

## Andrew G Haldane: Capital discipline

Remarks by Mr Andrew G Haldane, Executive Director of the Bank of England, based on a speech given at the American Economic Association, Denver, Colorado, 9 January 2011.

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The Basel Committee sets capital standards for international banks. There are now three vintages of these standards: so-called Basel I dating from 1988, Basel II dating from around 2004 and Basel III which was agreed at the end of last year.<sup>1</sup> These international capital standards are supported by three pillars. Pillar I defines the regulatory rules, Pillar II provides scope for supervisory discretion, while Pillar III seeks to foster market discipline through disclosure. In countering systemic shocks, three supporting pillars have understandably been felt to be better than one.

But the success of international capital standards in forestalling banking distress has been mixed. Basel I regulatory rules were arbitrated due to their risk insensitivity. This gave rise to Basel II with its greater focus on risk calibration. But Basel II buckled under the weight of the recent crisis. Repairs have since been applied through Basel III. Historical experience suggests this is unlikely to be the end of road.

This paper assesses and suggests means of improving the robustness of this regulatory framework. The quest for risk sensitivity in Pillar I rules caused regulatory complexity and opacity to blossom. This may have inhibited the effectiveness of supervisory discretion and market discipline (Section 1). In consequence, Pillar I may have borne too much of the load and Pillars II and III too little. Here I focus on Pillar III.

There may be straightforward ways to rebalance the Basel scales, re-injecting market discipline. Having banks issue a graduated set of contingent convertible (“CoCo”) securities, which are responsive to early signs of market stress, is one possible way of doing so (Sections 2 and 3). That would have the practical effect of reinforcing Pillar I with Pillar III, so delivering a potentially more balanced and robust regulatory edifice.

Getting from here to there may take time. But some modest adjustment to dividend and bonus distribution policies by banks would help (Section 4). Section 5 concludes.

### The first pillar

The recently-agreed Basel III package delivers a material strengthening of regulatory standards. Though the details are complex, the essence of these reforms is easily described: “more of the same – and better”. So there will be more bank capital and in future it will be higher quality. Banks will be required, for the first time in an international accord, to hold liquid assets, and in future will be more resilient. Risk management will be more extensive and in future it will be more robust. And bank supervisors will be more plentiful and in future they will be smarter.

That has been the response to virtually every financial crisis of the past fifty years. It has not arrested the crisis cycle – if anything, the incidence of crises appears to have risen.<sup>2</sup> It may

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<sup>1</sup> Goodhart (2011 forthcoming).

<sup>2</sup> Bordo et al (2001).

not even have slowed this cycle, as the massive costs of this time's crisis attest. So although the recent Basel III package may be necessary, there must be a real question about whether it will be sufficient to cope with next time's crisis. History, at least, provides grounds for pessimism.

As a thought experiment, imagine instead we were designing a regulatory framework from scratch. Finance is a classic complex, adaptive system. What properties would a complex, adaptive system such as finance ideally exhibit to best insure about future crises? *Simplicity* is one. There is a key lesson, here, from the literature on complex systems. Faced with complexity, the temptation is to seek complex control devices. In fact, complex systems typically call for simple control rules. To do otherwise simply compounds system complexity with control complexity.<sup>3</sup> Uncertainty would not then divide, it would multiply.

*Robustness* would be a second. This has a particular meaning in the context of complex systems: resilience given ignorance.<sup>4</sup> More often, this is called Knightian uncertainty or simply model error. The dynamics of complex systems, such as large banks or interconnected financial webs, are not well understood. That means uncertainty needs to be taken seriously if financial regulatory frameworks are to be robust.

*Timeliness* would be a third criterion. Complex systems often exhibit a knife-edge property, with discontinuities and tipping points a naturally-recurring feature.<sup>5</sup> Those same features have punctuated the present financial crisis. In physics as in finance, once over the cliff-edge there is little chance of full recovery. That underscores the importance of timely, pre-emptive regulatory intervention if financial disaster is to be averted.

#### **(a) *Simplicity***

How do existing regulatory rules compare against these criteria – simplicity, timeliness, robustness? Take simplicity. By any standard, existing regulatory rules are far from simple. For large banks, they can be highly complex. They have become more so over time given the evolution of the Basel framework.

Back in the days of Basel I, calculating a regulatory capital ratio was not especially taxing or time-consuming. It involved little more than half a dozen calculations. These calculations could be conducted on the back of a small envelope by a competent clerk. Possessing envelopes and clerks, banks, regulators and market participants were able to perform those calculations. They were transparent and verifiable. In that way, regulatory rules (Pillar I) provided a solid platform for supervisory discretion by regulators (Pillar II) and market discipline by investors (Pillar III). The Basel pillars were mutually reinforcing.

Basel II changed that calculus. In part to avert regulatory arbitrage, there was a quest for greater risk-sensitivity. Regulatory capital rules became more finely calibrated to banks' underlying portfolio of risks. In practice, that meant two things. First, the number of independent categories of risk assets increased. And second, greater use was made of banks' own internal models to generate the risk metrics associated with each asset class. The consequences of this regulatory shift for system complexity have been extraordinary.

For large and complex banks, the number of risk categories has exploded. To illustrate, consider the position of a large, representative bank using an advanced internal set of models to calibrate capital. Its number of risk buckets has increased from around seven under Basel I to, on a conservative estimate, over 200,000 under Basel II. To determine the

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<sup>3</sup> For example, Perrow (2007) and Cliff (2011).

<sup>4</sup> Hansen and Sargent (2007).

<sup>5</sup> Haldane (2009), Haldane and May (2011).

regulatory capital ratio of this bank, the number of calculations has risen from single figures to over 200 million. The quant and the computer have displaced the clerk and the envelope.

