Where does the Information in Mark-to-Market Come from?

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Abstract

We study the ex-ante efficiency of mark-to-market accounting (MTM) in a loan market by taking into account its real effects on banks’ origination and retention decisions. Despite its benefit of improved valuation accuracy, MTM could reduce the overall efficiency of the economy. The efficiency loss results from the central idea of the paper: the attempt to exploit the information in market price, by adopting MTM, interferes with the market process that generates the information in price. Relative to historical cost accounting, MTM could induce banks to retain excessive exposure to the risk of the loans they originated, damage price discovery in the loan market, and reduce banks’ ex-ante incentive to originate good loans. These results imply an economy with an inefficient risk distribution and a lower overall loan quality, two important factors that have contributed to the current financial crisis.

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1 Introduction

The prevailing logic for mark-to-market accounting (MTM) is that it makes asset valuation more accurate by exploiting information in asset prices. The enhanced accuracy then generates various benefits. Notwithstanding these benefits, we show that MTM also affects firms’ behavior that determines their balance sheets MTM measures. The induced change in behavior could then inflict a cost on the economy and the overall efficiency of MTM thus involves a trade-off. In particular, in the context of a loan market, MTM could induce banks to retain excessive exposure to the risk of the loans they originated, damage price discovery in the loan market, and reduce banks’ ex-ante incentive to originate good loans, resulting in an economy with an inefficient risk distribution and a lower overall loan quality.

We focus on the loan market with banks following the “originate-to-distribute” (OTD) model. Banks have expertise in originating loans but it is too costly for them to maintain the loans on their own books for various exogenous reasons. If there is no information asymmetry between banks and investors, banks pass through all the loans they originated to investors. The liquidity in the loan market is perfect and independent of accounting measurement. Accounting is then simply irrelevant. However, banks receive private information about the quality of their loans because of their expertise in loan origination. Facing the lemons problem, banks rely on market mechanisms to improve price discovery in the loan market. One mechanism is for good banks (banks with good loans) to retain some portion of their loans and sell the rest at a high price. Price discovery becomes costly because it is sustained by signaling. The cost of price discovery in turn adversely affects banks’ ex-ante incentive to originate good loans.

Accounting measurement affects the bank’s origination and retention decisions through its interaction with the costly price discovery in the loan market. We consider two polar
cases of accounting measurement: MTM and HC (historical cost). HC records the retained interest (from signaling) at its cost, while MTM values it at the market price of the portion of the loan that was sold. In essence, MTM requires the early recognition of the expected economic profits or losses associated with the retained interest by exploiting the information in loan price.

The inefficiency of HC is obvious. HC ignores the information in loan price. In a signaling equilibrium, the loan price is informative about the quality of the loan. Furthermore, there seems to be a liquid market for the retained interest because the sold portion of the same loan is actively traded. Yet, HC does not allow banks to recognize the expected economic profit associated with the retained interest until the loan pays off. This delayed recognition increases the cost for banks to keep the retained interest on their books and reduces banks’ ex-ante incentive to originate good loans.

MTM attempts to overcome this inefficiency. By using the information in the loan price to value the retention, MTM improves the accuracy of the valuation of retained interest. All else equal (retention held constant), this enhanced valuation accuracy under MTM reduces the cost of price discovery and stimulates banks’ ex-ante incentive to originate good loans. However, switching from HC to MTM also changes the incentive for bad banks to mimic good ones and thus alters the equilibrium retention. In an attempt to exploit the information in the market price, MTM interferes with the signaling process that sustains the informativeness of the market price. It is this feedback effect that compromises the overall efficiency of MTM. In particular, we demonstrate three consequences of MTM.

First, relative to HC, MTM forces banks to retain excessive exposure to the risk of loans they originated. Even though only good banks retain a portion of the loans in equilibrium, MTM also reduces the marginal cost for bad banks to hold retained interest. Thus, good banks have to retain an even higher portion of the loan to distinguish themselves. As a result, the risk of the loan concentrates more on the banks’ own books and the loan market does not distribute the risk to investors who are better able to bear it.

Second, signaling could break down and the informativeness of the loan price could be
destroyed under MTM. As one moves to MTM, the required retention for good banks to differentiate themselves increases. As the required retention exceeds a threshold (beyond which sales accounting is not applicable), separation becomes infeasible. In any resulting non-separating equilibrium, the market prices of loans are less informative about the quality of the loans. The attempt to exploit the information in the market price by moving to MTM destroys the informativeness of the market price.

Finally, MTM could reduce the value of originating good loans, resulting in banks' lower ex-ante incentive to originate good loans and a lower overall quality of loans in the economy. The value of originating good loans hinges on signaling that sustains the price discovery in the loan market. MTM has two opposing effects on the cost of price discovery. On the one hand, improved valuation accuracy reduces the unit cost of holding retained interest, reducing the signaling cost. On the other hand, the early recognition under MTM also leads to higher retention in equilibrium, increasing the signaling cost. When the latter effect dominates the former, MTM increases the cost of price discovery and reduces the value of originating good loans.

These results suggest a possible link between MTM and the current financial crisis, especially given the expansion of MTM over the past decade having coincided with the development of the crisis. While the deteriorated quality of subprime mortgages triggered the subprime mortgage crisis, it developed into a full-fledged financial crisis mainly because of the banking sector’s excessive exposure to the risk of the loans they securitized. Greenlaw, Hatzius, Kashyap, and Shin (2008) report that commercial banks held about one third of the approximately 1.4 trillion dollar exposure of the financial system to subprime mortgages. Our analysis suggests that MTM may have contributed to both the deterioration of loan quality and banks’ excessive risk exposure to these loans through its real effects on loan origination and retention.

Our mechanism is new to the current debate about the role of MTM in the financial crisis. Most of the current debate has focused on whether and how MTM has exacerbated the crisis, not on the overall efficiency of MTM. It is inherently difficult to evaluate the
overall efficiency of a policy or system based on ex-post results in a second-best world. It is therefore imperative to consider the overall efficiency of MTM from an ex-ante perspective. Taking this approach, our analysis sheds light on the role of MTM in the build-up of problems in the system that have led us to the crisis. Such analysis could also inform the ensuing regulatory reform.

In particular, our ex-ante approach highlights an important deficiency in the current debate about MTM that treats information and liquidity in asset markets as orthogonal to accounting measurement. The essence of the popular argument is two-fold. On the one hand, MTM is theoretically justified because it enhances the accuracy of asset valuation. On the other hand, MTM may experience some implementation difficulty when asset markets are not very liquid. Valuation errors due to illiquidity in combination with the rigid reliance on accounting numbers by various parties could result in inefficient decisions that put further pressure on liquidity in asset markets, setting into motion a downward spiral. Therefore, liquidity is an important determinant of the overall efficiency of MTM.

Our analysis emphasizes on the reverse causality: MTM influences banks’ behavior that endogenously determines the information and liquidity in asset markets. This interaction creates a conceptual issue for MTM and the implementation difficulty is only a symptom of this conceptual difficulty. In the model, the information in loan price and liquidity in the loan market, liquidity defined broadly as the sensitivity of market prices to banks’ (trading) behavior, are endogenous and fragile because they are sustained by the privately costly signaling. As soon as one attempts to exploit them by marking the retained interest to the market price, the signaling game changes and leads to a new balance sheet for the bank. The benefit of MTM in the form of the improvement in valuation accuracy of the balance sheet could be dominated by the endogenous cost arising from the change in the bank’s balance sheet.

