Incentive Compensation, Accounting Discretion and Bank Capital

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Abstract

This paper examines the impact of the U.S. banking agencies' recent guidance on incentive compensation on efforts to have banks build countercyclical capital buffers that can absorb losses during periods of economic weakness. The connection arises from the impact of the compensation guidelines on bank senior managers' incentives to engage in earnings management. The results suggest that the parts of the guidance related to accounting earnings based compensation create earnings management incentives that are consistent with countercyclical capital buffers. However, the parts that encourage the payment of compensation in the form of equity-linked instruments may create incentives for senior managers to reduce capital buffers during periods of higher earnings.

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The financial crisis that began in 2007 sparked a sweeping review of prudential regulatory and supervisory policies in developed countries with an express goal of reducing the probability of future crises. The breadth of issues under consideration and the determination to move quickly have resulted in many of these issues being addressed independent of each other. Yet, some of the various reform measures are likely to have unintended consequences for other reform measures. This paper examines unintended consequences that new supervision of bank incentive compensation may have on the effectiveness of measures to make banks build countercyclical capital buffers.

The idea behind countercyclical capital buffers is that banks should increase their buffers for absorbing losses in good times and use these buffers to absorb losses during economic downturns. Much of the policy discussion has related to varying the numerical capital requirements over the business cycle with higher requirements during boom times than during periods of weakness.[1] Policymakers, however, recognize that another way of building such a buffer would be by requiring banks to build up their loan loss allowance during good times and allowing it to drop during weakness as was done with Spain's dynamic provisioning requirements.[2] What is perhaps less well recognized is that earnings management through discretionary accounting policies can have the effect of building up or reducing buffers. For example, if a bank is using earnings management to smooth reported earnings, it will under-report earnings and capital during good periods and over-report earnings (and possibly capital) during periods of economic weakness. Whether and how

[1] Basel Committee on Banking Supervision (2011) introduces new requirements for numerical capital buffers that vary with the business cycle.

[2] Saurina (2009) makes the case for the Bank of Spain's provisioning policies as a macroprudential tool and Balla and McKenna (2009) simulate its application using U.S. data. See also Caprio (2010) and Carbó-Valverde and Rodríguez-Fernández (2010) for an analysis of dynamic provisioning policies. Basel Committee on Banking Supervision (2011) also supports accounting methodologies that encourage earlier provisioning for losses.

senior bank managers engage in earnings management will depend on the impact of reported earnings on their incentive compensation (IC). Bank executive IC has become a topic of considerable interest to bank supervisors since the crisis, in large part due to concerns that poorly structured IC systems encouraged bank employees (including senior managers) to take excessive risk.[3] In July 2010, the Board of Governors et al. (2010) set out supervisory expectations with regards to bank IC systems for employees that can take material risk.[4] In most cases the Board of Governors et al. (2010) guidance (BOG Guidance) provides only general recommendations and lets banks decide how to implement the recommendations. However, the BOG Guidance lays out more specific expectations with respect to senior executives at large banking organizations. To the extent the Board of Governors et al. (2010) changes the way senior managers are compensated, it has the potential to impact the way in which these managers exercise their accounting discretion to manage reported earnings.

In order to analyze the impact of the BOG Guidance on the use of accounting discretion, this paper decomposes IC into two parts: the component whose value depends upon reported earnings and the component that depends on the stock market's valuation of the firm.[5] The part of IC that

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[3] Jarque and Prescott (2013) and Kupiec (2013) analyze the risk implications of regulating incentive compensation contracts. In contrast to this paper, the focus of these papers is more on the incentives of employees below the senior management level.

[4] The Section 956 of the Dodd-Frank Wall Street Reform and Consumer Protection Act requires that various federal financial regulatory agencies, including the bank regulators and the Securities and Exchange Commission issue guidelines or regulations prohibiting compensation arrangements that the regulators determine encourages risks that could lead to "material financial loss to the covered institution. The various regulatory agencies issued a joint proposed regulation that was generally similar to the Federal Reserve's guidance in February 2011 however that regulation has not yet received final approval.

[5] The full set of incentives determining bank management behavior is complex, often including fixed salary, cash bonuses, claims on equity (common stock and options, restricted and unrestricted), retirement benefits, perquisites, and future employment opportunities. A shareholder value maximizing board would want to take account of the how these elements interact to influence the manager's behavior, including the manager's use accounting discretion, in determining the compensation package. However, while many aspects of managerial compensation have been analyzed, no integrated model addressing all of these issues exists yet and the creation of such a model would be beyond the scope of this paper.

depends solely on reported earnings is analyzed in a two period model that allows for three types of IC: fixed bonuses for achieving a target, a variable bonus for exceeding the target and a variable penalty for missing the target. As shown below, the Board of Governors et al. (2010) may also impact the timing of payments which is incorporated into the model via the discount rate applied to future payments.

The part of IC that depends on the market's valuation of the firm is important because the guidance encourages banks to pay senior executives IC in the form of equity-linked instruments. Both theoretical and empirical evidence suggests that earnings management may impact a firm's stock price implying that to the extent the Board of Governors et al. (2010) results in the greater use of equity-linked compensation that it may also impact earnings management.

The results suggest that parts of the BOG Guidance dealing with the amount and timing of incentive compensation paid to senior executives at large, complex banks is likely to work to reinforce the goals of countercyclical capital requirements. However, other provisions in the guidance that encourage the payment in equity linked instruments may amplify volatility around the times bank senior executives convert these instruments to cash. The net effect may be to dampen earnings volatility and create countercyclical capital buffers most of the time, but to increase volatility and reduce capital buffers around the time senior management plans on selling substantial fractions of its shares.[6]

[6] Ideally any such model should then be taken to the data. However, devising a clean test of the results of the compensation guidelines is likely to face two problems. First, identifying the changes solely due to the guidelines may not be possible given that they were introduced shortly after the crisis when banks were still trying to rebuild their financial strength and during which many other changes were being made to regulatory policy. Second, the focus of supervisory enforcement of these guidelines has been at the largest U.S. banks which substantially reduces the degrees of freedom for estimating empirical models.

The next three sections of the paper lay the ground work by discussing countercyclical capital, incentive compensation, and accounting discretion. The fourth section analyzes the impact of the accounting earnings based portions of Board of Governors et al. (2010) on earnings management and capital. The fifth considers the equity compensation portion and its implications for earnings management and capital. The paper concludes with summary remarks.

1. Countercylical capital

The Basel Committee on Banking Supervision (BCBS) (2010, p. 2) gives as the primary aim of countercyclical capital that of protecting the banking sector from "periods of excess aggregate credit growth." Achieving this would accomplish three benefits according to BCBS (2010). First, it would help reduce the likelihood that banks would become insolvent during periods of stress. Second, it would help ensure that the banking system has sufficient capacity to maintain the flow of new lending to the economy during periods of stress. Third, it would also help damp the excess growth of credit during good times.

The BCBS (2010) takes the most direct way to establish regulatory capital requirements that vary through the business cycle by imposing higher requirements during periods of economic strength and lower requirements during periods of weakness. Another way of building capital buffers during good times is to require banks to have higher allowances for losses during the good times and use this build-up to reduce required provisions during economic weakness. While the focus here is building a capital buffer via the loan loss allowance, the same principle could be applied to other loss allowances. Wall and Koch (2000) note that proposals to build up loan loss allowances during good times are consistent with the way bank supervisors think about loan losses in that bad loan portfolios are created during good times and are revealed as such during economic downturns. However, Wall and Koch (2000) also note that accounting authorities recognize that this approach allows banks to smooth reported net income and mask the true variability in the firm's earnings. The U.S. accounting and bank supervisory authorities have debated the correct approach to loan loss provisioning whereas the Bank of Spain required Spanish banks to adopt dynamic provisioning.

The level of capital buffers may also be significantly influenced by the use of managerial discretion in financial accounting. Specifically, managerial discretion used to smooth earnings will tend to produce countercyclical capital requirements similar to Spain's dynamic provisioning. Banks that smooth earnings will reduce reported earnings, asset values and capital during good times which will build a buffer to absorb future losses. This buffer is then drawn down during periods of weak performance to raise reported earnings. Implicitly, provisions for loan losses alternatively exceed expected losses during good times and fall short of expected losses during bad times. Thus, for any given level of reported capital during economic good times, the bank will have a larger economic buffer to absorb losses during periods of negative earnings. Conversely the use of discretion to boost short-run earnings by reducing provisions for loan losses during good periods will tend to make the buffers more procyclical because provisions will tend to increase during economic downturns.[7]

The differences between the three approaches are shown in Figure 1. Countercyclical capital rules and dynamic provisioning policies respectively require banks to have more capital or provisions during economic expansions and allow lower values during recessions. In contrast, income smoothing results in discretionary changes in both expansions and recessions. Another important difference is that the buffers due to earnings smoothing would not necessarily be readily observable

[7] Considerable research documents the procyclical impact of banks' loan-loss provisioning. For example, see Laeven and Majnoni (2003), and Bikker and Metzemakers (2005).

to third parties and thus cannot be easily incorporated into regulatory capital requirements. Nevertheless, the effect of banks' earnings management on capital buffers is no less real than cyclically varying numeric requirements or dynamic provisioning.[8]

2. Incentive Compensation

The compensation contract of senior managers at banks virtually always contain clauses that adjust the amount of the compensation up or down based on their personal performance and that of their firm.[9] Typically IC provisions are justified as ways to encourage senior managers to increase their bank's value. However, the terms under which the IC is paid to the senior managers may also encourage the senior managers to take actions which will not increase long-run shareholder value. For example, bonuses based on accounting earnings may encourage the senior managers to use accounting discretion to report higher earnings. Similarly, the use of stock options as an IC tool may incent senior managers to have their bank take more risk than is optimal for shareholders.

