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Cash Holdings and Bank Compensation

1. Introduction

Executive pay in banks and the possible incentives it provides for excessive risk taking have been the focus of considerable attention in the wake of the financial crisis. A particular concern is that traditionally compensation has been designed to align management's interests with those of equity holders but not those of creditors or other stakeholders such as taxpayers. From a regulatory perspective, the challenge is to modify compensation design in a way that continues to encourage value creation even as it discourages excessive risk taking that could lead to bank failures.

In this article, we offer a simple set of guidelines for this purpose. Our approach, which relies on the use of cash rather than debt or equity as compensation, offers a framework for thinking about the role of cash in a bank's capital structure and for identifying a lower bound on the amount of cash that banks should be required to hold to help reduce the risk of systemic crises. The simplicity and transparency of a cash requirement—as well as the ease with which such a requirement could be made operational—are key. Our objective is to draw on the various properties of cash as part of a bank's assets to furnish us with a benchmark level of cash holdings that is optimal from a regulatory standpoint.

Distilled to its basics, our approach is to use cash compensation in banks as a *contingent asset* of the banks. We propose that incentive compensation in banks involve a substantial cash component; that this component be deferred and placed in an escrow account with a vesting schedule; and that ownership of the account revert to the bank in "stressed" times (subject to creditors' forfeitures), allowing the bank to access this cash to pay down its debt or otherwise bolster its assets.

Importantly, we do not pin down the absolute size of cash holdings but determine this sum in relation to the bank's equity levels and other parameters; *inter alia*, as the equity cushion decreases, our proposed cash holding requirement increases. As an alternative to holding more cash, banks can choose to deleverage to bring down the minimum required cash holdings.

For "typical" numbers for U.S. banks, we find a cash requirement of around 18 to 25 percent of equity value. However, empirical analysis suggests that the numbers are highly variable depending on the actual asset mix used by a bank at a given point in time; for instance, looking at the years immediately preceding the crisis, we find that cash requirements for many U.S. financial institutions (including those like Fannie Mae and Freddie Mac that would later fail) often exceeded 50 to 60 percent even by late 2006 and early 2007.[1]

[1] Several recent proposals aim to increase the liability of bank management and thereby address risk-taking incentives (notably, Admati, Conti-Brown, and Pfleiderer [2012]; Baily et al. [2013]; and Calomiris, Heider, and Hoerova [2015]). While there are some conceptual differences between our cash compensation proposal and theirs, the key distinguishing features of our proposal are that it is easy to operationalize, fits naturally into the "stress test" approach used by regulators to manage risks of systemically important financial institutions, and, as we show in this article, can be readily calibrated.

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There is an important, if obvious, caveat to our proposal. Since our analysis focuses on avoiding bank failures in stressed times, the cash holdings we derive will necessarily be more than those required in "normal" times. We regard this as the natural cost of a strategy that aims to reduce the costs of financial system disruption stemming from bank failures.

Our proposal is outlined in Section 2; a discussion of its empirical properties follows in Section 3. Section 4 examines the use of deferred cash in compensation and its role in promoting financial stability relative to that of other instruments, such as inside debt, deferred equity, and contingent capital. The model underlying the proposal is presented in Section 5.

2. The Proposal

In Section 5 we derive our minimum cash holding rule in a simple model. We find that a bank's minimum cash C holding must satisfy

$$C \geq (1 - q)D - qE(1 - MES), \tag{1}$$

or, equivalently, that

$$\frac{C}{E} \geq (1 - q)\frac{D}{E} - q(1 - MES), \tag{2}$$

where D is the amount of the bank's debt, $1 - q$ is the potential loss in asset value that would result from a liquidation in stressed times, E is the equilibrium value of the bank's equity (assuming implementation of our proposal), and MES is the marginal expected shortfall of bank equity conditional on the bank's being stressed at the time.

2.1 A Numerical Illustration

Suppose that

1. the initial capital structure is $\frac{D}{E} = 9.0$;
2. the loss in asset value from forced liquidation is 6 percent, so $q = 0.94$; and
3. in a stress scenario, the bank loses 50 percent of equity value in a crisis, so that $MES = 0.50$.

Then, plugging these numbers into the right-hand side of expression (2), we obtain the condition

$$\frac{C}{E} \geq (0.06 \times 9.0) - [0.94 \times 0.50] = 0.07,$$

meaning that the bank's cash holding should be around 7 percent of its equity value. Of course, cash requirements would climb steeply as losses in liquidation mount. For example, if we assume $1 - q = 8$ percent, the required minimum cash ratio rises sharply to 26 percent, while at $1 - q = 10$ percent, the required minimum escrowed cash holding surges to 45 percent of equity value.

