CHAPTER 12

"Too Big to Fail" from an Economic Perspective

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Strengthening the resilience of TBTF banks

In assessing the resiliency today of the biggest US banks, the G-SIFIs[1]—those that are often considered "too big to fail" (TBTF)—it is important to disentangle the progress that has been made in shoring up their safety and soundness since 2008 from the lingering concerns and prejudices regarding their riskiness. As a community, we have required more and better capital and have implemented more conservative risk-management practices at the biggest banks, while we have at the same time reduced our belief in the power of markets and incentives to manage any remaining risk. We have increased supervisory oversight of the biggest banks even as we have continued to assume the likely failure of this supervision. We have better harmonized international information flows, communication, and approaches to critical safety measures beyond any historical expectation. But we have simultaneously become fixated on the remaining areas of imperfect cross-border coordination. Our attention, in short, has been drawn to the points of maximum difficulty, rather than to those of greatest economic importance.

We should instead view improvements to the safety and soundness of the US G-SIFIs through the prism of economic importance. In our view, doing so demonstrates that they are far more resilient to economic shocks

This paper was co-authored by Amanda Hindlian, Sandra Lawson, Jorge Murillo, Koby Sadan, and Balakrishna Subramanian, all of Goldman Sachs. The authors would like to thank Richard Ramsden, Charlie Himmelberg, Louise Pitt, Conor Fitzgerald, Jehan Mahmood, Daniel Paris, and Ron Perrotta for their significant contributions to this paper.

1. The Financial Stability Board identifies annually a list of Global Systemically Important Financial Institutions (G-SIFIs) that are subject to capital surcharges because of their size and interconnectedness. There are eight US G-SIFIs as of November 2013: Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, State Street, and Wells Fargo.

today than is widely believed. This is particularly easy to see once we make two subtle modifications to the prevailing narrative.

First, a change in perspective: rather than focusing on the most challenging remaining obstacles to the resolution of US G-SIFIs—like derivatives and liquidity—we should emphasize instead the multiple lines of defense that have been strengthened or newly created to protect against their failure in the first place. We examine the resilience of the banks across each line of defense in sequential order. This is relevant because it is far more economically meaningful to fix the first and second lines of defense than to fix the fifth, unless the first few lines of defense are systematically ineffective. As we show, the improvements already made to the first two lines of defense—equity capital and the incentives it creates—have in fact been significant and robust. This makes the next lines of defense—the "debt shield" and the incentives it creates—unlikely to be used in the "normal" course. Instead, these additional lines of defense would only be necessary in inherently low-probability states characterized by unusual events and extreme conditions. We think they should be evaluated in this light, rather than as part of the "normal" resolution process.

Second, a shift in terminology: rather than using standard statistical notions like confidence intervals to measure resilience, we focus instead on the more easily interpreted notion of "mean time between failures." This concept enables us to assess the likely frequency of failures at US G-SIFIs—measured in years—across each line of defense. Using a measure of years makes it clear that increasing the mean time between failures from twenty years to seventy years, for example, is more economically important and less theoretical than extending the mean time between failures from seventy years to 120 years. Thus we believe the concept of mean time between failures lends itself to easy assessments of the cumulative impact of various regulatory measures, and their relative economic importance, in ways that other frameworks don't.

When US G-SIFIs are viewed within this framework, we believe it is possible to demonstrate—using a model based on assumptions that conform to standard market assessments and normal pricing—that the likely frequency of their failure has shifted from years (frighteningly few before the crisis for banks with weaker capital positions) to several decades under the new capital rules. Additionally, the likely frequency of failure has moved even further—from several decades to centuries—when the new improvements in incentives and supervision that drive voluntary recapitalization are taken into account.[2] Our work shows that the anticipated "debt shield" (long-term debt that can be forcibly converted to equity in a crisis) would also maintain mean time between failures at centuries rather than decades. Unlike incentives, the debt shield would only come into play in the case of a massive firm-specific failure or a historically severe macro-stress event. Either would require extraordinary—not normal course—regulatory responses. Also unlike incentives (which some distrust), the debt shield has the added benefit of protecting the government by ensuring that there are sufficient private-sector resources available to absorb losses even in such unusual circumstances.

Distrust of figures like centuries between failures is natural, but the statistical frameworks we use to model bank failures incorporate the notion that models do fail. Of course our methods may not prove sufficient, as prior statistical analyses have sometimes failed to anticipate the potential scope and size of unanticipated events. But the failure of the model would

2. By providing regulators with a readily available source of private-sector capital that can be used to recapitalize a failed bank, the debt shield reduces the cost of regulatory intervention and thus increases incentives for banks to manage their capital conservatively. In theory, the managerial incentives created by the existence of "bail-in" debt are sufficiently strong that the risk of a gradual deterioration into severe distress is essentially reduced to zero. This is because a bank faced with losses would, whenever feasible, respond by reducing debt or raising equity to maintain a target leverage ratio. Thus, as a practical matter, the only losses that would be large enough to push a bank into severe distress would be losses arising from "jump risk." This intuition can be formalized in a model designed for the pricing of contingent capital bonds that convert to equity on highly dilutive terms for existing shareholders (see, for example, "Pricing Contingent Capital Bonds: Incentives Matter," October 2012, working paper, Charles P. Himmelberg and Sergey Tsyplakov). This line of reasoning suggests that the risks that need to be considered when evaluating the default risk of well-incentivized financial institutions are those that result in large, discontinuous "jump" events. Moreover, like well-structured contingent capital securities, the debt shield creates incentives for shareholders of a failing bank to recapitalize the bank during the early signs of distress. Well-structured contingent capital also creates these incentives by "triggering" early, at a point when significant intrinsic value in the bank remains, and by imposing extremely high dilution rates for existing shareholders (e.g., 90 percent or more). Although the debt shield may trigger later than well-structured contingent capital might, it creates similarly strong incentives for shareholders to recapitalize because it threatens to fully dilute existing shareholders. This intuition is also discussed in "Pricing Contingent Capital Bonds: Incentives Matter," http://www.efmaefm.org/0EFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2012-Barcelona/papers/EFMA2012_0599_fullpaper.pdf.

