volatility is not reflected in bank share prices. Of particular interest to bank regulators, Barth, Landsman, and Wahlen (1995) also find that banks violate regulatory capital requirements more frequently under fair value than historical cost accounting, and that fair value regulatory capital violations help predict future historical cost regulatory capital violations, but share prices fail to reflect this increased regulatory risk.

Barth, Beaver, and Landsman (1996), Eccher, Ramesh and Thiagarajan (1996) and Nelson (1996) use similar approaches to assess the incremental value relevance of fair values of principal categories of banks assets and liabilities disclosed under SFAS no 107 in 1992 and 1993, ie, investment securities, loans, deposits, and long-term debt. Supporting the findings

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[9] Bank regulators are also interested in these and related questions. As discussed below, some US-based studies address the effects of fair values on regulatory capital.

[10] Another equally plausible explanation is that investment securities' fair value gains and losses are naturally hedged by fair value changes of other balance sheet amounts, which are not included in the estimating equations. Ahmed and Takeda (1995), which includes other on-balance sheet net assets in the estimating equations, provide support for this explanation with evidence of incremental explanatory power for unrecognised securities gains and losses in explaining banks' stock returns.

of Barth (1994) using pre-SFAS no 107 data, all three studies find investment securities fair values are incrementally informative relative to their book values in explaining bank share prices. However, using a more powerful research design that controls for the effects of potential omitted variables, Barth, Beaver and Landsman (1996) also finds evidence that loans' fair values are also incrementally informative relative to their book values in explaining bank share prices. Barth, Beaver and Landsman (1996) also provide additional evidence that loans' fair values reflect information regarding loans' default and interest rate risk. Moreover, the study's findings suggest that investors appear to discount loans' fair value estimates made by less financially healthy banks (ie those banks with below sample median regulatory capital), which is consistent with investors being able to see through attempts by managers of less healthy banks to make their banks appear more healthy by exercising discretion when estimating loans fair values.

Finally, Venkatachalam (1996) examines the value relevance of banks' derivatives disclosures provided under SFAS no 119 for a sample of banks in 1993 and 1994. Findings from the study suggest that derivatives' fair value estimates explain cross-sectional variation in bank share prices incremental to fair values of the primary on-balance accounts (ie cash, investments, loans, deposits, and debt).

International research

Because Australian and UK GAAP permit upward asset revaluations but, as with US GAAP, require downward revaluations in the case of asset impairments, several studies examine the dimensions of value relevance of revaluations in these countries. Most studies, including Easton, Eddey, and Harris (1993), Barth and Clinch (1996), Barth and Clinch (1998), and Peasnell and Lin (2000), focus on tangible fixed asset revaluations. However, Aboody, Barth and Kasznik (1999) examine the association between asset revaluations for financial, tangible, and intangible assets for a sample of Australian firms in 1991–95. Focusing on the financial assets, Aboody, Barth and Kasznik (1999) find that revalued investments for financial firms as well as non-financial firms are consistently significantly associated with share prices.

One interesting study of Danish banks, Bernard, Merton and Palepu (1995), focuses on the impact of mark-to-market accounting on regulatory capital as opposed to the value relevance of fair values for investors. Denmark is an interesting research setting because Danish bank regulators have used mark-to-market accounting to measure regulatory capital for a long period of time. Bernard, Merton and Palepu (1995) find that although there is evidence of earnings management, there is no reliable evidence that mark-to-market numbers are managed to avoid regulatory capital constraints. Moreover, Danish banks' mark-to-market net equity book values are more reliable estimates of their equity market values when compared to those of US banks, thereby providing indirect evidence that fair value accounting could be beneficial to US investors and depositors.[11]

US-based stock option research

As noted above, estimates of employee stock options fair values have been required to be disclosed for several years under SFAS no 123. Several studies examine the value relevance of such disclosures, including Bell, Landsman, Miller, and Yeh (2002), Aboody,

[11] Bernard, Merton and Palepu (1995) cautions that drawing inferences from the Danish experience with fair value accounting for banks regarding the benefits of requiring fair value accounting for US banks is subject to many caveats. These include differences in the relative size of the US and Danish banking sectors, as well as relative differences in US and Danish banking regulatory systems.

