

Chapter 1

The Greatest Story Never Told

*The Leverage That Killed Us ■ The Number That Leads
to Toxic Leverage ■ Financial Risk Mismanagement ■ Too Many
Exceptions ■ Lessons Unlearned*

Amid all the pomposity that surrounded the analysis of the 2007 credit crisis (“Capitalism is over!,” “The American way is doomed!,” “Hang anyone with a pinstriped suit!”) it was easy to forget what had really happened, and what truly triggered the malaise. Simply put, a tiny bunch of guys and gals inside a handful of big financial institutions made hugely leveraged, often-complex, massively sized bets on the health of the (mostly U.S.) subprime housing market. In essence, the most influential financial firms out there bet the house on the likelihood that precariously underearning mortgage borrowers would honor their insurmountable liabilities. As the subprime market inevitably turned sour, those bets (on occasions many times larger than

the firm's entire equity capital base) inevitably sank the punters, making some of them disappear, forcing others into mercy sales, and sending all into the comforting arms of a public bailout. As these global behemoths floundered, so did the financial system and thus the economy at large. Confidence evaporated, lending froze, and markets everywhere became uncontrollable chute-the-chutes. Investors lost their shirts, workers lost their jobs.

It wasn't a failure of capitalism or a reminder that perhaps we had forgone socialism a tad too prematurely (so far, we haven't yet heard calls for the rebuilding of the Berlin Wall). The crisis did not symbolize how rotten our system was. While certain bad practices were most certainly brought to the fore by the meltdown, and should be thoroughly corrected, the crisis did not symbolize the urgency of a drastic overhaul in the way we interact economically or politically. What the crisis truly stands for is the failure to prevent a tiny group of mortgage and derivatives bankers (I'm talking just a few hundred individuals here) from recklessly exposing their entities to the most toxic, unseemly, irresponsible of punts. The fact that Wall Street and the City of London were allowed to bet, via highly convoluted conduits, their very existence and survival on whether some folks from Alabama with no jobs, no income, and no assets would repay unaffordable, ill-gotten loans is the theme that should really matter, and not whether we should hastily resurrect Lenin. If capitalism was fine (overall) in May 2007, it should be just as fine today.

Rather than try to fix beyond recognition an arrangement that overall has served humanity quite well, why not focus on understanding what truly happened and on making sure that it can never happen again? If we don't address the heart of the matter, instead devoting all our time to distracting platitudes, we may be condemning ourselves to a repeat down the road. We surely don't want to go through this capitalism-doubting song and dance again five years from now, do we?

So the key questions throughout should have been: What really allowed those insanely reckless bets to take place? Several factors were and for the most part have continued to be held responsible for allowing this very specific mess to take place.

The conventional list of culprits typically has included the following key malfasants: a less-than-perfect pay structure at banks, the use

of deleteriously complex securities, asleep-at-the-wheel regulators, fraudulent mortgage practices, blindly greedy investors, and ridiculously off-target rating agencies. It is clear that each and every one of those factors played a substantial role and deserves a large share of the blame. But the familiar list has tended to leave out what I would categorize as the top miscreant. While the more conventionally acknowledged elements were definitely required, the carnage would not have reached such immense body count had that prominent, typically ignored, factor not been present. I put forth the contention that that one variable (a number, in fact) ultimately allowed the bets to be made and the crisis to happen.

That number is, of course, VaR. In its very prominent role as market risk measure around trading floors and, especially, the tool behind the determination of bank regulatory capital requirements for trading positions, VaR decisively aided and abetted the massive buildup of high-stakes positions by investment banks. VaR said that those punts, together with many other trading plays, were negligibly risky thus excusing their accumulation (any skeptical voice inside the banks could be silenced by the very low loss estimates churned out from the glorified model) as well as making them permissibly affordable (as the model concluded that very little capital was needed to support those market plays). Without those unrealistically insignificant risk estimates, the securities that sank the banks and unleashed the crisis would most likely not have been accumulated in such a vicious fashion, as the gambles would not have been internally authorized and, most critically, would have been an impossibly expensive capital-wise.

Before banks could accumulate all the trading positions that they accumulated in a highly leveraged fashion, they needed permission to do so from financial regulators. Whether such leveraged trading is possible is up to the capital rules imposed by the policymakers. Capital rules for market risk (under which banks placed those nasty CDOs) were dictated by VaR. So by being so low (\$50 million VaR out of a trading portfolio of \$300 billion was typical), VaR ultimately allowed the destructive leverage.

Had trading decisions and regulatory policies been ruled by old-fashioned common sense, the toxic leverage that caused the crisis would not have been permitted, as it insultingly defied all prudent risk management. But with VaR ruling, things that should have never been

okayed got the okay. By focusing only on mathematical gymnastics and historical databases, VaR turned common sense on its head and sanctioned much more risk and much more danger than would have been sanctioned absent the model. VaR can lie big time when it comes to assessing market exposures, unseemly categorizing the risky as riskless and thus giving carte blanche to the no-holds-barred accumulation of the risky. By disregarding the fundamental, intrinsic characteristics of a financial asset, VaR can severely underestimate true risk, providing the false sense of security that gives bankers the alibi to build huge portfolios of risky stuff and regulators the excuse to demand little capital to back those positions. VaR allowed banks to take on positions and leverage that would otherwise not have been allowed. Those positions and that leverage killed the banks in the end.

Thus, we didn't need all that pomposity calling for all-out revolution. What was, and continues to be, needed is to target the true, yet still wildly mysterious to most, decisive force behind the bloodshed and wholeheartedly reform the fields of financial risk management and bank capital regulation. The exile of VaR from financeland, not the nationalization of economic activity or the dusting-off of *Das Kapital*, would have been the truly on-target, preventive, healing response to the mess.

And yet few (if any) commentators or gurus focused on VaR. You haven't seen the CNBC or Bloomberg TV one-hour special on the role of VaR in the crisis. This is quite puzzling: The model, you see, had already contributed to chaos before and had been amply warned about by several high-profile figures. By blatantly ignoring VaR's role in past nasty system-threatening episodes as well as its inherent capacity for enabling havoc, the media made sure that the populace at large was kept unaware of how their economic and social stability can greatly depend on the dictates of a number that has been endowed with way too much power by the world's leading financiers and policymakers. VaR, in fact, may have been the greatest story never told.



Imagine that someone has just had a terrible accident driving a bright red Ferrari, perhaps while cruising along the South of France's coastline. Not only is the driver dead, but there were plenty of other

casualties as the recklessly conducted vehicle crashed into a local market, at the busiest hour no less. The bloodbath is truly ghastly, prompting everyone to wonder what exactly happened. How could the massacre-inducing event have taken place? Who, or what, should be held primarily responsible? Public outrage demands the unveiling of the true culprit behind the mayhem.

After a quick on-site, postcrash check technicians discover that the Ferrari contained some seriously defective parts, which inevitable malfunctioning decisively contributed to the tragic outcome. So there you have it, many would instantly argue: The machine was based on faulty engineering. But wait, would counter some, should we then really put the blame on the car manufacturer? What about the auto inspectors, whose generously positive assessment of the vehicle's quality (deemed superior by the supposedly wise inspectors) decisively encouraged the reckless driver to purchase the four-wheeled beast? In this light, it might make sense to assign more blame onto the inspectors than on the manufacturers.

However, this is not the end of the story. Just because automobile inspectors attest to the superior craftsmanship of the Ferrari doesn't mean that you can just own it. While the (misguidedly, it turned out) enthusiastic backing by the inspectors facilitated the eventual matching of driver and car, it wasn't in itself enough. Necessary yes, but not sufficient. Unless the driver positively purchased the red beauty, he could never have killed all those people. And in order to own a Ferrari, you absolutely must pay for it first.

It turns out that our imaginary reckless conductor had not paid in cash for the car as by far he did not have sufficient funds, but had rather been eagerly financed by a lender. He had bought the Ferrari in a highly leveraged (i.e., indebted) way under very generous borrowing terms, being forced to post just a tiny deposit. Now, this driver had a record of headless driving, having been involved in numerous incidents. It appeared pretty obvious that one day he might cause some real trouble behind the wheel. And yet, his financiers more than happily obliged when it came time to massively enable the purchase of a powerfully charged, potentially very dangerous machine. Without such puzzlingly friendly treatment and support, the future murderer (and past malfeasant) would not have been able to afford the murder weapon.

Yes, he was obviously personally responsible for the accident. Yes, the manufacturing mistakes also played a decisive part. Yes, the okay from the inspectors mightily helped, too. All those factors were required for the fatality to occur. But, at the end of the day, none of that would have mattered one iota had the Ferrari not been bought. So if you are looking for a true culprit for the French seaside town massacre, indiscriminately point your finger at the irresponsible financiers that ultimately and improbably made possible the acquisition of the dysfunctional vehicle by the speed demon who, having trusted the misguided rosy expert assessment, inevitably took his own life and that of dozens of unsuspecting innocent bystanders.

This fictional story serves us to appreciate the perils of affording excessive leverage to purchase daring toys, and so to illustrate why the 2007 meltdown took place. If you substitute the reckless driver with investment banks, the red Ferrari with racy toxic securities, the auto inspectors with the credit rating agencies (Moody's, Standard & Poor's), and the eager financiers with financial regulators, then you get a good picture of the process that caused that very real terrible accident. In order for the wreckage to take place you obviously needed the wild-eyed bankers to make the ill-fated punts, the toxic mechanisms through which those punts were effected (you can't have a subprime CDO crisis without subprime mortgages and CDOs), and the overtly friendly AAA ratings (without such inexcusably generous soup letters the CDO business would not have taken flight as it did). But at the end of the day, the regulators allowed all that to matter explosively by sponsoring methodologies (VaR) that permitted banks to ride the trading roller coaster on the cheap, having to post up just small amounts of expensive capital while financing most of the punting through economical debt. Such generous terms resulted in a furious amalgamation of temptingly exotic assets. And when you gorge on such stuff in a highly indebted manner the final outcome tends to be a bloody financial crash.

If VaR had been much higher (thus better reflecting the risks faced by banks), the positions would have been smaller and/or safer. This was a subprime CDO crisis because VaR allowed banks to accumulate subprime CDOs very cheaply. Without the model, the capital cost of those intrinsically very risky securities would have been higher, making the system more robust.