At one level, this is technical progress; it is the appliance of science to risk management. But there are costs. Given such complexity, it has become increasingly difficult for regulators and market participants to vouch for the accuracy of reported capital ratios. They are no longer easily verifiable or transparent. They are as much an article of faith as fact, as much art as science. This weakens both Pillars II and III. For what the market cannot observe, it is unlikely to be able to exercise discipline over. And what the regulator cannot verify, it is unlikely to be able to exercise supervision over. Banks themselves have recently begun to voice just such concerns.

## **(b) Robustness**

A further cost to complexity arises from model error. Model uncertainty, as distinct from risk, is rarely taken into account when interpreting reported capital ratios. But without some idea of uncertainty, it is difficult to know how much confidence to place in reported solvency measures. How large are the confidence intervals investors and regulators ought to place around them?

Calibrating confidence intervals around capital would involve aggregating across myriad assets and multiple models. Rather tellingly, that is too complex a calculation for anyone to have carried out. But by drawing on banks' own published model output, it is possible to gauge uncertainty around some of the key balance sheet components – for example, the retail credit portfolio, the wholesale credit portfolio and the trading book.

For the retail credit portfolio, consider a simple, single source of model error – calculating the probability of default (PD) for different classes or borrower. Under the advanced model-based approach to calculating retail PDs, each loan is placed in a risk bucket. So there is a degree of intrinsic uncertainty both about where in the risk bucket the true PD lies and indeed about whether it lies in the assigned risk bucket at all.

To gauge the importance of these uncertainties, the mortgage portfolios of two large banks were examined and capital calibrated using their reported models. These capital ratios were then simulated under two counterfactual assumptions: (a) that true PDs were uniformly distributed within the risk bucket; (b) that true PDs were higher than recorded PDs by one risk bucket.

The results are illustrated in Charts 1 and 2. Chart 1 looks at the distribution of the reported capital ratio, indexed to 100, assuming model uncertainty only exists within each risk bucket and is symmetric. Even under this assumption the confidence intervals are significant, with the “true” capital ratio lying anywhere between 15% above or below the reported ratio. Once we allow for the possibility of PDs being systematically under-estimated, the degree of uncertainty is greater still. The “true” ratio then lies up to 35% below the reported ratio. That equates to several percentage points of capital.

A different way of gauging the effects of model uncertainty is to look at how different banks value essentially identical exposures. For UK banks' wholesale credit portfolio, the FSA conducted just such an exercise in 2009.<sup>6</sup> A hypothetical portfolio was constructed based on 64 externally rated corporate, bank and sovereign exposures. Banks were then asked to use their models to generate PDs and capital for this hypothetical portfolio, which could be compared across banks.

The range of reported capital requirements held against this common portfolio was striking. For wholesale exposures to banks, capital requirements differed by a factor of over 100%.

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<sup>6</sup> Financial Services Authority (2010).

For corporate exposures, they differed by a factor of around 150%. And for sovereign exposures, they differed by a factor of up to 280%. Those differences could equate to a confidence interval around reported capital ratios of 2 percentage points or more.

A final means of gauging potential model error is to consider past evidence. During the crisis, model error was largest and most egregious in the trading book. Charts 3 and 4 compare UK banks' pre-crisis capital held against the trading book to trading book losses during the crisis. Losses were up to six times greater than pre-crisis trading book capital (Chart 3). And capital ratios would have needed to be up to 2.5 percentage points higher to accommodate this model risk (Chart 4). A fundamental review of the trading book is underway to address this problem.

This evidence only provides a glimpse at the potential model error problem viewed from three different angles. Yet it suggests that model error-based confidence intervals around reported capital ratios might run to several percentage points. For a bank, that is the difference between life and death. The shift to advanced models for calibrating economic capital has not arrested this trend. More likely, it has intensified it. The quest for precision may have come at the expense of robustness.

Hayek titled his 1974 Nobel address "The Pretence of Knowledge".<sup>7</sup> In it, he highlighted the pitfalls of seeking precisely measurable answers to questions about the dynamics of complex systems. Subsequent research on complex systems has confirmed Hayek's hunch. Policy predicated on over-precision risks catastrophic error. Complexity in risk models may have perpetuated Hayek's pretence in the minds of risk managers and regulators.

### **(c) *Timeliness***

One of the purported benefits of model-based calibration is that it increases the sensitivity of capital requirements to changes in risk. Reported regulatory capital ratios should better reflect risk and thus should in principle offer timely advance warnings of impending bank stress.

The data tell a somewhat different story. To see that, consider the experience of a panel of 33 large international banks during the crisis. This panel conveniently partitions itself into banks subject to government intervention in the form of capital or guarantees ("crisis banks") and those free from such intervention ("no crisis banks").

Chart 5 plots the reported Tier 1 capital ratio of these two sets of banks in the run-up to the Lehman Brothers crisis in September 2008. Two observations are striking. First, the reported capital ratios of the two sets of banks are largely indistinguishable. If anything, the crisis banks looked slightly stronger pre-crisis on regulatory solvency measures. Second, regulatory capital ratios offer, on average, little if any advance warning of impending problems. These conclusions are essentially unchanged using the Basel III definitions of capital.

This visual evidence can be formalised by constructing some Type I (false positive) and Type II (missed crisis) error estimates for the same 33-bank panel. Assume, by way of illustration only, that if a bank's Tier 1 capital ratio dips below 8%, this is deemed to signal distress (Table 1). The probability of a Type I error using regulatory capital ratios is 50%, while the probability of a Type II error is around 43%. On those assumptions, this suggests regulatory capital ratios do about as well in predicting crises as a coin toss. They are essentially uninformative about future bank stress.

Taken together, this does not paint an altogether encouraging picture. A critic might argue that regulatory capital ratios have become too complex to verify, too error-prone to be reliably

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<sup>7</sup> Hayek (1974).

robust and too leaden-footed to enable prompt corrective action. From a first principles perspective, they score poorly as an optimal control device over a complex system such as finance.