This section begins with a general discussion of different types of IC, focusing on those types with implications for reported net earnings. The second subsection considers how these structures may influence risk-taking decisions by senior management and reviews the limitations on senior managers IC set out by the Board of Governors et al. (2010).

[8] In order for countercyclical capital, dynamic provisioning or earnings smoothing to result in economically meaningful countercyclical buffers, the increased loss absorption due to these actions must not be (completely) offset by changes in the amount or riskiness of the banks' portfolio.

[9] The set of senior managers that may influence financial accounting certainly includes the chief executive officer, CEO, but may also include other senior managers. For example, Jiang, Petroni, and Wang (2010) finds evidence that the chief financial officer, CFO, may exercise more influence over accounting discretion than the CEO. For our purposes, which senior manager or managers in a firm have control over the exercise of accounting discretion is unimportant. The potential methods of compensation and the limitations set by the Board of Governors et al. (2010) do not distinguish among the different senior officers.

2.1 Alternative incentive compensation structures

While firms may pay incentives based on a variety of measures, the measures most relevant to reported capital levels are incentives based on measures of accounting profits. Murphy (1998, 2001) examined CEO incentive contracts across a wide range of industries and found that "almost all companies rely on some measure of accounting profits." This is especially so for the financial and insurance firms in his sample where (almost) all of the firms used earnings or EBIT.[10]

The relationship between earnings and incentive payouts may take a variety of forms. Murphy (1998) finds that CEO compensation typically takes the form of salary plus positive bonuses for achieving various objectives. Firms in his sample often did not pay a bonus until the CEO's performance exceeded some threshold. After exceeding the threshold, the CEO obtains a threshold performance bonus about one-half of the time. In addition, after exceeding the threshold, the CEO often receives a variable bonus that increases in the firm's performance. Often this variable bonus is capped so that earnings above some level do not cause an increase in the bonus.

In principal, firms could also impose penalties in the form of reduction in salary or a taking back of past bonuses.[11] Penalties appear to have been rare at the time of Murphy (1998, 2001) with no mention of penalties, clawbacks or malus. However, with the adoption of the Sarbanes Oxley Act in 2002, CEOs at publicly-traded companies are vulnerable to clawbacks if as a result of

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[10] The ambiguity in Murphy (1998, Table 2) about the proportion of firms using earnings or EBIT (earnings before interest and taxes) arises in part because one firm relied solely on discretionary measures which may (or may not) include earnings and in part because of the way the data are summarized for the firms using two or more measures. Murphy (2001, Table 1) summarizes the same information but provides a little less detail.

[11] The penalties could take the form of requiring reimbursement of bonuses already paid out (called clawbacks) or in the case of deferred bonuses vesting less than 100 percent of the original grant (called malus).

misconduct, a restatement was necessary because of material noncompliance with financial reporting requirements under federal law.[12]

Another way to incent CEOs to boost shareholder value is to provide them with grants of their company's stock or options on the stock. Stock grants are often restricted and the stock is not available for sale until a set interval after the grant date. While the amount of these grants may be related to the firm's performance, the sizes of the grants in Murphy's study do not appear to be determined by performance. Stock options are typically offered with exercise prices at the money at the time of the option award. The ability to exercise options is then staggered over time in an attempt to influence manager retention and encourage a focus on longer-term performance. Even if the number of shares or options is not tied to the firm's performance, the value of the grant will depend on the investors' perceptions of the firm's past and future performance.

2.2 Interagency guidance

The structure of a bank's IC system may incent a CEO to take more risk. For example, the market value of stock options granted the senior managers are increasing in the variance of the firm's stock returns. That compensation structure may play an important role in bank risk-taking is supported by a survey published by the Institute for International Finance (2009) in which 98 percent of the large international banks participating in a survey agreed that compensation structures were a factor in the financial crisis of 2007 and 2008.[13] In response to concerns that IC helped cause the

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[12] Public Law 107-204.

[13] One limitation of this finding for our purposes is that the survey does not specifically address the question of whether senior management compensation was a significant factor. Nevertheless, the finding of widespread industry agreement that compensation was a problem gave additional support to efforts to increase supervision of bankers' incentive compensation. Subsequent research has found mixed evidence on the impact of CEO compensation policies and bank risk taking. See Bhagat, and Bolton (2014), Bolton, Mehran, and Shapiro. (2011), Fahlenbrach and Stulz (2011), and DeYoung, Peng and Yan (2014).

crisis, the G-20 Leaders (2009) in effect called for its members to adopt Financial Stability Forum (2009) and Financial Stability Board (2009) statements related to IC principles and implementation of the principles. The Board of Governors et al. (2010) emphasizes the importance of compensation arrangements that balance risk and financial results for all employees that can take material risk. Importantly, the guidance emphasizes the need to tailor the arrangements to the range and time horizon of risks that may be taken by the employee. The guidance also calls for reduced sensitivity to short-term performance as the employee achieves higher levels of performance.

The BOG Guidance leaves the decision on how best to achieve balanced incentives for most employees to each bank. However, for the senior executives at large, complex banking organizations, Board of Governors et al. (2010, p. 33) provides firmer direction about what is required to achieve balance. Specifically, the BOG Guidance notes that senior executives make a variety of decisions that are not easily captured by reliable quantitative measures and the use of ex ante measures to risk adjust their rewards is unlikely to provide balance. The guidelines instead recommend that the IC be spread over multiple years or that performance be measured over multiple years. It further states that balance is more likely to be achieved if the payments are made in the form of equity-based instruments where a substantial portion would vest over a several year period and where the amount of instruments ultimately received depends on the bank's performance.

The BOG Guidance has several implications for the design of senior management compensation at large banking organizations. The general call for reduced sensitivity to short-term performance at the higher range of performance is certainly consistent with the concept that banks impose a cap on the bonus payments to senior managers. It does not require it, however. Second, the BOG Guidance calls for deferred payments that vest over several years with the amount actually vested depending upon performance such that strong (poor) performance allows greater (smaller) amounts to be vested. The call for penalties for poor performance is a significant change from Murphy (1998, 2001) where performance based penalties were so rare as to not merit substantial discussion. Additionally, the call for the penalties to be based on poor performance in subsequent years would give CEOs an incentive to consider the impact of earnings management on the banks' ability to hit long-term performance targets—possibly even targets in the years after the CEO retires. Third, the recommendation that CEOs be paid in equity-linked instruments reinforces current practices of paying a substantial fraction of CEO compensation in some form of equity.

3. Accounting Discretion and earnings management

The accounting literature includes both theoretical analysis suggesting that senior management incentive compensation may influence corporations' use of accounting discretion and empirical analysis suggesting that banks manage earnings through accounting discretion and real operating decisions. The following two subsections provide a brief overview of the theory on the use of earnings management and the empirical analysis of earnings management at financial firms. The focus of this discussion will be on the use of earnings management associated with accounting discretion which imposes no costs on the firm but for which the range of possible management is limited by GAAP. However, some theoretical and empirical papers that are important for our purposes either do not distinguish the type of earnings management or explicitly consider earnings management methods that are costly in expected value terms.[14]

[14] For example, some studies assume that increased earnings management are associated with higher expected costs which is more consistent with real earnings management.

3.1 Earnings management theory

Compensation contracts contain incentives intended to induce senior managers to take hidden actions that will maximize shareholder value. One set of important measures of firm value creation are the earnings of the firm. Even under the assumption that the underlying economic profits are observable to the senior managers; the only verifiable measures that outsiders receive are the accounting earnings prepared in accordance with GAAP. Yet as discussed above, there are a variety of ways in which GAAP earnings may be managed. Crocker and Slemrod (2007) show that in this setting, it is not possible to design a contract that both incents managers to maximize shareholder value and incents them to report profits honestly.[15]

Murphy (1999, 2001) finds that IC contracts frequently contain fixed bonus for attaining some threshold. Degeorge, Patel and Zeckhauser (1999) show that fixed bonuses generally induce CEOs to smooth income in a two period model. In the first period, the CEO uses discretion to reduce reported earnings relative to latent earnings if latent earnings exceed the threshold and raises earnings up to the threshold if possible. However, in their model it is possible for first period earnings to fall so far short that attaining the threshold is impossible. In this case, their model predicts the CEO will forgo any effort to reach the threshold, and instead reduce reported earnings relative to latent earnings in what Degeorge, Patel and Zeckhauser's (1999, p. 12) they label "Saving for a better tomorrow." This "saving" gives the CEO additional discretion to meet the earnings target in the second period.

Healy (1985) incorporates both a fixed bonus for attaining a threshold and variable bonus for exceeding the threshold that is capped above some level. The addition of the capped variable bonus

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[15] Goldman and Slezak (2006) and Sun (2009) analyze the implications of the potential for earnings management on the optimal structure of IC. The focus of these papers is on a tangent from the purpose of this paper which is to analyze the impact of supervisory IC guidance on bank's incentive to engage in activities that smooth and activities that increase the variance of reported net earnings.

creates a high and low threshold. On the high side, discretion is used to exactly reach the cap if possible and to reduce earnings to the maximum extent possible if earnings exceed the cap amount by more than the available discretion. On the low side, if the reported earnings can reach the threshold then CEO uses maximum discretion to reach or exceed the threshold if possible. If the threshold cannot be reached the CEO uses maximum discretion to reduce current period earnings to save for tomorrow, which Healey (1985) describes as taking "a bath." Healey parenthetically notes that absent a cap, the manager has an incentive to use maximum accounting discretion to boost earnings whenever latent earnings are sufficient to reach the minimum threshold. That is, absent a cap the CEO has no incentive to engage in earnings smoothing when earnings are very good.