Why exactly can sanctioning leveraged punting be so dangerous in the real financial world? What's so wrong with gearing? Why can an undercapitalized banking industry pose a threat to the world? In short: It is far easier for a bank to blow up fast if it's highly leveraged. Given how important and influential banks tend to be for a nation's economy, anything that makes it easier for banks to go under poses a dire threat to everyone. The bad thing about leverage is that it substantially magnifies the potential negative effects of bad news: Just a small reduction in value of the assets held by a bank may be enough to wipe out the institution. Conversely, the less leverage one has the more robust one is to darkish developments.

A bank's leverage can be defined as the ratio of assets over core equity capital (the best, and perhaps only true, kind of capital, essentially retained earnings plus shareholders' contributed capital). The difference between assets and equity are the bank's liabilities, which include its long-term and short-term borrowings. For a given volume of assets, the higher the leverage the less those assets are financed (or backed) by equity capital and the more they are financed by debt. That is, financial leverage indicates the use of borrowed funds, rather than invested capital, in acquiring assets. Regulated financial institutions face minimum capital requirements, in essence a cap on the maximum amount of leverage they can enjoy. A bank with \$15 billion in capital may want to own \$200 billion in assets, but if policy makers have capped leverage at 10 (i.e., a 10 percent capital charge across the board) the bank must either raise an additional \$5 billion of capital (so that those \$200 billion are backed by a \$20 billion capital chest, keeping the leverage ratio at 10) or lower the size of its bet to \$150 billion; under such regulatory stance, \$15 billion can only buy you \$150 billion of stuff. Were regulators to become more permissive, say increasing the maximum leverage ratio to 20 (from a 10 percent to a 5 percent minimum capital requirement), the bank could now own as much as \$300 billion in assets without having to raise extra capital. It is clear that minimum capital rules will impact the size of a bank's balance sheet: If those rules are very accommodating, a lot of stuff will be backed by little capital (we'll see in a moment how accommodating a VaR-based rules system can be). VaR can easily lead to a severely undercapitalized banking industry; few things can create more economic and social problems than a severely undercapitalized banking industry.

If an entity has no equity it is said to be worth zero, as the value of its assets is equal to that of its liabilities (i.e., everything I own I owe). If assets go down in value, those losses must be absorbed by the equity side of the balance sheet (equity is actually defined as the overall amount of an entity's loss-absorbing capital, or the maximum losses an entity can incur before it defaults on its liabilities); if those losses are severe, the entire equity base may be erased before there's time or chance to raise some more, leaving the bank insolvent. Therefore, the more equity capital (i.e., the less leverage), the more a bank can sustain and survive setbacks.

Shouldn't then banks try to finance their assets with as much equity as possible? After all, bank executives are supposed to be trying hard to preserve their firms' salubriousness. Well, it's not that simple. Banks, almost by definition, must run somewhat leveraged operations, otherwise making decent returns might be hard; after all, the prospect of such positive results is what attracts equity investors in the first place. At the same time, equity capital can be expensive (since equity investors, unlike creditors, have no claims on a firm's assets and are first in line to absorb losses they would demand a greater rate of return) and inconvenient (as new shareholders dilute existing ones and may imply a redesign of the firm's board of directors) to raise, especially when debt financing is cheap and amply available. So banks will almost unavoidably have x amounts of equity backing several times x amounts of assets. Leverage, in other words, is part of banking life. Gearing needn't be destructive as a concept.

But if the size of the gearing and/or its quality get, respectively, too large or too trashy big problems could beckon. If a bank has \$10 million in equity backing up \$100 million in assets (a 10-to-1 leverage ratio), a 1 percent drop in the value of the assets would eat away 10 percent of its equity, an ugly but possibly nonterminal occurrence. However, if those same \$10 million had now to sustain \$500 million in assets (50-to-1 gearing), for the same decrease in assets value the decline in equity would be 50 percent, a decidedly more brutal meltdown. The key question, naturally becomes: What's the chance that the assets will drop in value? If we believe it to be zero, then perhaps a higher leverage would be the optimal choice even for those banks most eager to run a safe and sound operation: If assets are not

going to fall by even that modest 1 percent, I would rather go with the 50-to-1 ratio, as any increase in assets value will yield a greater return on equity (in this case, plus 50 percent versus plus 10 percent). Thus, if the assets being purchased are iron-clad guaranteed to never descend in worth, more gearing will be no more harmful, return-wise, than less gearing while offering more juice on the upside.

Leverage, in other words, can be a great deal when asset values go up all the time (or almost all the time) since for every increase in value, I get wonderful returns on capital. That is why banks often prefer a lot of leverage rather than just a little bit of it. It is obviously better to make 50 percent positive returns on capital than 10 percent positive returns on capital. Traders and their bosses get bigger bonuses when they are generating 50 percent returns on capital than when they are generating 10 percent, so building up massive leverage is a big temptation for them. VaR can be wonderful for those purposes, given how easy it is for the model to churn out very low capital requirements. But this only works fine if your trading portfolio is behaving well, otherwise the plus 50 percent bliss could quickly transform into a minus 50 percent nightmare.

Of course, in real life few assets (if any) come with a guarantee never to lose value. Since even the soundest-looking possibilities can be worth less, more leverage can be safely ruled as more daring than less of it, for a given asset portfolio. Having said that, the nature of the portfolio can also dictate whether the leverage ratio is prudent or not. Whether a larger leverage ratio will be a more harmful choice will depend on the quality of the asset side of the balance sheet. A 10-to-1 ratio can seem wisely conservative or recklessly wild, depending on what type of assets we're talking about. Illiquid, complex, toxic assets that can sink in value abruptly and very profoundly may render the \$10 million cushion extremely insufficient, extremely rapidly. Relatively more trustworthy and liquid plays, like Microsoft stock or World Bank bonds, should (in principle) be more foreign to sudden debacles, rendering the \$10 million grandiosely sufficient. In fact, a, say, 30-to-1 gearing ratio exclusively on standard assets may be considered a safer, more insolvency-proof capital structure than 10-to-1 gearing exclusively on toxic assets, as it could be deemed more likely to witness a 10 percent tumble in the weird stuff than a 3 percent decline in

the vanilla stuff (of course, this cuts both ways: During good times, a rapid 10 percent rise in complex securities may be more feasible than a 3 percent vanilla uplift, which is naturally why the nasty stuff can be so tempting).

Naturally, the very worst thing would be a higher leverage structure comprised largely of high-stakes punts; essentially, a recipe for sure disaster. Encouraged and enabled by the low equity requirements sanctioned by VaR and other tools as well as by the very economical access to short-term credit, most of the world's leading financial institutions spent the first years of the twenty-first century hard at work arriving at such a perilous state of affairs. Banking leverage was not invented by VaR; it existed before the model showed up. Not even very large leverage was invented by VaR (in the pre-VaR days, the rules essentially allowed banks to build unlimited leverage on debt securities issued by developed countries, an asset class that, as more recent events have showcased is not exactly devoid of problems). But VaR did signify a revolutionary, potentially very chaotic development, pertaining to banking gearing: thanks to VaR, vast leverage on vastly toxic assets was now possible, something that the pre-VaR financial police did not allow.



The mayhem that officially started in the summer of 2007 was the inevitable result of a regulatory structure that had allowed too many influential players to afford too many financial Ferraris too cheaply. For the past 15 years or so, worldwide financial institutions (to a greater or lesser degree) have enjoyed extremely generous financing terms from the markets' policemen whose job description supposedly includes the safeguarding of the system. The rules have actively encouraged wild leveraged punting, and not just on semi-safe assets like government bonds (the Volvos of finance) but also on impossibly exotic, accident-prone stuff. Negligible regulatory capital requirements were demanded from banks in years prior to the meltdown when it came to obviously lethal assets, both trading-related and credit-related; and given how easy and economical it was to obtain borrowed funds, bankers found it irresistibly convenient to load up on subprime CDOs and other

trading stuff. Without the humongous losses suffered on such largesse, there would have been no farewell funerals for Bear Stearns, Lehman Brothers, or Merrill Lynch. In other words, no real crisis.

How can we be so sure that the regulatory measures abetted bankers' ferociously enthusiastic embarking on the leverage express, which eventual derailment sank the world? Among other things, because the numbers dictate so. The proof, if you want, is in the pudding. As of August 31, 2007, for instance, the \$400 billion—strong asset side of Bear Stearns balance sheet contained \$141 billion in financial instruments, \$56 billion of which were mortgage-related. All those billions were supported by just \$13 billion in equity. That means that at the outset of the crisis, Bear was leveraged more than 30 times over (the ratio for November 2006 was pretty similar). Or consider Lehman Brothers. As of May 31, 2007, \$21 billion supported \$605 billion in assets, half of which were of the financial instruments variety (\$80 billion mortgage-related). Similarly, on September 31, 2007, Merrill Lynch's balance sheet showed \$1 trillion in assets (\$260 billion trading assets, \$56 billion mortgage-related, \$22 billion subprime residential-related) on top of just \$38 billion of equity. That's three for three so far when it comes to Wall Street powerhouses leveraged 30 times, with trading positions outnumbering equity by around 10 to 1, and with mortgage positions (including very nasty stuff) by themselves way above the entire equity capital base. If losses exceeded just 3 percent of assets value, the entire equity cushion would be gone and the firm would collapse; given how many of those assets were suspect and how low the value of suspect assets can go in a short period of time, it seems clear that those Wall Street giants were sitting on dynamite.¹

But wait, there's more. Swiss giant UBS was on September 28, 2007, the proud owner of assets worth \$2.2 trillion (\$39 billion in U.S. subprime residential-related garbage, \$20 billion of which were megatoxic CDO tranches), backed by \$42 billion of equity. That's right, the Helvetian entity had not only been allowed to gear itself 50 times over, but, apparently not content with such feat alone, had decided to make bets for an amount equal to its whole equity base on the likelihood that a bunch of poorly employed, income-challenged, assets-deprived faraway Americans would repay their (mostly ill-gotten) unaffordably inflated home loans.

Even the most notorious white-shoe legends incurred in geared action. As of November 2007, Goldman Sachs' \$42 billion equity base shouldered \$452 billion of trading assets (\$1.1 trillion total assets). Coincidentally in time, Morgan Stanley's \$31 billion equity capital resourcefulness carried the burden of \$375 billion in financial instruments (\$1 trillion total).

It is abundantly clear that banks had become amply leveraged, overall. But it gets worse. Those figures don't reflect the vast gearing that was allowed specifically for trading games. The prior analysis reflects banks' equity levels as a whole. Capital charges for market risk-specific were far smaller preceding the crisis, making the leverage experienced on trading activities alone sordidly unbounded, way beyond the already highly geared ratios implied by the all-encompassing (trading assets plus all other kinds of assets) above data. That is, the leverage enjoyed by investment banks on their trading activities (usually their riskiest activities by far) was immensely larger than those overall, by themselves headline-grabbing 30-to-1 ratios.