### Resurrecting the third pillar

What could be done to strengthen the framework? As a thought experiment, consider dropping risk models and instead relying on the market. Market-based metrics of bank solvency could be based around the market rather than book value of capital. The market prices of banks are known to offer useful supplementary information to that collected by supervisors when assessing bank health.<sup>8</sup> And there is also evidence they can offer reliable advance warnings of bank distress.<sup>9</sup>

To bring these thoughts to life, consider three possible alternative bank solvency ratios based on market rather than accounting measures of capital:

- **Market-based capital ratio:** the ratio of a bank's market capitalisation to its total assets.
- **Market-based leverage ratio:** the ratio of a bank's market capitalisation to its total debt.
- **Tobin's Q:** the ratio of the market value of a bank's equity to its book value.

The first two are essentially market-based variants of regulatory capital measures, the third a well-known corporate valuation metric.<sup>10</sup> How do they fare against the first principles of complex, adaptive systems?

They clearly offer the advantage of simplicity and transparency. 200 million separate calculations would condense to a simple, single sum. The clerk would make a glorious return and displace the quant. Market-based measures could be observed and verified in real-time by regulators and market participants. That could help in enhancing both supervisory discretion and market discipline. Market-based capital ratios could support all three Pillars, helping to rebalance the Basel scales.

Market-based solvency metrics offer two further advantages. First, they are not reliant on myriad, mis-specified models. They are largely model-free, if not error-free.<sup>11</sup> They are robust to model error and ignorance. Second, history suggests that, at least in the latest crisis, they would have given far timelier signals of impending stress, and so a better guide to prompt corrective action, ahead of the crisis cliff-edge being reached.

To illustrate that, Charts 6–8 look at the three market-based measures of solvency for the 33-bank panel, again broken down between “crisis” and “no crisis” banks. There is now clear blue water between the solvency ratios of the crisis and non-crisis banks, with the second materially weaker. In the two years prior to the Lehman Brothers crisis, the average market-based capital ratio was around 5 percentage points lower for crisis than for no crisis banks.

Second, market-based measures of capital offered clear advance signals of impending distress. For example, the market-based capital ratio of crisis banks began to fall in April 2007, well over a year ahead of the Lehman's crisis. To formalise that visual impression, Table 1 shows Type I and II errors for the three market-based capital measures. These now

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<sup>8</sup> Cannata and Quagliariello (2005), Gunther et al (2001), Krainer and Lopez (2004).

<sup>9</sup> Berger et al (2000).

<sup>10</sup> Calomiris and Herring (2011) prefer a variant of the first measure.

<sup>11</sup> Largely, because even market-based measures of solvency will rely on disclosures by banks, which will themselves be model-dependent to some degree.

comfortably outperform a coin toss. Replacing the book value of capital with its market value lowers errors by a half, often much more. Market measures provide both fewer false positives and more reliable advance warnings of future banking distress.

Taken together, then, market-based solvency metrics perform creditably against first principles: they appear to offer the potential for simple, timely and robust control of a complex financial web.

### **Contractual prompt corrective action**

But how should these market-based metrics be put to use in the design of a regulatory framework? Market warnings are useless unless they are acted on, either by the market itself or by regulators. It is not too difficult to devise a reconfiguration of banks' capital structure that would bake-in the benefits of simplicity, robustness and timeliness. This would involve a cocktail of revised regulatory capital standards fortified by market discipline. It might work as follows.

Alongside equity, banks would be required to issue a set of contingent convertible instruments – so-called “CoCos”. These instruments have attracted quite a bit of attention recently among academics, policymakers and bankers, though there remains uncertainty about their design.<sup>12</sup> In particular, consider CoCos with the following possible design characteristics.

- Triggers are based on market-based measures of solvency, as in Charts 6–8.
- These triggers are graduated, stretching up banks' capital structure.<sup>13</sup>
- On triggering, these claims convert from debt into equity.

Although novel in some respects, CoCos with these characteristics would be simple to understand. They would be easy to monitor in real time by regulators and investors. And they would alter potentially quite radically incentives, and thus market dynamics, ahead of banking stress becoming too acute.

To see why, imagine a bank whose expected future profits, and hence market capitalisation, have slumped. If this erosion of profits is sufficiently material, conversion at the highest trigger occurs. Upon triggering, a chunk of that bank's debt converts into equity, automatically recapitalising the bank and providing it with an extra equity cushion. This equity infusion ought to help restore market confidence in the bank's soundness.

If the first conversion does not do the trick, or if the profits shock is sufficiently large, there are other rungs in the ladder. Lower triggers provide a graduated safety net. As these triggers are pulled, converting CoCos offer progressively greater stuffing for the cushion. This is a double boon. It confers the benefits of (contractually pre-agreed contingent) equity. But knowledge of the graduated safety net ought also to help stabilise investors' confidence in the bank.

Under this capital structure, banks' insurance contract would be fundamentally different than at present. Instead of equity being provided at haste under stress, the safety net would extend automatically in advance. And instead of being provided by the state ex post, insurance would come from private creditors ex ante. Timely self-insurance would replace laggardly public insurance. There would be prompt corrective action. But it would operate on autopilot, using a contractual, market-based navigation system.

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<sup>12</sup> For example, Flannery (2010), Flannery and Perotti (2011), Duffie (2011), Calomiris and Herring (2011).

<sup>13</sup> Alternatively, there could be graduated tranches of CoCos operating with a single trigger. The economic impact of these two structures would be very similar.

This contractual automaticity would provide a shot in the arm to incentives and thus market discipline. First, for the incentives of *investors*. Knowing that a trigger might be close to being pulled, and their claims converted, CoCo investors are likely to sit up and take notice. If conversion takes place below the prevailing market price, the incentives among existing shareholders are similarly sensitised. Early signs of deteriorating profits or sentiment are likely to result in greater investor activism. Such activism was absent in the run-up to the crisis, in part because there was no early morning wake-up call for investors.