Although Murphy (1999, 2001) does not discuss penalties for missing earnings targets in IC contracts, CEOs are nevertheless subject to the large fixed penalty of being fired. Fudenberg and Tirole (1995) consider the case of a divisional manager that is subject to being fired for failing to attain an earnings target. Their results are generally consistent with that of a fixed bonus in that the fixed penalty creates an incentive to smooth earnings. The one difference in Fudenberg and Tirole (1995) is that if the manager cannot reach the minimum threshold for retaining his job, the decision to use accounting discretion is moot.

Ownership of equity is another major motivating factor for CEOs. Murphy (1999, 2001) finds that stock and option grants are common in his sample of major firms. The potential wealth gain due to higher prices when liquidating these stock and options provide a strong incentive to maximize the market's expectation of future earnings, both by improving the firm's performance and by managing the firm's accounting earnings. Equity analysts and sophisticated shareholders are well aware of the likelihood that a firm is managing its reported earnings. Nevertheless, managers may be able to influence stock valuations given that investors are unable observe actual amount of earnings management.

Stein (1989) develops a model in which management takes as given investors' conjectures about the extent of earnings management. In this setting, earnings manipulation produces a one-for-one increase in investors' perception of the firm's latent earnings in the steady state. In equilibrium, management has an incentive to engage in value reducing real earnings management up to the point where the marginal value of the increase in the stock price equals the marginal discounted cost of lower earnings in future periods.

3.2 Earnings management evidence in banking

A number of empirical papers have sought evidence of earnings management on the part of banking organizations. This literature is only loosely related to the theoretical earnings management literature because important details in senior managers' compensation contracts are rarely revealed. As a substitute for compensation contracts, many studies analyze the use of earnings management to help meet supervisory capital adequacy requirements.

Wall and Koch (2000) review the results of six studies of bank earnings management, especially through the management of loan loss provisions. The papers they survey consistently found evidence that estimates of discretionary loan loss provisions and other earnings management tools are related to bank capital levels. Some of the papers also found evidence that discretionary provisions were related to earnings management but others failed to find a statistically significant relationship. Adams, Carow and Perry (2009) found evidence that mutual savings banks engaged in earnings management prior to their initial public offering (IPO) to drive down the price managers paid for their stock purchases when the savings bank converted to stock ownership. More recent studies find evidence consistent with earnings smoothing including El Sood's (2012) analysis of a sample of U.S. bank holding companies and Bushman and Williams' (2012) cross-country analysis.

Dechow, Myers and Shakespeare (2010) examine the firm's fair value estimates made in connection with securitized assets. They note that sponsors must estimate the fair value of their retained interest in securitizations. These estimates depend in part on the assumptions about the revenant likelihood of default, prepayment rates, and appropriate discount rates. They find evidence that these assumptions were chosen to smooth earnings, with high gains reported the firm would otherwise have low reported earnings and vice versa.[16] Fietcher and Meyer (2010) analyze unrealized gains on securities valued using Level 3 information. They find evidence that banks with poor pre-managed earnings during the period from 2008 Q1 to 2009 Q1 were using their discretion in valuing the Level 3 securities to report even larger losses or "take a big bath." Consistent with earnings management, the firms with negative pre-managed earnings subsequently show positive pre-managed earnings in future periods.

4. Impact of accounting based incentive compensation

This section analyzes the impact of the Board of Governors et al. (2010) on earnings management by banks. The four subsections below use a two period model to analyze how the structure of IC changes incentives to engage in earnings management. The first subsection presents the model and develops some of its properties. The second subsection analyzes how different parts of the compensation function influence the manager's choice of accounting discretion. The last subsection uses this analysis to evaluate the impact of the Board of Governors et al. (2010).

[16] Barth and Taylor (2010) concur that banks were using securitization to manage earnings. However, they argue that the earnings management could take the form of increased sales of securitized credit (real earnings management) rather than through exploiting the accounting discretion available under fair value accounting.

4.1 Model

A risk neutral manager with a positive rate of time preference, r, runs the firm. The firm realizes its latent earnings at three dates, $t = 1$, and 2. Immediately after the end of the period the manager observes the true value of the firm's underlying or latent earnings, LE_1 and LE_2. The auditor then informs the manager of the range of acceptable accounting discretion.

$$-MAXDA \leq DA \leq MAXDA$$

where

MAXDA = maximum amount of discretionary adjustment that may be made by the manager.

DA = amount of discretionary adjustment actually made by the manager.

Next the manager selects the amount of accounting discretion to include in reported earnings and announces reported earnings. Reported earnings in period *t* are latent earnings adjusted for *DA*. At time 1, the adjustment takes the form of adding discretionary adjustments to latent earnings. At time 2, the discretionary adjustments are assumed to be reversed out of earnings.[17]

$$RE_1 = LE_1 + DA,$$

and

$$RE_2 = LE_2 - DA,$$

where

RE_t = reported pre-bonus earnings at time *t*.

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[17] Reversing out discretionary adjustments in the second period is a simplified way of operationalizing the assumption that current discretionary adjustments constrain future discretionary adjustments. If discretionary adjustments at time 1 are negative, the subsequent recovery of the adjustment into time 2 income recognizes that negative adjustments in one period provide a sort of hidden capital which will be taken back into income in a subsequent period. If discretionary adjustments at time 1 are positive, subtracting that adjustment from time 2 income recognizes that firms will have to report lower earnings in some future periods.

The manager uses his accounting discretion to maximize the expected, discounted value of his compensation. The manager earns compensation at t=1 and t=2, with the amount of compensation dependent upon the relationship between RE_t and time t target earnings, TE_t.[18] The manager may earn both a fixed bonus and variable bonus for exceeding the target in period t. Conversely, the manager may be subject to a variable penalty at time t if RE_t is less than TE_t. Although target earnings may differ between times 1 and 2, the other terms of the bonus function are assumed to be the same at both times. The bonus function, $BP(RE_t)$, takes the form

$$BP(RE_t) = FB + vb(RE_t - TE_t) \qquad \text{if } RE_t \geq TE_t\text{, and}$$

$$BP(RE_t) = vp(RE_t - TE_t) \qquad \text{otherwise,} \tag{1}$$

with

$$FB, vb, vp \geq 0,$$

where

FB = fixed bonus paid at time t if $RE_t \geq TE_t$,

vb = variable bonus rate paid at time t on the amount by which RE_t exceeds TE_t.

vp = variable penalty rate assessed at time t on the amount by which RE_t is less than TE_t.

The manager's problem is to select the value of DA that maximizes the expected, discounted value of his compensation package (hereafter, simply the value of his compensation or his value):

$$E(ME) = BP(RE_1) + \frac{1}{1+r}\int_{-\infty}^{TLE} vp(RE_2 - TE_2)p(LE_2)dLE_2 + \frac{1}{1+r}\int_{TLE}^{\infty}\left(FB+vb\left(RE_2 - TE_2\right)\right)p\left(LE_2\right)dLE_2 \tag{2}$$

[18] The fixed salary component of compensation is normalized to zero.

with

$$TLE = TE_2 + DA \tag{3}$$

subject to:

$$-MAXDA \leq DA \leq MAXDA$$

where

$E(ME)$ = expected discounted value of managerial earnings,

$p(LE_2)$ = probability of LE_2 and

TLE_2 = latent earnings required to obtain the target for reported earnings at time 2.

Given the discontinuity in the bonus function at t=1, the analytical procedure followed by the manager is to first determine the value of DA that maximizes E(ME) conditional on reported earnings is less than time 1 target earnings (if possible given LE_1), then determine the value of DA that maximizes E(ME) conditional on at least equaling the time 1 target earnings (again, if possible given LE_1), and finally select the value of DA that maximizes the overall value of E(ME).

4.1.1 Value maximization when RE_1 is less than TE_1

For values of RE_1 less than TE_1, the manager's problem is to select the value of DA that maximizes equation(4):

$$\begin{aligned} \mathrm{E}(ME \mid RE_1 < TE_1) = vp(RE_1\text{-}TE_1) + \frac{1}{1+r}\int_{-\infty}^{TLE} vp(RE_2 - TE_2)p(LE_2)dLE_2 \\ + \frac{1}{1+r}\int_{TLE}^{\infty} (FB{+}vb(RE_2 - TE_2))p(LE_2)dLE_2 \end{aligned} \tag{4}$$

subject to:

$$-MAXDA \leq DA \leq MAXDA\,.$$

Given that the firm's reported earnings are greater than its target earnings at time 1, taking the first order condition for a maximum of *ME* with respect to *DA* and substituting in the definition of *TLE* from equation (3) yields:

$$\partial E(ME \mid RE_1 < TE_1) / \partial DA = vp - \left(1/\left(1+r\right)\right)\begin{bmatrix} vp\int_{-\infty}^{TLE} p(LE_2)dLE_2 \\ +vb\int_{TLE}^{\infty} p(LE_2)dLE_2 \\ +FBp(TLE_2) \end{bmatrix} \quad (5)$$

The first term in equation (5) is the decrease in the variable penalty associated with an increase in *DA*. The first term inside the bracket represents the increase in the expected amount of the variable penalty at time 2 (higher values of *DA* reduce RE_2). The second term represents the decrease in the expected amount of the variable bonus and the third is the reduction in probability of receiving the fixed bonus.

Equation (5) may be zero for some value of *DA* within the bounds of managerial discretion set by –*MAXDA and MAXDA*, but such a result is not guaranteed. The derivative may be either strictly positive or strictly negative for all values of *DA*.