of necessity be part of a sequence of extraordinary events. The regulatory progress made to date suggests that even such extreme events could be better addressed than critics would suspect, although it is of course true that unprecedented events can only be anticipated to a limited extent. But to assume that all frameworks fail no matter how they are designed, simply because some models do fail, leaves little hope and even less guidance as to how to proceed.

First things first: getting the first line of defense right

The first line of defense is the most important in our view, yet the least discussed: the regulatory changes that have already been implemented to require more and better capital. Capital provides a buffer to absorb unexpected or exceptional losses on a going-concern basis. Accordingly, appropriate capital buffers should be sufficient to prevent banks from failing even when losses are at the tail end of a "normal" probability distribution. We believe the combination of regulatory reforms, market pressures, and industry efforts have significantly improved the capital positions of the US G-SIFIs since the 2008 crisis.

In 2007, the six largest US banks (excluding Goldman Sachs and Morgan Stanley, which as broker-dealers at the time were not required to disclose risk-weighted assets) had loss-absorbing capital (common equity, preferred, and trust preferred) of only 6.2 percent of aggregate risk-weighted assets (RWA). Of this, just 4.6 percent was tangible common equity, which was the sole part of the capital structure that could truly absorb losses without extraordinary action. Other classes of capital that were considered loss-absorbing at the time, including preferred and trust preferred shares, turned out not to be: in reality they could only absorb losses through special actions that required significant stress and time to execute and which would massively dilute the common equity shareholders whose interests the bank management represented.[3] A low effective common equity base created lags in the recapitalization process as well as poor incentives for common equity shareholders.

Today, even before Basel III is fully implemented, the eight US G-SIFIs (including Goldman Sachs and Morgan Stanley, which are now banks)

3. See "Trust Preferred Securities and the Capital Strength of Banking Organizations," *Supervisory Insights*, Winter 2010, FDIC, http://www.fdic.gov/regulations/examinations/supervisory/insights/siwin10/trust.html.

have on average aggregate loss-absorbing capital worth 13.1 percent of RWA, as we show in figure 12.1. Of this, 11.6 percent is tangible common equity—more than twice the pre-crisis figure. Risk weights are also significantly higher under Basel III, which makes risk-weighted capital measures more robust today and thus further improves banks' ability to absorb losses. This level of capital is more than adequate even for a stress scenario as severe as the one embedded in the Federal Reserve's 2012 Comprehensive Capital Analysis and Review (CCAR) exam. Our banking analysts estimate that the US G-SIFIs could withstand a CCAR-like shock today and still remain above—in many cases well above—a 7 percent tier 1 common equity minimum.

While capital ratios are clearly a useful and important metric, they do not translate easily into a measure of the likely frequency of bank failures. As a more accessible alternative, we examine banks' improved resiliency through the lens of "mean time between failures." The appendix describes our methodology in detail. Our analysis suggests that the US G-SIFIs' current capital position should be sufficient to cover losses even in a "once-in-every-several-decades" shock. This is a vast improvement over the "once-in-less-than-a-single-decade" frequency that prevailed prior to 2008 for banks that maintained weaker capital positions (see figure 12.2).

Equity-driven incentives: a stronger second line of defense

The second line of defense also involves capital—not the quantum or quality itself but the incentives it creates for banks' shareholders and management to recapitalize early in a stressed situation, before losses can spiral into outright failure and the bank is put into resolution.

Under the old rules, it was possible for shareholders of an "adequately" capitalized bank to have virtually no remaining intrinsic equity value even relatively early in a stressed situation. This is because starting equity levels simply weren't sufficiently high or of sufficiently robust quality to absorb significant losses. Faced with severe stress, the incentives for both bank management and shareholders (who are the primary source of discipline on the bank's behavior) were to increase risk in hopes of recovering value—because if the only value you have left is option value, the best way to maximize that value is to increase volatility. Moreover, shareholders were not at risk of losing their equity stakes and the optionality that equity entailed until the point of bankruptcy itself—which would only occur if the bank's attempt to "earn its way out of trouble" failed. Bank