Barth and Kasznik (2004), and Landsman, Peasnell, Pope and Yeh (2005). Findings in Bell, Landsman, Miller and Yeh (2002) differ somewhat from those in Aboody, Barth and Kasznik (2004), although both studies provide evidence that employee option expense is value relevant to investors. Landsman, Peasnell, Pope and Yeh (2005) provide theoretical and empirical support for measuring the fair value of employee stock option grants beyond grant date, with changes in fair value recognised in income along with amortisation of grant date fair value.

Because quoted prices for employee stock options typically are not available because of non-tradability provisions, the fair value estimates are based on models that rely on inputs selected by reporting firms. Aboody, Barth and Kasznik (2005) find evidence that firms select model inputs so as to manage the pro forma income number disclosed in the employee stock option footnote. This finding is potentially relevant to accounting standard setters as well as bank regulators in that it is additional evidence that managers facing incentives to manage earnings are likely to do so when fair values must be estimated using entity-supplied estimates of values or model inputs if quoted prices for assets or liabilities are not readily available.[12] If managers have the incentive to use discretion when estimating fair values of on and off-balance sheet asset and liability amounts when such values are not recognised in the financial statements, it is reasonable to assume the incentive will only increase if fair value accounting is used for recognition of amounts on the balance sheet and in the income statement.

Marking-to-market implementation issues

Marking-to-market financial instruments are relatively easy if they are actively traded in liquid markets. The problem becomes more complicated if active markets do not exist, particularly if the financial instrument is a compound instrument comprising several embedded option-like features, values for which depend on inter-related default and price risk characteristics. Moreover, Barth and Landsman (1995) makes the observation that in the absence of active, liquid markets, fair value is not well defined in the sense that an instrument's acquisition price, selling price, and value-in-use to the entity can differ from each other.[13] Stated another way, even if an instrument's acquisition or selling prices are observable, these prices can only, at best, provide upper or lower bounds on its "fair value". The FASB's stated preference for using an instrument's selling price as its measure of fair value is appropriate when fair value is well defined, but is somewhat arbitrary when it is not.

In this section, I discuss issues relating to implementation of fair value estimates when market prices for particular financial instruments are not readily available by focusing on findings from two related studies by Barth, Landsman and Rendleman (1998, 2000) on the use of binomial option pricing models to estimate fair values for corporate debt and its components.

Binomial option pricing of corporate debt

Barth, Landsman and Rendleman (1998) use a binomial option pricing model to estimate the fair values of corporate debt and its components, ie, conversion, call, put, and sinking fund

[12] See also the discussion above of the Barth, Beaver and Landsman (1996) findings relating to loans fair values estimates by banks with lower regulatory capital.

[13] Note that neither the FASB nor IASB considers value-in-use as a candidate for fair value if it differs from the other two prices.

features, to provide evidence on the relevance and reliability of estimated fair values. A companion study, Barth, Landsman and Rendleman (2000), describes details of how the binomial model is implemented. The 1998 empirical study is based on data from 1990 for a sample of 120 publicly traded US firms that have corporate debt with multiple embedded option features. The binomial model the study implements is based on the models of Cox, Ross and Rubinstein (1979) and Rendleman and Bartter (1979), and considers directly only default risk, but includes information in the interest rate yield curve.

Findings from Barth, Landsman and Rendleman (1998) reveal component value estimates are relevant in that they represent large fractions of estimated total bond fair value. In addition, implementing a fundamental components approach in which call options are classified as assets, conversion options as equity, and put options as debt, indicates there are material changes to recognised balance sheet accounts and debt-to-equity ratios for sample firms.[14] The study also finds that estimates of component fair values depend on whether a bond has multiple features. For example, the value of conversion feature for a convertible, callable bond depends on the value of the call feature and vice versa. In addition, because components' values are interdependent, the order in which components are considered when estimating each bond's total fair value can materially affect each component's estimated fair value. This issue is particularly important if a fundamental components approach is used for separate recognition of bond components as assets, liabilities, and equity.

However, additional evidence in Barth, Landsman and Rendleman (1998) suggests model estimates of total bond value may lack reliability. In particular, when the authors re-estimate bond fair values excluding from the sample those bonds with available market prices (such bonds comprise approximately half of sample bonds), estimated bond values for those bonds that are not publicly traded differ significantly from value estimates when all bonds are included in the estimation procedure. This finding suggests that financial instruments' fair value estimates are sensitive to whether actual market price information from other instruments an entity has on its balance sheet is available to be used as model inputs.