4.1.2 Value maximization when RE_1 equals or exceeds TE_1

For values of RE_1 that exceeds TE_1, the manager selects the value of *DA* to maximize equation (6) :

$$E(ME \mid RE_1 \geq TE_1) = \Big(FB{+}vb(RE_1\text{-}TE_1)\Big) + \frac{1}{1+r}\int_{-\infty}^{TLE} vp(RE_2 - TE_2)p(LE_2)dLE_2 + \frac{1}{1+r}\int_{TLE}^{\infty}(FB{+}vb(RE_2 - TE_2))p(LE_2)dLE_2)) \quad (6)$$

subject to:

$-MAXDA \leq DA \leq MAXDA$

Given the firm will at least equal its target earnings, the first order condition (after substituting in equation (3) is:

$$\partial E(ME \mid RE_1 \geq TE_1) / \partial DA = vb + \left(1/\left(1+r\right)\right)\begin{bmatrix} -vp\int_{-\infty}^{TLE} p(LE_2)dLE_2 \\ -vb\int_{TLE}^{\infty} p(LE_2)dLE_2 \\ -FBp(TLE_2) \end{bmatrix} = 0 \qquad (7)$$

The first term in equation (7) is the increase in the time 1 variable bonus resulting from an increase in *DA*. The second term is the decrease in expected time 2 compensation resulting from the increase in *DA* causing an increase in the expected value of the variable penalty, a reduction in the expected value of the variable bonus, and a reduction in the probability of the fixed bonus.

A value for *DA* may exist that satisfies this condition within the constraints, but the derivative could also take on a positive or negative value for all permissible values of *DA*.

4.2 Analysis of the elements of the compensation function

The previous two sections present special cases that may be combined to analyze the impact of the three compensation parameters (*FB*, *VP* and *VB*) and the manager's rate of time discount. The following three subsections analyze the compensation parameters one at a time to determine their individual impact on the manager's use of accounting discretion. The fourth section considers one interesting case related to the manager's discount rate, the impact of an infinite discount rate. An infinite discount rate is interesting because it has the same effect as the manager retiring after time 1.

4.2.1 A non-zero penalty

If the compensation contract provides for a non-zero variable penalty but no fixed or variable bonuses, the manager set discretionary accrual according to Proposition 1.

Proposition 1. If the parameters of the manager's compensation function take the values $vp > 0$, vb, $FB = 0$, and $0 < r < \infty$

the manager optimally sets DA as follows:

A. **If** $LE_1 + MAXDA \leq TE_1$ **then** $DA = MAXDA$

B. **If** $LE_1 - MAXDA > TE_1$ **then** $DA = -MAXDA$

C. **If** $LE_1 \leq TE_1$ **and** $LE_1 + MAXDA \geq TE_1$ **or**

if $LE_1 > TE_1$ ***and*** $LE_1 - MAXDA \leq TE_1$ **then** $DA = TE_1 - LE_1$

Proof: See Appendix 1.

Proposition 1 shows that the manager uses his accounting discretion to report time 1 earnings as close to target earnings as possible. So long as reported earnings at time 1 are above target earnings the manager would not pay a variable penalty at time 1, so the only impact of using discretion to reduce earnings is to reduce the expected discounted value of the time 2 variable penalty. Conversely, if reported earnings at time 1 are below then using discretion to boost earnings reduces the size of the time 1 variable penalty while causing a smaller increase in the expected, discounted value of the time 2 variable penalty. If possible, the maximum value of value of managerial earnings is obtained at the value of discretionary adjustments where reported earnings equal target earnings.

4.2.2 Positive fixed bonus

The implications of a compensation contract that contains only a fixed bonus combined with a positive, finite discount rate is considered in Proposition 2:

Proposition 2. If the parameters of the manager's compensation function take the values *FB* > 0, *vb, vp* = 0, and $0<r<\infty$, the manager optimally sets *DA* as follows:

A. **If $LE_1 + MAXDA < TE_1$ then $DA = - MAXDA$**

B. **If $LE_1 – MAXDA > TE_1$ then $DA = - MAXDA$**

C. **If $LE_1 \leq TE_1$ and $LE_1 + MAXDA \geq TE_1$ <u>or</u>**

if $LE_1 > TE_1$ *and* $LE_1 – MAXDA \leq TE_1$ then $DA = TE_1 - LE_1$

Proof: See Appendix 1.

Thus, a fixed bonus has an earnings smoothing impact on accounting discretion similar to that of a variable penalty with one exception. If the manager lacks sufficient discretion over *DA* to report earnings at least equal to the target, he optimally using his discretion to minimize time 1 reported earnings in order to maximize the probability of obtaining the time 2 fixed bonus.

4.2.3 Variable bonus

The manager's compensation contract may contain only a variable bonus. Proposition 3 considers the case of an uncapped variable bonus. Proposition 4 considers the more common case of a capped bonus.

Proposition 3. If the parameters of the manager's compensation function take the values *vb* > 0, *FB, vp* = 0, and $0<r<\infty$ then *DA* will either take the value of –*MAXDA* or *MAXDA*.

Proof: See Appendix 1.

Thus, if the only incentive compensation received by the manager is an uncapped variable bonus, the manager optimally uses his discretion to minimize or maximize discretionary adjustments.

In practice, firms often impose a cap on the manager's variable bonus payments. Such a cap provides the manager with a linear bonus function for reported earnings above some threshold on target earnings for time *t*, TE_{tl}, but pays no additional variable bonus for earnings above some upper threshold, TE_{tu}. Such a capped variable bonus acts like the variable bonus at low levels of latent earnings and like a fixed bonus at higher levels. A modified form of the manager's objective function to incorporate a cap on variable bonus payments would take the form of:

$$\max\ E(ME) = \min\left(\max\left(0, vb\left(RE_t - TE_{tL}\right)\right), vbTE_{1U}\right) + \frac{1}{1+r} vb\int_{TLEL}^{TLEU}\left(RE_{t+1} - TE_{t+1,L}\right)p(LE_{t+1})dLE_{t+1} \tag{8}$$

Where

$TLEL = TE_{2L} + DA$

$TLEU = TE_{2U} + DA.$

Equation (8) incorporates the cap on the bonus by setting a maximum on the time 1 payments of $vbTE_{1U}$, and limiting the upper bound for reported earnings that incrementally increase the time 2 payment at *TLEU*.

Proposition 4. If the parameters of the manager's compensation function take the values *FB, vp* = 0, 0<*r* < ∞, *vb* > 0, and with bonus payments capped at $vbTE_{tU}$, then *DA* will take one of three values: -*MAXDA*, *MAXDA*, or ($TE_{1U} - LE_1$).

Proof: See Appendix 1.

If $LE_1 + MAXDA \leq TE_{1U}$ the manager's problem is identical to that in Proposition 3 and the same results obtain. If the bonus cap is binding, the result is similar to that with a fixed bonus in that the manager would use accounting discretion to report earnings exactly equal to the upper threshold for earnings TE_{1U} if possible. Otherwise, the manager uses maximum accounting discretion to reduce earnings as close to the upper threshold as possible. These results are similar to those discussed in Healy (2005).

4.2.4 Infinite discount rate

In most cases the manager can reasonably be assumed to have a positive, finite value of time discount, in which case the manager puts less weight on his time 2 compensation. However, an interesting exception occurs when the manager that is going to retire at time 1 and will receive no time 2 compensation. In this case the manager will assign no value to time 2 compensation, a case which can be analyzed in this model by assuming the manager has an infinite discount rate.

Proposition 5. If the parameters of the manager's compensation function take the values vb, $vp > 0$, $FB \geq 0$, and $r = \infty$, the manager optimally sets $DA = MAXDA$.

Proof: See Appendix 1.

Proposition 5 indicates that the manager maximizes time 1 earnings if he completely discounts time 2 earnings. If latent earnings are below the target, the manager can reduce the penalty by moving towards the target with discretionary adjustments that boost income. If reported earnings would equal or exceed the target, the manager can maximize his bonus by using any remaining discretion to maximize the increase in reported earnings. The maximum use of discretion to boost earnings will result in the maximum reduction of time 2 reported earnings, but the manager completely discounts the effect of time 2 reported earnings.

4.3 Accounting based IC and the Interagency Guidance

Likely the biggest impact of the Board of Governors et al. (2010) on capital buffers is its call for deferred senior managers' bonus payments to be subject to malus, which is reduced vesting if the bank has poor performance. This is potentially a large change in bank senior managers' IC as penalties appear sufficiently rare in Murphy's (1999, 2001) analysis to not merit any discussion. The effect of malus would be similar to that of a variable penalty in the above model which is to induce the senior manager to engage in earnings smoothing in order to minimize the expected present value of the penalty. The direct effect of such income smoothing will be to build a countercyclical buffer to absorb losses. Reported earnings and the reported increase in retained earnings during periods of high earnings will understate the increase in the bank's ability to absorb losses. The buffer will then be used during periods of low or negative earnings to boost reported earnings and increase retained earnings more (decrease retained earnings less) than would otherwise have been the case.

The Board of Governors et al. (2010) also calls for a substantial portion of senior managers' compensation to be deferred. The above analysis showed that senior managers are incented to maximize earnings in a "Live for Today" approach if their decisions in period 1 have no impact on their utility in period 2. The effect of requiring deferred compensation is that retiring CEOs would not necessarily be able to cash out the full value of their prior bonuses upon retirement but would rather have to wait until their bonuses vest. Given that these bonuses are subject to malus if future earnings fall below the relevant target, a CEO that used accounting discretion in a "Live for Today" manner could find the value of bonuses earned late in his career reduced by malus because the firm failed to meet its targets after his resignation.