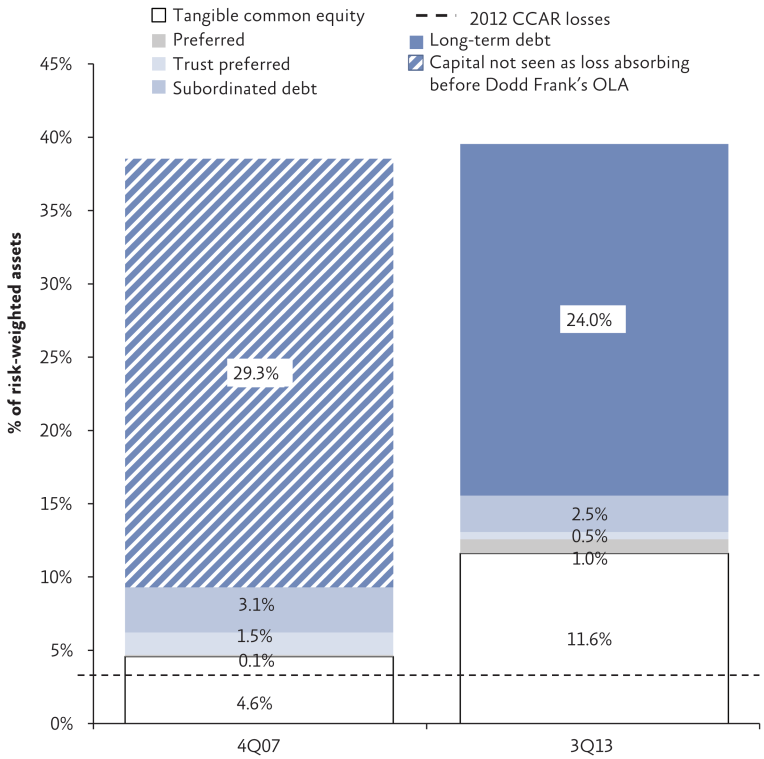

FIGURE 12.1 Loss-absorbency among US G-SIFI banks has risen sharply since the crisis

Note: Aggregate regulatory financial data is based on Basel I definitions. Long-term debt is defined as all other borrowed money, which is largely senior debt. US G-SIFI banks are Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JP Morgan Chase, Morgan Stanley, State Street, and Wells Fargo. As broker-dealers before the crisis, Goldman Sachs and Morgan Stanley were not required to disclose risk-weighted assets. They are therefore excluded from the 4Q2007 data but, because they are banks today, are included in the 3Q2013 data. Excluding Goldman Sachs and Morgan Stanley from 3Q2013 would result in tangible common equity of 11.2 percent, preferred equity of 0.9 percent, trust preferred of 0.4 percent, subordinated debt of 2.4 percent, and long-term debt of 20.5 percent. The CCAR loss calculation includes results from Goldman Sachs and Morgan Stanley.
Source: Federal Reserve, SNL Financial, Goldman Sachs Global Investment Research.

Pre-crisis expected frequency of undercapitalization	**# of years**
Frequency of falling below 4% tier 1 capital for well capitalized banks in 4Q2007	41
Frequency of falling below 4% tier 1 capital for less well capitalized banks in 4Q2007	7
Post-crisis expected frequency of failure	**# of years**
Frequency of falling below 5.5% tier 1 capital	39
Frequency of falling below 4% tier 1 capital	56
Frequency of wiping out equity	86
Frequency of wiping out equity and long-term debt worth 12% of RWA	358
Frequency of wiping out equity and long-term debt worth 16% of RWA	563

FIGURE 12.2 Bank failures have become far less likely after the crisis

Note: We use a decline in tier 1 common equity below 4 percent as a threshold for regulatory action, reflecting market expectations prior to the crisis. We also include a 5.5 percent threshold for the post-crisis period because we believe market expectations have shifted in the wake of Dodd-Frank's Orderly Liquidation Authority, putting the expected threshold closer to 5.5 percent. In 4Q2007, the relatively better-capitalized banks had 6.6 percent tier 1 common equity, on average, while the relatively less-well-capitalized banks had 5.1 percent tier 1 common equity, on average. We assume a tier 1 common equity starting point of 8 percent in the post-crisis analysis. Our post-crisis base-case assumptions are in the appendix.
Source: Goldman Sachs Global Investment Research.

management faced another troubling incentive: taking a public action like cutting dividends to strengthen the balance sheet would likely have been seen as a signal that an already tenuous capital position was weakening further.

This dynamic played out in big banks' behavior during the 2008 financial crisis. Banks that entered the financial crisis in a position of relative capital weakness—the very banks that should have acted promptly to strengthen their balance sheets—in fact delayed taking steps to do so until their capital positions had deteriorated even more significantly. In contrast, banks that entered the crisis in a position of relative capital strength did not delay; they improved their balance sheets while their capital ratios were still relatively robust.

Specifically, as we show in figure 12.3, banks that entered the crisis in a weaker capital position recapitalized only when their capital ratios were roughly 150 basis points lower, on average, than those of their better-capitalized peers. And the less-well-capitalized banks cut dividends only when their capital ratios were roughly 120 basis points lower, on average, than those of their better-capitalized peers.

		Capital ratio during the financial crisis (Tier 1 common / RWA)										
	Company name	4Q07	1Q08	2Q08	3Q08	4Q08	1Q09	2Q09	3Q09	4Q09	Capital ratio prior to first capital raise	Capital ratio prior to first dividend cut
Commercial banks & thrifts — Less capital	Citigroup	4.9%	4.2%	4.4%	3.7%	2.3%	2.2%	2.8%	9.1%	9.7%	4.2%	2.3%
	Bank of America	4.9%	4.6%	4.8%	4.2%	4.6%	4.5%	6.9%	7.2%	6.6%	4.8%	4.6%
	National City	5.1%	4.9%	4.7%	9.0%	-	-	-	-	-	4.7%	4.9%
	Wachovia	5.3%	4.8%	4.8%	4.1%	-	-	-	-	-	4.8%	4.8%
	PNC	5.4%	5.7%	5.7%	5.7%	4.8%	4.9%	5.3%	5.5%	6.0%	4.9%	4.9%
Commercial banks & thrifts — More capital	U.S. Bancorp	5.6%	5.7%	5.6%	5.7%	5.1%	5.4%	6.7%	6.8%	6.8%	5.4%	5.1%
	Wells Fargo	6.5%	6.5%	6.3%	6.3%	3.1%	3.1%	4.5%	5.1%	6.4%	6.3%	3.1%
	JPMorgan Chase	7.0%	6.9%	6.3%	6.3%	6.5%	6.9%	7.7%	8.2%	8.8%	6.3%	6.5%
	Washington Mutual	7.2%	6.9%	8.5%	-	-	-	-	-	-	6.9%	7.2%
	Less capital at start of crisis	5.1%	4.9%	4.9%	5.4%	3.9%	3.9%	5.0%	8.2%	7.4%	**4.7%**	**4.3%**
	More capital at start of crisis	6.6%	6.5%	6.7%	6.1%	4.9%	5.1%	6.3%	6.7%	7.3%	**6.2%**	**5.5%**