Second, for the incentives of *management*. If investors are grumpy about their early morning wake-up call, management of the bank are likely to hear their hoarse protests. And anticipating these protests, management are less likely to sail close to the wind or at least will be quicker to tack when fearing a squall. Management, too, would be provided with incentives to remain shipshape.

Third, for the incentives of *regulators*. In the depths of crisis, as recent experience has shown, the temptation to forbear or bail-out is very strong. It is no surprise that the authorities often opt for the greater certainty of bail-out ex post, whatever their preferences ex ante. This policy time-consistency problem lies at the heart of the current regulatory debate.

Better resolution tools, which would be needed if CoCos are not enough, can lessen the dilemma and are an essential part of the reform programme. They give the authorities extra options such as creditor bail-in through write-downs or debt-for-equity conversions. They provide a statutory backstop, enabling bail-in of private sector creditors. As such, they are a necessary ingredient for restoring market discipline.

CoCos buttress market discipline and help lift the authorities from the horns of the time-consistency dilemma. They augment regulatory discretion at the point of distress with contractual rules well ahead of distress. Capital replenishment is contractual and automatic; it is written and priced ex-ante and delivered without temptation ex-post. Because intervention would be prompt, transparent and rule-based, the scope for regulatory discretion would be constrained. For that reason, the time-consistency problem ought to be reduced, perhaps materially. A contractual belt is added to the resolution braces.

To achieve these benefits, change would be needed to banks' capital structure. But this reconfiguration would not be especially dramatic. Indeed, it would be as simple as CDE: C(oCos) + D(debt) + E(quity). The layer of bank equity would be augmented with a layer of CoCos, with slices defined by market-based triggers. Banks' capital would comprise multi-sliced equity, some actual, some contingent. In some respects, this model is not greatly dissimilar to the one recently proposed by the Swiss banking commission.<sup>14</sup>

In achieving this capital structure, one option would be for regulators to require it, as in Switzerland. But it is possible that banks themselves might find such a capital structure in their own best interests. To see why, consider a standard model of optimal capital choice by a value-maximising firm. The firm faces a trade-off. Debt confers the benefits of tax deductibility, while equity offers the benefits of lower expected bankruptcy costs.<sup>15</sup> The trade-off between these two sets of benefits defines an optimal capital ratio for a firm to maximise its expected value (Chart 9).<sup>16</sup>

Now consider adding CoCos to the mix. They are, in effect, a hybrid of debt and equity whose payoffs depend on the state of nature. When nature is kind and times are good, they offer the upswing (tax-deductibility) benefits of debt. And when nature is cruel and times are bad, they offer the downswing (bankruptcy costs) benefits of equity. They are, in the

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<sup>14</sup> Commission of Experts for Limiting the Economic Risks Posed by Large Companies (2010).

<sup>15</sup> Debt could also provide some incentive benefits in disciplining management (Jensen (1986)).

<sup>16</sup> Leland (1994).

language of economists, a form of “contingent” contract when the contingency in question is crisis.

As Chart 10 illustrates, the optimal fraction of CoCos in banks’ optimal debt structure is likely to be non-zero. In other words, a CDE capital structure might be a smart option for value-maximising investors and managers, even without the need for regulatory intervention. The *social* value of such a capital structure might, of course, be greater still – for example, because the social costs of crisis are higher than the private costs. That would justify a regulatory capital backstop.

This capital structure shares the risk-sharing benefits of some other reform proposals. For example, it has similar risk-shifting properties to a mutual fund or limited purpose banking model.<sup>17</sup> When required, risk is shared across the capital structure, as in a mutual fund whose equity claims adjust in value. But risk-spreading would only kick-in when it needs to. Banks are banks when nature is kind and mutual funds when it is cruel. They can be butterflies in summer, provided they are hedgehogs in winter.

### **From here to there**

If such a structure is for the best in most states of the world, why does it not already exist? At least two legitimate concerns have been raised. First, might market-based triggers invite speculative attack by short-sellers? The concern is that CoCo holders may be able to short-sell a bank’s equity to force conversion, then using the proceeds of a CoCo conversion to cover their short position.

There are several practical ways in which the contract design of CoCos could lean against these speculative incentives. Perhaps the simplest would be to base the conversion trigger on a weighted average of equity prices over some prior interval – say, 30 days.<sup>18</sup> That would require short-sellers to fund their short positions for a longer period, at a commensurately greater cost. It would also create uncertainty about whether conversion would indeed occur, given the risk of prices bouncing back and the short-seller suffering a loss. Both would act as a speculative disincentive.

A second potential firewall against speculative attack could come from imposing restrictions on the ability of short-sellers to cover their positions with the proceeds of conversion. Restrictions on naked short-selling are applied around the time of seasoned equity offerings in some jurisdictions.<sup>19</sup> A rule to prevent the covering of short positions with the proceeds of a CoCo conversion could provide a further disincentive to destabilising short-selling of banks’ equity.

A related concern is that CoCos alter the seniority structure of banks’ capital, as holders of CoCos potentially suffer a loss ahead of equity-holders. But provided the price at which CoCos convert to equity is close to the market price, conversion does not transfer value between existing equity-holders and CoCo investors. And provided conversion is into equity it need not imply investor loss. If a market move really is unjustified, prices will correct over time towards fundamentals. The holder of a converted CoCo will then garner the upside.

So while CoCos are susceptible to market aberrations, these can in my view be managed. In this respect, market errors are fundamentally different to model errors. Market errors are temporary risk, while model errors are permanent uncertainty. Market error can be managed,

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<sup>17</sup> For example, Kotlikoff (2010).

<sup>18</sup> For example, Flannery (2010).

<sup>19</sup> Safieddine and Wilhelm (1996), for example.

while model error cannot. Put differently, with market-based CoCos the cost of Type I errors may be relatively modest for end-investors.