The Bank for International Settlements (BIS; the Switzerland-based central bank for international central bankers) studied the trading-specific capitalization prowess of a group of banks for 2007 and found that although trading assets accounted for between 27 percent and 57 percent of total assets, trading risk capital only constituted between 4 percent and 11 percent of total capital requirements (and yes, the bank with 57 percent of its possessions into trading was the one boasting the gargantuan 4 percent trading/total capital ratio). In other words, capital requirements against trading books (precisely where asset growth was taking place, and where the toxic waste was mostly being laid) were extremely light compared to those for (in principle, more solid) banking books. In further words, required trading book capital was obscenely insignificant, morbidly inadequate. And (hold on to your seats), the BIS found that market risk capital requirements as a percentage of total trading assets were in the range of between 0.1 percent and 1.1 percent (only one of the banks had posted capital in excess of 1 percent of all its trading positions).² Yes, that would be between 1,000-times leverage and 100-times leverage. If assets go down by just 1 percent or even by just 0.1 percent the capital allocated to those trading positions would be wiped out. Pretty leveraged, if you ask me.

Especially when a lot of those trading assets are junk, as (thanks to yet more permissive regulation) banks had been parking billions and billions of dollars in subprime CDOs and related securities inside their VaR-ruled trading books (as opposed to inside their banking books, where as credit-related illiquid positions they truly belonged; capital requirements for trading books have traditionally been assumed to be lower than for banking books).

By crowning VaR as the capital-charge king, financial policy makers pretty much assured banks that they could, very economically and basically worry-free, fool around with even the most adventurous of financial fare. That VaR can produce tiny capital charges, and thus encourages and affords risk-taking beyond common sense, is borne out by the numbers exposed above. VaR demanded only \$1 or even just \$0.1 for every \$100 in trading assets that a bank would want to accumulate; it is clear that the model can make it extremely easy for massive risks to be taken on in an incredibly unprotected manner. VaR allowed banks to expose themselves to being blown up if their positions went down by less than 1 percent. That is, VaR made it essentially certain that those banks would blow up. Prevalent regulatory rules for trading-related capital requirements resulted in massive speculative gearing up to the 2007–2008 massacre. VaR was the prevalent regulatory rule. VaR, thus, resulted in massive speculative gearing.

And as was just said, the resultant leverage ratios on illiquid complex assets alone may be deemed intolerably reckless. As famed fund manager David Einhorn put it,³ if Bear Stearns' only business was to have \$29 billion of illiquid, hard-to-mark assets, supported by its entire \$10.5 billion of tangible equity that by itself would be an aggressive, very risky strategy; were the high-risk positions to sink they could well lose half their value (or even all of it: toxic financial stuff has been known to be worth zero on occasions), wiping out the bank's capital. But on top of all that, that sliver of equity also had to support an extra \$366 billion of other assets, making it essentially improbable that the firm could survive even the slightest of setbacks. That is, a tool that allows you to accumulate illiquid exotic assets three times over your entire equity capital resources would be dangerous already; one that lets you add 12 times that in other financial stuff is lethally permissive. A ticking time bomb, patiently waiting to detonate a casualties-infested bloodbath.

As 2006 ended and 2007 approached, Merrill Lynch and Lehman Brothers had one-day 95 percent VaR of \$50 million, while Bear Stearns disclosed a 95 percent VaR of \$30 million. Regulatory capital requirements were roughly defined as 10-day 99 percent VaR multiplied by a factor of three, which (again roughly) would imply multiplying one-day VaR by 9. That would be the amount of capital that would have to be committed by the banks. Let's say, roughly, \$470 million in the cases of Merrill and Lehman, \$280 million in the case of Bear Stearns. Merrill at the time owned \$203 billion of on-balance-sheet trading assets, Lehman \$226 billion, and Bear \$125 billion. \$1 billion equals \$1,000 million. This would yield market risk capital requirements equal to 0.23 percent, 0.21 percent, and 0.22 percent of total trading assets respectively. Am I the only one who would categorize such cushions as insufferably small? Certainly, my off-the-cuff calculations are bound to be less than exact, but it is interesting to note that even if we doubled the nominal size of those capital requirements the trading-specific leverage ratio would be remarkably in line with the results outlined in the BIS study highlighted earlier. Even if we doubled them again, none of the three institutions would have presented, barely six months before the unleashing of the mayhem, market-specific capital charges of at least 1 percent of (on-balance-sheet) trading positions. I think this is again more than enough to allow us to say that VaR wildly erred on the side of excessive gearing.

We can do similar calculations for other banks. Take UBS, for instance. In June 2007, the venerable European institution was the proud owner of CHF950 billion in on-balance sheet trading assets, backed by a 10-day 99 percent VaR of CHF455 million.⁴ Let's then do the math once more: This yields a capital requirement of (again, roughly) CHF1.365 billion, or 0.14 percent of total trading assets. Want to double that number, just to be on the safe side and correct for any unacceptably erroneous calculating on my part? Okay, let's say 0.28 percent of total trading assets. That would still be an awful lot of leverage, wouldn't it? Especially when UBS at the time had accumulated truly vast amounts of subprime junk in its trading book. Just like at many of UBS's peers, VaR was allowing unheard-of-before gearing on portfolios containing unheard-of-before amounts of financial trash.

Or take Citigroup. Its December 31, 2006, one-day VaR was \$98 million, measured over trading assets worth \$394 billion. Thus the corresponding rough capital charge of \$882 million would amount to only 0.22 percent of trading positions. Clearly, trading books all around had been allowed to gear themselves up enormously. Thanks to VaR's permissiveness, the area where banks kept the riskiest and wildest stuff had been allowed to operate essentially with no capital. VaR's insultingly low estimations permitted banks to play the trading game almost for free, precisely at the time when such entertainment was becoming both more voluminous and dangerous than ever before.

Would a thinking person have considered 100-to-1, 500-to-1, or 1,000-to-1 leverage on trading portfolios loaded up with nasty subprime securities prudent? Of course not. It would not have been allowed.

Given how dominant the trading division had become inside banks, an extremely leveraged trading book naturally translates into an overall extremely leveraged banking industry, translating into an extremely fragile financial, economic, and social system. Now we better understand why the banks had large total leverage ratios. VaR was simply too little relative to trading assets, leading to very humble VaR-total assets ratios. For instance, the 2007 year-end levels of that ratio for JP Morgan, Citigroup, and Goldman Sachs were, respectively, 0.006 percent, 0.007 percent, and 0.012 percent. The 2008 year-end levels, with VaR figures that had gone considerably up due to the setbacks and turbulence caused by the financial meltdown, the ratios were still just between 0.015 percent and 0.016 percent for JP and Citi and 0.028 percent for Goldman. While the trading component of a bank's overall activities was increasingly sizeable, trading added little to the overall capital pot. By year-end 2007, the contribution of regulatory VaR to total equity capital was 0.75 percent at JP Morgan, 1.30 percent at Citigroup, and 2.93 percent at Goldman.⁵ The corresponding figures for UBS and Merrill Lynch as of late September 2007 were 3.66 percent and 2.02 percent. Not too high, right? Particularly, again, given how much smelly mortgage-related stuff these and other firms held as market assets (on December 31, 2007, Citigroup held \$40 billion in gross subprime CDO tranches, which it kept in its trading book; one year later the exposure was still sizeable at \$19 billion. UBS and

Merrill Lynch held similar amounts). It seems obvious that the contribution of the trading book to the overall equity base was negligible, completely out of tune with how big and how daring those trading activities were. Something funny was definitely going on inside those trading books, something that was very unrealistically saying that the stuff inside them was nothing to be worried about and therefore nothing that warranted even a mildly decent capital cushion against. Balance sheets across Wall Street and the City of London had a lot of toxic waste because VaR made it very cheap to have toxic waste.

Once you have let the toxic leverage dynamite in, you are doomed. You've irremediably poisoned yourself. Once that junk inevitably takes a dive, you are a goner, fast. If you have financed a lot of trading bets with a lot of very short-term debt and very little equity as soon as your bets turn a bit sour no one believes you can save yourself and your very short-term financing lines are rashly cut off, instantly preventing you from surviving as a going concern. And that is precisely why VaR can be so destructive as a capital-charge setter. A VaR-less system would have essentially forbidden the billionaire trading orgy, as much more capital would have been required to back up such unbounded speculating, especially in the case of the smelliest assets. Once those billions found a home inside Wall Street's institutions, the game was up. The tiny capital cushions could not even begin to cope with the precipitous fall in value of those punts. VaR opened the gates to the destructive stuff. It let it in. That's what sealed our fate, and the pre-VaR universe would not have allowed it.

Institutions with the power to ignite global tremors (the kind that result in bankrupt companies and lost jobs all over the world) played for several years a game of Russian roulette, with the gun loaded with not just one but several bullets, manufactured in the famously lethal subprime mortgage factory. VaR allowed them to rabidly imitate Christopher Walken's suicidal character in *The Deer Hunter*, by making sure that the gun and the ammo would be affordably economical. The fate of the globe was left in the hands of a clique of traders that were given unfettered permission to gamble our well-being on the (implausible) chance that the CDO gun would not fire. VaR made that happen, by persistently denying that the gun contained any bullets. Akin to Robert DeNiro telling his pal Walken to go ahead and keep pulling

the trigger in that last movie scene at the shady Asian parlor; go ahead, shoot, there's no risk.



Even without hard cold numerical evidence, we could have easily guessed that VaR would have a weakness toward tiny capital figures and risk estimates. Besides the empirical evidence, we would have conceptual backing. VaR's structural foundations dictate that the concoction would tend to disappoint those with a predisposition for conservative risk management. It is very likely that VaR, by design, will tend to underestimate true risk.