(dashed oval) = common dividend cut; (box) = common equity raised; (red fill) = bank sold or failed

FIGURE 12.3 During the crisis the better capitalized banks were more aggressive in strengthening their capital than the less well capitalized banks

Note: Common dividend cut defined as a quarterly dividend reduced to $0.00–$0.10.

Source: Company data, SNL Financial, FactSet, Goldman Sachs Global Investment Research

Although stand-alone broker-dealers were not required to disclose risk-weighted measures of capital during this period, their leverage (defined as tangible assets over tangible common equity) tells a similar story, as we show in figure 12.4.

The aggregate economic impact of these incentives is telling. Compare the economic losses sustained by banks that failed or received special assistance during the crisis to the impact of their capital actions, like share buybacks and dividends. As we show in figure 12.5, the depletion of capital from voluntary capital actions was nearly twice as large as the impact of net economic losses—even during the worst economic downturn in decades. Merrill Lynch looks like an exception, with outsized net economic losses. However, it should be noted that Merrill Lynch posted a significant portion of these losses in its last quarter as an independent company, likely in anticipation of its announced acquisition by Bank of America. If Merrill Lynch is excluded from the analysis, the ratio of capital depletion from voluntary actions to net economic losses is far higher—at fourteen times.

The new capital rules ensure that all banks have strong incentives to behave like the better-capitalized banks did during the last crisis. With higher and more robust common equity levels as a starting point, equity holders should still maintain significant intrinsic value even in a highly stressed environment. This gives them incentives to protect that value by forcing management to quickly and aggressively strengthen their balance sheets. Their ability to exercise market discipline is reinforced by the ongoing CCAR process, which makes it far easier for equity holders to detect incipient problems than was possible in the past. The CCAR process also makes it notably easier for regulators to force actions should these incentives prove insufficient to motivate the private sector. As we noted earlier, these incentives should only strengthen our finding that the biggest US banks are far more resilient today, moving the mean time between failures from several decades under the new capital rules alone to centuries under the combination of these capital rules and their associated incentives.

The likely effectiveness of these incentives may be easy to dismiss in the current environment of extreme skepticism about the effectiveness of market discipline without strong regulatory oversight. But even the incentives that existed before the crisis were sufficient for the biggest US banks to recapitalize in 2008, as long as they had a reasonable (albeit relatively low by today's standards) level of common equity. Well-capitalized banks

		Leverage during the financial crisis (tangible assets / tangible common equity)										Leverage prior to first dividend cut	Leverage prior to first capital raise
		Company name	4Q07	1Q08	2Q08	3Q08	4Q08	1Q09	2Q09	3Q09	4Q09		
Stand-alone broker dealers	More levered	Merrill Lynch	45.0x	50.4x	59.6x	35.3x	77.0x	--	--	--	--	--	37.0x
		Lehman Brothers	38.8x	43.0x	40.7x	37.8x	--	--	--	--	--	--	43.0x
		Morgan Stanley	38.4x	37.3x	33.8x	31.1x	24.7x	23.0x	22.1x	25.5x	25.4x	24.7x	23.0x
	Less levered	Bear Stearns	37.6x	37.5x	--	--	--	--	--	--	--	--	--
		Goldman Sachs	30.7x	32.9x	28.4x	27.7x	20.6x	22.0x	17.3x	16.4x	14.3x	--	27.7x
		More levered to start the crisis	40.7x	43.6x	44.7x	34.7x	50.8x	23.0x	22.1x	25.5x	25.4x	--	34.4x
		Less levered to start the crisis	34.1x	35.2x	28.4x	27.7x	20.6x	22.0x	17.3x	16.4x	14.3x	--	27.7x
Commercial banks & thrifts	More levered	Citigroup	29.6x	33.1x	30.9x	34.1x	43.6x	41.5x	34.8x	16.2x	14.4x	43.6x	33.1x
		Bank of America	25.3x	27.1x	27.0x	31.7x	30.2x	28.2x	19.7x	19.3x	19.9x	30.2x	27.0x
		Wachovia	23.5x	26.3x	27.4x	34.2x	--	--	--	--	--	27.4x	26.3x
		Washington Mutual	23.1x	26.5x	19.6x	--	--	--	--	--	--	26.5x	26.5x
		JPMorgan Chase	19.5x	20.0x	21.3x	24.1x	24.5x	22.6x	20.1x	18.8x	18.2x	24.5x	21.3x
	Less levered	PNC	18.7x	20.1x	19.9x	23.4x	29.3x	27.1x	24.5x	20.7x	19.1x	27.1x	27.1x
		U.S. Bancorp	18.5x	18.9x	19.1x	19.4x	26.3x	23.5x	18.1x	17.0x	17.6x	26.3x	23.5x
		National City	18.1x	19.6x	21.0x	11.1x	--	--	--	--	--	19.6x	21.0x
		Wells Fargo	16.3x	16.6x	17.1x	18.2x	28.2x	27.7x	21.4x	18.0x	15.4x	27.7x	18.2x
		More levered to start the crisis	24.2x	26.6x	25.2x	31.0x	32.8x	30.7x	24.9x	18.1x	17.5x	**30.4x**	**26.8x**
		Less levered to start the crisis	17.9x	18.8x	19.3x	18.0x	27.9x	26.1x	21.3x	18.6x	17.4x	**25.1x**	**22.4x**