The logic that how we measure a bank’s balance sheet changes the bank’s balance sheet is a general feature of accounting measurement beyond our particular model. It is reminiscent of the “Lucas Critique” that policies derived from the observed empirical
relation could change the underlying relation. The retention required to signal under MTM differs from that under HC. Therefore, it is not appropriate to predict the consequences of MTM based on the retention decisions made under HC.

In general, attempting to resolve accounting measurement problems via a market-based solution could lead to unintended and sometimes undesirable consequences. While illiquidity in asset markets is the immediate cause, there is a deeper root of illiquidity. A firm’s business model is viable only if it has some competitive advantage over the market in conducting its activities. As a result, the core assets and liabilities on a firm’s balance sheet, dictated by its business model, are often subject to the same market frictions that sustain the business model. Market prices in these markets are thus endogenously linked to the firm’s activities that are guided partially by accounting measurement. Accounting measurement does not only measure a firm’s balance sheet but it also actively shapes the firm’s balance sheet. This feedback loop is illustrated in figure 1.

![Figure 1: Feedback loop of accounting measurement](image)

The rest of the paper is organized as follows. Section 2 reviews the literature, Section 3 describes the model, Section 4 presents the equilibria, Section 5 states our main results, Section 6 considers various extensions to the basic model, and Section 7 concludes. The Appendix includes details on the accounting for securitizations and the proofs that are not in the text.
2 Literature review

The most prominent argument linking MTM to the financial crisis is the procyclicality of MTM, as presented in Allen and Carletti (2008) and Plantin, Shin, and Sapra (2008). Given illiquidity in asset markets, Plantin, Shin, and Sapra (2008) show that MTM creates complementarities among financial institutions’ decisions to sell their asset holdings resulting in fire sales and “artificial” volatility for assets. Allen and Carletti (2008) show that the interaction of MTM and capital requirements of financial institutions could cause contagion among otherwise independent financial sectors through the market price link. In contrast, Laux and Leuz (2009a,b) argue that it is unlikely that MTM has contributed to or exacerbated the current financial crisis for at least two reasons. First, the existing MTM accounting rules have built-in “circuit breakers” that allow banks to deviate from market prices in their books to avoid a downward spiral in the presence of illiquidity. Huizinga and Laeven (2009) provide evidence consistent with banks using MTM to hide losses during the crisis. Second, the crisis was caused by a lower quality of mortgages and the price crash in the market; hiding the loss in the crisis wouldn’t have made the situation better. The authors also call for studies on the ex-ante effect of MTM on firm behavior.

In addition to the general point on the real consequences of MTM, our paper also provides a new mechanism for the link between MTM and the current crisis. First, we focus on the real effects of MTM on banks’ origination and trading (retention) behavior. We directly link MTM to the overall quality of loans in the economy and banks’ risk exposure, two factors that are viewed as immediate causes of the crisis. Therefore, we respond directly to the call in Laux and Leuz (2009a,b) for studies on the ex-ante effect of MTM but reach a conclusion different from their conjecture. Second, unlike in Allen and Carletti (2008) and Plantin, Shin, and Sapra (2008), we endogenize (il)liquidity in the model. As a result, we are able to show that MTM could cause, instead of being crippled by, illiquidity. We view this as an important conceptual problem with MTM. Finally, our analysis shows that even in absence of the (rigid) regulatory use of accounting earnings,
MTM could have adverse consequences for the economy. Therefore, simply severing the link between GAAP and RAP (Regulatory Accounting Principles) is no panacea to solve the problem of MTM.

Our major theoretical point that the attempt to exploit information in MTM interferes with its production is also shared by Reis and Stocken (2007) and Gorton, He, and Huang (2008). Reis and Stocken (2007) study the effect of MTM on the production and price setting behavior of firms in a duopoly. They emphasize on the point that market prices used in MTM are endogenous and transaction accounting measures are affected by the measurement. Gorton, He, and Huang (2008) study the optimal use of information gleaned from market prices of securities in solving the agency problem between a principal-investor and an agent-trader. They show that the inclusion of market prices in the compensation contract induces traders to collude and manipulate market prices when they are able to do so.

There are other papers studying the pros and cons of MTM and HC in general. Heaton, Lucas, and McDonald (2008) study a model in which accounting as well as capital requirements are designed to curtail banks’ risk-taking incentive. Market prices could be inefficient in this task because market prices reflect the correlation of the payoffs of assets among banks while banks’ incentive to take risk depends on the total volatility of the payoff of its own assets. Bleck and Liu (2007) point out that MTM can provide investors with an early warning mechanism while HC gives management a “veil” under which they can potentially mask a firm’s true economic performance. Their model offers a mechanism by which HC leads to higher volatility and more frequent and severe asset price crashes. O’Hara (1993) studies the consequence of MTM for banks’ choices of loan maturity and Burkhardt and Strausz (2009) models the impact of MTM on the asset substitution problem. There is also a literature on the application of MTM to hedging activities prescribed by FAS 133. One point made in some papers complements ours in that relying on MTM in the presence of other frictions could alter firm behavior and lead to undesirable consequences (e.g. Melumad, Weyns, and Ziv (1999); Kanodia, Mukherjee, Sapra, and Venugopolan (2000);
3 Model

We add accounting measurement of the retained interest on top of a typical “skin in the game” model for banks that follow the originate-to-distributed model. The timing of the model is as follows. There are three dates: $t = 0, 1, 2$. At $t = 0$, the bank makes a lending decision (loan origination) and receives private information about the quality of the loan. At $t = 1$, the bank chooses what fraction of the loan to retain and sells the rest to the loan market (loan distribution). Accounting measurement of the retained interest affects the tradeoff of the retention decision. At $t = 2$, the loan pays off. The risk free rate is zero and all parties are risk neutral.

3.1 Loan origination

The first component of the originate-to-distribute (OTD) model implies that the bank has expertise in originating loans. This expertise is modeled as the bank exerting an unobservable effort $m$ to improve the ex-ante quality of the loans it originates. Loan quality, denoted by $\theta$, is either good ($G$) or bad ($B$), $G > B$. The difference $G - B$ is assumed to be sufficiently large so that the good bank always has an incentive to differentiate itself whenever possible. The bank privately learns the quality of its loan after exerting effort. Effort $m$ originates a good loan with probability $m$ and a bad loan with probability $1 - m$.

A loan of type $\theta$ pays off $\theta + \tilde{x}$ at $t = 2$. The random component $\tilde{x}$ has density $f(x)$ in $[x, \bar{x}]$, with $-\infty \leq x < \bar{x} \leq \infty$, and mean zero.

In sum, at $t = 0$, the bank’s origination decision is to choose a costly effort $m$ to maximize its expected payoff

$$\max_m m V^A_G + (1 - m) V^A_B - s(m), \quad A \in \{H, M\}$$

where $V^A_\theta$ is the expected value of a loan of type $\theta$ to the bank under accounting regime $A$. 

Sapra (2002)).
$s(m)$ is the effort cost and satisfies $s'(0) = 0$, $s'(1) = S$, $s'' > 0$, where $S$ is a large positive number. These conditions guarantee that the optimal effort is interior.

The optimal origination effort under accounting regime $A$, $\hat{m}^A$, is given by the solution to the first-order condition of the maximization problem (1)

$$V_G^A - V_B^A = s'(\hat{m}^A), \quad A \in \{H, M\}$$

Note that it is the expected value differential of good and bad loans at $t = 1$ that determines the bank’s ex-ante incentive to exert effort. The higher the value differential, the higher the optimal effort $\hat{m}^A$. $\hat{m}^A$ is also a measure of the average quality of loans in the economy. Price discovery in the loan market drives the origination efforts by the bank and thereby determines the overall quality of loans in the economy. Now we turn to the loan market to determine the value of loans of different types to the bank under different accounting regimes.