First, and for the umpteenth time, VaR heavily borrows from historical data. This is particularly true in the case of possibly the two most popular methods for calculating VaR, so-called *Historical Simulation* and *Covariance*. Historical Simulation, which became the favorite of banks leading up to the crisis, literally simulates how a current portfolio would have behaved during a preselected past period and builds estimation of future losses based on those results. As simple as that. It's interesting to note that while VaR was promoted and embraced by bankers and regulators largely due to its perceived sophistication and high-tech engineering, in the end, the number was calculated with the simplest, most rudimentary of methods: Take a look at a database of past market prices and manually select the worst loss that took place; not a lot of high-tech sophistication there. Covariance was the original methodology and is much more mathematically and computationally intensive, and also resorts to past market data for the purposes of estimating the future volatilities of and correlations between the portfolio's components. If during the selected sample market volatility was tame and the presence of extreme negative events was limited or non-existent, then the risk estimates and the amount of required capital churned out from the model will be in accordance with such an apparently placid environment, that is, a pretty lenient number. If the past was calm, VaR will be tiny. Of course, the opposite holds true: sometimes VaR may be quite large rather than quite low; in fact sometimes VaR may be overestimating real risk, for instance if the market for certain otherwise sound securities just experienced nastiness; so the true

problem with VaR is not that it will perennially underestimate risks but rather that it is very easy for VaR to underestimate risks, in particular those of the intrinsically most risky assets; VaR will not always understate upcoming danger, but as long as VaR is around there's a big chance that upcoming danger will be understated.

In finance, the past behavior of an asset and the true riskiness of that asset need not be perfectly correlated. Just because an asset behaved well during a certain past period doesn't mean it will always behave well. Many times, an apparently well-behaving asset suddenly becomes much naughtier and losses ensue "unexpectedly." In fact, and as anticipated earlier in the book, it could be said that, conditional on existing, highly risky assets will only present a rosy past. Given the nature of those plays, they just don't tumble a bit in value if a market correction takes place. Rather, they sink all the way to zero and are never traded again. So those daring assets are either worth a lot (as a bubble in them is created and sustained) or nothing (as the bubble inevitably blows up). VaR would analyze those positions and proclaim that everything is fine, based on the rosy performance. But in reality, the trades couldn't be more dangerous. A clear example of how the model can hide true risk. In abiding by historical financial evidence, VaR follows a mischievous and untrustworthy guide. Blinded by what happened yesterday, VaR can be very deceitful about real risk. In markets, the rearview mirror often lies about what lays ahead.

Even if the past did contain tumultuousness, who is to say that such agitation would be a good predictor of future, yet-to-be-seen, perhaps doubly (or more) agitated developments? Financial markets are simply dominated by monstrous rare events for which there tends to be little historical precedent, so chances are that when such freakish events present themselves capital levies calculated by looking at the past would be rendered exceedingly inadequate.

In the run-up to summer 2007, markets had been trotting along calmly (recall, for instance, the notorious, widely reported, death of volatility in years prior? Or the never-ending mentions to the "great moderation"?), making sure that VaR would be very small. VaR was saying, "There's no risk!," all the while letting banks accumulate as much risk as possible. When VaR declares the nonexistence of future risk the opposite may well be true, courtesy of VaR's very declaration.

VaR would not only be lying (by denying the existence of present danger) but would itself have created the lie (by encouraging the trades that guarantee that the future will not be as tame as the past). A low VaR can help fuel a trading bubble through the complacency, false sense of security, and humble capital requirements that such modest number enables; by denying the existence of risk, the glorified risk radar can create risk out of thin air, making VaR a tool that can transform tranquility into chaos.

Secondly, the probabilistic foundations on which the tool typically rests don't assign large odds to the extreme materializing out there (while the Covariance method does assume Normality, the Historical Simulation method doesn't make any initial assumption as to the portfolio's probability distribution; rather, it lets the market reveal its "true" distribution through its past behavior). By endowing VaR with Normality, the tool's engineers condemned it to being unrealistically small. Financial markets are simply not Normal, and extreme moves and big losses take place quite a lot and quite severely. The Normality straightjacket introduces two highly suspect statistical parameters into the calculation: standard deviation (or "sigma") and correlation. Sigma is supposed to measure turbulence in a given asset, and correlation is supposed to measure co-movement between different assets. But these variables are in themselves calculated by looking at the rearview mirror, and so will only reflect upcoming chaos and joint dependencies accurately if those statistical siblings display the same behavior going forward as they did before. However, time after time, the markets behave in a rebellious non-stationary fashion: what was volatile (timid) yesterday can well be timid (volatile) tomorrow, what moved together (disparately) yesterday can well move disparately (together) tomorrow. This is, by the way, what took place before the credit crisis. The statistical guidance on which VaR is built was again proven to be less than worthy, precisely at the time when such steering was most urgently needed.

Naturally, it doesn't take a genius to understand that a tool based on "the past is prologue" and "Normality rules" can't deserve to be considered inalterably trustworthy. Many may have been fully aware of VaR's deficient foundations but chose to keep their doubts to themselves as they had more to gain from the preservation of VaR as a relevant tool. Bankers have been basically allowed to calculate their VaR in

any way they wanted, using as much past data as they see fit, employing the mathematical trickeries of their choice, and even choosing which financial assets should be included in the calculation. Essentially, a bank's VaR will be whatever that bank wants it to be. And the temptation to have a VaR as low as possible can be difficult to fight: For many financiers, more leverage and more risk-taking can be the path to untold quick riches. So what do you do? You can search for the most favorable historical time period: If the past two years contain too much volatility you may want to also borrow from the three years prior, which happened to be quite sunny and tranquil, so as to compensate and obtain an overall sample that will paint the desired not-too-turbulent picture that can yield a not-too-abundant VaR. Or you can search for the most desirable combination of assets that happen to display the right type of historical correlation (i.e., no or negative co-movements) that, through the diversification effects allowed by the model, can deliver a tamed VaR. Definitely another strong argument for concluding that VaR will tend to be too low. And bank leverage and risk-taking, thus, a tad too overextended.

To illustrate the reductions in overall VaR (and thus in risk estimates and capital charges) that the use of correlation can yield, take a look at the table below, which indicates asset-specific and firmwide VaR levels for Merrill Lynch at several dates.

(dollars in millions)

	Sept. 28, 2007	June 29, 2007	Dec. 29, 2006	High 3Q07	Low 3Q07	Daily Average 3Q07	Daily Average 2Q07	Daily Average 2006
Trading Value-at-Risk ¹								
Interest rate and credit spread	66	48	48	77	55	63	61	48
Equity	27	36	29	47	13	27	31	19
Commodity	17	21	13	25	17	20	20	11
Currency	<u>5</u>	<u>5</u>	<u>3</u>	11	3	<u>6</u>	<u>4</u>	<u>4</u>
Subtotal	115	110	93			116	116	82
Diversification benefit	<u>(33)</u>	<u>(39)</u>	<u>(41)</u>			<u>(40)</u>	<u>(39)</u>	<u>(32)</u>
Overall	82	71	52	92	60	76	77	50

¹Based on a 95% confidence level and a one-day holding period.

As can be seen, overall VaR can be reduced by almost 50 percent as a result of including in the calculation estimated co-movements among asset families (what Merrill called “diversification benefits”). Where do those diversification figures come from? Historical evidence. Here is Merrill’s literal justification for enjoying a sharply reduced final VaR: “*The aggregate VaR for our trading portfolios is less than the sum of the VaRs for individual risk categories because movements in different risk categories occur at different times and, historically, extreme movements have not occurred in all risk categories simultaneously.*”⁶ But what if the future betrays the (selective) past and asset families that were not supposed to move together begin to naughtily move together? What if assets that were not supposed to move against Merrill at the same time begin to move against Merrill at the same time? Then the correlation argument would have turned out to be a hoax, a conduit to hiding true risk, and to produce undercapitalized banks incapable of coping with real danger when it materializes.

If you think about it, the entire notion of basing bank regulation and risk management practices on the arbitrary personal selection of a bunch of historical data is childish, and prone to generate dangerously silly results in areas that are anything but child-play. To base outcomes as critical as bank capital and bank risk-taking on whether, say, two or six years of data are selected is astonishingly short-sighted. Keep in mind that you could achieve VaR numbers that are completely different based on the chosen sample: The two-year VaR may be twice or half as big as the six-year VaR, thus giving rise to twice or half as big leverage and risk taking. But nothing about the bank or its trading portfolio or the market or the economic environment has changed one bit. Just because someone arbitrarily decides to calculate VaR with two years or with six years of data doesn’t mean that more or less leverage or more or less risk should be automatically welcomed. Whether X amount of leverage and X amount of risk are acceptable or not should depend on more robust fundamental analysis, not on the arbitrary technicalities of a statistical analysis. Let’s illustrate with an example.

Imagine that you are using the Historical Simulation method. If you select the past six years, the 99th percentile loss was \$50 million, but if you select just the past two years the 99th percentile loss was \$1 million. So what do you do if you want much lower capital requirements? You

select two years and churn out the much lower VaR. Just like that, by simply making the internal voluntary decision of using two years of data, a bank is allowed to be immensely more (50 times more) leveraged on its trading portfolio. Just like that, trading desks are allowed to accumulate lots more positions. As a result of those capricious decisions, the system becomes much more leveraged and exposed, thus much more prone to accidents. Nothing else has taken place that would justify such increase in danger. All that has occurred is that a few risk managers inside a handful of big institutions have selected more or less cells in their historical price data Excel spreadsheets. Is that an adult and responsible way to determine factors as influential as bank capital and bank risk? Why not leave it all to coin-tossing? “How much leverage should the banking industry enjoy? How much risk should banks take on? Uh, let me see. . . . Heads we use two years of data to get VaR; tails we use six years of data. Flip it up!” Call me crazy, but I suspect there must be sounder approaches to dealing with issues that affect the lives of millions around the globe.

I personally learned of the flakiness of making financial estimations based on past data more than a decade ago, when I was trying to build a VaR system for a corporate treasury department. All the quantitative technicalities, all the advanced statistical indoctrination stopped to matter about one minute after I opened the spreadsheet containing all the historical price series. A decidedly much more plebeian, much less scientific issue took center stage: How much data, exactly, should I use to get the volatility, the correlations, the loss percentiles? Two years? Five? Ten? The myriad of technical documents and books piled on my desk and of quantitative risk management lectures attended ceased to matter one iota. High-minded considerations of probability distributions and econometric models were suddenly swept aside. At the end of the day, and when confronted with the inescapably practical decision of how to actually arrive at a VaR number, the only thing that truly mattered was how far down I should drag my computer mouse so that the Excel column housing the past data used for the calculation would contain more or fewer cells. Should I drag it down a lot or stop midway? Whether I went one way or another, I began to notice, my results could be excruciatingly different: Based on how I operated my mouse, my company’s interest rate risk could be \$100 million or \$35

million or \$234 million. This made no sense to me. After all, my company's exposure to interest rates should be a fixed quantity (whatever that was), not a roller coaster that goes up by 100 percent or down by 50 percent based simply on my capricious dragging of the cell selection. How can my company's perceived risk, and thus the perceived appropriateness of its policies, ultimately depend entirely on how many Excel cells I arbitrarily feel like selecting? I began to wonder how the big boys were dealing with this. I realized that far from laughing at such flakiness, they seemed to take the data selection thing quite seriously. I found that different banks used different rules: One went for two years of data, another for five years, and so on. I was perplexed. Why two years? Why five years? What's the basis for such decisions? I now knew that said selection could yield completely differing risk estimates, so why even attempt to follow such fishy guidance? Historical counsel can be such an unreliable grey area that perhaps it would be much better to not rely on it too much.