Finally, the Board of Governors et al. (2010) called for reduced sensitivity of IC to higher levels of short-term performance. A reasonable interpretation of this guidance is that firms should not pay uncapped short term bonuses to their senior managers. The problem with uncapped bonuses is that they incent senior managers to use their discretion to maximize reported earnings during periods of unusually good latent earnings. In other words, uncapped variable bonuses by themselves encourage banks to reduce their effective capital buffers at precisely the time they are best able to increase the buffers. The significance of this change depends largely on the extent to which variable bonuses have been effectively uncapped.[19]

5. Stock-based compensation

Bank managers have an incentive to be concerned about their firm's share price because it impacts other key participants in the corporate governance process (their shareholders and board of directors). Senior managers also have an incentive to be concerned about share prices to the extent they hold stock and other equity linked instruments. In order for the Board of Governors et al. (2010) to have an effect on senior managers' behavior, the guidance must significantly increase these managers' asset portfolio's exposure to their bank's stock price. Such increases in exposure, however, not only create a general incentive to increase the firm's share prices but also a specific incentive to maximize share prices around the time of the senior manager is selling a substantial fraction of his firm's shares. If the value of the bank's equity can be influenced by earnings management, the senior manager may also be incented to engage in earnings management shortly before liquidating his equity linked compensation.

One way in which earnings management may influence share price is by helping the bank build a reputation as a low risk, consistent performer. For example, Barth, Elliott and Finn (1999) find that firms that consistently report increasing earnings per share have higher price earnings

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[19] That is either no cap exists or the cap is set at levels beyond reasonably possible performance values.

multiples. To the extent stock-based compensation motivates managers to show such consistent earnings performance, the implications for earnings management are similar to those for fixed bonuses. In both cases the manager has a strong incentive to use discretion to report earnings below the target.

Another way in which earnings management could influence share price is through its impact around the specific times during which the manager is planning on selling a substantial fraction of his holdings. This section analyzes such incentives considering both the case where the manager seeks to sell at time 1 and where he seeks to sell at time 2. Whether the grant is for stock or for stock options that are in the money is not important for the analysis. The amount and timing of the grant is assumed to be independent of other performance measures to focus on the direct impact of stock-based compensation.

The model for latent and reported earnings is generally similar to that of the accounting earnings based compensation but with a few important differences to make the model relevant to share price valuation. First, financial reporting must provide information about the value of the firm to have an impact on share prices. In this model the latent earnings are taken to be equivalent to the firm's cash flow. These latent earnings follow a random walk which has the effect of inducing investors to estimate future earnings based on current reported earnings. Second, a terminal third period is added in which the latent earnings are realized and distributed to shareholders. There is no earnings management in this period. Third, shareholders know the distribution of latent earnings and the distribution of the range of feasible earnings management but cannot observe their realizations (except third period earnings). The result is that shareholders rationally anticipate earnings management but their observation of reported earnings is not sufficient to allow them to precisely determine latent earnings.

The first subsection develops the earnings model. The next subsection discusses stock valuation in the model. The third subsection develops the implications for earnings management and bank capital cushions.

5.1 Model

A risk neutral manager with a positive rate of time preference, r, runs the firm. The firm realizes its latent earnings at three dates, t = 1, 2, and 3. Immediately after the end of the period the manager observes the true value of the firm's latent earnings. The auditor next informs the manager of the range of range of discretionary adjustments. The manager then selects the amount of discretionary adjustments to include in reported earnings and announces reported earnings.

The realized latent earnings at time 1 are:

$$LE_1 = E_0(LE_1) + \varepsilon_1, \quad (9)$$

where,

LE_1 = gross latent earnings at time 1

$E_0(LE_1)$ = expectation as of time 0 for latent earnings at time 1, and

ε_t = innovation in latent earnings from time 0 to time 1.

The latent earnings for periods 2 and 3 follow a random walk.

$$LE_2 = LE_1 + \varepsilon_2, = E_0(LE_1) + \varepsilon_1 + \varepsilon_2 \quad (10)$$

And

$$LE_3 = LE_2 + \varepsilon_3 = E_0(LE_1) + \varepsilon_1 + \varepsilon_2 + \varepsilon_3. \quad (11)$$

The innovation in earnings is independently and identically distributed as $\varepsilon_t \sim N(0,\sigma_\varepsilon)$ and is uncorrelated across the three periods. Investors know the distribution of the innovation terms, but only the manager observes the realized value of ε_t.

Reported earnings in period t are latent earnings adjusted for net discretionary adjustments (DA). At time 1, the adjustment takes the form of adding discretionary adjustments to latent earnings. At time 2, the discretionary adjustments are assumed to be reversed out of earnings as they were in the model with IC based on accounting earnings.

The amount of discretionary adjustments is set subject to limits set by the auditor. As with the accounting IC model, assume that the manager must set discretionary adjustments within the bounds [-*MAXDA*, *MAXDA*]. In this model, however, *MAXDA* is a random variable distributed with $MAXDA \sim N(EMAXDA, \varepsilon_{DA})$ and is uncorrelated with the innovation in earnings, ε_1, ε_2, and ε_3.[20] Investors are assumed to know the distribution of *MAXDA* but to be unable to observe the realization.

5.2 Stock valuation

The firm invests its latent earnings from times 1 and 2 in a zero net present value project until the firm is liquidated at time 3. Upon liquidation, shareholders receive the sum of the latent earnings in the three periods. Thus, the gross value of the firm (SP_3) at time 3 is

$$SP_3 = LE_1 + LE_2 + LE_3. \tag{12}$$

Investors are risk neutral with a zero rate of time preference. Thus, they value the firm as the sum of its expected latent earnings conditional on their information. Prior to the first report of earnings the firm's value is"

$$SP_0 = E_0(LE_1) + E_0(LE_2) + E_0(LE_3) = 3\ E_0(LE_1). \tag{13}$$

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[20] The distribution assumptions contain two simplifications. First, the use of the normal distribution leaves open the possibility that *MAXDA* will take a value less than zero. However, the use of the normal distribution simplifies the analysis and is unlikely to have any qualitative impact for reasonable values of *EMAXDA* and ε_{DA}. Also, the use of symmetric boundaries around zero does not allow for the possibility that the auditor may allow greater income reducing discretionary adjustments than income increasing adjustments. This potential problem could be resolved at the cost of additional notation, but would add little to the results below.

The stock price at time 0 reflects only latent earnings at time 1 because innovations in the earnings have an expected value of zero. At time 1, investors update their estimation of the firm's value based on the reported earnings.

$$SP_1 = E_1(LE_1|RE_1) + E_1(LE_2|RE_1) + E_1(LE_3|RE_1) = 3\,E_1(LE_1|RE_1). \quad (14)$$

The expected reported earnings for the last two periods are equal to the first period's reported earnings because the expected value of the innovations is zero.

At time 2, investors again update their expectations based on the firm's reported earnings:

$$SP_2 = E_2(LE_1|RE_1, RE_2) + 2E_2(LE_2|RE_1, RE_2). \quad (15)$$

Investors update their estimate of LE_1 using RE_2 because RE_2 contains information about the manager's use of his accounting discretion.

5.3 Earnings management

The manager would have an incentive to influence an investor's estimate of the firm's value if he receives stock-based compensation and he is allowed to sell stock after the earnings report at time 1 or time 2. A potential tool for exercising such influence is the manager's control over discretionary accounting adjustments which affords him some ability to control reported earnings. Whether the manager's control over reported earnings influences the firm's value depends on how investors use reported earnings to infer latent earnings, which in turn depends on their assumptions about the manager's use of discretionary adjustments. In order to minimize the manager's ability to deceive investors, assume that investors know whether DA is positive or negative. In order to further reduce the manager's scope for deception, assume that investors conjecture that the manager is using all of his discretion, setting DA equal to its maximum absolute value. The analysis below demonstrates the validity of this conjecture. If investors conjecture that the manager is using all of his discretion, the manager will rationally use all of his discretion.

The problem facing investors is how to combine their prior knowledge of the distribution of latent earnings and managerial discretion, with the manager's disclosure of reported earnings to form an updated estimate of reported earnings. The method for solving the problem is provided by Greene (1990). The solution for the first period's latent earnings is provided by Lemma 1 in Appendix 2. Intuitively, at the end of the first period, investors use RE_1 to update their estimates of LE_1 and *MAXDA.* The change in the respective estimates of LE_1 and *DA* depends on the ratio of their two variances. As the ratio $\sigma^2_{DA}/\sigma^2_{\varepsilon}$ goes to 0, virtually all of an increase in RE_1 gets attributed to latent earnings. As the ratio goes to infinity, virtually all of an increase would be attributed to discretionary adjustments.

Investors receive additional information at time 2 in the form of RE_2 and use this information to update their expectations of LE_1, LE_2 and *DA* as shown in Lemma 2 in Appendix 2. Lemma2 shows that all three expectations at time 2 are conditioned on both time 1 and time 2 reported earnings because both earnings reports contain information about the value of *DA*. Thus, investors use time 2 earnings to update their estimate of the manager's accounting discretion and use the updated estimate to form estimates of time 1 and time 2 latent earnings.

Proposition 6. If the manager must sell his shares at time 1, he obtains the maximum proceeds by setting

DA = MAXDA.

Proof: See Appendix 2.

The manager maximizes investors' estimate of first period latent earnings by using all of his discretion to boost accounting earnings. Investors rationally infer that any increase in reported earnings is likely a result of the firm's use of accounting discretion, but rationally infer that part of the increase is due to higher latent earnings. Thus, if investors expect management to use all of its discretion to boost time 1 earnings, the managers will rationally do so.