### 3.2 Loan distribution

The other component of the OTD model is that it is costly for the bank to retain loans on its own books. We capture this feature by assuming that the bank incurs a cost $c$ for every unit of the risky loans it keeps. Because of this cost $c$, the bank would like to distribute (sell) the loans it originated, rather than hold them until their maturity.

Conceptually, $c$ reflects the cost excess for the bank, relative to other parties, to hold the loan. In the past three decades, the banking business model has been shifting from the traditional “originate-to-hold” model to the “originate-to-distribute” model (e.g. Bernanke (2008)). This shift is driven by the relative cost of financing loans with internal vs.

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1The second-order condition for a maximum is satisfied given $-s'' < 0$.

2By the second quarter of 2008, the outstanding balance of asset-based securities (ABS), including both mortgage and non-mortgage related ABS, is estimated to be $10.24$ trillion in the United States and $2.25$ trillion in Europe, with an issuance of $8.455$ billion in the U.S. and $652$ billion in Europe in 2007, according to SIFMA data. Securities Industry and Financial Markets Association (SIFMA), [http://www.sifma.org/research/pdf/2008-08_ESF_Q2.pdf](http://www.sifma.org/research/pdf/2008-08_ESF_Q2.pdf). In addition, banks also distribute loans through the syndicated loan market and the secondary loan market, which had an annual volume exceeding $1$
external capital. Berger, Kashyap, and Scalise (1995) “emphasizes regulatory changes and technical and financial innovations as the central driving forces behind transformation of the industry”. Deregulation has increased competition in deposit markets and increased the cost to fund loans with deposits; technical and financial innovations reduce the cost to obtain funds from the loan market. As the internal cost of capital increases and external cost of capital decreases, it becomes more likely that the bank who originated the loan is not the best party to hold the loan. We capture this driving force for the OTD model by assuming that the bank, relative to investors in the loan market, incurs an extra cost $c$ for retaining a unit of risky asset on its balance sheet.

One interpretation of the cost $c$ is the regulatory cost imposed on regulated financial institutions for retaining risky assets on their balance sheets. It could be thought of as the assessment set by the Federal Deposit Insurance Corporation (FDIC) in the United States, which is a function of the risk of a bank’s balance sheet. Alternatively, a typical capital requirement stipulates that banks set aside a capital reserve for the risky assets on their balance sheets. $c$ reflects the marginal cost for the bank to meet the capital requirement when they take on one more unit of a risky asset. Capital requirements have figured prominently as a motive for loan sales (e.g. Dewatripoint and Tirole (1995); Picker (1996); Saunders and Cornett (2006)).

For unregulated financial institutions, the cost $c$ could correspond to any cost differentials for them and investors to fund loans. For example, $c$ could be interpreted as the cost associated with the lack of diversification when a financial institution retains all of the loans it originates on its own books (e.g. Leland and Pyle (1977)). For another example, $c$ could reflect the relative expertise or investment opportunity of the financial institution and investors in the loan market. The financial institution has a competitive advantage in originating loans but other parties (investors) have competitive advantage in managing the loans; similarly, the financial institution has other profitable investment projects but faces a financial constraint while investors have idle capital (e.g. Gorton and Pennacchi trillion in the past few years.)
Even though there could be a host of justifications for $c$, we will stick to the interpretation of $c$ as a regulatory cost for the ease of reference and discussion in the rest of the paper.

Due to the cost $c$ the bank has an incentive to sell the loan but faces the information asymmetry problem in the loan market. Investors could not ascertain the quality of the loan and the bank could not credibly reveal its information to investors directly. The informational advantage of the bank is an inalienable feature of the loan origination process, a common assumption in the banking literature (e.g. Rajan (1992)), and well documented empirically (e.g. Lummer and McConnell (1989); Dahiya, Puri, and Saunders (2003); Marsh (2006)). To overcome the lemons problem and signal the quality of its loan to investors, the bank retains $k$ portion of the loan on its own books and investors respond with a price $p(k), k \in [0, k]$. $k$ is the upper limit of retention beyond which the transfer of a loan cannot be recognized as a sale for accounting purposes.

Retaining partial interests by the bank could be a solution to both its information advantage over investors or its unobservable incentive to improve the value of loans (e.g. Leland and Pyle (1977); Kihlstrom and Mathews (1990); Gorton and Pennacchi (1995); DeMarzo and Duffie (1999)). Gorton (2008) argues that “skin in the game” was used at least to some extent to alleviate the lemons market problem faced by banks. The direct evidence is that players in the OTD chain have suffered significant losses from the very beginning of the subprime mortgage crisis in 2007. A number of originators and underwriters have recorded billions of dollars of write-downs, closed shop, declared bankruptcy or been acquired and sold. Many top executives and other employees along the chain have been fired and laid off.

There is also empirical evidence indicating that banks do have private information and use retention as a signal. Sufi (2007) provides evidence consistent with this hypothesis in the context of the syndicated loan market. The author shows that the lead arranger retains a large stake in the loan, approximately 28.5% on average. The effect is reduced
but does not vanish when controlling for reputation as an alternative mechanism (see also Simons (1993)). Loutskina and Strahan (2008) find similar evidence consistent with this assumption. The authors show that concentrated lenders - those who focus on one or a small number of markets - retain a greater stake in their loan origination (about 60%) than diversified lenders (about 35%). This finding supports the notion that when investors expect the lender to be informed, the lender retains more “skin in the game” to convince investors of the quality of their loan origination. Keys, Mukherjee, Seru, and Vig (2009) find that “skin in the game” may partially alleviate inventive problems for mortgage brokers in the context of securitized subprime loans in the United States.

Taking “skin in the game” as a starting point, we model how accounting measurement interacts with the signaling process and price discovery in the loan market.

### 3.3 Accounting measurement

The key accounting measurement issue is how we measure the value of the retained interest. We consider two polar accounting regimes: HC and MTM. Under HC, the $k$ portion of the loan that is retained by the bank is recorded at its initial book value $B_0$, $G > B_0 > B$. Under MTM, the retained portion is revalued to the market price of the portion of the loan that was sold. In other words, MTM requires the bank to recognize the expected economic profit or loss, $k[p(k) - B_0]$, at $t = 1$ before the loan pays off. $p(k)$ is the loan price for the portion of the loan that was sold. Early recognition of the expected economic profit or loss associated with the retained portion of the loan is the main difference between HC and MTM. As will be discussed in Section 6, HC with impairment (or lower-of-cost-or-market) behaves in exactly the same way as HC in our model. We include in Appendix A a detailed description of the current accounting treatment for retained interests resulting from a securitization.

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3 In practice, MTM reflects the extent to which market prices for the same or similar assets influence the valuation of an asset. For example, under MTM retained interests could be directly marked to the market prices of the homogeneous portion that has been sold. Alternatively, if there are no homogeneous assets for the retained interest, retained interests could be valued by valuation models that use inputs implied from the market prices of the sold assets that derive from the same loan pools.
Retained interest is typically a large component on a bank’s balance sheet and exerts important influences on a bank’s income statement. Using the data from Schedule HC-S in Y-9C reports that U.S. bank holding companies file quarterly with the Federal Reserve, Chen, Liu, and Ryan (2008) report that on average the value of interest-only strips and subordinated asset-backed securities, two components of retained interests, accounts for about 11% of the outstanding principal balance of private label securitized loans. Figure 2 reproduces the example of Merrill Lynch, the former investment bank, from Gorton (2008) that illustrates the significance of the retained interests on its balance sheet and the loss associated with the retained interests on its income statement (page 37, 2007 Annual Report).