When presenting my VaR calculations, I was left with no option but to illustrate several possible scenarios, based on several different data selections (I wasn't pretentious enough to assume that I could precisely select a single unalterably superior period with perfect forecasting powers, even if such thing existed at all). My bosses received several, widely different, risk estimates. They, too, grew skeptical of the results. I don't think they fully bought into the "scientificness" of modern risk modeling.

In essence, by basing banks' trading decisions and regulatory capital requirements on past market behavior, the fate of the system was determined by how far down risk managers felt like dragging their computer mouse. How's that for a rigorous, solid structure?

Having a regulatory capital measure that is calculated by looking at the data rearview mirror can be a uniquely permissive enabler not only of overall leverage, but in particular of toxic leverage. For here is where the cost savings in terms of capital can become incredibly large with respect to a VaR-less, fundamentals-based regulatory system. When it comes to vanilla financial plays, VaR can still likely result in sizably reduced capital charges, but the play may nonetheless still have been put on under the more conservative alternative policy: If you want to accumulate standard assets, the pre-VaR capital requirement (based on rather commonsensical assessments of an asset's intrinsic

and fundamental riskiness) would still have been relatively permissible (in fact, some government bonds were assigned a capital charge of 0 percent, a feat that not even the most generously accommodating VaR figure may be able to accomplish). So the punt on, say, bonds issued by an Italian bank would likely still have happened, even if perhaps in less substantial volumes than under a VaR system, as the latter may deliver a number below the 1.6 percent mandatory charge (20 percent risk weight times the 8 percent minimum mandatory capital levy) that was typical for claims on developed countries' banks under the old, so-called *Basel I*, international bank capital regulatory regime. Even if VaR-based figures would at times have allowed cheaper punting on vanilla assets, the older methods possibly were permissive enough to not entirely deter trading in those assets. Large-scale vanilla speculation by banks did not necessarily have to wait for VaR to show up.

But the same can't be said about nonstandard punts. Here, the old policies were quite taxing, reflecting among other things the need to make sure that obviously riskier stuff should demand more cushiony capital backing than obviously safer stuff. Anything too exotic was made very expensive capital-wise by the regulators. If you were a bank in the pre-VaR days, it was tough for you to fool around with adventurous fare, forcing you to either limit the size of those nonvanilla bets or to raise tons of additional capital, which may be costly or even well nigh impossible. In this case, the older methods did most possibly act as strict deterrent, preventing the accumulating of too many weird securities.

Once VaR showed up, things changed drastically. Since VaR has no idea whether an asset is intrinsically daring or not, it does not discriminate between asset families and can't place those families in different risk buckets according to fundamentals. VaR can't say outright that Treasury Bonds should automatically be cheaper than complex mortgage derivatives. VaR doesn't know what a Treasury Bond is. All VaR knows are blips of historical data, thus leveling the field for all types of securities, no matter their obvious intrinsic differences. Given that it is certainly not impossible for toxic securities to have behaved more placidly than sounder ones during a specific period of time, it is certainly possible for VaR to dictate that the former should require less capital commitment; and recall that the most toxic assets may always have low VaRs as long as they are trading. So

a system based on past market data rather than fundamental analysis will structurally declare the most risky plays risk-free. If you can find a complex asset that happens to have enjoyed recent calm (and/or the right correlations with the other assets in your portfolio), VaR will allow you to trade it in a much more leveraged fashion than the preexisting system would. VaR can make the difference between not being able to afford exotic plays at all and being able to afford monstrous amounts of them.

This is most likely a side effect of VaR that did not go on unacknowledged by at least some of the original VaR-promoters within financial institutions; in fact, that has most likely continued to not go unrecognized through the years. Toxic leverage can be the most desirable kind for many a trader, as few things can lead to greater and faster profits and returns on equity than accumulating higher-yielding positions on borrowed money. The unique comparative advantage of VaR for traders is that it makes that kind of leverage possible; alternative risk methodologies, in sharp contrast, made it utterly impossible. The temptations that VaR makes uniquely possible can in fact be so irresistible that it may seduce bankers into creating bubbles on all kinds of convoluted funny-looking securities: Since toxic leverage can be so easy, why not make sure that the market value of that toxic stuff goes up and up and up and so reap enormous short-term rewards from our hugely geared positions? If VaR lets you accumulate, say, \$100 billion in complex securities backed up by just, say, \$1 billion in regulatory capital that's a great thing because the market value of said illiquid trades is (in good times, at least) controlled by you and a few other firms, and all you have to do is consensually decide that the stuff is worth 1 percent more for your returns to be a whopping 100 percent. So VaR may end up encouraging the development and pushing of less-than-sound financial products.

Is that a good thing?



It is critical to note that VaR can (and did) cause trouble via multiple conduits. Inconveniently smallish capital requirements for trading activities are not the only possible deleterious by-product of the

model. It can contribute to havoc-wreaking by just playing its originally conceived role, the part that it was intended to act since the very beginning, before policy makers picked it up and adopted it for regulatory purposes. In other words, VaR can hurt us by simply being VaR. You see, VaR was not initially invented as capital-charge setter. That came later, as financial mandarins became irremediably infatuated. VaR was, and of course still is, designed as a measure of market risk, probabilistically speaking. VaR was invented so that bank executives could be told how much money they could lose, say, 99 percent or 95 percent of the time, according to the model's assumptions. That number (e.g., \$100 million) tells you the maximum market-related setback that you will experience, say, 99 or 95 days out of 100 (the confidence level can be whatever the user wants; 99 percent and 95 percent levels are the norm, with the former typically delivering a higher VaR figure than the latter). Or, more important, tells you that only on, say, 1 day or 5 days out of a 100 you will lose more than \$100 million, without going so far as indicating the size of that isolated negative development (though, as we've seen, the model's engineering dictates that odds are that it won't be exceedingly large). Of course, "will experience" and "will lose" become truisms only if the model's underlying assumptions hold true out there in real-life finance.

VaR was then invented to measure in monetary terms what can happen to your trading positions, probabilistically speaking. Bank CEOs worried about the enhanced levels of their (increasingly complex, increasingly larger) market exposures apparently found such neatly presented numbers useful, and gave their quantitative analysts carte blanche to play with their VaR toys. And that's how VaR became, some 20 years ago, the worldwide market risk radar de rigueur. Inside Goldman Sachs, Morgan Stanley, JP Morgan, Deutsche Bank, Barclays, and the like, trading decisions began to be subjected to what VaR said, and with the rise of VaR came the general rise of financial risk management as both executives and quants fully bought into the assuaging certainties that the model promised. It is no exaggeration to say that the advent of VaR produced revolutionary changes within the financial industry. Nothing would ever be the same.

VaR's impact as imperial risk beacon has not been neutral. By endowing VaR with acceptability, bankers gave VaR the power to affect

their own actions, and therefore market activity in general. By judging trades (and traders) based on their VaR figures, by setting trading limits based on VaR, and by describing your exposures to the outer world via the VaR lenses, financiers allowed a stranger to influence their play and, most poignantly, all economic participants (many of whom, naturally, would not be expected to have a clue as to what that VaR thing is and how it works). Such influence can't be counted on to be magnanimous for two main reasons. One, by attempting to measure that (financial markets) which is not amenable to quantification, VaR encourages the development of misplaced confidence and an unfettered faith in complacency-building "precision." Clearly, those would not count as the strongest of foundations for financial decision making. With VaR, you may think that you know something about the future, but all you have is a description of the past (a subjectively selected subset, to boot) mixed in with inappropriate probabilistic assumptions. VaR's presumptuously precise take on future risks is bound to be woefully misleading. In the name of soothing concreteness, financial players (and their stakeholders) would be given a map replete with falsehoods. Second, its natural tendency to be unrealistically low and to hide true danger encourages reckless, even deceitful wild risk-taking, and can cause untold volatility both as the VaR-aided bubble collapses and as a result of forced (and typically en masse) liquidations directly mandated by VaR.

It is straightforward to understand how VaR can, besides its role as determiner of the capital cushion, encourage excessive risk-taking. If you are a punter, you may love nothing more than being able to collect rich returns (in the short term, at least) while giving the impression of running a robustly riskless operation. You are making good money in an apparently wholesome way. You are a hero inside the dealing room, and you are paid accordingly. Your trading limits are expanded. You make yet more money. You love your life.

How can VaR help you achieve such state of rapture? Easy. Just scour the financial world for assets that have the following attributes: (1) they are to a greater or lesser extent "trashy," and thus offer a good return; (2) they have enjoyed little volatility and negligible setbacks in the recent past; (3) you can attach some story to them, some feel-good argument for justifying your choice ("selling pet food online is

the new paradigm,” “Russia can’t default,” and “solid as house prices” are known to have been used at one point or another). It is not exactly impossible to find such golden combinations; plenty of nonstandard markets have enjoyed prolonged days in the sun throughout history. VaR, per attribute #2, will testify in court as to the Fort Knox–like safeness of the punt, and everything else will follow. When the glorified number claims to see no danger, who’s to argue with such wisdom? “Punt, punt, punt!” would utter your bosses and your risk managers. Keep printing those risk-free profits.

Soon, many of your colleagues, jealously eyeing your fattened bank account, replicate your strategy. So do some of your rivals at enemy firms. Suddenly, VaR has helped you create a bull market in your chosen exotic product. As other traders join the bandwagon, values go up, and complacency gets further enhanced. The prospect of a surprise gets further diminished. VaR goes down, becoming even smaller. Yet more cash is showered on the punt, all across the Street.

Naturally, the fact that VaR says there’s no risk does not eliminate real risk from the picture. Financial institutions in effect become concurrently exposed, in huge amounts, to a drop in the value of an asset of suspect fundamental soundness, notwithstanding its placid recent past. A monstrous bubble is created, but VaR is conveniently hiding the potential for trouble. VaR is in effect a risk-management device that can decisively contribute to creating, not controlling, risk. VaR’s low numbers can be used as an alibi to initially take on the exposures and can add fuel to the fire progressively as more and more participants are attracted to the apparently-risk-lite high-return party.