A second key practical issue is whether it is plausible to imagine an investor base for CoCos emerging. Recent signs have been encouraging. Two major international banks have issued CoCos totalling around US\$10bn since the start of the year. Credit Suisse recently issued a \$2bn CoCo in a public auction, which was reportedly 11-times over-subscribed. Some market commentary suggests the CoCo market could grow to around \$1 trillion over the next few years.<sup>20</sup>

Despite that progress, investor demand for CoCos remains uncertain. Tellingly, none of the CoCos issued so far have had market-based triggers, none have a graduated ladder of triggers and, in my view, none extend very far up banks' capital structure. In short, the case for a CDE capital structure is, at present, unproven.

But there may be simple, evolutionary ways to catalyse market demand to achieve this capital structure. Perhaps the simplest way to do so would be to require banks to make discretionary distributions to staff and shareholders in CoCos. In this way, an investor base for CoCos would emerge organically and grow in line with banks' profits.

As well as catalysing the CoCo market, this distributive approach would have two further benefits. First, it would boost the resilience of banks by keeping revenues in the business and augmenting banks' capital base. Given the large dividends and bonuses paid out by banks historically, distributing in CoCos could increase banks' capital base materially.

Consider UK banks. Imagine that 50% of bonuses had been paid in CoCos rather than cash from 2000 to 2006. By 2007 at the start of the crisis, UK banks' capital ratios would have been around 1 percentage point higher (Chart 11). Had 50% of dividends in addition been CoCoed, and assuming CoCos counted as Tier 1 capital, capital ratios would have been 3 percentage points higher. That is roughly £70 billion, or around the amount of external capital UK banks raised during the crisis.

Second, CoCo payouts potentially better align risk-taking incentives among staff and shareholders than cash or even equity payouts. The crisis demonstrated all too visibly some of the downsides of equity-based remuneration. One is the temptation to gamble for resurrection when poised on the brink, given the gambler's option embedded in equity. A second is the perverse incentive not to seek external equity because of the dilutive impact it might have on managerial wealth. Both of these adverse side-effects were evident at Bear Stearns and Lehman Brothers.

Remunerating management in CoCos removes this temptation, in much the same way as would credibly loss-absorbing sub-ordinated debt.<sup>21</sup> In peacetime, management is no longer offered the upside of equity, only the downside. The asymmetry of payoffs embedded in peacetime bonus packages – “heads I win, tails society loses” – is neutralised somewhat by paying in CoCos. This better aligns risk for shareholders and staff with the risks for society at large.

There is an old lesson, here, about eating your own cooking. This ought to help discipline the chefs, reducing the temptation to pursue risky recipes in the first place. Encouragingly, banking practice may already be beginning to match the theory. Several banks have recently announced they will in future consider remunerating shareholders and staff in CoCos.

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<sup>20</sup> Standard & Poor's (2010).

<sup>21</sup> Calomiris (2010) and Gordon (2010).

## Conclusion

Tackling complex banking through complex regulation is to fight fire with fire. This is unlikely to work in theory. Crisis experience suggests it has not worked in practice. A regulatory framework is needed in which the state is neither omniscient Walrasian auctioneer (shouting out hundreds of millions of risk prices) nor deep-pocketed financier (doling out hundreds of billions of taxpayers' money). A regulatory Gosplan will work no better for bankers than it did for tractors.

The role of regulation is instead to set the overarching rules of the game. In tackling banking stress, that means the framework for banks' capital structure. As far as possible, that framework should aim to leave the pricing of risk ex-ante, and the consequences of risk ex-post, to the market. The framework outlined here could be one simple, robust and timely way to help achieve that. It is different. But it is far from radical. Nothing could be less radical than returning banks, and banking risk, to the market.

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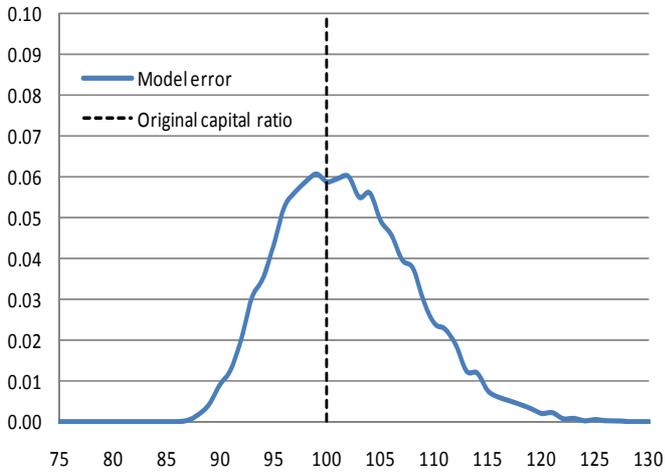
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## Annex

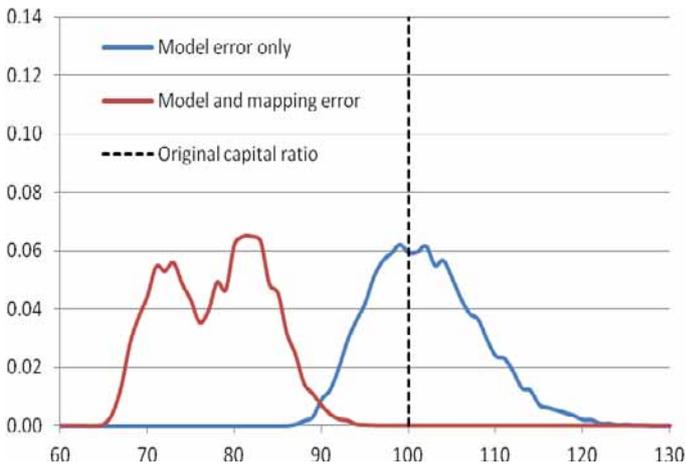
**Chart 1: Distribution of capital ratio for the retail mortgage book with model error**



Sources: 2009 Pillar 3 disclosures of Lloyds Banking Group and Royal Bank of Scotland and Bank calculations

(a) The model error takes the probability of default (PD) for each given risk bucket of mortgagees as the realisation of a uniformly-distributed random variable across the range of possible PDs within that risk bucket. This maps to a new risk-weighted assets number for the retail mortgage book, and a new capital ratio for this portion of the bank's book (assuming the initial capital ratio is 100). This error is simulated 5,000 times for each of two banks and the chart shows the resulting distribution.