(dashed circle) = common dividend cut; (blue box) = common equity raised; (red box) = bank sold or failed

FIGURE 12.4 During the crisis, less-levered firms strengthened their capital more aggressively than more-highly-levered peers did

Note: Common dividend cut defined as a quarterly dividend reduced to $0.00–$0.10.

Source: Company data, SNL Financial, FactSet, Goldman Sachs Global Investment Research

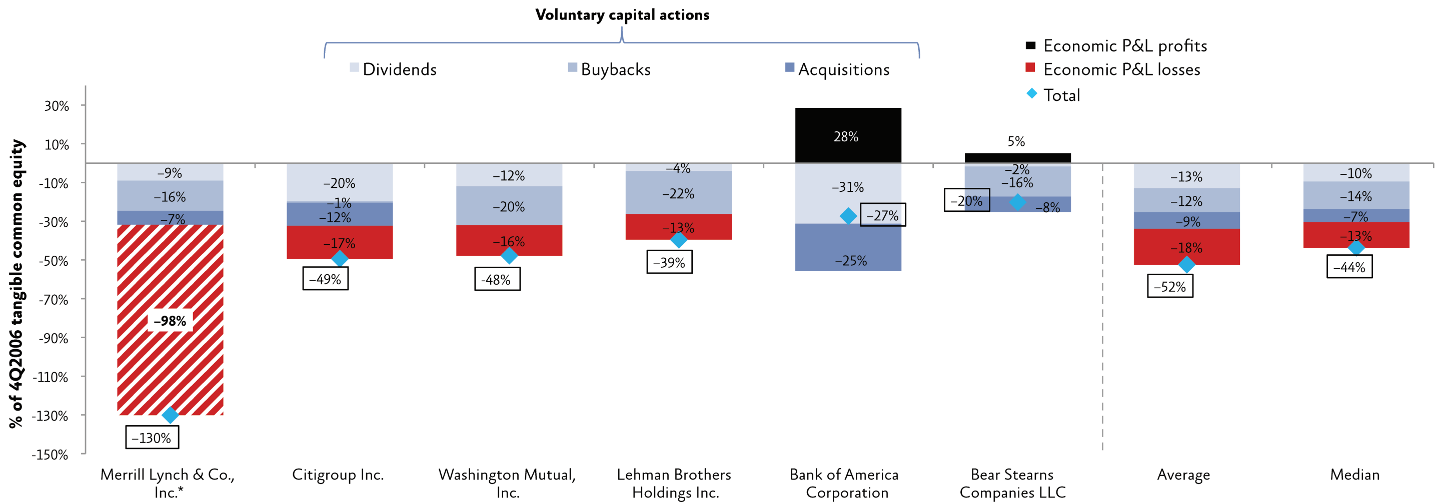

FIGURE 12.5 The depletion of capital from voluntary capital actions was nearly twice as large as the impact of economic losses during the crisis

*Merrill Lynch posted outsized net economic losses in 4Q2008, likely in anticipation of its acquisition by Bank of America in the following quarter.

Note: calculated as dividends, buybacks and net income (ex goodwill writedowns which is not a capital event) from 2007 through the time of failure or receiving special assistance

Source: SNL Financial, FactSet, Goldman Sachs Global Investment Research did recapitalize in 2008, despite poor and inconsistent public disclosures along with fragmented and relatively modest regulatory oversight. With today's far stronger capital standards, better disclosures, more rigorous supervisory practices, and the public nature of the CCAR process, these incentives should be thought of as highly robust despite any (quite natural) lingering skepticism.

Using plain English to assess the need for the debt shield

Before discussing the next line of defense—the debt shield—it is important to understand the math behind the bond pricing models that we use to assess bank resiliency. Doing so enables us to get a better sense of the actual level of uncertainty surrounding bank failures and associated losses. This is important because, as our mean time between failures assessment shows, the debt shield should only be needed in the most extreme situations, which makes mathematical assessments inherently imprecise.

Bond models rely on a variety of highly technical approaches and jargon, and they sometimes seem designed to appear more scientific and precise than is possible given the underlying level of uncertainty. To pierce this veil, we translate a bit of the jargon back into everyday English.

These models typically begin by assuming that prices move up and down according to the observable data. As long as banks are well-capitalized at the start, are correctly incentivized to recapitalize when capital deteriorates, and are subject to price movements that are in line with these models, nothing interesting should ever happen! And if banks don't default, no special resolution powers are needed.

But reality is different. Banks do fail, and bond markets do price the possibility of failure. Models address this fact by introducing a second mathematical concept called "jump-to-default." Jump-to-default is essentially the assumption that at times models fail and the totally unexpected happens: in an instant the bank and its investors find themselves in a state they would never have reached in the normal course. The jump-to-default scenario is necessarily marked by limited data and extreme outcomes.