The presence of VaR in finance can lead very influential and sizable players to own exactly the same positions, not only because they would all face the same VaR-stamped encouragement (if a bank can find an asset or group of assets with a placid past and accommodating correlations, so can all the other banks) but also due to the self-feeding effect that a VaR-based trading architecture can give rise to: A low VaR (especially in the case of an exotic play) will generate interest from traders in the asset and will make complacent risk officers and executives okay the trades, driving up the asset’s value and thus attracting yet more traders and thus ever-lower quantitative risk estimates. After a few years of such juicy states of affairs, even the most skeptical and reluctant of players has

no option but to join the party. Soon everybody is long Thailand bonds, or Mexican index volatility, or U.S. residential mortgages.

Given how low VaR numbers have become, the slightest of setbacks will result in internal VaR limits being breached across essentially all banks at exactly the same time. When a VaR limit is breached (i.e., when the real losses suffered by a trading desk happen to be higher than the maximum loss limit imposed on it by risk managers), traders are typically asked to cut down positions until their exposures are reduced back below their VaR limit. In a quest to reduce risk, traders are forced to sell some of their portfolio into the market. If many firms do this concurrently, massive volatility and crashing prices may rapidly ensue; if everyone (or almost everyone) is dumping large amounts of the same stuff, liquidity can quickly disappear as prospective buyers either shy away or bid their time waiting for prices to unavoidably tumble yet further. The end result: massive liquidations leading to additional massive liquidations (as VaR gets breached over and over again), causing huge losses and potentially a system-wide breakdown (as after one point not only the more exotic stuff, but all types of assets get sold in a desperate search for liquidity). Market correlations go to one as every asset family is dumped, banks stop trusting each other, average investors lose their shirts (without knowing exactly why), short-term credit is constrained, and politicians may have to come to the rescue.

This type of phenomena is exactly what took place during the now legendary 1997 and 1998 market crises. When Asian economies ran into trouble and Russia defaulted, respectively, the complacent VaR numbers that had aided the big similar bets were quickly overtaken by the initial increase in volatility, kick-starting a liquidation cascade that led, among other things, to the blowup of mega-hedge fund LTCM and a government-coordinated intervention. For a few days, the viability of the financial system held in the balance.

With VaR as the preeminent risk management tool, volatile crashes may be easier because banks' trading decisions and policies become homogeneous, coordinated into consensus by the VaR beacon. It's as if all banks shared the same risk department, which counsel they all followed at once. Risk concentration becomes much more feasible this way, and risk concentration within banking circles can be a bad thing for the economy. What hurts one bank will hurt all the rest, in a

self-feeding downward spiral. Not only can VaR make everyone own the same stuff at the same time, it can make them dump it at the same time too. And given how ridiculously modest VaR numbers can be, massive risk concentration and massive liquidations both become extremely likely. If VaR was more realistic and less unworldly, neither the concentration nor the liquidations would be so worrisome.

Unfortunately, nothing was learned from the 1997–1998 lessons and VaR remained the undisputable risk management paradigm. This allowed the model to have a starring role in the even more monstrous 2007–2008 cataclysm, an event that highlighted like nothing else how bad a risk manager VaR is.



Merrill Lynch's one-day VaR on December 29, 2006 was a paltry \$52 million (\$50 million average daily VaR for the entire 2006), implying mathematically projected one-year losses of around \$800 million (with 95 percent probability), not a devastatingly large amount for such a towering firm. In those pre-crisis (crisis-manufacturing, in fact) days Merrill's VaR endowed the firm's trading operations with sublime complacency. Bear Stearns' November 30, 2006, VaR was not only typically modest at \$28 million (\$440 million annual projection, 95 percent probability), but was actually slightly higher than the one prevailing on February 28, 2007, and exactly the same as May 31, 2007. The complacency inside the firm was kept unchecked literally until seconds before the explosion. Lehman's average daily VaR for the quarter ending on November 30, 2006, was \$48 million, which also appears a tad appeasing. All those humble analytical estimates of losses turned out to be exaggeratedly off the mark. Real losses turned out to be excruciatingly larger than what VaR had predicted. The 2007 year-end one-day VaR for JP Morgan, Citigroup, and Goldman Sachs was respectively \$103 million (99 percent), \$163 million (99 percent), and \$134 million (95 percent), implying projected annual 2008 trading setbacks of, respectively, \$1.62 billion, \$2.57 billion, and \$2.12 billion. Contrast this with real credit crisis-related write-downs for the three firms for that year of \$41 billion, \$102 billion, and \$8 billion.⁷ Merrill Lynch's maximum

daily VaR for Q3 2007 was \$92 million (average \$76 million), and yet the firm suffered a trading-inflicted \$8.4 billion write-down,⁸ rather above the \$730 million projected annual loss that one would obtain by scaling that \$92 million figure three months into the future. VaR proved to be a very unreliable risk estimator, across all banks. VaR's "predictions" are bound to be off-base, but what happened during the crisis was flat-out obscene. The analytical misfirings were monumental. Take Swiss giant UBS, a prominent victim of the crash. It reported 50 VaR exceptions for 2008 and 29 for 2007. At the 99 percent confidence level chosen by UBS, there should have only been about 2.5 exceptions (trading days when actual losses exceeded VaR's predictions; 1 percent of roughly 250 trading days per year in this case) per year. Or take local rival Credit Suisse. The Zurich powerhouse experienced 25 and 9 VaR exceptions in 2008 and 2007, respectively; also at 99 percent confidence, this implies above six times more real losses than theoretically forewarned. It seems unnecessary to state that VaR did not properly warn the Helvetians during the unfolding of the bloodbath.

You didn't need to be based in a neutral country with magnificent ski slopes and exquisite private bankers in order to experience your own dose of VaR disillusionment. Being American, for instance, would also do. Perhaps it shouldn't be exceedingly surprising that Lehman Brothers and Bear Stearns witnessed less-than-glorious VaR behavior, particularly in the latter case (around 30 exceptions during its last three quarters as a living independent entity, more than three times the predicted number for the adopted 95 percent confidence level, which allows for only 12 yearly exceptions or 5 percent of 250 annual trading days); but they were not alone by any means, with Morgan Stanley, JP Morgan, and Bank of America (BoA), for example, similarly witnessing the breakdown of the theoretical dogma (BoA 14 violations in 2007 at 99 percent, JP Morgan 8 in 2007 at 99 percent, Morgan Stanley 18 violations in 2008 at 95 percent). And other Europeans can boast plenty of misguiding, too. Mighty Deutsche Bank, for one, was surprised to observe 35 VaR violations in 2008 and 12 the year before, in all around 10 times higher than theory would dictate.

By pulling together all the institutions listed above, we would roughly have about 120 VaR exceptions for 2007. Those banks' VaRs

(using differing degrees of confidence) would have altogether allowed for some 50 exceptions annually. So that would amount to something like two-and-a-half times more real setbacks than theoretically predicted. But because basically all the breaches took place in the second half of the year, we could state that when it came to crisis time, the theory actually underperformed five-to-one (120 real violations versus 25 allowed). And this analysis crucially does not include Merrill Lynch or Citigroup, which don't seem to have reported their own figures for breaches. It is highly feasible that they posted huge exceptions during the fall and winter of 2007, given that they shouldered monstrous losses. Also, don't forget that the real/theoretical exceptions ratio only conveys the magnitude of VaR's disappointing performance, not its size. Many of those exceptions were brutally large. We are not talking here about real losses overtaking theoretical projections by just a few dollars (in which case, frankly, who would care much?). The reality check was expressed in the millions. For instance, of UBS's 30 breaching days, more than 10 saw setbacks in excess of CHF150 million over VaR. That is, it's not simply that VaR failed; the real drama is that it failed by a lot. And keep in mind that all those scandalously prevalent violations were taking place as VaR (drinking from the enhanced volatility) was itself growing substantially; that is, VaR was unveiled as vastly underestimating even as it was going up! In fact, for those of the above-listed institutions that made it through 2008, the ratio of actual exceptions to allowed-for exceptions was 133–134 (a fourfold theoretical underperformance) even though VaR, on average, was in most cases approximately twice that of 2007.

When Merrill Lynch inaugurated its descent into meltdown by posting trading-originating losses in excess of \$2 billion in Q3 2007, it was quick to publicly betray the tool that had given it so much for so long, by openly finger pointing:

VaR significantly underestimated the magnitude of actual loss from the unprecedented credit market environment, in particular the extreme dislocation that affected US subprime residential mortgage-related and Asset-Backed-Securities CDO positions. In the past, these AAA ABS CDO securities had never experienced a significant loss of value.⁹

Merrill's statement is a double-blow to VaR, and serves well to highlight why its presence among us can be so pernicious. First, the befallen Wall Streeter reminded the world, the tool can't be even in the vicinity of predicting turmoil when it truly matters. Second, the tool can itself help create the turmoil in the first place. Keep these words in mind: "In the past, these AAA ABS CDO securities had never experienced a significant loss of value." That is, it was VaR heaven for all those punters wishing to earn good money (temporarily) on the wager that subprime borrowers may be able to meet their mountainous obligations. The rearview mirror swore that those bets (impossibly toxic to anyone with half a brain) could not be expected to sustain heavy losses. Here is Merrill mercifully letting us know how VaR abetted it, and its cousins, into succumbing to multibillion dollar write-downs. The toxic stuff had never seen cloudy days (among other things because it had been invented two minutes ago, a commonsensical individual might opine), so in VaR fantasyland that translates into unfettered permission to ride the CDO roller coaster.

Merrill, of course, learned about VaR's deceitful limitations the hardest way. Even though it had one of the lowest VaR numbers on the Street, it became one of the largest sufferers from the cataclysm. For instance, while Goldman Sachs, with a VaR double in size, went as far as posting record earnings, Merrill saw a net downfall of \$8.5 billion in 2007, which contrasts sharply with the theoretical "prediction" of just \$800 million discussed earlier.