Proposition 7. If the manager must sell his shares at time 2, he obtains the maximum proceeds by setting *DA* equal to –*MAXDA* at time 1 and *MAXDA* at time 2 to maximize RE_2.

Proof: See Appendix 2.

Setting *DA* to –*MAXDA* results in *MAXDA* being added to time 2 earnings and, hence, maximizes investors' $E_2(LE_2)$. However, this increase in the estimated value of LE_2 is offset by an equal decrease in investors' $E_2(LE_1)$. Indeed, investors can calculate total latent earnings in the first two periods by simply summing the values of the two periods. However, given that $E_2(LE_3)$ is equal to $E_2(LE_2)$, the market value of the shares is nevertheless maximized by setting discretionary adjustments at time 1 to –*MAXDA*. Thus, senior managers can use their accounting discretion to increase the price at which they sell their shares even in an environment where shareholders know that earnings are being managed, know the direction of the management and rationally conjecture that management is using all of its accounting discretion.

5.4 Equity-linked IC and the Interagency Guidance

The senior managers of large, publicly traded firms, including banks, often hold equity positions in their firm that are material to their personal wealth. The Board of Governors et al. (2010) interagency guidelines encourages banks to increase senior managers' exposure to their bank's stock price moves by calling for more IC payments to take the form of equity linked instruments. To the extent that banks replace cash with equity and this increased equity motivates managers to increase their bank's share price, these results suggest that the guidelines will also encourage increased earnings management on the part of banks. In particular, senior executives will have an incentive to use their accounting discretion to maximize reported earnings shortly before converting their equity instruments in cash.

The impact of this incentive to manage earnings on countercyclical buffers also depends on when senior managers sell their shares. If managers tend to build accounting discretion during periods of high latent earnings and sell their shares at the trough of latent earnings, the resulting earnings management will have a countercyclical impact on the buffer. However, to the extent that the sales tend to occur at the peak of latent earnings, such earnings management would tend to make the buffers countercyclical.

We are unaware of any study that empirically analyzes the timing of management stock sales in relationship to the business cycle properties of bank earnings. Our conjecture would be that a disproportionate share of the volume of sales takes place around the peaks of latent earnings. Looking beyond the formal model presented above, a reasonable assumption would be that senior managers know more about the true distribution of latent earnings than investors. To the extent this is true; managers have an incentive to sell when latent earnings are at the upper end of the manager's estimated earnings distribution. Assuming our conjecture is correct, the impact of the Board of Governors et al. (2010) encouragement for senior management bonuses to be paid in equity based compensation will tend to result in the use of accounting discretion in ways that make capital more procyclical.

6. Conclusion

Bank supervisors are engaged in a variety of parallel efforts to reduce the probability of future financial crises. Some of the efforts are likely to have unintended implications both good and bad for other efforts. This study highlights one such case, that of the impact of incentive compensation guidelines for efforts to have banks build capital buffers during good times which can absorb losses during periods of economic weakness.

The results suggest that the part of Board of Governors et al. (2010) interagency guidelines dealing with accounting based incentive compensation are likely to supportive of efforts to build countercyclical buffers. Especially noteworthy is the call for banks to implement deferred compensation that is subject to reduced vesting (or malus). The limited available evidence suggests that accounting income based penalties were rare prior to the crisis. An accounting earnings based penalty creates unambiguous incentives to use earnings management to reduce earnings during good periods which would have the effect of causing banks to build a capital buffer during good times.

However, the part of the guidance that encourages the use of equity-linked instruments can have the effect of encouraging banks to use accounting discretion to report higher earnings during good times when the senior managers seek to cash in a substantial part of their equity. The result of using discretion to report higher earnings during good times would be to reduce the capital available to absorb subsequent losses. The impact of this part of the guidance on practice is unclear as equity-linked compensation is already a substantial portion of senior management compensation in the U.S.

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Figure 1
Alternative Countercyclical Capital Policies

	Counter-cyclical capital rules	**Dynamic provisioning**	**Income smoothing**
Expansion	Mandate higher capital ratios	Mandate higher provisions	Discretionary earnings reduction
Recession	Allow lower capital ratios	Allow lower provisions	Discretionary earnings increase

Appendix 1: Accounting based incentive compensation

Proposition 1. If the parameters of the manager's compensation function take the values *vp* > 0, *vb*, *FB* = 0, and 0<*r* < ∞

the manager optimally sets *DA* as follows:

A.	**If $LE_1 + MAXDA \leq TE_1$**	**then $DA = MAXDA$**
B.	**If $LE_1 - MAXDA > TE_1$**	**then $DA = -MAXDA$**
C.	**If $LE_1 \leq TE_1$ and $LE_1 + MAXDA \geq TE_1$ <u>or</u>**	
	if $LE_1 > TE_1$ *and* $LE_1 - MAXDA \leq TE_1$	**then $DA = TE_1 - LE_1$**

Proof:

Consider each of the three cases:

A. $LE_1 + MAXDA \leq TE_1$

Plugging the assumed parameter values into equation (5) yields:

$$\partial E(ME \mid RE_1 < TE_1) / \partial DA = vp - \left(vp / (1+r)\right)\left(\int_{-\infty}^{TLE} p(LE_2)dLE_2\right) \quad (16)$$
$$> 0$$

An increase in *DA* directly reduces the expected penalty in the first period and increases the expected net present value of the second period penalty. However, the expected net present value of the expected value of the penalty in the second period is lower than that of the first because it is discounted at a positive discount rate and the second period penalty occurs with a probability of less than one. Thus, the manager's value is maximized at *DA* = *MAXDA,* which reduces the difference between reported earnings and target earnings to the maximum extent permitted by the auditor.

B. $LE_1 + MAXDA > TE_1$

Plugging the assumed parameter values into equation (5) yields:

$$\partial E(ME)/\partial DA = \left(-vp/\left(1+r\right)\right)\left(\int_{-\infty}^{TLE} p(LE_2)dLE_2\right) < 0 \qquad (17)$$

If latent earnings at time 1 are sufficiently high so that the manager will not incur a penalty for period 1, the only impact of a change in *DA* is on the expected time 2 penalty. Thus, a decrease in *DA* increases the manager's expected wealth for all values of *DA*. Thus, the optimal response is to set $DA = -MAXDA$, which also reduces the absolute difference between reported earnings and target earnings to the maximum extent permitted by the auditor.

C. $LE_1 < TE_1$ *and* $LE_1 + MAXDA \geq TE_1$ <u>or</u> $LE_1 > TE_1$ *and* $LE_1 - MAXDA \leq TE_1$

Consider first the case where time 1 latent earnings are less than target earnings. The results of equation (16) established that if the manager may incur a penalty during time 1, it is always in his interest to set *DA* to minimize that penalty. The point at which the manager will not incur a penalty is to set *DA* so that reported earnings equal or exceed the target earnings at time 1. Yet if reported earnings equal target earnings, equation (17) shows that any further increase in reported earnings will only increase the expected time 2 penalty. Thus, if $LE_1 < TE_1$ the manager optimally sets

$DA = LE_1 - TE_1$

The same logic holds if time 1 latent earnings exceed target earnings. The manger may reduce expected time 2 penalties by decreasing *DA*. However, he should not decrease *DA* by so much that he incurs a penalty at time 1. Thus, the manager should set *DA* so that reported earnings at time 1 that exactly equal target earnings if such a value for *DA* would fall within the range permitted by the auditor.

QED.

Proposition 2. If the parameters of the manager's compensation function take the values *FB* > 0*, vb, vp* = 0, and 0<*r* < ∞, the manager optimally sets *DA* as follows:

A. If $LE_1 + MAXDA < TE_1$ then $DA = - MAXDA$

B. If $LE_1 - MAXDA > TE_1$ then $DA = - MAXDA$

C. If $LE_1 \leq TE_1$ and $LE_1 + MAXDA \geq TE_1$ <u>or</u>

if $LE_1 > TE_1$ *and* $LE_1 - MAXDA \leq TE_1$ then $DA = TE_1 - LE_1$

Proof:

Consider each of the three cases:

A. $LE_1 + MAXDA < TE_1$

Substituting in the assumptions of Proposition 2 into equation (5) yields:

$$\partial E(ME)/\partial DA = -\left(FB/\left(1+r\right)\right)p(TLE_2) < 0 \tag{18}$$

If the manager cannot report earnings sufficient to make his time 1 fixed bonus, an increase in *DA* will only reduce the probability of his receiving a time 2 fixed bonus. Thus, under the conditions of Proposition 5A, the manager optimally sets his *DA* equal to -*MAXDA.*

B. $LE_1 - MAXDA > TE_1$

Substituting in the parameter values from Proposition 2 into equation (7) produces:

$$\partial E(ME)/\partial DA = -\left(FB/\left(1+r\right)\right)p(TLE_2) < 0 \tag{19}$$

Similar to the first case, if the manager must report earnings sufficient to make his time 1 fixed bonus, increases in *DA* will only reduce the probability of his receiving a time 2 fixed bonus. Thus, under these conditions, the manager optimally sets his *DA* equal to -*MAXDA.*

C. $DA = LE_1 - TE_1$ if $LE_1 \leq TE_1$ and $LE_1 + MAXDA \geq TE_1$

or if $LE_1 > TE_1$ *and* $LE_1 - MAXDA \leq TE_1$

Suppose the manager could set a value for *DA* that resulted in the firm exactly obtaining its time 1 earnings target. Consider first the case where the firm's time 1 latent earnings are below its target earnings. If the firm sets a value of *DA* to exactly obtain the time 1 fixed bonus, the manager obtains *FB* with probability 1. A lower *DA* will cost the manager the time 1 bonus, but in return he will only increase the probability of receiving the fixed bonus and that bonus, if received, will have a present value of $FB/(1+r)$. Thus, the manager always obtains greater wealth by obtaining the time 1 fixed bonus.