Barth, Landsman and Rendleman (1998) reaches several conclusions regarding limitations to implementation of binomial option pricing models for estimating bond fair values that generalise to all financial instruments issued or held by an entity. First, the authors had to make several educated guesses for values of model inputs (eg, conversion schedules and equity volatility). In principle, managers of the reporting entities likely have access to better information than financial statement users (including academic researchers), and the authors suggest that fair value estimates could improve if firms were required to disclose them. Second, models quickly become too complex and difficult to implement if they are to consider all of the dimensions of risk and value that can affect an instrument's fair value. For example, presently, few models consider both interest rate and default risk. In addition, financial instruments' fair values are interdependent. For example, the fair value of one debt instrument issued by an entity is dependent upon actions that holders of another debt instrument issued by that entity can take. The model implemented by Barth, Landsman and Rendleman (1998) considers some sources of bond value interdependence (eg debt priority) but basically ignores the issue because of its complexity. The issue of financial instruments'

[14] See FASB (1990, 2000) for a description of the fundamental components approach to accounting for complex financial instruments. In addition to the FASB, several other standard setters have considered separating compound financial instruments into components, including the CICA (Section 3860 of the CICA Handbook, "Financial Instruments—Disclosure and Presentation"), the AASB (AASB Accounting Standard 1033, Presentation and Disclosure of Financial Instruments), and the IASB (IASB, 2003a). Each of these standard setters representing Canada, Australia, and the international community concludes issuers of a compound financial instrument should present the liability components and equity components of that financial instrument separately.

value interdependence is another illustration of the issue raised by Barth and Landsman (1995) that a financial instrument's fair value may not be well defined (eg its selling price may not equal its value-in-use to the entity).

Manipulation of model inputs

Having to rely on managers' model estimates of financial instruments' fair values introduces the general problem of informational asymmetry – ie, managers have private information regarding appropriate values to select for model inputs as well the true underlying economic value of a financial instrument to the firm. Informational asymmetry creates two somewhat different problems, adverse selection and moral hazard. An important implication of adverse selection is that the market will tend to value apparently similar financial instruments held by two different firms similarly when assessing their fair values and the values of the firms' equities. Thus, for example, in the absence of credible and verifiable information, two banks that are otherwise equivalent except one has a higher quality loan portfolio than the other will have their stocks valued similarly by the securities market. A solution to the adverse selection problem is to permit managers of the bank with a higher quality loan portfolio to signal their loans are of higher quality. For the signal to be credible, it must be costly, but less costly for the bank with higher quality loans. This can be achieved, for example, by permitting bank managers to disclose selectively attributes about the loans' fair values that would be too costly for bank managers with low quality loans to disclose.

The problem of moral hazard is that managers will tend to use their private information to their advantage by manipulating the information that they disclose to the securities markets and regulators. In the case of banks, this can lead to mispricing of their stocks and an inaccurate portrayal of their capital ratios and their financial health to bank regulators. As noted above, the findings in Aboody, Barth and Kasznik (2005), which indicates that managers select model parameters to manage estimates of disclosed employee stock option fair values, raise the broader question of whether managers will behave similarly when selecting model parameters for fair value estimates of other financial instruments, including those whose values are recognised in the body of the financial statements. The Barth, Landsman and Rendleman (1998) conclusion that managers can provide better estimates of bond fair values because they have access to private information presumes implicitly that managers apply their private information in a neutral fashion, ie, they do not succumb to the temptation to manipulate bond fair value estimates for private gain.

If fair value accounting for financial instruments is generally applied for financial statement recognition and regulatory capital determination, accounting standard setters as well as securities and bank regulators face the challenge of determining how much latitude to give managers when they estimate fair values, balancing the benefit of permitting managers to reveal private information, thereby mitigating the adverse selection problem, and the moral hazard cost of their exercising discretion to manipulate earnings or capital ratios when selecting model parameters.

Marking-to-market: additional issues for bank regulators

I now turn to discussing additional issues that bank regulators in particular need to consider if they are to require banks to mark-to-market financial instruments when determining regulatory capital and when assessing other dimensions of bank performance.

Fair values measurement error

The first obvious issue bank regulators face is that fair value estimates of bank assets and liabilities (which are principally financial instruments) are likely to contain measurement error. If the findings in Barth, Landsman and Wahlen (1995) relating to investment securities are generalised to other bank assets and liabilities, implementation of a full fair value model for recognition of financial instruments at fair value could yield unrecognised gains/losses that could cause earnings and regulatory capital to be more volatile than earnings and regulatory capital based on the current historical cost model. This would be expected to occur particularly if measurement error in bank assets' fair values – which is likely to be positively correlated across assets – is not fully offset by measurement error in bank liabilities' fair values.