Some may wonder how seriously financial pros really took VaR as guide through the market jungle. Perhaps they voiced to the world that they followed VaR for risk-management purposes, but they didn't entirely abide by the tool when making risk-based decisions, such as trading. Banks may report VaR religiously, but how obediently do they actually listen to it? How intensely do they actually let it influence their decisions? This is admittedly a potentially gray area. Traders are assumed to be restricted by internal VaR limits, so, yes, a low VaR will always tend to help those eager to punt and punt and punt. A low VaR will always assist those eager to take risky bets in the name of risklessness. But it is not incontrovertibly clear how each institution truly lets its internal trading wishes be affected by its VaR numbers. Some may postulate that such grayness may diminish the

charge that VaR caused the crisis; perhaps banks would have acted just the same in the absence of low VaR figures, even in the absence of VaR itself.

Of course, we know that not to be the case because there is nothing gray about VaR's prominent role when it came to determining capital requirements for trading activities. Its presence in the formula was indelible. There's not a shred of doubt as to VaR's decisively deterministic role there. Banks' individual preferences and intrinsic ways of doing things don't matter one iota in this case (except when it comes to the actual chosen methodology behind the calculation of VaR, naturally). Whatever your trading preferences, whatever your risk appetite, your final actions would be hostage to the capital price tag dictated by VaR. You will only be able to leverage yourself to the hilt if VaR lets you. You may not have cared much for what VaR says about future danger, but your trading prowess would be ultimately determined by VaR. You may want to trade a lot but only VaR would tell you if you can afford it.

There's no controversy whatsoever about the requisiteness of low VaRs before banks could afford the leverage that sank the world. In order for VaR to help cause the crisis it wasn't an absolute requirement that bankers listened to VaR (though they did, and many were mightily glad to hear the model condone wild risk-taking). The only true requirement was that the capital price of their trading lottery tickets would be set by VaR. That's the ultimately incontestable, unquestionable conduit through which VaR aided mayhem. What are we saying here? That while banks' use of VaR as an internal risk beacon can indeed have problematic repercussions, VaR's real threat to the world lies in its other main role. Perhaps it wouldn't be unjustifiable if financial entities kept calculating and following their VaR (provided that they don't abide too much by it), as long as the tool is irrevocably abandoned by regulators. Although we may be able to live with VaR as a risk-management instrument, we may not be able to survive with VaR as a bank capital utensil.

So the truly key questions concerning VaR are: Will policy makers continue to embrace such an inaccurate and potentially deleterious concoction? Why did they fall in love with such a visibly

flawed tool in the first place? How was this allowed to happen by the financial police?



One of the most puzzling developments to take place in finance over the past 15 years or so has been the overenthusiastic embracement of VaR by international regulators. The tool, as we've said, was initially developed by banks themselves, not imposed from above by intruding policy makers. By the late 1980s and early 1990s, financial institutions were starting to run inundating amounts of trading-related exposures in a myriad of different markets and through an intoxicatingly diverse family of products. This put risk measuring at the top of the to-do list inside dealing floors and Wall Street executive suites. The technical resources to embark on the task had also become conveniently available, with fast-delivery computer power and long databases of historical prices now within easy reach. Banks wanted a risk measure that was easy to understand and interpret and that could be equally applied across all asset categories. VaR dutifully obliged, and could be mathematically and computationally tamed with the help of the hundreds of PhD-endowed scientists that had been progressively invading the financial industry for the prior few years. Soon, trading firms began to experiment with their own proprietary creations for internal use. All that was now required for VaR to become prevalent was a little push, an incentivizing propellant that directed banks toward no-holds-barred, even fanatical adoption of the tool.

Bureaucrats provided that necessary jolt. In 1993 the Basel Committee¹⁰ decided to add market risk to its mandate and put forward a proposal for measuring trading-related capital requirements. While the recommendations may lack force of law, countries implicitly commit to adopting them into their domestic rules book. Confrontingly, though the U.S. SEC initially refused to give up its own cherished method for calculating the capital charges of Wall Street broker-dealers for the one preferred by the Committee, thus guaranteeing that, in the case of the United States, banking (regulated by the Basel-abiding Federal Reserve) and securities requirements would remain, in

principle, not harmonically homogeneous (as was the case in the European Union) but rather distinct.

By the time the Basel market risk proposal was released, tons of financial institutions were already using their own proprietary, and typically quite complex, versions of VaR. Banks liked their beloved tools much more than the methodology initially put forward by the regulators, the so-called *standard model*, which was a building block approach that assigned fixed predetermined arbitrary capital charges to each different asset class. In essence, Basel was attempting to treat market risk just like it had been treating credit risk, with very little flexibility, no equations, and no allowance for historical data-driven volatility or correlation effects. To the banks such an arrangement seemed inhospitably archaic (and, quite possibly, also too expensive; VaR, by allowing you to select the data sample of your liking and to make friendly mathematical assumptions, can be made to be much less taxing on your capital wallet).

Soon, banks began to lobby to have things changed. The “science” of risk measurement would have to rule supreme over more boorish proposals. The first big lobbying salvo came in July 1993, when the influential Group of Thirty (G30; an assemblage of top bankers, academics, and regulators) released a report on derivatives best practices that included as the main recommendation the adoption of VaR as the most appropriate measure of market risk.¹¹ Interestingly, this document may be the first time that the term *Value at Risk* appeared in print. The G30 backing of VaR put substantial pressure on the Basel Committee to endow VaR with capital powers. It took a little while for the financial mandarins to finally succumb. The definite convincing moment probably came in October 1994, when JP Morgan released unto the open world its *RiskMetrics* system, symbol-filled documentation and data-inundated software describing and facilitating the calculation of the bank’s version of VaR (deeply rooted in the math-heavy, hypothesis-inundated Covariance methodology).

Why was this a seminal moment? Because it gave a tremendous popularity boost to the model (a public relations firm placed ads and articles in the press, JP Morgan staff went on a multicity promotional tour¹²) and because it made it much easier for any type of entity to calculate their own VaR. JP Morgan’s VaR provided a one-two punch to any reluctance to bring the model into the regulatory fold: It looked

intelligently complex and sophisticated, but at the same time it could be very easy to compute. The best risk-measurement techniques that elite Wall Street brainiacs can devise within convenient reach? Who could resist that? VaR became unassailable gospel.

Whether or not JP Morgan's 1994 move was self-interestingly aimed at knocking down any resistance to the global imposition of the VaR regime (maybe the bank was engaging in a selfless act of community service?), that's exactly the effect it had. So as not to disrupt things too much and in order to avoid being perceived as promoting backwardness, the Committee did in January 1996 flexibly accept the use of banks' internal VaR models, subject to its veto, through the famous Market Risk Amendment to the original 1988 Basel Capital Accord (interestingly, the regulators favored the banks twice, with the introduction of a strange thing called *Tier 3 capital* that banks could use to satisfy market risk requirements; Tier 3 was not really capital, as it was composed not of hard-core equity but of subordinated debt; so the 1996 policy U-turn not only delivered a tool that was almost certain to enable lots of high-risk leverage but also lowered the quality of the capital supporting all that trading, something that would come to bite the banking industry severely some 10 years later). In the words of an expert witness, "*This was a significant step forward. Prior to this, regulatory requirements and internal risk calculations had been diverging at an increasing rate. The 1995 Internal Markets Proposal, for the first time, represented a significant convergence between banking regulation and internal practice.*"¹³ By the way, that expert, when analyzing the bank capital regulatory arena in VaR-crazed 1998, outrightly recognized that the arrival of VaR on the scene meant substantially lower market risk capital charges. Banks could choose whether to employ the standard model or VaR (an early study showed that VaR could deliver capital savings of as much as 85 percent when compared to the standard model¹⁴). Should they, as has tended to be the case ever since, select the latter, the minimum daily market risk capital charge is to be calculated as the maximum of the previous day's VaR or the result of multiplying the average VaR for the past 60 days by a multiplication factor (typically equal to three, maybe higher if VaR behaves badly as an estimator of losses). Banks were free to select any VaR calculating method they wanted and any historical data sample beyond one year.

This arrangement is the one that essentially prevailed for more than a decade, until the 2007–2008 crisis prompted regulators to introduce some add-ons and twists to the formula described above. As we know, even U.S. securities regulators eventually became enchanted when in 2004 the SEC developed an enhanced sense of international solidarity and decided to join the Basel bandwagon by allowing Goldman Sachs and its domestic siblings to compute capital charges according to VaR.

What explains the regulatory lovefest with VaR? Anyone who spends a few minutes thinking about it would understand that there is something very fishy about assuming that when it comes to the markets Normality rules, or that the past is prologue. Financial regulators are smart people, typically with tons of years at the job, so how could they miss such no-brainers?

Though it is true that some financial mandarins have now shown some (atonement-seeking?) contrition and some desire to correct for the tool's failures—all the while refusing to do away with it—it all feels like too little too late. No amount of atonement may be able to compensate for the fact that for so long the watchdogs that we trust to take care of our system encouraged, promoted, and endorsed the peddling of airbags that won't inflate if we hit a wall.



The response of many (nonregulatory) VaR-lovers to the VaR crisis that unleashed the 2007 subprime crisis has been, in general, quite disturbing. Rather than admitting to the utterly visible failures that have produced so much wreckage, they cling to old, tired, empty arguments in a desperate attempt to preserve the tool, at all cost. Although disappointing, said response is welcomed for one key reason: It allows the world to contemplate, now without any shred of doubt, the dogmatism of these people, as well as their allergic relationship with empirical truth. Empirical evidence (all those exceptions, all those stupidly insufficient capital charges, all those huge trading-related losses, all those failed measurements and predictions) is a nuisance, to be radically discarded at the slightest sign of VaR-negating proof. They just don't care if the thing works out there or not. They just want it to remain alive, forever.

The postcrisis tactic appears to have been to try to confuse with the ultimate goal of erasing from the debate any discussion on the actual performance of VaR and the actual consequences of having VaR around. Many VaR defenders have taken to lecture people on how, whatever the circumstances, you must definitely go on using VaR because it wasn't VaR, it was the mishandling of the poor analytical baby by impudent rogues inside trading floors and policy-making circles! That's it, that's right, VaR doesn't kill people, people kill people; VaR wasn't the problem, it was people who never understood VaR, they were the problem; poor misunderstood VaR was manhandled, it wasn't VaR it was those idiotic people! After years of excitedly calling it the golden new benchmark for risk, the new paradigm that would change the world, the arrival of the Chosen One, many VaRistas have suddenly developed a weird tendency to belittle the model; (it is true that VaR has been disclaimed about in the past by its more ardent peddlers, but those statements were rather mild compared to the postcrisis belittling; in any case, warning about the model's shortcomings should not earn VaR and its fans brownie points: the point should not be to employ flawed models which weaknesses are adequately warned about, rather the point should be to stop using flawed models, no matter how intensely the flaws have been emphasized; a model that has to be disclaimed about all the time should not be used, period). You can't just convert to sincerity and admit that you had been peddling a deleteriously fallible tool that just happened to help cause the worst crisis ever. But at the same time, you badly want to preserve the model, and in the face of bloodshed and unremitting criticism you may have to talk-down VaR a little, so as to keep it around, in a diminished form perhaps, but alive nonetheless. The reputation of your tool may suffer a slide, but you can live with that. What you surely can't live without is VaR. So you do whatever it takes to keep VaR around, and if that includes publicly betraying the thing a bit, that's okay.