The first two lines of defense against bank failure—stronger common equity capital and the associated incentives for early recapitalization—should be sufficiently robust to address the ordinary "once-in-several-decades" events. Thus the only time the resolution apparatus should be used is in the jump-to-default scenario. The idea that the resolution process for US G-SIFIs will almost certainly never be used in the "normal course," and that it should instead be understood as part of an "extraordinary" process, appears to have been lost in the broader discussion, as regulators and others have sought to make every possible type of failure addressable in the normal course.

The extraordinary shocks that could drive a jump-to-default can be split into two categories: idiosyncratic or bank-specific and macroeconomic.

The idiosyncratic or bank-specific failure requires a massive failure of control, akin to fraud, that goes undetected for an extended period. Because US G-SIFIs are highly regulated and supervised today in ways that aren't comparable to the past, relevant historical examples of this sort of failure are hard to come by. AIG and Enron provide a flavor, but they too fall short of a direct comparison to today's US G-SIFIs given the lack of regulation and supervision to which those firms were subject at the time.

Bank-specific failures by their very nature typically cannot be prevented by things like capital buffers and liquidity ratios. Such failures are characterized either by a complete misunderstanding of the underlying risk being taken or by significant fraud. Perversely, more capital and liquidity may only provide additional fuel that enables the problem to grow larger for longer. This could make unwinding it that much more difficult, and the economic and market damage that much harder to offset, once the failure is finally identified. This type of failure can only be addressed by robust supervision; the good news is that this is one of the areas of particular improvement since the crisis.

In the context of resolution, it is critical to understand how regulators would likely address such a failure. While certain parts of the bank may need to be spun out and liquidation may ultimately be required, orderly resolution of the firm itself wouldn't necessarily be regulators' first concern. Instead, the risk associated with the failure of the bank would likely lie in the broader markets. This is because banks that fail under these idiosyncratic circumstances tend to have large net market positions—and the unwinding of these positions tends to be highly destabilizing to markets. Thus regulators would likely shift their focus to maintaining market stability, which might require extraordinary steps that aren't strictly resolution-related.

The second possible path to jump-to-default is an extreme macroeconomic shock. Under the changes to the capital rules that are already in place—Basel III and the US CCAR process—today's US G-SIFIs have sufficient capital to weather any historical macroeconomic shock, and with a significant margin of error. This means that a macroeconomic crisis severe enough to generate a resolution requiring use of the debt shield—rather than a voluntary recapitalization—would need to be unprecedented: a shock significantly larger than either 2008 or the Great Depression. This in turn makes it all the more likely that this would be a severe systemic crisis.

Calculating the probability of such an extreme macroeconomic shock is clearly subject to a high degree of uncertainty, especially because there is necessarily no appropriate historical data. While we make a more technical assessment in the appendix, our estimates suggest that the probability is less than "once in every few hundred years." Such estimates should be viewed as inherently imprecise, as there is clearly insufficient data to have tremendous confidence in any data-based estimation (this is the typical problem in assessing highly unlikely events for which there is no observable history, but for which risk analysis is needed). Regardless, it is clear that the type of macroeconomic shock that would trigger use of the debt shield, given the new capital and supervisory structures, would be unprecedented. As such, central banks as well as governments would need to respond in an extreme fashion, invoking their extraordinary powers as part of an extraordinary process.

The debt shield: a new third line of defense

We believe the new third line of defense—the debt shield—needs to be thought of in this context, as a tool to be used in extraordinary circumstances rather than in the "normal course." The first two lines of defense—common equity and the associated incentives for recapitalization—would be used in the normal course and the debt shield would be invoked only if those failed, whether due to a bank-specific failure or to a macroeconomic shock. Even in extreme circumstances, the debt shield is designed to provide the added benefit of sufficient private-sector financial resources to protect the government from losses.

The debt shield is an integral part of the Single Point of Entry (SPOE) approach to resolution, which provides regulators with a robust and systemically safer answer to the question of "what next?" in extraordinary circumstances. It makes a critical distinction between "capital liabilities," which are principally long-term unsecured debt issued by the bank holding company, and "operating liabilities," which include short-term funding and derivatives contracts and are overwhelmingly transactions of the operating companies rather than of the holding company. SPOE effectively makes operating liabilities senior to capital liabilities by allowing regulators to put a troubled bank's holding company, but not its operating entities, into resolution. Equity would be written to zero and some or all of the holding company's long-term unsecured debt would be converted to equity in a bridge bank; the bridge would use this new equity to recapitalize its material operating subsidiaries. Shareholders and bondholders of the holding company would bear losses—not taxpayers—but counterparties of the operating companies would not, and customers of the bank's systemically important functions (payments processing, clearing, etc.) would not be affected.

SPOE requires banks to have a thick tranche of loss-absorbing debt—a debt shield—to make the recapitalization work. The Federal Reserve has indicated its intention to propose a rule requiring the holding companies of US G-SIFIs to issue long-term debt that is explicitly subject to "bail-in." (While commonly referred to as the debt shield, it is possible that the buffer may include equity above the regulatory minimum.) The debt shield requirement is anticipated to be worth at least 12 percent of RWA, although some estimate this figure at closer to 16 percent (we use both figures in our mean-time-between-failures analysis but assume a base case of 12 percent).