Of course not all earnings or regulatory capital volatility arising from the application of fair value accounting is the result of measurement error. Barth (2004) makes the observation that there are three primary sources of "extra" volatility associated with fair value-based accounting amounts relative to those determined under historical cost. The first is true underlying economic volatility that is reflected by changes in bank assets' and liabilities' fair value. The second is volatility induced by measurement error in estimates of those fair value changes. The third, induced volatility arising from using a mixed-attribute model would be less of a concern if all instruments are recognised at fair value. The relevance/reliability trade-off that accounting standard setters consider is certainly applicable to bank regulators. A primary goal of regulators would appear to develop a framework for measuring financial instruments' fair values – and changes in value – so as to maximise the ratio of (a) additional economic volatility in bank earnings (or capital ratios) arising from using fair value accounting instead of historical cost to (b) additional volatility arising from measurement error in fair value estimates. As noted above, a significant dimension to this problem is determining how much discretion to give bank managers when they estimate fair values of their assets and liabilities.

Before leaving the discussion of measurement error, it is important to note that although fair value estimates of bank assets and liabilities likely contain measurement error relative to true economic values, so do book value estimates. Casting the debate in terms of whether fair values are "good" or "bad" is inappropriate. The more appropriate question to ask is whether fair value-based financial statements improve information investors receive relative to information provided by historical cost-based financial statements, and whether regulation of bank capital will be more efficient under one accounting system or the other.

Economic considerations

A natural question to ask is what the real economic consequences will be of accounting standard setters and financial reporting and bank regulators requiring mark-to-market accounting to measure bank performance and financial condition. The desired outcomes are, of course, greater economic and informational efficiency. However, as noted above, the extent to which these goals are met depends on a variety of factors relating to how the model is implemented (eg the amount of discretion managers are granted when selecting fair value model inputs).

One notable implementation issue is whether real economic decisions made by bank managers would improve. On the one hand, managers would have less incentive to use accounting-motivated transaction structures designed to exploit opportunities for income management arising from the current mixed attribute accounting model. On the other hand, extra volatility of fair value income and regulatory capital could cause bank managers to apply a sub-optimal decision rule by selecting investments of lower risk than would be the case if investment decisions were based solely on economic considerations.

The effects on economic and informational efficiency of requiring fair value accounting to measure bank performance and financial condition are likely to vary considerably across countries, reflecting differences in richness of securities markets, legal systems, bank and securities markets regulatory enforcement, and a host of other institutional features. The burgeoning "law and finance" literature (La Porta, Lopez-de-Silanes, Shleifer and Vishny 1998) suggests that these differences are likely to play an important role in determining the effectiveness of using fair value accounting for financial reporting and bank regulation.

Concluding remarks

In this paper I identify issues that bank regulators need to consider if they are to use fair value accounting for determining bank regulatory capital and when making regulatory decisions. In the financial reporting arena, the FASB and IASB have issued several disclosure and measurement and recognition standards for financial instruments, and all indications are that it's only a matter of time before both standard setters will mandate recognition of all financial instruments at fair value. To help identify important issues for bank regulators, I briefly review capital market studies that examine the usefulness of fair value accounting to investors, and discuss marking-to-market implementation issues of determining financial instruments' fair values. In doing so, I identify several key issues. First, regulators need to consider how to let managers reveal private information in their fair value estimates while minimising strategic manipulation of model inputs to manage income and regulatory capital. Second, they need to consider more broadly how best to minimise measurement error in fair values so as to maximise their usefulness to investors and creditors as they make their investment decisions, and how best to ensure bank managers have incentives to select those investments that maximise economic efficiency of the banking system. Cross-country institutional differences are likely to play an important role in determining the effectiveness of using mark-to-market accounting for financial reporting and bank regulation.