3. Empirical Analysis

Using historical estimates of *MES* from the NYU Stern School of Business V-Lab, which calculates long-run marginal expected shortfall (*LRMES*) in a stress scenario (modeled as a 40 percent decline in the S&P 500 index) and making an assumption concerning q, we can use the model to compute the required cash holding-to-equity ratio for banks.[2] Of course, these numbers are only meant to be indicative. Different values for q and for anticipated equity-value losses in a stressed situation will give rise to different numbers.

We present in Chart 1 the computed values of this ratio for five banks that survived the crisis—Bank of America, Citigroup, JPMorgan Chase, Goldman Sachs, and Morgan Stanley—from March 2000 to July 2013 on a monthly basis. The computations take $q = 0.94$ (so the loss in asset value from forced liquidation is $1 - q = 0.06$ or 6 percent). For each month, we smooth the calculated values by taking the average of the cash-to-equity ratio over the past three months.

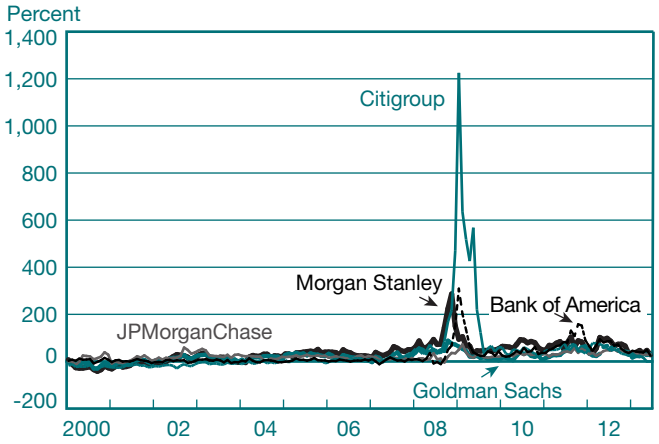
Chart 2 depicts the same information with a different scale on the y-axis. Note that even prior to the collapse of Bear Stearns in mid-March 2008, three of these banks would have needed cash-to-equity ratios greater than 20 percent, according to the model. That is, in a scenario in which losses in a future market downturn were anticipated to be 40 percent, these firms were operating well off the model's minimum recommended cash-to-equity ratios.

The model can also be used to compute cash-to-equity ratios for institutions that failed during the crisis. Charts 3 and 4 present this information for Bear Stearns, Lehman Brothers, Fannie Mae, Freddie Mac, and Wachovia. Chart 3 displays computed ratios from July 2000 to August 2008 that show the cash requirements exploding as these firms approach severe distress, near-failure, or failure.

Chart 4 focuses on the period July 2006 to August 2008, and shows that for all of these institutions except Wachovia,

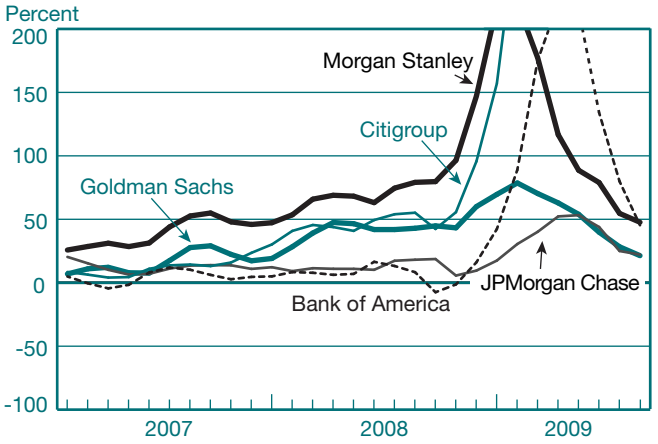
[2] For more discussion, see Acharya et al. (2010); Acharya, Engle, and Richardson (2012); and Brownlees and Engle (2011).

Chart 1
Minimum Recommended Cash Holdings-to-Equity Ratios by Bank, 2000-13



Source: Authors' calculations.

Chart 2
Minimum Recommended Cash Holdings-to-Equity Ratios by Bank, 2007-09



Source: Authors' calculations.

the cash-to-equity ratio requirement would already have been much higher than 20 percent by March 2007. Fannie Mae and Freddie Mac, in particular, would have required cash-to-equity ratios exceeding 60 percent even by late 2006, reflecting their steeply rising debt levels during this period.