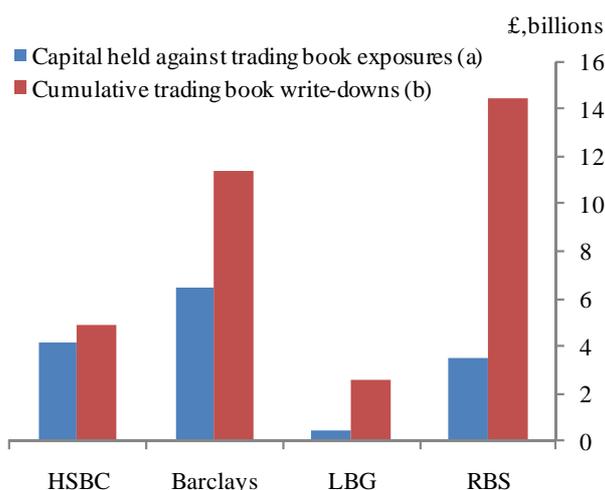
**Chart 2: Distribution of capital ratio for the retail mortgage book with model and mapping errors**



Sources: 2009 Pillar 3 disclosures of Lloyds Banking Group and Royal Bank of Scotland and Bank calculations

(a) The mapping error maps the PD for each mortgagee to the next higher risk bucket. It compounds with the model error described in Chart 1. This maps to a new risk-weighted assets number for the retail mortgage book, and a new capital ratio for this portion of the bank's book (assuming the initial capital ratio is 100). This error is simulated 5,000 times for each of two banks and the chart shows the resulting distribution.

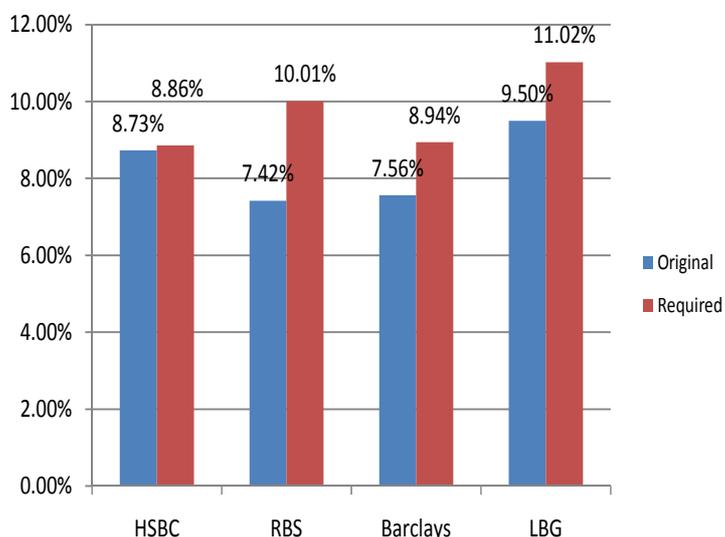
**Chart 3: Cumulative losses on trading book relative to capital requirements**



(a) As of end-2007. Capital charges against trading book exposures are calculated as the sum of market risk and counterparty credit risk RWAs, multiplied by 8%. This might overestimate the amount of capital banks hold against their regulatory trading books as some market risk and counterparty credit risk capital charges relate to positions booked in the banking book.

(b) Cumulative between 2007 H2 and 2009 H1. Includes write-downs due to mark-to-market adjustments where details are disclosed by firms. Not all these positions will necessarily be included in the regulatory trading book.

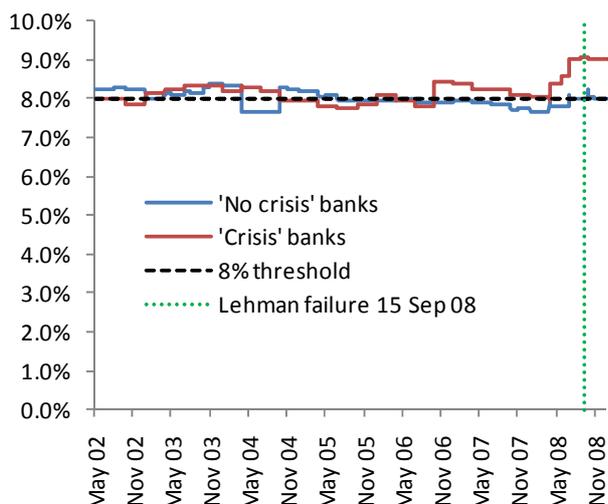
**Chart 4: Tier 1 capital ratios to absorb trading book losses**



Sources: Published accounts, Capital IQ and Bank calculations

(a) The red bars show the Tier 1 capital ratios that would have been required at end-2007 to fully absorb trading book write-downs and leave the bank with the Tier 1 capital ratio that was actually reported (blue bars).

**Chart 5: Tier 1 capital ratios for “crisis” and “no crisis” banks**



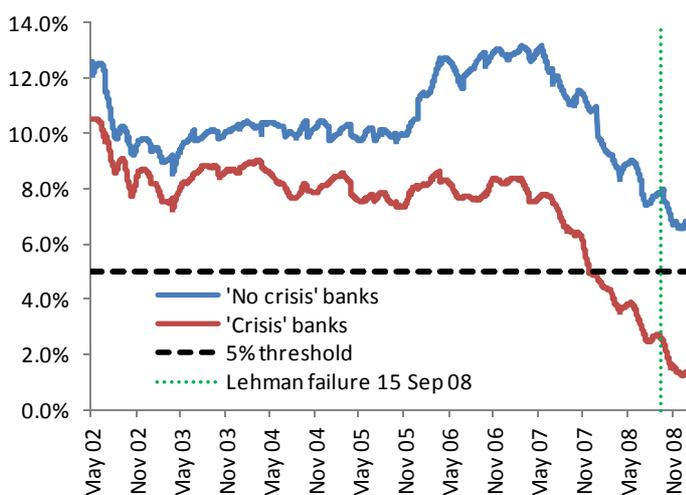
Sources: Capital IQ and Bank calculations

(a) “Crisis” banks are a set of major financial institutions which in autumn 2008 either failed, required government capital or were taken over in distressed circumstances. These are RBS, HBOS, Lloyds TSB, Bradford & Bingley, Alliance & Leicester, Citigroup, Washington Mutual, Wachovia, Merrill Lynch, Freddie Mac, Fannie Mae, Goldman Sachs, ING Group, Dexia and Commerzbank. The chart shows an unweighted average for those institutions in the sample for which data are available on the given day.