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Relevance and reliability of fair values: discussion of issues raised in "Fair value accounting for financial instruments: some implications for bank regulation"

James O'Brien[15]

Introduction

In his paper, Professor Landsman reviews research on both the relevance and reliability of reporting fair values for loans and other financial instruments (Landsman (2005)). Accounting standard setters define fair value as the amount that would be paid or received for the item being valued in an arm's length transaction between knowledgeable parties. This is a market value definition and the standard setters have indicated that, if available, a current market price for the item is said to be the best estimate of its fair value. Relevance means that the fair value is capable of making a difference to financial statement users' decisions. Reliability means that the reported fair value represents what it is purported to represent (Barth et al (2001), p 80).

Professor Landsman concludes that the evidence on fair value reporting supports its relevance. On reliability, he suggests there is some uncertainty, using evidence from Barth, Landsman and Rendleman (1998) based on testing a pricing model for corporate bonds. He further discusses banks' use of their private information in determining loan fair values and consequences of model valuation errors on earnings volatility.

In my discussion, I first comment on issues concerning fair value relevance tests and the standard setters' relevance criterion. I then consider the potential importance and reliability of models for loan fair values. Here my comments expand on Professor Landsman's discussion of model reliability.

Relevance of reported fair values

By revealed preference, the accounting standard setters view market exchange values as providing the best combination of relevance and reliability. My conjecture of what underlies this view is the following: regarding reliability, market exchange values are objective measures of value and can be obtained from markets where the instruments are being traded. When not directly observed, the standard setters believe that exchange values can be closely approximated by reference to market information and the use of valuation models. Historical costs are more reliable as a cost measure but they lack the relevance of current market exchange values to the primary users of financial statements. These users would be investors in claims to the firm's earnings, eg, equity claims and debt claims. Current market exchange values for the firm's assets better reflect the assets' contribution to the current market values of the claims on the firm's earnings. Thus, fair values provide investors, and others with aligned interests, with more useful information than historical costs on what is determining the value of their investments.

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This greater usefulness of market value information is hypothetical and the accounting literature has sought to evaluate it primarily by using regressions of firms' equity values on reported fair values, with controls for historical costs and other variables. Professor Landsman concludes that the literature provides support for fair value relevance, citing findings of statistically significant coefficients (with the appropriate signs) between equity values and reported fair values. While I think this literature improves our understanding of how the market may be using the fair value information, the equity value tests are subject to significant interpretation difficulties. It also is not clear that the tests and the standard setters' relevance criterion effectively address arguments opposing the adoption of full fair value accounting. I comment on both issues.

Regarding statistical difficulties in interpreting results of the equity value regressions, two problems appear frequently in the literature. One is that the tests cannot distinguish between relevance and reliability. Are weak results an indication that the market does not find fair value relevant to its decisions or are the reported values not reliable? The other is omitted variables. Equity values will be related to all the positions in the balance sheet and it can be difficult to account for everything. Moreover, assets that represent the core economic value of firms may not be balance sheet items making it difficult to control for their influence on equity values. Omitted on- and off-balance sheet assets or liabilities that are correlated with the reported fair values will bias the estimated relation between market equity values and the reported fair values.

To illustrate the interpretation difficulties of the equity-fair value regressions, Eccher et al (1996) and Nelson (1996) get mixed results on the significance of regression coefficients for loan fair values. This might be attributable to a lack of reliability in the reported fair values (eg Nissim (2003)). However, Barth, Beaver and Landsman (1996) get strong results in testing loan fair value relevance. They attribute Eccher et al and Nelson's weak results to insufficient control variables in their regressions, not to unreliable reported values.[16]

For securities fair values, reliability would seem to be less of an issue since market values are more readily available. However, in their 1996 study, Barth et al report mostly insignificant coefficients for security investment fair values and mostly smaller coefficients than for the loan fair values (tables 3 and 4). Also, Barth (1994) finds mixed results when testing the significance of banks' securities gains and losses on bank stock returns. Barth (1994) suggests that this may reflect reporting errors in securities gains and losses. However, Ahmed and Takeda (1995) argue that there is an omitted variables bias and, after accounting for this, find securities gains and losses significantly affect bank stock returns. Carroll et al (2002) also take issue with the reporting error explanation of Barth (1994). They find very strong support for securities gains and losses in explaining closed-end mutual fund stock prices, which completely dominate historical costs. For mutual funds, explicitly accounting for all of the firms' assets might be an easier task.