4. Why Cash and Not Inside Debt, Deferred Equity, or Contingent Capital?

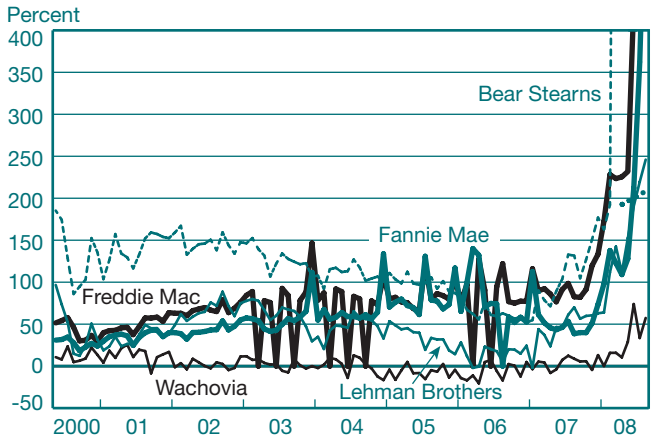
Deferred cash compensation is akin to "inside debt," that is, debt claims held by those inside the firm. The use of debt in executive compensation provides incentives for executives to undertake corporate policies that protect the value of these fixed claims, thereby lowering the firm's default risk (Jensen and Meckling 1976). Such policies could include some or all of the following: investing in safer projects, lowering the firm's leverage, reducing payouts (such as dividends) to other claimholders, stockpiling cash, and engaging in diversification activities that lower risk (even those that may sometimes be value-reducing).[3]

[3] Substantial evidence supports the idea that the form of managerial compensation affects corporate policies (see, for example, Murphy [1999] or Frydman and Jenter [2010]). On the theoretical side, compensation ideas have been developed in the context of financial firms by Mehran (2008) and Bolton, Mehran, and Shapiro (2015).

A number of recent papers have confirmed that debt-like compensation reduces incentives for risk taking (Bebchuk and Spamann 2009; Edmans and Liu 2011; Mehran 2008; Sundaram and Yermack 2007; Wei and Yermack 2011). For instance, Sundaram and Yermack (2007) find that higher holdings of inside debt by managers reduce the likelihood of firm default. Similarly, Wei and Yermack (2011) find that firms in which chief executive officers (CEOs) had larger pensions and deferred pay in their compensation packages exhibited lower credit spreads and higher bond prices, implying that markets were pricing in the lowered risk incentives stemming from the deferred debt-like claims. The findings for financial firms mirror those for nonfinancial firms. For example, Bennett, Güntay, and Unal (2015) document that a higher incidence of inside debt relative to inside equity in a CEO pay package in 2006 is associated with lower default risk and better performance during the crisis period 2007-08. They also find that higher CAMELS ratings (bank supervisory assessments of capital adequacy, asset quality, management capability, earnings, liquidity, and sensitivity to market risk) are associated with greater CEO inside debt compensation.

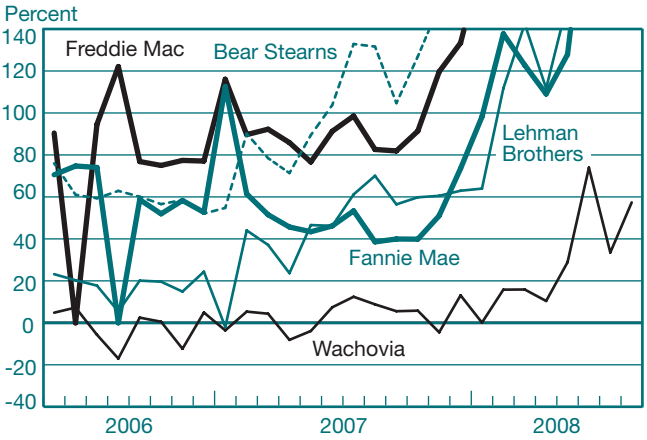
Nevertheless, three important features distinguish our deferred cash proposal from the inside debt approach and lead us to prefer our proposal. First, under our proposal, ownership of the (escrowed) deferred cash compensation reverts to the bank in times of stress so that the bank can repay its debts (or, more generally, so that it can repay any nonequity liabilities that if ignored could constitute a default). Thus, almost by definition, the deferred cash compensation of insiders in

Chart 3
Cash-to-Equity Ratios: Selected Institutions (2000-08)



Source: Authors' calculations.