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>U.S. Sub-prime:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warehouse lending</td>
<td>$137</td>
<td>$(31)</td>
</tr>
<tr>
<td>Whole loans</td>
<td>994</td>
<td>(1,243)</td>
</tr>
<tr>
<td>Residuals</td>
<td>655</td>
<td>(1,582)</td>
</tr>
<tr>
<td>Residential mortgage-backed securities</td>
<td>723</td>
<td>(332)</td>
</tr>
<tr>
<td><strong>Total U.S. sub-prime</strong></td>
<td><strong>$2,709</strong></td>
<td><strong>$3,188</strong></td>
</tr>
<tr>
<td>U.S. Alt-A</td>
<td>2,687</td>
<td>(542)</td>
</tr>
<tr>
<td>U.S. Prime</td>
<td>28,189</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-U.S.</td>
<td>9,582</td>
<td>(465)</td>
</tr>
<tr>
<td>Mortgage servicing rights</td>
<td>389</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$43,556</strong></td>
<td><strong>$4,195</strong></td>
</tr>
</tbody>
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Figure 2: Merrill Lynch’s retained interest in mortgage-backed securities

Banks maximize expected earnings under a given accounting regime. In particular, at \( t = 1 \), the privately informed bank chooses the fractional retention \( k \) to maximize the sum of the expected earnings at \( t = 1 \) and \( t = 2 \)

\[
\max_{k \in [0,1]} U^A(k; \theta) \equiv e_1^A(k) + E \left[ \max \left\{ \tilde{e}_2^A(k; \theta), 0 \right\} \right], \quad A \in \{H, M\} \tag{3}
\]

\( e_1^A(k) \) and \( \tilde{e}_2^A(k; \theta) \) are the earnings the bank recognizes at \( t = 1 \) and \( t = 2 \) under accounting regime \( A \).
The objective function of the bank captures two features. First, the bank and its management care about accounting earnings. This assumption has been extensively used in the accounting literature. It is also easily justified since we focus on the economic consequences of different accounting measurement rules. There is a vast literature that explains how and why accounting earnings enter the bank’s objective function. In practice, accounting earnings are an important factor in determining the distribution of a bank’s resources. The compensation of bank managers on many levels depends heavily on earnings; debt covenants and other contracts are written over accounting earnings and ratios; regulatory actions are influenced by a bank’s accounting earnings; the dividend a bank is allowed to distribute is also restricted to (retained) earnings. We direct interested readers to the extant literature on this assumption in particular (e.g. Bleck and Liu (2007); Plantin, Shin, and Sapra (2008); Allen and Carletti (2008)) and to the large empirical and theoretical literature on the importance of accounting performance measures in compensation contracts in general (e.g. Lambert and Larcker (1987); Jensen and Murphy (1990); Paul (1992); Bushman and Indjejikian (1993)).

The second feature of this objective function is that the bank and its management care about the temporal distribution of earnings. This feature is closely related to the first one. Accounting measurement is one type of interim evaluation. Interim evaluation is meaningful only if the temporal distribution of earnings matters. In particular, the bank prefers the early recognition of expected profits. The max function is one way to capture the preference for early recognition. Take it as an example of the use of accounting earnings in managers’ compensation contracts. The objective function states that the manager has to be compensated in each period based on accounting earnings and her previous compensation cannot be clawed back later. In practice, we do observe that it is difficult or too costly to defer all compensation of a manager until her bank or unit

\[\text{To allow for an (expected) loss at } t = 2, \text{ we could introduce the initial equity of the bank } r. \text{ Then the expected earnings at } t = 2 \text{ would be } E \left[ \max \{ \bar{e}_2^2 (k; \theta), -r \} \right]. \text{ As long as the initial equity is not large enough to cover the loss in the worst state of the world, the bank still benefits from early recognition and all the results remain qualitatively intact.} \]
is liquidated, and that it is difficult to claw back the compensation paid to managers in
previous periods. The current debate about how to hold bankers accountable for the
current financial crisis illustrates this point. While changes to the future compensation of
bank managers has been one of the most prominent measures proposed to guard against
future crises, changing existing compensation contracts has faced much resistance and
legal contention.5 Take as another example the use of accounting earnings in determining
the distribution of dividends. The objective function reflects the fact that dividends are
distributed before a bank is liquidated and that dividends cannot be clawed back when the
bank later becomes insolvent. Thus, the objective function captures an element of limited
liability for the bank and its management. This feature of limited liability is particularly
prominent for the banking and financial industries and is the source of many frictions in
the banking literature such as asset substitution.

\[ e_1^A(k) \text{ and } \hat{e}_2^A(k; \theta) \text{ are determined as follows} \]

\[
e_1^A(k) = (1 - k) [p(k) - B_0] - kc + k [p(k) - B_0] 1_{A=M}
\]

\[
\hat{e}_2^A(k; \theta) = k \left[ (\hat{x} + \theta) - B_1^A \right]
\]

\[
B_1^A = p(k)1_{A=M} + B_0(1 - 1_{A=M}) \quad \theta \in \{G, B\}, A \in \{H, M\}
\]

where \(1_{A=M}\) is the indicator function that equals 1 if \(A = M\) and 0 otherwise. Note that
the expected value of a loan of type \(\theta\) to the bank at \(t = 0\) is given by \(V_\theta^A \equiv U^A(k^*; \theta)\),
where \(k^*\) is the solution to the maximization problem (3). Thus, the retention decision in
(3) is directly linked to the origination decision in (2).

At \(t = 1\), the bank recognizes the realized profit for the portion of the loan that was
sold, \((1 - k) [p(k) - B_0]\). \(kc\) is the regulatory cost charge against earnings. \(k [p(k) - B_0]\)
is the profit of the retained interest recognized by the bank under MTM, which determines
the new book value for the retained interest on the bank’s books. That is, the bank revalues

5A case in point is the struggle to claw back bonuses paid to managers at the American International
the retained interest from \( kB_0 \) to \( kp(k) \), its new book value, and recognizes a profit for the difference. Under HC, the book value of the retained interest remains unchanged at its original cost \( kB_0 \); the expected profit on the retained interest is not recognized until the maturity of the loan.

At \( t = 2 \), when the loan pays off, \( \hat{e}_2^A(k; \theta) \) is recognized as the difference between the cash flow of the retained interest and its book value. Under HC the book value at \( t = 1 \) remains unchanged, that is \( B_1^H = B_0 \), so that the earnings at \( t = 2 \) equal \( k \left[ (\theta + \bar{x}) - B_0 \right] \). In contrast, under MTM the book value at \( t = 1 \) is set to the market price of the portion of the loan that was sold, \( B_1^M = p(k) \), so that the earnings at \( t = 2 \) are given by \( k \left[ (\bar{x} + \theta) - p(k) \right] \).