Another statistical issue is that tests are only for significance (and correct sign) against a null hypothesis of a zero coefficient. There should also be tests of a null hypothesis based on the hypothetical coefficient value when the reported fair value is reliable and the market is properly assessing its relevance, eg a coefficient of 1.0. A rejection of this alternative null

[16] Nonetheless, there appears to be a significant omitted variables issue in Barth et al's (1996) estimated loan fair value coefficients, as well as in the other studies. Unbiased estimates of the loan value coefficients in the equity regressions (such as specified in Bart et al's (1996) theoretical equation (4)) require controlling for the value of deposit insurance under fixed-rate deposit insurance systems. The equity regression equations use bank liabilities as an explanatory variable but a substantial fraction of these liabilities are (explicitly or implicitly) insured deposits. As such, the specifications omit the value of the deposit insurance. This value will be negatively correlated with the value of the bank's assets, which will create a negative bias in the estimated asset value coefficients relative to the hypothetical values in the authors' specifications.

hypothesis is important in assessing the consistency between the reported fair values and the null hypothesis and potentially whether the market is correctly using the reported fair values.

The equity relevance tests and the relevance criterion adopted by the accounting standard setters do not consider whether the reported fair values are or will be used appropriately. In failing to do so, they do not adequately address arguments against full financial fair value accounting for banks. These arguments are often couched in terms of excess volatility being introduced into bank earnings that include fair value gains and losses on loans that are held to maturity. Implicit in the arguments is that the market or other users of reported earnings will not correctly interpret or react to the increase in reported earnings volatility due to the inclusion of fair value gains and losses.

Freixas and Tsomocos (2004) and Plantin, Sapra and Shin (2004) have developed formal models where fair value gains and losses will create an excess volatility in reported earnings. In these models, the excess volatility arises because the economic value of the bank is more stable (and exceeds) the market exchange value of the loans. The two papers emphasise different, but not incompatible, economic values of the bank. Freixas and Tsomocos emphasise intertemporal income smoothing of earnings paid to the ultimate claimants to the bank's earnings; Plantin, Sapra and Shin emphasise bank investment in borrower credit information and monitoring that produces positive net present value in bank lending that cannot be properly valued in (arm's length) market transactions. In both papers, fair value gains and losses generate reported earnings volatility that exceeds the volatility of payments that go to the holders of claims on the bank. Nonetheless, banks' will respond to the higher volatility in reported earnings by undertaking either or both new dividend policies and asset management policies that will be incompatible with maximising their economic value in terms of intertemporal income smoothing or providing value-added in investing in credit-risky assets.

Implicit in bank management responses to the reporting of fair value gains and losses is that the users of earnings reports will incorrectly interpret the increased earnings volatility as reflecting volatility in the underlying economic value of the bank. The accounting standard setters relevance criterion and the equity value regression tests of relevance cannot address this misinterpretation issue or the broader issue of relevance of the loan fair values for the economic value of the bank.

In should be noted that Freixas and Tsomocos (2004) and Plantin, Sapra and Shin (2004) see some role for (accurate) market value reporting by banks and hence a trade-off in the adopting a market value accounting system. In particular, in Freixas and Tsomocos, reporting market values is useful in identifying the current condition of the balance sheet and can be effective in preventing moral hazard behaviour.

At the least, there seems to be agreement that fair value reporting of bank assets that reflects the assets' current credit condition and market interest rates has substantial benefits in providing objective and timely information on the bank's financial condition. What has not gotten much scrutiny, however, is the reliability of reported fair values when market prices are not observed but must be estimated.

Fair value and model reliability for bank loans

In discussion papers on financial fair value, accounting standard setters have set reliability hierarchy for different fair value reporting methods. At the top of the hierarchy are observed market prices of the instruments being valued. At the bottom is the use of models when market prices are not available. The discussion papers seem to suggest that most often market prices will be available for the exact item or a close substitute. The modeling category is more of a residual.

The vast majority of bank loans, however, are not traded and arm's length market transactions prices generally will not be available. Thus for most loans reported fair values will contain some mixture of modeling and reliance on market prices. The amount of modeling and model assumptions may be significant even where market prices are being used. For illustration, consider the following hierarchy of commercial loan valuation approaches based on three levels of market price availability:

1. Valuation with the borrower's debt market prices

2. Valuation with the debt market prices of related borrowers

3. Valuation with models without debt market prices

In determining the fair values for loans in these categories and the need for modeling, the bank's full use of its information on borrower credit worthiness is assumed. I ignore the issue of how or if the bank might be able to actually sell loans in arms' length transactions at their internally calculated values (as raised in Plantin, Sapra and Shin (2004)). I also ignore the issue of the bank's incentives to report estimated values that fully reflect its private information (as discussed in Professor Landsman's paper).