Chart 4
Cash-to-Equity Ratios: Selected Institutions (2006-08)



Source: Authors' calculations.

our proposal is junior to all other debt. In contrast, current inside debt proposals, to the best of our knowledge, would give insiders a slice of bank debt that is repaid in tandem with other debts.[4]

Second, deferred cash under our proposal would be escrowed, and management and shareholders would not have the discretion to deploy the cash for risk-taking purposes. While rewarding insiders with debt (rather than cash) would preserve the bank's cash, the current inside debt proposals do not explicitly require that retained cash be outside of managerial and shareholder discretion. Indeed, if inside debt is not designated as the senior-most debt of the firm, management and shareholders would have incentives to deploy the cash for risk-taking purposes, with the intention of shifting risk to the senior creditors.

Third, deferred equity or equity-linked claims (including options) do not provide quite the same incentives toward conservatism as deferred cash or debt-like claims. Although the deferral aspect will induce some risk aversion, equity, as the residual claim on the firm's assets, *benefits* from an increase in firm volatility. Hence, the incentive to reduce risk is smaller with deferred equity than it is with deferred cash or inside debt.

Finally, our proposal is closely related to, but distinct from, the notion of "contingent capital" (Flannery 2005; Squam Lake Working Group on Financial Regulation 2009). Contingent capital is debt that converts to equity under pre-specified triggers, thus reducing the leverage ratio of the bank in stressed times. As such, contingent capital is effectively a contingent *liability* of the bank, whereas the cash in our model represents a contingent *asset*; of course, to the extent that cash may be viewed as negative debt, this distinction in terminology may not in itself be that important. But unlike contingent capital, the contingent asset in our proposal is intended to come entirely from deferred executive compensation, and so directly affects risk-taking incentives of the executive. Moreover, there is no dilution of existing equity from the trigger in our approach. Further, the cash is compensation that has already been paid out by the bank but which is held in escrow to be clawed back in poor times; it is a not a liability owed by the bank.

[4] We observe, too, in this context that the transfer of ownership of cash compensation from insiders to the bank in the event of stress does *not* constitute (in a technical sense) "default" by the bank on its creditors. In contrast, failure to pay on inside debt would constitute a default unless the terms of the contract explicitly allow for the possibility.

5. Deriving the Minimum Cash Holding Rule

Here we turn to the model underlying the proposal. Consider a single-period binomial model for distribution of the value of a bank's noncash assets. The current value of assets is A. At the end of the period, the assets may be worth A^h in state H, which arises with a probability of $p \in (0,1)$. Alternatively, they may be worth A^l in state L which arises with a probability of $(1 - p)$, where $A^h > A^l$.

The bank's owners have an option at date 0 to alter the quality of noncash assets from the benchmark cash flow structure to a riskier cash flow structure, such that the future value of assets in states H and L and is given respectively by $A^{h'}$ and 0, and the probability of these states is altered as well to p' and $(1 - p')$, respectively. In this case, the current value of the assets will be denoted as A'.

The bank has legacy debt of face value D, which is due at the end of the period, and a starting stock of *contingent* cash assets worth C, which are assumed to be riskless with no fluctuation in value across the states H and L. The cash C is to be thought of as an escrow account carrying the deferred cash compensation of bank employees. However, if the bank cannot meet its creditor payments, the escrow account would be made available to fulfill these payments; only if creditor payments can be met fully from asset cash flows will the deferred cash compensation be paid out to bank employees.

The discount rate is assumed to be zero throughout, which is also the rate of return on cash assets. Bank owners as well as creditors are assumed to be risk-neutral. Debt claims are assumed senior to all other claims, and there is no violation in any state of this priority structure. Under these assumptions, it follows that

$$A = pA^h + (1 - p)A^l, \text{ and} \tag{3}$$

$$A' = p'A^{h'}. \tag{4}$$

We will assume further that an interim and perfect signal about the future state of the world becomes available to bank owners as well as creditors. Upon receipt of this signal, if it is optimal for creditors to "run" on the bank's assets and force them to be liquidated, then the liquidation value of assets is a fraction $q \in [0,1)$ of the future value. We assume that $A^l > D > qA^l$, so that even if the bank has no cash assets ($C = 0$), creditors can be paid in full in state L if they wait for realization of the value of the noncash assets. But if they force early asset liquidation, they incur a haircut in their recovered payoff relative to the promised payoff. We also assume, in contrast, that $qA^h > D$ and $qA^{h'} > D$, so that in state H creditors can be paid in full, even if the bank has no cash assets and early liquidation is forced.

We will assume for now that, owing to a coordination problem, creditors may run on the bank in state L (in the case of the benchmark assets) and force asset liquidation provided that

$$qA^l + C < D. \tag{5}$$

This run can be rationalized as a "sun spot" along the lines of Diamond and Dybvig (1983).