(b) The “no crisis” institutions are HSBC, Barclays, Wells Fargo, JP Morgan, Santander, BNP Paribas, Deutsche Bank, Crédit Agricole, Société Générale, BBVA, Banco Popular, Banco Sabadell, Unicredit, Banca Popolare di Milano, Royal Bank of Canada, National Australia Bank, Commonwealth Bank of Australia and ANZ Banking Group. The chart shows an unweighted average for those banks in the sample for which data are available on the given day.

(c) The dotted black line is a suggested trigger level for contingent capital calibrated by minimising a loss function which takes into account both Type I and Type II errors. Type I error is the probability that conversion occurs despite capital not being required. Type II error is the event that conversion does not occur despite capital being required. The loss function places greater weight on Type II errors. Note that the loss function takes into account the full range of banks, not just the average score for each set.

**Chart 6: Market capitalisation to book-value of total assets**

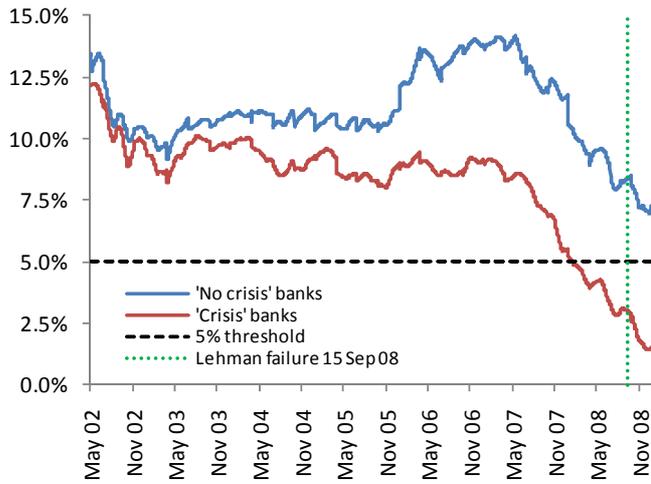


Sources: Capital IQ and Bank calculations

(a) 30-day moving average of market capitalisation

Other Footnotes as per chart 5

**Chart 7: Market capitalisation to book-value of debt**

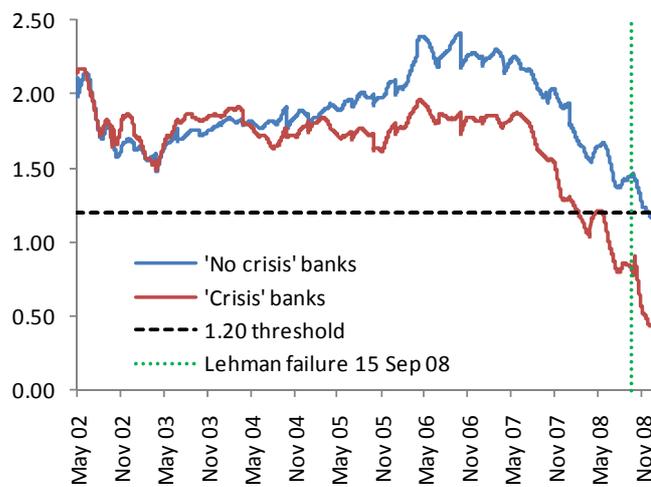


Sources: Capital IQ and Bank calculations

(a) 30-day moving average of market capitalisation

Other Footnotes as per chart 5

**Chart 8: Market capitalisation to book-value of equity**

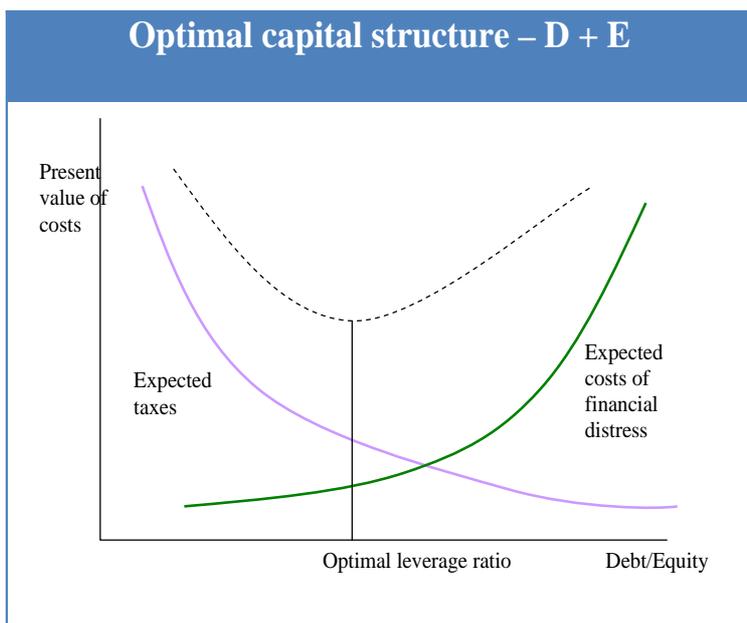


Sources: Capital IQ and Bank calculations

(a) 30-day moving average of market capitalisation

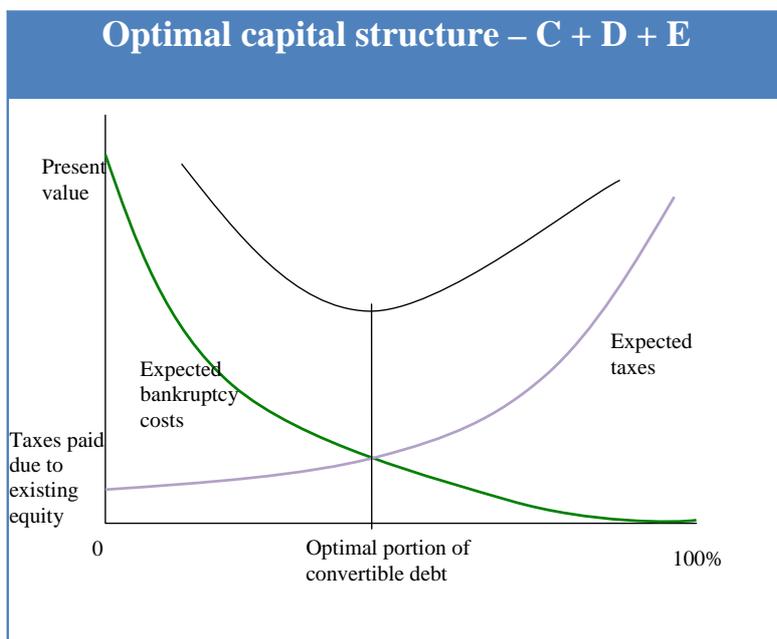
Other Footnotes as per chart 5

**Chart 9: Optimal capital structure – Debt and Equity**



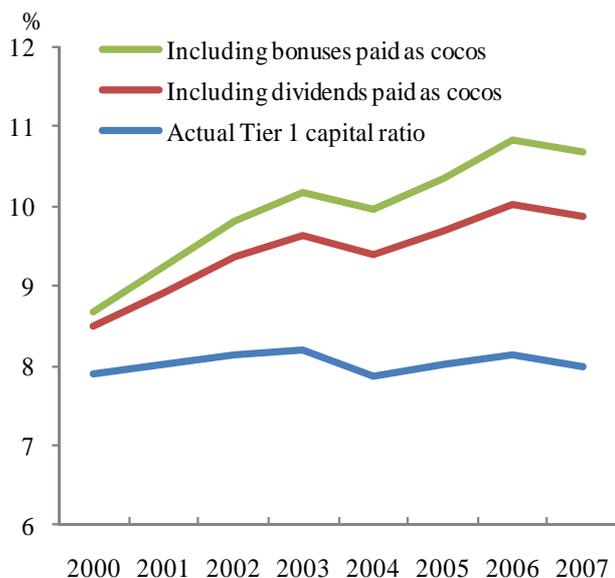
Source: Bank of England