While the amount of modeling is lowest for Level 1, it is still likely to be important in determining fair values. Modeling and various model assumptions will be required to adjust the market prices for the firm's traded debt to account for differences between the traded debt and loan contractual features. The different contractual features will produce differences between the traded debt and loans' periodic payments, expected lives, and loss in the event of default. For example, large banks frequently use credit default swaps (CDSs) on bonds issued by large corporations to hedge or internally value loans made to the corporations. The CDSs will capture the market's assessment of the firms' default likelihood but significant modeling is required to account for other differences between the underlying bonds and the loans. The differences will include embedded options often in loans but not bonds, eg prepayment option, certain loan fees and periodic loan repricing contingent on balance sheet measures of the borrowing firm's condition. Further, the loans are frequently part of a credit facility that includes a line of credit. The line of credit exposes the bank to a contingent liability whose value must be included in the valuation of the credit facility.[17]

The majority of bank loan obligors will not have traded debt. For these obligors, a Level 2 fair value approach might be used by making use of market prices or credit spreads of related borrowers. A likely candidate will be generic credit spreads (or a term structure of credit spreads) for bonds sorted by rating, industry, and possibly other criteria. However, these generic credit spreads may be just the basic building blocks in loan fair value model calculations. Modeling becomes more important because of systematic differences between default probabilities embedded in the generic bond credit spread data and the loan default probabilities, as well as the differences between the contractual features of the bonds and bank loans.[18]

A level 3 approach will make little use of market bond prices or credit spreads. It differs from a level 2 approach in that the firm's underlying default likelihood and loss in default is directly estimated, rather than being fully or partly inferred from market credit spreads. Standard models used for pricing corporate bonds will involve estimating the obligor firm's asset value

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[17] See Chava (2002) for a loan commitment valuation model using contingent claim pricing methods.

[18] Aguais, Forest, and Rosen (2000) give a detailed presentation of constructing valuations of corporate loans, including loan commitments, that would ultimately make use of generic market credit spreads.

and its asset volatility in determining default probability and loss in the event of default. Other determinants will be the firm's total liabilities and the contractual features of the bonds (or loans) being valued. Typically in corporate bond pricing, firm asset values and asset volatility are estimated using the firm's equity value and estimates of equity return volatility. This approach is referred to as a structural model approach, while the use of credit spreads as the basic building block is referred to as reduced-form modeling.[19]

There is little evidence on the accuracy of loan pricing using levels 1, 2, or 3 approaches. There is a good bit of evidence on the accuracy of bond pricing models using a structural approach. Professor Landsman discusses results from Barth, Landsman, and Rendleman (1998), who developed and tested a structural bond pricing model. Here I add to Professor Landsman's discussion by presenting results from a recent extensive study by Eom, Helwage and Huang (2004). They estimate and test 4 well-known bond pricing models and some variants of the basic models (a total of 9 models are tested). All the pricing models are structural models.

Eom et al, estimate parameters for the various structural model using firms' market equity values and equity return volatility and make no use of the firm's bond market prices other than to evaluate the accuracy of the bond model prices. They limit their sample to bonds that should be simplest to price: all bonds are senior and straight debt and all firms have a simple capital structure. The bond prices also are traded quotes.

Table 1 presents some of the principal results in Eom et al. The first three columns report statistics on pricing errors as a percent of actual bond prices. The last two columns present percentage errors in estimated credit spreads (the bond yield minus a comparable maturity Treasury yield). The mean errors measure bias in the pricing models; the absolute mean errors measure accuracy in terms of average size of (positive or negative) errors, the standard deviations measure dispersion of the errors across the different bonds. The last row in the Table presents the median values for the error statistics across the 9 models. For brevity, I will only make some points based on the results in table 1.

First, consider pricing model accuracy (col 2). The last row indicates that for the median model, the average absolute pricing error is a little less than 5 percent of the bond price. While not extreme, this pricing error is still sizable given the selection of bonds that should be easiest to value. Also important to note is that accuracy differs substantially across models, ranging from about 3 to over 12 percent.