In what follows, we calculate what cash levels enable the bank to avoid a run in state L, preserve equity value in this state, and in turn, preserve bank owners' ex ante incentives not to switch from the benchmark asset to the alternative riskier asset.

5.1 Analysis

We first calculate the value of bank equity in the benchmark assets case assuming a run and no run, denoted as E^r and E^{nr}, respectively.

- Run: In the case of a run in state L, bank owners and employees are left with no residual cash flows; in state H, creditors are paid off from cash flow A^h, cash is paid out to employees, and the residual $(A^h - D)$ is residual cash flow that accrues to bank equity. As a result,

$$E^r = p(A^h - D). \tag{6}$$

- No run: In the case in which there is no run in state L, the bank owners are left with a residual cash flow $(A^l - D)$ and employees are paid out the cash C. As a result,

$$E^{nr} = p(A^h - D) + (1 - p)(A^l - D) = A - D. \tag{7}$$

It can be readily observed that $E^r < E^{nr}$ for all D.

Next, it is straightforward to see that the value of bank equity in the riskier assets case is given by

$$E' = p'(A^{h'} - D). \tag{8}$$

Since there is no cash flow from assets in state L in the riskier assets case, whether there is a run or not is irrelevant for bank equity valuation.

We now analyze the incentives of bank owners at the beginning of the period to alter the riskiness of noncash assets from the benchmark case to the riskier one:

- Run: If bank owners anticipate a run in state L in the benchmark assets case, they switch to the riskier asset if and only if

$$E^r < E'. \tag{9}$$

- No run: If bank owners do not anticipate a run in state L in the benchmark assets case, they switch to the riskier asset if and only if

$$E^{nr} < E'. \tag{10}$$

Then, we obtain the standard asset-substitution or risk-shifting result (Jensen and Meckling 1976) that there is an incentive to switch to the riskier asset whenever the firm's debt level is sufficiently high. So, we have the following:

Lemma 1: $E^{r} < E'$ *if and only if* $D > \overline{D}^{r} \equiv \frac{pA^{h} - p'A^{h'}}{p - p'}$.

Similarly,

Lemma 2: $E^{nr} < E'$ *if and only if* $D > \overline{D}^{nr} \equiv \frac{A - p'A^{h'}}{1 - p'}$.

Finally,

Proposition 1: $\overline{D}^{nr} > \overline{D}^{r}$.

In other words, risk-shifting incentives are weaker when there is no expectation of a run in state L in the benchmark assets case. The intuition is that this condition preserves equity value in state L and reduces the benefits of gambling for resurrection by switching to the riskier assets.

We can now ask what level of cash assets would be necessary to avoid a run and also have the desirable effect of reducing bank owners' risk-shifting incentives. There is no run in state L in the benchmark assets case provided that

$$qA^{l} + C \geq D, \tag{11}$$

or, in other words, provided that

$$C \geq D - qA^{l}. \tag{12}$$

We define the bank's expected shortfall (ES^{nr}) to be the percentage change in equity valuation between the beginning of the period and state L in the case of no run. The result is that

$$ES^{nr} = 1 - \frac{(A^{l} - D)}{(A - \mathrm{D})}. \tag{13}$$

Rearranging this equation, we can express A^{l} in terms of ES as

$$A^{l} = D + (A - D)(1 - ES^{nr}) \tag{14}$$

$$= D + E^{nr}(1 - ES^{nr}). \tag{15}$$

Substituting in the condition for no run, we obtain our main result, which expresses the cash requirement for the bank that avoids a run as:

Proposition 2: $C \geq (1 - q)D - qE^{nr}(1 - ES^{nr})$.

Since the asset liquidation losses $(q < 1)$ are generally incurred during systematic states of nature, we can replace ES^{nr} with MES^{nr}, which is the marginal expected shortfall of bank equity, conditional on an adverse market or adverse aggregate state.

Finally, if we consider incentives from the standpoint of a bank management that not only owns all bank equity but also factors in its cash payouts, we again obtain the result that there is risk shifting when bank debt is sufficiently high. In the cases of a run and no run, the critical debt levels above which risk shifting occurs are given respectively by $\overline{D}^{r,m} = \overline{D}^{r} + C$, and $\overline{D}^{nr,m} = \overline{D}^{nr} + C$. In turn, it follows that $\overline{D}^{nr,m} > \overline{D}^{r,m}$. Risk-shifting incentives are weaker for management than bank owners, because management has additional liability from its deferred cash compensation. However, the relative risk-shifting incentives between the run and no-run cases are unaffected, so that if it is desirable to avoid the run in order to reduce risk-shifting incentives, then the cash requirement is identical to the one in our proposition.

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