Note that the early recognition under MTM is economically relevant because the bank cares about interim earnings. Otherwise, the sum \( e_1^A(k) + \hat{e}_2^A(k; \theta) \) would be independent of the accounting regime \( A \), and the accounting regime would be irrelevant for the retention decision. To further highlight the effect of the early recognition under MTM, we could reorganize the components of \( U^A(k; \theta) \) as follows

\[
U^A(k; \theta) = (1 - k) p(k) + k (-c + \theta + A_{\theta}) - B_0
\]

where

\[
A_{\theta} \equiv \int_{\left[ (x+\theta)-B_1^A \right] > 0} \left[ x + \theta - B_1^A \right] dF(x) - \left[ \theta - B_1^A \right] = \int_\mathbb{R} (B_1^A - \theta - x) dF(x)
\]

\( A_{\theta} \) is the option value of limited liability for the bank or its management of type \( \theta \), \( \theta \in \{G, B\} \), under accounting regime \( A \), \( A \in \{H, M\} \). It is the value of a put option on a security with a random payoff of \( \bar{x} + \theta - B_1^A \) at a strike price of 0. Thus, the value of this option varies across bank types and accounting regimes.

The tradeoff driving the retention decision is clear from equation (4). The value of
the retained interest $k$ has three components. First, the bank bears a regulatory cost $c$, driving the bank to reduce its retention. Second, the bank receives an expected payoff of $\theta$. This differential payoff makes signaling possible. Third, retention also gives the bank a free option $A_{\theta}$ and the value of this option varies across accounting regimes and types, offsetting the cost of retention for the bank.

We use as a benchmark the case of symmetric information in the loan market in which banks would follow the OTD model. Thus, we assume throughout the paper that the cost $c$ is high enough to discourage retention in the benchmark case despite the option value of retention. In particular, we assume $c > c_1 \equiv H_B + \left( \frac{1-k}{k} \right) (G - B)$. As will become clear later, this cutoff also ensures that a separating equilibrium (surviving the Intuitive Criterion of Cho and Kreps (1987)) always exists under HC so that we could use HC as a benchmark against which to evaluate MTM.

4 Equilibrium

4.1 Symmetric information

We first establish the benchmark case of symmetric information in which the quality of loans is public information.

**Lemma 1.** *When the quality of the loan is public information, the bank follows the OTD model. That is, it exerts first-best effort $(s'(\hat{m}^*) = G - B)$ at $t = 0$ and sells the entire loan ($k^* = 0$) at $t = 1$. The accounting regime is irrelevant.*

4.2 Asymmetric information

We use the equilibrium concept of Perfect Bayesian Equilibrium (PBE) for the game at $t = 1$. A PBE is a strategy profile $(p, k)$ and belief $\mu(\theta | k)$ such that

1. given investors’ pricing strategy $p(k)$ and belief $\mu(\theta | k)$, the bank’s retention strategy $k(\theta)$ maximizes its expected payoff $U(k(\theta); \theta)$;
2. given the bank’s retention strategy \(k(\theta)\), investors break even under the pricing strategy \(p(k)\);

3. investors’ belief \(\mu(\theta|k)\) is consistent with their pricing strategy \(p(k)\) and updated according to Bayes rule, where possible.

We use the Intuitive Criterion by Cho and Kreps (1987) to select a unique equilibrium among the PBEs under MTM and HC.

### 4.2.1 Historic cost accounting

**Proposition 2.** Under HC, there is a unique equilibrium consisting of the strategy profile \((p, k)\) and beliefs \(\mu\) such that

\[
k(\theta) = \begin{cases} 
  k^H &= \frac{G - B}{G - B + c - H_B} \text{ if } \theta = G \\
  0 &= \text{ if } \theta = B
\end{cases}
\]

\[
p(k) = \begin{cases} 
  G &= \text{ if } k \in [k^H, \overline{k}] \\
  B &= \text{ otherwise}
\end{cases}
\]

and

\[
\mu(\theta = G|k) = \begin{cases} 
  1 &= \text{ if } k \in [k^H, \overline{k}] \\
  0 &= \text{ otherwise}
\end{cases}
\]

In this equilibrium, the loan price is informative about the quality of the loan. Since the loan retained on the bank’s books is homogeneous to the part sold in the market, the loan price is also informative about the quality of the retained interest. However, this informativeness of the loan price comes at a cost in that the bank with a good loan has to retain a critical fraction \(k^H\) of the loan on its books. This signal costs the bank \(k^H [c - H_G]\). The assumption \(c > c_1\) guarantees that \(k^H < \overline{k}\).

The equilibrium payoffs of the good and bad bank are

\[
V^H_G = G - B_0 - k^H [c - H_G]
\]

\[
V^H_B = B - B_0
\]
4.2.2 Mark-to-market accounting

**Proposition 3.** Under MTM, there are two cases.

1. Case 1: if \( c \geq c_2 > c_1 \), there is a unique equilibrium consisting of the strategy profile \((p, k)\) and beliefs \( \mu \) such that

\[
k(\theta) = \begin{cases} 
k_M = \frac{G-B}{G-B+c-M} & \text{if } \theta = G \\
0 & \text{if } \theta = B
\end{cases}, \quad p(k) = \begin{cases} 
G & \text{if } k \in [k_M, \overline{k}] \\
B & \text{otherwise}
\end{cases}
\]

and

\[
\mu(\theta = G|k) = \begin{cases} 
1 & \text{if } k \in [k_M, \overline{k}] \\
0 & \text{otherwise}
\end{cases}
\]

2. Case 2: if \( c_2 > c > c_1 \), there does not exist any pure-strategy separating equilibrium.

In the first case of the separating equilibrium, the bank with a good loan retains \( k_M \) to serve as a signal of its quality and the price discovery in the loan market again comes at a cost. The cost of sustaining the informativeness of the loan price through signaling for the good bank is \( k_M [c - M_G] \). The good and bad bank’s payoffs are

\[
V^M_G = G - B_0 - k_M [c - M_G] \\
V^M_B = B - B_0
\]

The condition of \( c \geq c_2 \) ensures that the equilibrium retention under MTM is such that \( k_M \leq \overline{k} \). We analyze this case in Sections 5.1 and 5.2.

In the second case of \( c_2 > c > c_1 \), the good bank still has an incentive to separate itself from the bad bank because the benefit of separation \( G - B \) is assumed to be sufficiently large. However, the good bank could not perfectly do so because the level of retention is restricted by an upper bound of \( \overline{k} \). We examine this case in Section 5.3.
5 Analysis

In this Section, we analyze the economic consequences of moving from HC to MTM for banks and the loan market. Relative to HC, MTM forces banks to retain greater exposure to the risk of the loans they originated on their own books and reduces banks’ ex-ante incentive to originate good loans, two factors that have been at the root of the current financial crisis. We also show that MTM, in an attempt to exploit the information in the loan price, could destroy its informativeness.

5.1 MTM and banks’ exposure to risk

Proposition 4. When \( c > c_2 \), banks retain more loans on their own balance sheets under MTM than they do under HC, that is \( k^M > k^H \).

MTM induces banks to deviate further away from their OTD model. The OTD model dictates that banks distribute the risk of the loans they originated to investors who are better able to bear it. In the absence of information asymmetry in the loan market, banks therefore dispose of all of their loans regardless of the accounting regime, as in Lemma 1. However, the information asymmetry between banks and investors is an inevitable consequence of banks’ expertise in originating loans. In this second best scenario, the efficiency of the loan market in identifying loan quality is only sustained by good banks’ suboptimal exposure to the risk of the loans they originated. The accounting regime matters now by influencing the economic tradeoffs of the retention decision.