Second, consider bias (col 1). This is potentially important in considering model accuracy at the portfolio level. For the median model, the bias is fairly modest, less than 2 percent of the actual price. Since the average absolute error is almost 5 percent, this suggests important cancelling between positive and negative pricing errors across different bonds. Nonetheless, for several variants of one model (CDG), the bias is over 10 percent of the actual bond prices. When Barth et al (1998) estimate their bond pricing model without using the bond's actual prices, the estimated prices also have a very large bias. A large bias implies potentially large portfolio-wide errors if the model is used to value a large part of the portfolio.

There is also another source of portfolio bias that is not revealed by the cross-section pricing errors reported in table 1. Over time, changes in market or economic conditions can produce correlated changes in the valuation errors of individual bonds or loans and hence the entire portfolio.

Third, consider credit spreads. By definition, credit spreads are intended to reflect credit or default risk. The average absolute credit spread errors (each expressed as a percent of the actual credit spread) are shown in col 5. Average absolute errors are very large for all

[19] For an extensive review of structural and reduced-form bond pricing models, see Duffie and Singleton (2003).

models, with the absolute error being 125 percent for the median model. These results indicate that structural models for credit risky debt cannot price the credit risk, or at least cannot match the observed market spreads on credit risky bonds. The results are consistent with earlier studies of structural pricing models. An inability to price credit risk will assume progressively greater importance for bonds or loans the lower the credit quality of the bonds or loans.[20]

Barth et al (1998) found larger pricing errors (when model prices were not used in model parameter estimation) than the median model errors shown in Table 1. However, in contrast to the straight bonds studied by Eom et al, the bonds studied by Barth et al include various conversion, call, put, and sinking fund provisions. Bonds with embedded options and other provisions may be more difficult to value. Barth et al also found that the bond provisions account for a significant proportion of the bonds' values, suggesting their importance in bond pricing.[21]

These conclusions are limited to bonds (and to structural models). Without formal study, it is difficult to say whether loan valuation models will be more or less prone to error than bond valuation models. One important feature of bank loans may make loan valuation significantly easier. This is the much higher recovery rate on defaulted loans than on bonds. This can significantly lower the loan's credit risk and thus make accurate valuation easier. However, the greater number and flexibility of provisions in loans may make valuation more difficult and bond market prices less applicable. There is also the important issue of the bank's incentives in judiciously making use of its information on borrower credit quality, which is discussed by Professor Landsman.

Presently, all important issues on how banks will determine loan fair values appear to be outstanding. These issues include the extent of model use, the range of models and estimation methods that might be employed, the likely accuracy of reported fair values, and the methods by which reported values might be verified. Before adopting full financial fair value reporting for banks, formal study of these issues would seem necessary. Adopting full fair value accounting without such study risks the potential for wide-spread abusive modeling practices or the imposition of heavy-handed rules on how fair values are to be calculated.

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[20] The large errors in the model credit spreads as a percent of the actual credit spreads could reflect errors of only a few basis points for high-grade bonds with small spreads. However, this explanation of the large percentage spread errors does not appear to be the case. In further graphic results, Eom et al show that the errors in estimated spread levels increase dramatically with the spread level in going from high-grade to junk bond status.

[21] Their results on the added difficulties in valuing complex instruments are somewhat ambiguous. In their estimations that use the bond's actual price to estimate model parameters, model accuracy for straight bonds was not better than that for the full set of bonds that included those with various provisions. However, they presented further evidence that suggest difficulties in estimating the values of the individual provisions in the bonds.

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Table 1

Accuracy of structural bond pricing models: Eom, Helwege, Huang (2004)

Pricing model	1 mean pricing error	2 mean abs pricing error	3 std dev of pricing error	4 spread error[1]	5 mean abs credit spread error[1]
Merton	1.69	3.67	4.94	-50.42	78.02
Geske (face recovery)	0.70	3.22	4.89	-29.57	66.93
Geske (firm recovery)	2.09	3.11	3.97	-52.92	65.73
Leland-Toft	-1.79	4.06	7.54	115.69	146.05
LS (1-day CMT)	-2.69	5.63	8.19	42.93	124.83
LS (1-month CMT)	-0.68	4.56	6.94	6.63	96.83
CDG (baseline)	-11.21	12.64	13.12	269.78	319.31
CDG (low κ)	-10.5	12.09	13.03	251.12	304.32
CDG (low μ)	-3.76	7.35	10.13	78.99	170.16
median values	-1.79	4.56	7.54	42.93	124.83

[1] Spread refers to the credit spread (yield minus risk-free rate). Error is expressed as a percent of the bond credit spread.