**Chart 10: Optimal capital structure – Debt, Equity and Contingent Capital**



Source: Bank of England

**Chart 11: Major UK banks' Tier 1 capital ratio**



Sources: Annual accounts and Bank calculations

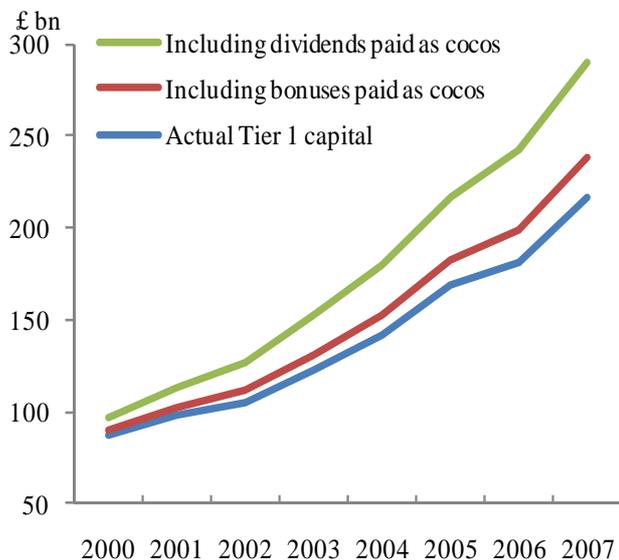
(a) Alliance and Leicester, Banco Santander, Barclays, Bradford & Bingley, HBOS, HSBC, Lloyds TSB, Nationwide, Northern Rock and RBS.

(b) Assumes that 50% of bonuses are paid as CoCos and retained. Bonuses are assumed to equal 20% of total staff costs.

(c) Contingent capital is assumed to be included in Tier 1 capital.

(d) Assumes that 50% of dividends are paid as CoCos and retained.

**Chart 12: Cumulative amount of Tier 1 capital for major UK banks**



Sources: Annual accounts and Bank calculations

Footnotes as per chart 11

**Table 1: Type I and Type II errors for Basel Regulatory Ratios and market-based capital measures**

	<b>Type I</b>	<b>Type II</b>
<b>Basel Regulatory ratios</b>	50%	43%
<b>Market capitalisation to book-value of total assets</b>	21%	5%
<b>Market capitalisation to book-value of debt</b>	20%	11%
<b>Market capitalisation to book-value of equity</b>	10%	11%

Sources: Capital IQ and Bank calculations

(a) A Type I error occurs when a bank's ratio falls below the trigger level (calculated according to a loss function as described in charts 5–8) and capital is not required (defined as that bank not suffering a "crisis" over the next 365 days). The number in this column is the proportion of days when a Type I error occurs.

(b) Timely conversion is defined as a bank's ratio falling below the trigger level no less than one month and no more than one year before a "crisis". The number in this column is the proportion of "crisis" banks for which timely conversion does not occur (i.e, there is a Type II error) at this trigger level.

(c) For each metric, the threshold for a signal of impending distress is as given in Charts 5 to 8.