Proposition 4 shows that MTM leads to greater suboptimal retention of risk than HC. The intuition is clear. The bad bank’s incentive to mimic drives the equilibrium retention. In equilibrium, the bad bank should be indifferent between selling the entire loan at the low price versus retaining a portion of the loan and selling the rest at the high price. From equation (4), the indifference is as follows

\[
U^A(k^A; B) = B - B_0 \iff (1 - k^A)(G - B) = k^A(c - A_B)
\]
for $A \in \{H, M\}$. Since the marginal benefit for bad banks to mimic is fixed at $G - B$, the equilibrium retention is determined by the bad bank’s marginal retention cost, $c - A_B$, $A \in \{H, M\}$.

**Lemma 5.** The option value of limited liability for bad banks is larger under MTM than under HC, that is $M_B > H_B$.

While holding the marginal benefit constant, early recognition of the expected economic profit associated with the retained position reduces the marginal retention cost for bad banks and thereby increases their incentive to mimic. As a result, good banks are forced to retain a larger position in order to distinguish themselves from bad banks. The retention levels by the good bank under two accounting regimes are depicted in figure 3.6

![Figure 3: Retention](image)

Proposition 4 helps explain the puzzling observation that banks have maintained excessive exposure to the risk of the loans they originated. This concentration of risk in the

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6The horizontal segment leveled at $k$ in the figure is from the unique partial or full pooling equilibrium for the case of $c_2 > c > c_1$ under MTM. We do not present the equilibrium in the text to avoid distraction. The results are available upon request.
banking sector was one of the key factors that turned the subprime mortgage crisis into a full-fledged financial crisis. Banks retain skin in the game to overcome the information asymmetry problem in the loan market. MTM exacerbates the problem by forcing banks to put even more loans on their own balance sheets.

This costly retention affects the net value of loans to banks. We examine the consequence of the loan value for the banks’ origination decision next.

5.2 Incentive to originate good loans

Proposition 6. When $c > \hat{c}$, the value of originating good-quality loans is lower under MTM than it is under HC, that is $V^M_G < V^H_G$.

Proof. Denote the value differential of a good loan under MTM and HC by $\Delta(c)$.

\[
\Delta(c) \equiv V^M_G - V^H_G = k^H (c - H_G) - k^M (c - M_G) = \frac{G - B}{(G - B + c - M_B)(G - B + c - H_B)} \times [(G - B)(M_G - H_G) + M_B H_G - M_G H_B - c [M_B - H_B - (M_G - H_G)]]
\]

As shown in Lemma 7, $M_B - H_B - (M_G - H_G) > 0$. Thus, $\Delta(c)$ is decreasing in $c$. Further, $\Delta \left( \frac{(G - B)(M_G - H_G) + M_B H_G - M_G H_B}{M_B - H_B - (M_G - H_G)} + \varepsilon \right) < 0$ for any positive $\varepsilon$. Thus, if $\Delta(c_2) < 0$, $V^M_G < V^H_G$; if $\Delta(c_2) > 0$, there exists a $c^* > c_2$ such that $\Delta(c^*) = 0$. For any $c > c^*$, $\Delta(c) < 0$. Whether $\Delta(c_2) > 0$ depends on the shape of $f(x)$. Thus, $V^M_G < V^H_G$ if $c > \hat{c} = \max \{c^*, c_2\}$.

Proposition 6 shows that MTM could reduce the value of originating good loans. In the presence of information asymmetry in the loan market, the value of owning a good loan crucially depends on price discovery in the loan market. However, price discovery, via signaling in the model, is costly and offsets the value of originating good loans. When the informativeness of the loan price relies on the banks’ incentive to signal and MTM changes
the banks' incentive to signal, the efficiency of MTM by exploiting the information in the loan market is compromised.

Under HC, the separating equilibrium is inefficient in that banks cannot recognize the expected economic profit associated with the retained interest, the quality of which is fully revealed in equilibrium. MTM intends to overcome this inefficiency through early recognition based on the loan price. All else equal, MTM increases the option value of retention to compensate good banks for bearing the retention cost. However, early recognition under MTM also increases bad banks' incentive to mimic. As shown in Proposition 4, MTM forces good banks to retain a higher portion of the loan. As a result, the net impact of MTM on the value of originating a good loan is a tradeoff between a lower unit retention cost and a higher equilibrium retention.

This tradeoff, as highlighted in equation (5), is complicated. For example, regulatory cost $c$ both reduces the retention level ($\frac{\partial k^A}{\partial c} < 0$) and increases the unit retention cost. Proposition 6 shows that the balance is tilted to the detriment of MTM as $c$ increases. The key to understanding the intuition behind Proposition 6 is the following Lemma.

**Lemma 7.** While the option value of limited liability increases for both good and bad banks when switching to MTM, it increases more for bad banks, that is $M_B - H_B > M_G - H_G$.

The bad bank benefits more from the early recognition under MTM because it is much closer to the threshold of limited liability if it holds the same amount of risk as the good bank. This differential change in the option value of limited liability for bad and good banks drives the result in Proposition 6.

The retention level is determined by the bad bank’s marginal retention cost $c - A_B$ while the unit retention cost is determined by the good bank’s marginal retention cost $c - A_G$. When switching from HC to MTM, the reduction in the good bank’s marginal retention cost is less than the reduction of the bad bank’s marginal retention cost. When $c$ is high, the level effect dominates the unit retention effect and MTM reduces the value of originating good loans.
Corollary 8. For $c > \hat{c}$, banks exert less effort ex ante to originate good loans under MTM than under HC, that is $\hat{m}^M < \hat{m}^H$. As a result, the overall loan quality in the economy is lower under MTM than it is under HC.

The ignition spark of the current financial crisis was the deterioration of the quality of mortgages banks originated in the past decade. While there are many hypotheses about why banks loosened their quality control and jumped on the bandwagon of subprime mortgages, our result indicates that MTM could be one contributing factor when the price discovery in the loan market becomes more expensive. In this respect, Propositions 4 and 6 demonstrate striking consequences of MTM for the banks’ risk taking and loan origination behavior.

5.3 Information and liquidity under MTM

Moving to MTM increases the equilibrium retention of loans. Since retention is restricted to $k$ at most, signaling becomes impossible when the required retention exceeds $\bar{k}$. This happens when the direct cost $c$ is mild and thus fails to deter bad banks from mimicking.

Proposition 9. For $c_2 > c > c_1$, there does not exist any pure-strategy separating equilibrium under MTM. In contrast, there is a unique pure-strategy separating equilibrium under HC.

In an attempt to “correct” the inefficiency of HC by exploiting the informativeness of the loan price, MTM destroys the information in the loan price. This paradoxical result highlights the main theoretical point of the paper. In the presence of market frictions, the informativeness of the asset price is fragile in that it is sustained by a costly underlying market process. The attempt to extract information from the asset price makes the underlying process costlier and in the extreme destroys the informativeness of the price.

This theoretical observation is of particular importance to accounting. Accounting is always an integral part of a firm’s institution and serves to fulfill a firm’s business model. A firm’s business model is viable only if the firm has some competitive advantage.
over the market in conducting its activities. In other words, a firm operates in areas where market frictions are present. Since which assets and liabilities a firm holds on its balance sheet is mainly dictated by its business model, it is unlikely that a firm’s core assets and liabilities, which accounting is designed to measure, are actively traded in frictionless markets. Therefore, when we contemplate on the effect of accounting rules, such as MTM, it is important to put the issue in the context of a firm’s business model and the accompanying market imperfections.

Since accounting is designed to cope with the frictions in the market, one should be cautious not to over-rely on the market to solve problems in accounting. So far, the debate about MTM focuses almost exclusively on the exogenous liquidity in asset markets. Many commentators have observed that there are no active markets for a bank’s assets and liabilities and consequently expressed concerns about applying MTM under those circumstances. In a recent speech on the financial crisis, the chairman of the Federal Reserve, Ben Bernanke, suggested that the accounting standard setter re-examine the application of MTM in inactive markets (Bernanke (2009)).