The manager could set *DA* so that the firm exceeds its target earnings. However, doing so will not increase the manager's fixed bonus. Moreover, setting a higher bonus would reduce the expected present value of next period's fixed bonus similar to that found in equation (19). Thus, if latent earnings are below the target, the manager should set *DA* to exactly obtain his target earnings.

Alternatively, suppose latent earnings exceed target earnings. The same arguments apply. The manager may increase the expected net present value of the time 2 fixed bonus without reducing the time 1 bonus by using *DA* to reduce time 1 reported earnings to the target level. However, any further reductions would result in the manager losing the time 1 fixed bonus in order to increase the probability of receiving a time 2 bonus with a lower present value. Thus, the manager optimally sets *DA* so that

$$\boldsymbol{DA = TE_1 - LE_1.}$$

QED.

Proposition 3. If the parameters of the manager's compensation function take the values *vb* > 0, *FB*, *vp* = 0, and 0<*r* < ∞ then *DA* will either take the value of –*MAXDA* or *MAXDA*.

Proof:

Three cases are relevant to Proposition 3: $RE_1 < TE_1$, $RE_1 > TE_1$, and $RE_1 = TE_1$ for some value of *DA* between –*MAXDA* and *MAXDA*.

First, consider the case where reported earnings are less than target earnings. Substituting in the compensation parameter values into equation (5) yields:

$$\partial E(ME) / \partial DA = \left(-1/\left(1+r\right)\right)\left(\int_{TLE}^{\infty} vb(p\left(LE_2\right)dLE_2\right) < 0 \qquad (20)$$

$\forall$ RE_1 such that such that $RE_1 = LE_1 + DA < TE_1$.

In equation (20) the manager does not earn a time 1 bonus, hence incremental decreases in *DA* have no impact on the time 1 bonus and reduces the expected value of the time 2 bonus. Given that the change in expected managerial earnings is strictly negative over this range, the expected earnings are maximized by setting *DA* to –*MAXDA*.

Alternatively, the incremental impact if RE_1 exceeds TE_1 substituting the parameter values in equation (7) yields:

$$\partial E(ME) / \partial DA = vb - \left(1/\left(1+r\right)\right)\left(\int_{TLE}^{\infty} vb(p(LE_2))dLE_2\right) > 0 \qquad (21)$$

$\forall$ RE_1 such that $RE_1 = LE_1 + DA > TE_1$.

The first term in (21) is the increase in the time 1 variable bonus due to an increase in *DA*, this increase happens with probability one is not subject to the manager's rate of time discount. The second term, which has the opposite sign, is the decrease in the time 2 discounted variable bonus due to an increase in *DA*. Thus, an increase in *DA* results in an increase in variable bonus and an equal reduction in time 2. However, the time 2 value is reduced both by the manager's discount rate and the probability that the manager will earn no variable bonus at time 2. Thus, the value of the derivative is strictly positive and expected managerial earnings is maximized with *DA* at *MAXDA*.

Finally there is a kink in the curve for the value of managerial compensation where $RE_1 = TE_1$. Both positive and negative changes in *DA* increase the value of managerial compensation. An increase in *DA* that causes $RE_1 > TE_1$ increases the value of compensation because the manager earns a time 1 bonus which is only partially offset by an equal size decrease in the time 2 bonus which occurs with probability of less than 1 and is discounted at the manager's rate of time preference. Conversely, if the manager decreases *DA* so that $RE_1 < TE_1$ there is no loss of a time 1 variable bonus and the expected discounted value of the time 2 bonus increases. Thus, it cannot be optimal for the manager to pick a value of *DA* such that $RE_1 = TE_1$. But we have already seen that *MAXDA* is optimal for $RE_1 > TE_1$ and *–MAXDA* is value maximizing for any $RE_1 < TE_1$. Thus, the manager will always use maximum earnings discretion if his IC consists solely of an uncapped variable bonus. Whether the manager will choose *MAXDA or –MAXDA* will depend upon the value of LE_1, *vb, r* and the distribution of time 2 latent earnings.

QED.

Proposition 4. If the parameters of the manager's compensation function take the values *FB, vp* = 0, 0<*r* < ∞, *vb* > 0, and with bonus payments capped at $vbTE_{tU}$, then *DA* will take one of three values: *-MAXDA, MAXDA,* or ($TE_{1U} - LE_1$).

Proof:

First note that so long as $LE_1 + MAXDA \leq TE_{1U}$ the cap on bonuses is not binding. Given that the manager's objective function in this case is identical to that in Proposition 3, the results from Proposition 3 also hold.

There are two possibilities if the bonus cap may be binding.

1. Consider first the case where the manager must report earnings in excess of TE_{1U}:

LE_1 - $MAXDA > TE_{1U}$.

In this case, the manager earns the maximum possible variable bonus at time 1 regardless of his choice of *DA* implying that his marginal decision for all values of *DA* is the same as that in equation (20)

$$\partial E(ME)/\partial DA = \left(-1/\left(1+r\right)\right)\left(\int_{TLE}^{\infty} vb(p\left(LE_2\right)dLE_2\right) < 0 \tag{22}$$

Thus, the manager will optimally set discretionary accounting adjustments equal to -*MAXDA* to maximize the expected value of his time 2 variable bonus compensation.

2. The other possibility is that manager may report earnings above or below TE_{1U}:

LE_1 - $MAXDA < TE_{1U}$ and $LE_1 + MAXDA > TE_{1U}$.

While manager may select a value of *DA* such that $RE_1 > TE_{1U}$, he will not do so. Any increase in RE_1 above TE_{1U} reduces expected time 2 variable compensation without any offsetting increase in time 1 variable compensation (as shown in equation (22),

Similarly, while the manager has the discretion to select a value of *DA* such that:

$TE_{1L} \leq RE_1 < TE_{1U}$

This is not optimal given that he has the accounting discretion to reach TE_{1U}. For any value of reported earnings below TE_{1U}, the marginal change in the value of compensation is the same as that in equation(21):

$$\partial \mathrm{E}(ME)/\partial DA = vb - \left(1/\left(1+r\right)\right)\left(\int_{TLE}^{\infty} vb(p(LE_2))dLE_2\right) > 0$$

Thus, there is a kink in the E(*ME*) function at TE_{1U},, where the function is at a global maximum. Therefore, the manager may optimally select the value of *DA* such that $DA = TE_{1U} - LE_1$.

Finally, nothing in the above analysis rules out the possibility that the manager would chose to report earnings below TE_{1L}. That, is depending upon the parameter values, the manager may optimally report discretionary adjustments equal to –*MAXDA* [21]

Proposition 5. If the parameters of the manager's compensation function take the values *vb*, *vp* > 0, *FB* = 0, and *r* = ∞, the manager optimally sets *DA* = *MAXDA*.

Proof: Consider three cases:

A. $LE_1 + MAXDA \leq TE_1$. Plugging the assumed parameter values into equation (5) yields:

$$\partial E(ME) / \partial DA = vp > 0 \tag{23}$$

The manager may minimize his current period's penalty by setting the highest possible value of *DA.*

B. $LE_1 \geq TE_1$. Plugging the assumed parameter values into equation (6) yields:

$$\partial E(ME) / \partial DA = vb > 0 \tag{24}$$

The manager may maximize his current period's bonus by setting the highest possible value of *DA, at MAXDA.*

C. $TE_1 - MAXDA < LE_1 < TE_1$. In this case, latent earnings are less than the target but the manager has the discretion to set reported earnings above the target. The manager may eliminate the variable penalty by setting $DA = TE_1 - LE_1$. He may then maximize his bonus by using the rest of his discretion to set

DA=*MAXDA*. .

[21] An example where such a case could arise if: (a) the maximum amount of earnings subject to a variable bonus at time 1, $TE_{1U} - TE_{1L}$, is small relative to $TE_{2U} – TE_{2L}$ and (b) LE_1 is substantially below TE_{1L} so that in order to obtain a time 1 bonus the manager would have to use a substantial amount of accounting discretion just to reach TE_{1L}.

Thus, the manager always benefits from *DA* = *MAXDA*.   QED.

Appendix 2: Stock based incentive compensation

The following two lemmas are helpful in proving Propositions 6 and 7.

Lemma 1. An increase in RE_1 causes an increase in $E_1(LE_1)$ and $E_1(DA)$.