Like today's common equity position, the debt shield also improves incentives—especially for regulators. SPOE sets up a system by which a stressed bank can be recapitalized even under the difficult market conditions that would be associated with an extreme event, without disrupting fragile short-term funding markets or the bank's systemically important operating functions. This incentivizes regulators to act early and decisively rather than wait to see whether problems can be resolved in time. The debt shield also makes it easier for regulators to provide emergency liquidity to operating subsidiaries by providing an extraordinarily strong cushion of capital between the holding company and operating subs. This in turn allows the FDIC to use all available collateral at the operating subsidiary for collateral at the Federal Reserve's discount window, as the FDIC will not need to worry about the need for additional loss absorbency. It should also make it much easier to maintain access to private-sector liquidity. The key in both cases is that the FDIC does not encumber or threaten to encumber operating-company assets.

Along with these new regulatory incentives come even more incentives for shareholders: if they don't voluntarily recapitalize the bank, regulators can forcibly do so. In doing so, they would eliminate shareholders' equity while significant value remains (given the expectation that regulators will trigger resolution well before equity reaches zero—though some of this value might be partially recouped through the grant of warrants). This threat should bolster the discipline equity holders will already exert over banks as a result of the stronger capital structure.

Again looking through the lens of mean time between failures, our analysis suggests that the debt shield requirement, on top of today's common equity, would reduce the frequency of failures—or the point at which both the full equity and the entire debt shield are depleted—to centuries. How many centuries is at best a guess, but it is clear that additional measures to protect against extraordinary failures would only add a marginal measure of safety, potentially at significant cost.

Conclusion: maintaining economic perspective

When the resilience of US G-SIFIs is viewed from the perspective of the lines of defense that have been enhanced or newly created since 2008 to protect against their failure, it is easy to see that the US financial system is far safer today than it was in the past. And while there are clearly some substantive issues that need to be solved for resolution to work well in practice, such as derivatives and liquidity, these remaining problems should be put in appropriate economic perspective.

As our analysis shows, the likelihood of resolution—rather than voluntary recapitalization—is low in the "normal course." It is instead only likely to be employed in extraordinary circumstances. Thus we believe any solutions that enable resolution to work better but that are costly to implement should be carefully and skeptically evaluated relative to their associated benefits. Doing otherwise would weigh on the ability of the banking system to provide the services that are vital to economic growth over the next several decades, in exchange for preventing the chance that a "once-in-several-centuries" storm emerges.

Appendix: modeling the frequency of bank failures

To demonstrate how the improved equity capital position, the debt shield, and their related incentives are likely to reduce the frequency of bank failures, we have constructed a model that calculates mean time between failures under various scenarios. This model uses assumptions that conform to standard market expectations and normal pricing and we demonstrate sensitivity analyses around these assumptions where appropriate.

Our model uses a probability distribution approach because the estimated frequency of failures is a function of the probability of different levels of losses. The higher the probability of losses that are severe enough to deplete equity and loss-absorbing debt, the more frequent the failures; conversely, the lower the probability of such losses, the less frequent the failures. In normal times, the probability distribution should be akin to a log-normal distribution. In times of systemic financial distress, the probability distribution should provide for more extreme results, such as a log-T distribution with "fat tails," as we show in figure 12.6.

We consider these two distributions equivalent to two economic states. The first is a "normal" or "non-crisis" state, in which financial markets have low to medium volatility. The second is a "systemic financial crisis" environment, in which several financial institutions are under stress simultaneously and financial markets experience high volatility. We assume that for any given period of time, a bank will have some probability of being in either environment; it must always be in either one or the other.

Our base case assumes that a theoretical bank has tier 1 common equity of 8 percent of RWA and a debt shield of 12 percent of RWA, for total loss-absorbing capital of 20 percent of RWA. We assume that the bank's bonds default when regulators put the holding company into resolution, modeled in our base case as the point at which tier 1 common equity falls below 5.5 percent of RWA. We also examine a decline in tier 1 common equity below 4 percent of RWA as a less conservative point at which regulators might put the holding company into resolution. Because assets are sold over time in a SPOE resolution, the implied losses do not include any liquidation costs. We assume that a systemic financial crisis environment occurs every twenty years, given historical experience since 1900 that suggests systemic financial crises have occurred in the United States every few decades.[4]

To model the "normal" or non-crisis environment, our base case assumes a log-normal probability distribution with a mean of zero, asset volatility of 1 percent, and expected losses on bonds given default of

4. For a discussion of historical banking crises, see Carmen M. Reinhart and Kenneth S. Rogoff, *This Time Is Different: Eight Centuries of Financial Folly* (Princeton, NJ: Princeton University Press, 2009).