Our model goes one step further. Not only does accounting passively respond to the exogenous liquidity, we also show that accounting could actively influence the provision of information and liquidity in asset markets. In fact, even if there appears to be an active market, applying MTM may be detrimental to the functioning of this market and could have unintended consequences both for the information and the liquidity in this market. We emphasize two such effects.

First, the informativeness of the loan price is sustained by the costly signaling of the good bank and could disappear under the pressure from MTM. Marking the retained interest to the market price makes it more costly for the good bank to send a signal relative to HC. The higher cost reduces the incentive to supply information to the market and the information in the loan price vanishes in the extreme.

Second, MTM directly influences market liquidity leaving it extremely fragile. Before applying MTM, there is an active market that trades the $1 - k$ portion of the same loan.
Since the retained securities are identical to those traded in the market, it therefore seems “indisputable” that an active market for the retained interest exists. Therefore, one may argue that MTM should be preferred for the valuation of the retained interest. The existence of an active market for the retained interest is nonetheless an illusion for the bank. As soon as the bank starts to mark the value of the retained interest to the market price, the loan market responds. The liquidity in the loan market is endogenously linked to the bank’s activities. Not only does MTM measure the bank’s balance sheet, it also actively shapes the bank’s behavior that eventually determines the bank’s balance sheet.

6 Extensions

The basic model illustrates the point that the attempt to exploit the information in asset price interferes with the market mechanism that sustains the informativeness of price in the first place. It is this feedback effect that could compromise the efficiency of MTM and other market-based policies. In this Section, we discuss the robustness of the model to various alternative specifications.

The first question is whether regulators could improve the efficiency of MTM by linking $c$ to such observable bank characteristics as the retention level. The optimal design of $c$ in a general setting is apparently beyond the scope of this paper. Instead, with the interpretation of $c$ as the FDIC assessment, we assume that regulators are subject to the same budget constraints under HC and MTM. Then, a combination of MTM and any assessment rule that links $c$ to the retention does not qualitatively change the trade-off of MTM. The main results in Propositions 4, 6 and 9 still hold with only slight changes in the values of the cutoffs. The intuition is as follows. Indexing $c$ to the retention is based on the same idea as MTM, namely to exploit the information in loan price. Since regulators have the same information problem investors face, the change in $c$ cannot be set as a function of the bank’s true type and instead has to be imposed uniformly on both good and bad banks. Since bad banks benefit more from early recognition, as shown in
Lemma 7, the differential benefit still holds after the regulators indiscriminately increase \( c \) for both banks. Further, indexing \( c \) to retention \( k \) in some situation could exacerbate the problem in the same way MTM does. In addition, the cost \( c \) could be caused by many other factors such as risk sharing and differential expertise, as we discussed in Section 3. It is more difficult for regulators to directly influence those sources of frictions.

One appealing logic about MTM is that the market price also aggregates information from other sources. If investors in the loan market also incorporate their private information about the quality of the loan, the loan price conveys new information to the bank as well. To the extent that this new information helps resolve the information asymmetry, MTM improves the valuation of retained interest and thus enhances banks’ ex-ante incentive to originate good loans. However, since this benefit of MTM is orthogonal to the cost-benefit analysis in our model, we do not expect this feature to change the central trade-off of our analysis.

Another aspect of our analysis is that it relies on the comparison of two accounting regimes in their pure forms. In the model, book values under MTM rely solely on current information extracted from market prices while book values under HC do not at all. This choice of pure accounting regimes is intentional to underscore the main theoretical point of the paper. In reality, HC is often implemented using information from market prices in some circumstances in the form of the so-called lower-of-cost-or-market rule (LCM). LCM requires a downward revaluation of the book value of an asset from its current book value but does not allow an upward revaluation. In other words, relative to HC, LCM requires the early recognition of expected losses. Note that in our model LCM (HC with impairment) would behave in the same manner as HC because early recognition of expected losses is not an issue. The inefficiency in our model under HC manifests itself as the undervaluation of retained interest and this undervaluation issue would still exist under LCM.

We model the retention as a proportional holding to circumvent the issue of optimal security design. In general, the optimal securities that should be retained as skin in the game are those that are most sensitive to the seller’s private information (Innes (1990);
DeMarzo and Duffie (1999); Fender and Mitchell (2009)). Proportional retention is optimal only in certain environments. However, endogenizing the security design in our model creates additional complexity. One issue is that the optimal security design provides banks another way for differentiation. How accounting measurement interacts with the optimal security design is an interesting topic in and of itself. Another issue regarding introducing optimal security design is that it requires the endogenous specification of the regulatory cost \( c \), which is an important component of the payoff of the retention. We leave this extension to future research.

The issue of the resale (hedge) of the retained interest does not arise in our model because it only spans two periods. However, when we apply the model to reality, we may complain that once the bad banks have sold their loans, investors know that those who retain some portion are good banks. Therefore, investors could offer to buy the retention at a high price immediately after the bad ones have sold their entire loans, which may upset the separating equilibrium. A resale or a hedge of the retention are variants of this same issue. There is a vast literature on how to address this commitment issue in signaling games (e.g. Admati and Perry (1987); Nöldeke and Van Damme (1990); Swinkels (1999)). One conclusion from this literature is that the separating equilibrium could be rescued by allowing a small possibility, which goes to zero in the limit, that bad banks may retain some portion of their loans and pool with good banks in each period. From a practical perspective, the fact that banks record significant amounts of retained interests and losses associated with them in the past two years indicates that retained interest as a signal is credible.

Observability of the retention is another important issue. If investors cannot observe a bank’s retention or subsequent investors cannot observe the bank’s previous retention commitment, then additional complexity about signaling arises and other mechanisms are needed to induce incentive compatible retention. One candidate mechanism is Bizer and DeMarzo (1992), in which borrowers are subject to a higher interest rate when their lenders cannot observe their deals with other lenders. Similarly, if investors cannot observe banks’
retention in our model, we conjecture that signaling will be preserved but becomes more costly as investors in all periods and markets price-protect themselves. Therefore, banks have an incentive to disclose information about their retention and such disclosure is much easier and more credible than the disclosure about the quality of their loans. In practice, the information about a bank’s aggregate position of retained interests is available from several sources, such as regulatory filings (e.g. Y-9C reports) and SEC filings (e.g. 10-Q and 10-K). Information about the retention at the transaction level is also available, albeit more difficult for the public to access. The prospectus that is filed with the SEC when a bank securitizes loans details the structure of securities that are issued to the public market.

7 Conclusion

In this paper, we propose a new mechanism by which MTM may have contributed to the current financial crisis. We show that, relative to HC, MTM could induce banks to retain excessive exposure to the risk of the loans they originated and reduce banks’ ex-ante incentive to originate good loans. These results derive from the main theoretical insight of the paper. In the presence of market frictions, the informativeness of the asset price is fragile in that it is sustained by an underlying market process. The attempt to extract information from the asset price makes the underlying process costlier and in the extreme destroys the informativeness of the price. It is this feedback effect that compromises the efficiency of MTM and causes damage to the real economy. Our paper underscores that information and liquidity in asset markets are not exogenous. Rather, they are determined by the incentives and ability of market participants to overcome market frictions. Accounting measurement changes these incentives. Understanding the interplay between accounting measurement and the market process that deals with the market friction is thus of importance if we are to improve the functioning of markets with frictions.
References


Appendix A: Accounting Treatment for Retained Interest in Securitizations

In general, the shift from HC to MTM has accelerated during the past decade. This appendix describes the accounting for retained interests of securitizations.