Investors use their knowledge to update their expectations of LE_1 as follows:

$$\mathrm{E}_1(LE_1 \mid RE_1) = \mathrm{E}\left(LE_1\right) + \left(RE_1 - E\left(RE_1\right)\right)\left(\sigma_\varepsilon^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right)\right) \tag{25}$$

Thus, an increase in RE_1 induces investors to increase in their time 1 estimate LE_1:

$$\partial \mathrm{E}_1(LE_1 \mid RE_1) \big/ \partial RE = \sigma_\varepsilon^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right) > 0. \tag{26}$$

Similarly, investors update their estimate of DA:

$$\mathrm{E}_1(DA_1 \mid RE_1) = \mathrm{E}\left(DA_1\right) + \left(RE_1 - E\left(RE_1\right)\right)\left(\sigma_{DA}^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right)\right) \tag{27}$$

and an increase in RE_1 causes an increase in the updated estimate of DA:

$$\partial \mathrm{E}_1(DA \mid RE_1) \big/ \partial RE = \sigma_{DA}^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right) > 0, \tag{28}$$

Proof: Let x_1 and x_2 be matrices of random variables (including the possibility that both matrices contain only a single vector) with mean vectors of μ_1 and μ_2. and a variance-covariance matrix of

$$\Sigma = \begin{bmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{bmatrix} \tag{29}$$

Assume the marginal distributions are

$$x_1 \sim N(\mu_1, \Sigma_{11}) \tag{30}$$

and

$$x_2 \sim N(\mu_2, \Sigma_{22}). \tag{31}$$

Then according to Greene (1990), the conditional distribution of x_1 given x_x is normal with a distribution of

$$x_1 \mid x_2 \sim N(\mu_{1,2}, \Sigma_{11,2}) \tag{32}$$

where

$$\mu_{1,2} = \mu_1 + \Sigma_{12}\Sigma_{22}^{-1}\left(x_2 - \mu_2\right) \tag{33}$$

First let x_1 be LE_1 and x_2 be RE_1 then

$$\mu = \begin{bmatrix} E(LE_1) \\ E(RE_1) \end{bmatrix} \tag{34}$$

and

$$\Sigma = \begin{bmatrix} \sigma_\varepsilon^2 & \sigma_\varepsilon^2 \\ \sigma_\varepsilon^2 & \sigma_\varepsilon^2 + \sigma_{DA}^2 \end{bmatrix} \tag{35}$$

Then applying equation (33) yields

$$\mathrm{E}_1(LE_1 \mid RE_1\ ) = \mathrm{E}\left(LE_1\right) + \left(RE_1 - E\left(RE_1\right)\right)\left(\sigma_\varepsilon^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right)\right). \tag{36}$$

Next, let x_1 be *MAXDA* and x_2 be RE_1 so that

$$\mu = \begin{bmatrix} EMAXDA \\ E(RE_1) \end{bmatrix} \tag{37}$$

and

$$\Sigma = \begin{bmatrix} \sigma_{DA}^2 & \sigma_{DA}^2 \\ \sigma_{DA}^2 & \sigma_{DA}^2 + \sigma_{DA}^2 \end{bmatrix} \tag{38}$$

Then applying equation (33) yields

$$\mathrm{E}_1(DA_1 \mid RE_1\ ) = \mathrm{E}\left(DA_1\right) + \left(RE_1 - E\left(RE_1\right)\right)\left(\sigma_{DA}^2 \big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right)\right). \tag{39}$$

QED.

Lemma 2. An increase in *RE*1 and *RE*2 causes an increase in investors' expectations of *LE*1,, and *LE*2. An increase in *RE*1 causes a decrease in the expected value of *DA*, but an increase in *RE*2 cause a decrease in the expected value of *DA*.

Investors update their prior expectations of *LE*1, *LE*2 and *DA* as follows:

$$\mathrm{E}_2(LE_1 \mid RE_1,RE_2) = \frac{EMAXDA\sigma_\varepsilon^2 + RE_1\left(\sigma_\varepsilon^2 + 2\sigma_{DA}^2\right) + 2RE_2\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \qquad \mathbf{(40)}$$

$$\mathrm{E}_2(LE_2 \mid RE_1,RE_2) = \frac{-EMAXDA\sigma_\varepsilon^2 + 3RE_1\sigma_{DA}^2 + RE_2\left(\sigma_\varepsilon^2 + 3\sigma_{DA}^2\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \qquad (41)$$

$$\mathrm{E}_2(DA \mid RE_1,RE_2) = \frac{EMAXDA\sigma_\varepsilon^2 + \sigma_{DA}^2\left(2RE_2 - 3RE_1\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \qquad \mathbf{(42)}$$

Both of the latent earnings expectations are positive functions of the reported earnings in their respective periods.

$$\frac{\partial \mathrm{E}_2(LE_1 \mid RE_1,RE_2)}{\partial RE_1} = \frac{\left(\sigma_\varepsilon^2 + 2\sigma_{DA}^2\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \qquad (43)$$

and

$$\frac{\partial \mathrm{E}_2(LE_2 \mid RE_1,RE_2)}{\partial RE_2} = \frac{\sigma_\varepsilon^2 + 3\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2}. \qquad (44)$$

Both latent earnings are also positive functions of reported earnings in the other period

$$\frac{\partial \mathrm{E}_2(LE_1 \mid RE_1,RE_2)}{\partial RE_2} = \frac{2\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \qquad (45)$$

and

$$\frac{\partial \mathrm{E}_2(LE_2 \mid RE_1, RE_2)}{\partial RE_1} = \frac{3\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2}. \tag{46}$$

The two variables have opposite effects on *DA*:

$$\frac{\partial \mathrm{E}_2(DA \mid RE_1, RE_2)}{\partial RE_1} = \frac{-3\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{47}$$

but

$$\frac{\partial \mathrm{E}_2(DA \mid RE_1, RE_2)}{\partial RE_1} = \frac{2RE_2\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{48}$$

Proof: Define

$$\mu_1 = \left[E(LE_1)\right], \tag{49}$$

$$\mu_2 = \begin{bmatrix} E(LE_2) \\ EMAXDA \\ E(RE_1) \\ E(RE_2) \end{bmatrix}, \tag{50}$$

and

$$\Sigma = \begin{bmatrix} \sigma_\varepsilon^2 & 0 & 0 & \sigma_\varepsilon^2 & \sigma_\varepsilon^2 \\ 0 & \sigma_\varepsilon^2 & 0 & 0 & \sigma_\varepsilon^2 \\ 0 & 0 & \sigma_{DA}^2 & -\sigma_{DA}^2 & \sigma_{DA}^2 \\ \sigma_\varepsilon^2 & 0 & -\sigma_{DA}^2 & \sigma_\varepsilon^2 + \sigma_{DA}^2 & \sigma_\varepsilon^2 - \sigma_{DA}^2 \\ \sigma_\varepsilon^2 & \sigma_\varepsilon^2 & \sigma_{DA}^2 & \sigma_\varepsilon^2 - \sigma_{DA}^2 & 2\sigma_\varepsilon^2 + \sigma_{DA}^2 \end{bmatrix} \tag{51}$$

Then plugging (49), (50), and (51) into (33) and solving for LE_1 yields:

$$\mathrm{E}_2(LE_1 \mid RE_1, RE_2) = \frac{EMAXDA\sigma_\varepsilon^2 + RE_1\left(\sigma_\varepsilon^2 + 2\sigma_{DA}^2\right) + 2RE_2\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{52}$$

Similarly, the vectors in equations(49), (50), and (51) can be realigned to solve for LE_2 and *DA*, plugged into equation (33) and solved to yield

$$\mathrm{E}_2(LE_2 \mid RE_1, RE_2) = \frac{-EMAXDA\sigma_\varepsilon^2 + 3RE_1\sigma_{DA}^2 + RE_2\left(\sigma_\varepsilon^2 + 3\sigma_{DA}^2\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{53}$$

and

$$\mathrm{E}_2(DA \mid RE_1, RE_2) = \frac{EMAXDA\sigma_\varepsilon^2 + \sigma_{DA}^2\left(2RE_2 - 3RE_1\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2}. \tag{54}$$

QED.

Proposition 6. If the manager must sell his shares at time 1, he obtains the maximum proceeds by setting

DA = MAXDA.

Proof.

Using equations (14) and (26).

$$\frac{\partial SP_1}{\partial LE_1} = 3\left(\frac{\partial E_1(LE_1|RE_1\,)}{\partial LE_1}\right) = 3\sigma_\varepsilon^2 \Big/ \left(\sigma_\varepsilon^2 + \sigma_{DA}^2\right) > 0 \tag{55}$$

QED.

Proposition 7. If the manager must sell his shares at time 2, he obtains the maximum proceeds by setting *DA* equal to –*MAXDA* at time 1 and *MAXDA* at time 2 to maximize RE_2.

Proof:

Setting *DA* to maximize RE_2 implies an equal reduction in the value of RE_1. The net effect of the two changes on $\mathrm{E}_2(LE_1| RE_1, RE_2)$ is

$$\frac{\partial \mathrm{E}_2(LE_1 \mid RE_1, RE_2)}{\partial RE_2} - \frac{\partial \mathrm{E}_2(LE_1 \mid RE_1, RE_2)}{\partial RE_1} = \frac{2\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} - \frac{\left(\sigma_\varepsilon^2 + 2\sigma_{DA}^2\right)}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} = \frac{-\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{56}$$

Similarly, the net effect on $\mathrm{E}_2(LE_2 | RE_1, RE_2)$ is

$$\frac{\partial \mathrm{E}_2(LE_2 \mid RE_1, RE_2)}{\partial RE_2} - \frac{\partial \mathrm{E}_2(LE_2 \mid RE_1, RE_2)}{\partial RE_1} = \frac{\sigma_\varepsilon^2 + 3\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} - \frac{3\sigma_{DA}^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} \tag{57}$$

Substituting equations (56) and (57) into equation (15) yields:

$$\frac{\partial SP_2}{\partial RE_2} - \frac{\partial SP_2}{\partial RE_1} = \frac{-\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + 5\sigma_{DA}^2} > 0 \tag{58}$$

Thus, an increase in *DA* to boost RE_2 increases $\mathrm{E}_2(LE_2|RE_1,RE_2)$ but it causes an equally large decrease in $\mathrm{E}_2(LE_1|RE_1, RE_2)$. The reason that the firm's stock price increases is that

$$\mathrm{E}_3(LE_3|RE_1,RE_2) = \mathrm{E}_2(LE_2|RE_1,RE_2)$$

implying that the increase in the investors' estimate of period 2 latent earnings increases their estimate of future latent earnings and thus boosts the firm's stock price. QED.