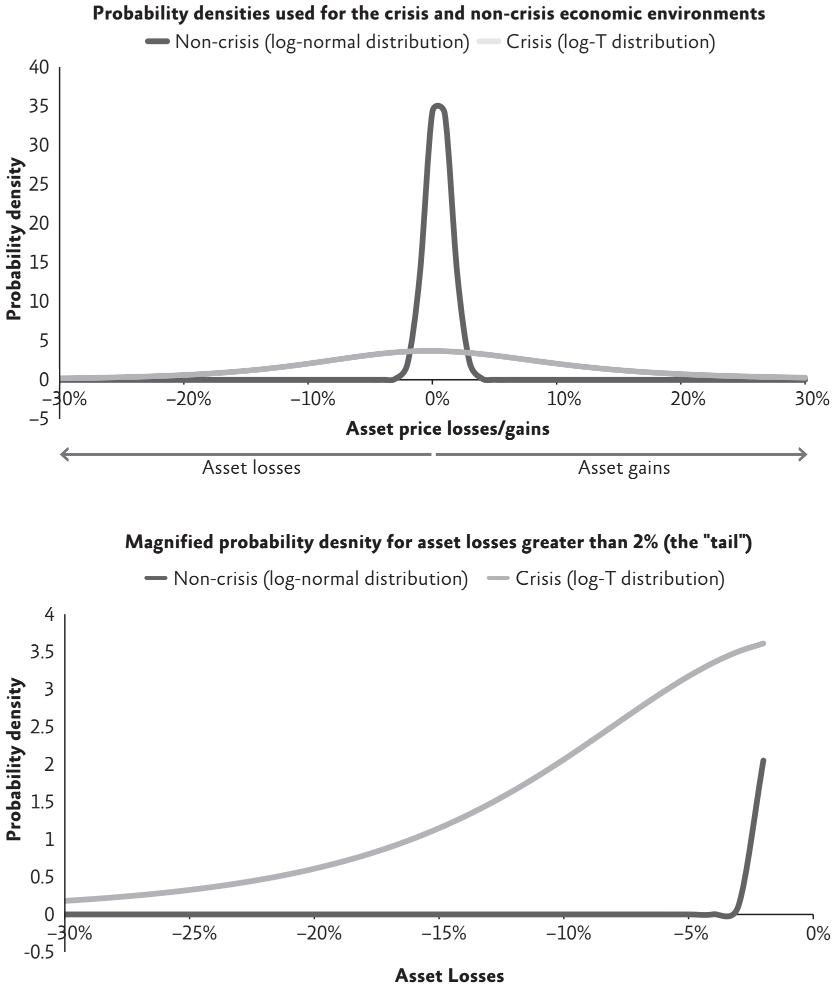

FIGURE 12.6 The log-T distribution better accounts for extreme losses than does the log-normal distribution

Source: Goldman Sachs Global Investment Research.

10 percent. To model the "systemic financial crisis" environment, our base case assumes a T-distribution with three degrees of freedom ("fat tails"), a mean of zero, and expected losses on bonds given default of 30 percent, which translates to maximum asset volatility of 10 percent.

We also validate our results using CDS pricing. Because investors use CDS as protection on bond instruments, the CDS price represents the cost of insurance and thus the market's expectation of both the likelihood of default and the associated losses. And because the full price of CDS also reflects characteristics of the CDS instrument itself, such as liquidity, our assumption that the price of CDS reflects in its entirety the market's expected loss on the bonds is inherently conservative. We incorporate CDS information by confirming that expected maximum losses are no greater than 100 basis points (average CDS prices for the six largest US banks over the past three months). In our base case scenario, expected maximum losses do not breach 100 basis points and are thus validated.

We model how frequently losses would be expected to deplete certain levels of loss-absorbing capital under these base-case assumptions, using the following thresholds:

- A loss of 2.5 percent of RWA (when tier 1 common equity falls below 5.5 percent and regulators put the bank into resolution)
- A loss of 4 percent of RWA (when tier 1 common equity falls below 4 percent)
- A loss of 8 percent of RWA (when equity is fully depleted)
- A loss of 20 percent of RWA (when equity and a 12 percent debt shield are both fully depleted)
- A loss of 24 percent of RWA (when equity and a 16 percent debt shield are both fully depleted)

The results of our base-case analysis can be seen in figure 12.7, which also shows the results of sensitivity analyses for these base-case assumptions. These sensitivity analyses show that the results do not vary significantly when we modify the inputs. We sensitize our model to:

- A threshold for bond default of 4 percent of RWA, rather than 5.5 percent
- A maximum expected loss using CDS spreads of 50 and 150 basis points
- Different degrees of freedom of the log-T distribution

		Sensitivity Test 1 - Varying the equity level at which bonds default	Sensitivity Test 2 - Varying the maximum expected loss on bonds (reflected by CDS prices)		Sensitivity Test 3 - Varying the degrees of freedom in the log-T distribution	
	Base case scenario	Bonds default when equity reaches 4.0% (vs. 5.5% base case)	Maximum expected loss on bonds: 50bps (vs. 100bps base case)	Maximum expected loss on bonds: 150bps (vs. 100bps base case)	Log-T distribution with 1 degree of freedom (vs. 3 DOF base case)	Log-T distribution with 25 degrees of freedom (vs. 3 DOF base case)
Frequency of falling below 5.5% tier 1 capital	39	39	49	39	45	38
Frequency of falling below 4% tier 1 capital	56	58	98	56	75	54
Frequency of wiping out equity	86	92	275	86	127	78
Frequency of wiping out equity and long-term debt worth 12% of RWA	358	422	2,954	358	316	463
Frequency of wiping out equity and long-term debt worth 16% of RWA	563	675	5,274	563	387	1,063

FIGURE 12.7 Sensitivity analyses do not significantly vary the results of the base case scenario

Note: Base case assumes the following parameters: Bonds default when equity breaches 5.5%; maximum expected loss on bonds is 100bps; crisis distribution has 3 degrees of freedom. All scenarios assume the following: synthetic bank with 8% equity to RWA ratio; 12% long-term debt to RWA ratio; normal probability distribution volatility is 1%; normal loss given default on bonds is 10%; crisis loss given default on bonds is 30%; frequency of crisis environment is 20 years
Source: Bloomberg, Goldman Sachs Global Investment Research