Conditional on sales accounting, FAS 140 stipulates the accounting treatment on the transaction date. The subsequent revaluation depends on how the retained interest, a security, is classified. Securities can be classified as trading, available-for-sale (AFS), or held-to-maturity (HTM), with different accounting treatments (FAS 115 and FAS 157). The only restriction FAS 140 imposes on subsequent classification is that prepayment-sensitive securities be classified as either trading or AFS. For simplicity, we assume that the loan is measured at cost before the transaction.
On the transaction date, items could be classified into two overlapping categories for accounting purposes: proceeds received and retained interest. Proceeds received include cash and any other assets obtained, such as derivatives received that do not use the transferred assets as underlying assets. Liabilities incurred, including recourse commitments, are both proceeds and retained interest. Other retained interests include interests in transferred assets, such as proportional holding, interest-only strips (IO), subordinated securities, and Mortgage Servicing Rights (MSRs).

Figure 4: Classification of considerations from a securitization

For accounting purposes, retained interests that are not proceeds are recorded at pro-rated cost at inception (the proration is based on fair value). The rationale is that the firm has not relinquished its control over these assets and therefore these are not considered to have been sold yet. However, this rationale is overwritten when the retention is classified as an AFS or trading security and thus FAS 115 and FAS 157 apply.

The proceeds are fair valued at inception. The firm receives these assets or assumes these liabilities as considerations for the sale. FAS 156 requires the fair value option for MSRs at inception (afterwards firms can choose whether to measure MSRs at impaired cost or fair value) and therefore treats MSRs as proceeds. FAS 166 further requires that all assets obtained and liabilities incurred in a securitization be initially measured at fair value. Thus, for accounting purposes, there are no retained interests that are not proceeds after FAS 166.

Subsequently, the accounting treatment of retained interests as well as the proceeds
depends on their classification. FAS 140 does not directly govern the classification; instead, FAS 115 and FAS 157 apply. The only requirement of FAS 140 is that prepayment-sensitive securities could not be classified as HTM. It can only be prepayment sensitive if the underlying loans are subject to prepayment (e.g. residential mortgages but not commercial mortgages). Therefore, not only the retained interests but also the proceeds could be revalued either at impaired cost or at fair value. Most big banks choose fair value. The incurred liabilities could be subject to FAS 5 Loss Contingency.

The transferability of the retained interests is typically not restricted in securitizations. Banks could transfer the retained interests, including selling MSRs or securitizing the IOs. This transferability does not contradict skin in the game. If the retention was previously used for signaling, banks wouldn’t be able to sell it at a price commensurate with “high retention”. As a result of this transferability and the FAS 140’s requirement that prepayment-sensitive retained interests couldn’t be classified as HTM, retained interests are rarely classified as HTM.

Appendix B: Proofs

Proof of Lemma 1

With the loan quality being public information, loans are priced at their expected cash flow \( \theta \). That is, \( p(k) = \theta \). A bank of type \( \theta \) under accounting regime \( A \) chooses \( k \) to maximize

\[
U^A(k; \theta) = \theta - B_0 - k(c - L(A, \theta))
\]

\[
L(A, \theta) \equiv \int_{\xi}^{B_1^A - \theta} \left[ B_1^A - \theta - x \right] dF(x), \quad A \in \{H, M\}
\]

By Lemma 5 and \( G > B_0 > B \), it could be verified that \( \max \{L(A, \theta) : A \in \{H, M\}, \ \theta \in \{G, B\}\} = H_B < c_1 \).
Thus, when $c > c_1 > \max \{L(A, \theta) : A \in \{H, M\}, \theta \in \{G, B\}\}$, $c - L(A, \theta)$ is always positive. Hence, $k^* = 0$ for both banks under both accounting regimes and $V^A_\theta \equiv U^A(0; \theta) = \theta - B_0$. The optimal effort $\tilde{m}^*$ is such that $s'(\tilde{m}^*) = G - B$, which is independent of the accounting regime $A$.

**Proof of Proposition 2**

We first prove that the proposed equilibrium is indeed a PBE. The key is to show that the bad bank is indifferent between retaining $k^H$ and 0, given the investors’ pricing strategy $p(k)$ and belief $\mu$. $k^H$ is thus determined by

$$U^H(k^H; B) = U^H(0; B)$$

as

$$k^H = \frac{G - B}{G - B + c - H_B}$$

Since $c > c_1 = H_B + \left(\frac{1 - \xi}{k}\right)(G - B)$, we have $k > k^H > 0$.

Note that the good bank’s incentive compatibility constraint (IC) is satisfied because $G - B$ is assumed to be sufficiently large. In particular, $U^H(k^H; G) > U^H(0; G)$ if $G - B > H_B - H_G$.

By invoking the result from Cho and Kreps (1987), we prove that this separating equilibrium is the unique equilibrium that survives their Intuitive Criterion.

**Proof of Proposition 3**

Case 1: $c \geq c_2$. We first prove that the proposed equilibrium is indeed a PBE. The key is to show that the bad bank is indifferent between retaining $k^M$ and 0 given the investors’ pricing strategy $p(k)$ and belief $\mu$. $k^M$ is thus determined by

$$U^M(k^M; B) = U^M(0; B)$$
as

\[ k^M = \frac{G - B}{G - B + c - M_B} \]

Since \( c \geq c_2 \equiv M_B + \left( \frac{1 - \bar{k}}{\bar{k}} \right) (G - B) \), we have \( \bar{k} \geq k^M > 0 \). \( c_2 \geq c_1 \) follows from Lemma 5.

Similarly, the good bank’s IC is satisfied if \( G - B > M_B - M_G \).

By invoking the result from Cho and Kreps (1987), we prove that this separating equilibrium is the unique equilibrium that survives their Intuitive Criterion.

Case 2: \( c_2 > c > c_1 \). From the proof of case 1, any separating equilibrium in which the threshold retention required to be identified as the good type is lower than \( k^M = \frac{G - B}{G - B + c - M_B} \) does not survive the Intuitive Criterion. Thus, there does not exist any pure-strategy separating equilibrium.

**Proof of Proposition 4**

For \( c \geq c_2 \), we have

\[ k^H - k^M = \frac{G - B}{(G - B + (c - H_B))(G - B + (c - M_B))} (H_B - M_B) < 0 \]

The last inequality follows from Lemma 5.

**Proof of Lemmas 5 and 7**

In both separating equilibria under HC and MTM, \( p(k^H) = p(k^M) = G \).

\[ A_\theta = \int_\bar{z}^{B_1^A - \theta} (B_1^A - \theta - x) \, dF(x) \]

Let \( y \equiv B_1^A - \theta \).

\[ \frac{dA_\theta}{dy} = \frac{d}{dy} \int_\bar{z}^{y} (y - x) \, dF(x) = F(y) > 0 \]

Further,

$$\frac{d^2 A_\theta}{dy^2} = f(y) \geq 0$$

Since $G > B$ and $(G - B) - (B_0 - B) = (G - G) - (B_0 - G)$, $(M_B - H_B) - (M_G - H_G) > 0$. This proves Lemma 7.

**Proof of Corollary 8**

It follows directly from Proposition 6 and the optimal origination effort in equation (2).

**Proof of Proposition 9**

It follows directly from Propositions 2 and 3.