Of course, in reality VaR was used exactly as it was intended to be used. As it had always been used. There was no confusion here. There was no mishandling. No misunderstanding. If anything, it could be posited that VaR (and what it can do) had been understood all too well by financial players. VaR was not embraced under false pretenses by confused pros and policy wonks. They knew exactly what VaR is

about. VaR failed because that's its nature, not because folks used it inappropriately.

Soon after the credit crisis materialized, a public debate on VaR's strengths and weaknesses broke out. As was mentioned earlier, this had the beneficial side effect of unveiling VaRistas' way of thinking, openly showing how detached from terra firma many of the analytical risk managers can be. As an illustrative sample, consider the following statement by an enthusiastic VaR defender participating in one of those debates:

We can improve our "weather forecast" methods and it would be a real mistake to abandon all the work done and leave again risk management to the common sense of the practitioners.¹⁵

It can be said louder, but not clearer. For such VaR espousers the "common sense of the practitioners" is nothing more than a mistake. Something to be avoided at all costs. The opposite of goodness. The enemy.

To all those financial professionals who have dared toil the markets for centuries (millennia?) unassisted by the holy quantitative scriptures and drawing only on their experience-honed common sense, let me tell you what VaRistas think you are: a big mistake, an unacceptable aberration. How dare you try to act on your own freethinking intuition and on the accumulated practical knowledge of your peers rather than blindly follow the dictates of a failed quant dogma?



A big problem for those quantitative risk managers and academics (let's call them *QuAnts*) denying VaR's capacity for destruction and for malfunctioning is that even the regulators have, rather rashly, left them behind. The hopelessly in-denial *QuAnts* may end up like those WWII Japanese soldiers who were left stranded in the jungles by their retreating, defeated generals; believing the conflict to still be going on, trusting their contribution to still be required, hoping that victory is still within reach. Long after the divine Emperor signed the concession papers aboard that U.S. ship, some of his soldiers were still thinking that they were fighting His war. Now that the regulatory demigods

have (to all effects) conceded defeat, will the jungles of finance be filled with disoriented, lost VaR soldiers still flying the flag?

In essence, regulators have decided to kill VaR without going as far as definitely removing it from the land. What have they done? They have modified the formula for setting trading-related capital charges in such a way as to basically guarantee that going forward requirements will be several times above what VaR alone would have traditionally dictated. In other words, they are recognizing that the prior arrangement (i.e., VaR alone) had delivered unrealistically low charges, especially, naturally, in the buildup to the crisis. They are recognizing, in fact, VaR's crucial role in fueling the leveraged fire that engulfed us all. Through their actions, regulators are saying that VaR was dangerously inappropriate. Guilty.

They still keep VaR around (perhaps so as to avoid hard questioning on their loving adoption of the tool all those years; brusquely dumping the model may unwelcomingly cause some to wonder why it was ever embraced in the first place). But the new formula clearly shouts that VaR is wrong, and can't be trusted with as relevant a task as setting bank capital charges.

VaR is still in the formula, but its influence has been noticeably diminished. Regulators no longer want VaR to be the sole determiner of market risk regulatory capital, of trading-related leverage. So they've made up something that achieves such goal without having to actually send out invitations to VaR's official burial ceremony.

The new Basel capital formula, as was mentioned, adds several add-ons to the prior method. The new capital levies required for market punting would be the number that the previous VaR-only methodology would have churned plus the add-ons. One of those add-ons is something called *Stressed VaR* (sVaR), introduced in 2008 and that is calculated by selecting a historical time series from a particularly, well, stressful past market period; kind of a parallel VaR where the data used for the calculation is the most volatile possible for each asset, thus in principle guaranteeing modest estimations of future losses. VaR + sVaR, thus, should be expected to yield far more conservative capital requirements than just VaR, in line with the regulatory desires to never again err on the side of undercapitalized banks and excessive leverage.

Another postcrisis add-on to the Basel capital formula is the so-called *Incremental Risk Charge* (IRC), introduced to better capture some

risks not well covered by VaR and which importance was indelibly highlighted by the 2007–2008 meltdown. IRC applies only to non-securitized positions, and deals with default risk (direct and indirect losses derived from an obligor’s default) and credit migration risk (losses due to other credit-related events, such as a rating downgrade). The IRC model estimates expected losses over a one-year horizon and with a 99.9 percent confidence interval. Just like with sVaR (and, naturally, VaR), banks can use any analytical methodology they wish to calculate IRC.

Finally, international regulators have dictated that securitizations (things like mortgage-backed-securities) and re-securitizations (things like CDOs made up of mortgage-backed-securities) should carry the same capital charge whether a bank includes the position in its banking book or its trading book, thus eliminating the possibility of “regulatory arbitrage” whereby bankers would shift an asset from one type of book to the other depending on which imposed a cheaper capital requirement at any point in time (precrisis banking book requirements depended on more or less fixed credit ratings, precrisis trading book requirements depended on much more volatile VaR; if market developments rendered the latter lower than the former, a bank could punt in a more leveraged way via the trading book and vice versa).

Some studies have estimated that under the revised, new methodology capital charges could be increased as much as three- or fourfold. It seems obvious that the hastily-put-together fixes were an unmitigated declaration by regulators that they had got it exceedingly wrong for so many years, that their beloved tool can’t cope with reality, and that they eagerly want to make amends with a victimized world. Only problem is that we had to be killed by VaR before VaR could be killed.

Those QuAnts desperately hanging on to VaR may not want the world to know about VaR’s perilous deficiencies, but their erstwhile allies from the public sector have already taken to the megaphones and let the populace know. One of the globe’s most important financial regulators, the U.K.’s Financial Services Authority, stated its view rather unshyly as part of its widely circulated and influential Turner Report in February 2009. When discussing the problem of enhanced banking leverage from 2003 onward under the heading of “What

Went Wrong?” the FSA declared that, “It is clear in retrospect that the VaR measures of risk were faulty and that required trading book capital was inadequate.”¹⁶ It continued, “Mathematical sophistication ended up not containing risk, but providing false assurance that other prima facie indicators of increasing risk (e.g., rapid credit extension and balance sheet growth) could be safely ignored.” So there you have it: The mandarins (the ones who endowed VaR with unlimited power in the first place) are saying that VaR delivered the leveraged punting and the faulty risk assessments. In other words, the crisis.

Will the QuAnts now show repentance, too? It’s unlikely, I fear. If, as VaRistas tend to believe, history is any guide, it’s a safe bet that they’ll keep skirting the issue, ignoring the empirical evidence, and blaming those using VaR (the traders and the executives that give them shelter inside financial institutions) for not being intelligent enough to truly comprehend how to use the poor misunderstood tool. They’ll keep proposing to badmouth the users, never the instrument (and those who manufacture it). Akin to someone saying that nuclear bombs had nothing to do with Hiroshima and Nagasaki, that only those flying the planes should be held responsible; that nuclear bombs don’t kill people, only people who drop nuclear bombs kill people; that nuclear bombs were never meant to be nuclear; that if we want a mushroom cloud-free planet we should get rid of all the military pilots, but not get rid of the bombs (and those who manufacture them). Just because some physical person must eventually use the destructive instrument (be it a real or a financial bomb) does not diminish the intrinsically destructive nature of the device; stop using such toys and nuclear winter (real or financial) will be instantly avoided.

To QuAnts, VaR is never the problem, those who (to the delight of QuAnts) used VaR are. QuAnts are like engineers who build an arsenal, sweet-talk the generals into using it, and then blame the inevitable unpleasant consequences on the men in uniform, while lobbying furiously for the continuing preservation and manufacturing of the bombs, and denying that they were ever supposed to act like bombs.

There is a key reason why the above analogies may be less than perfect (and not only because, as some may posit, military weaponry may oftentimes serve honorable purposes). With nuclear weapons, there’s no deceit. No one is claiming the bombs to do anything but

cause destruction. No one describes them as, say, fertilizer from which flowers will blossom. Everyone involved in the nuclear discussion understands that the bombs are made to destroy stuff. The same, of course, can't be said of VaR. We were never told by those promoting VaR that VaR could enable destruction; we were rather told that VaR could save us from destruction. VaR was imposed on us in the name of tranquility, a device that would prevent the shedding of blood in finance. The tool that (rather inevitably) claimed untold casualties was peddled on us as the tool that would deliver us from evil. We were, now we know, misled. As much as if an army general would sell us the benefits of nuclear armory by arguing that before they hit ground the bombs will morph into a sea of peaceful white doves.



What would a VaR-less world look like? Well, we may be already living in a VaR-lite universe given how policy makers have semi-abandoned the model, so the query may best be posed as: What *should* a VaR-less world look like? If VaR does in fact get killed, or terminally marginalized into irrelevant obscurity, what should replace it?

I am of the opinion that simply getting rid of a bad solution is in itself a valid solution, so answering “No VaR” to the question sounds optimal to me: First and foremost, let's make sure that we appreciate the benefits of not living under flawed practices (quitting cigarettes is no less healthy because you don't offer to do something alternative to puffing). By just erasing a bad model from financeland, we would make tremendous strides. No-VaR in itself would be a wonderful improvement over VaR.

Having said that, financial risks would continue to need managing and bank capital would continue to need regulating even in a post-VaR order so it probably doesn't hurt if we make tangible proposals as to how such system should operate. In a nutshell: Going forward let's do less mathematical financial risk analysis, please. Softer sapience based on traders' war scars, experience-honed intuition, historical lessons, and networking with other players will not only typically beat quant sapience when it comes to understanding and deciphering exposures (we humans can't be that bad!), but most crucially should be

far more effective in preventing obviously lethal, chaos-igniting practices. Commonsensical, rather than analytical, counsel ought not only identify risks much better, but especially keep toxicity at bay much more resolutely. And, at the end of the day, what's risk management if not the prevention of the worst kind of ills? With VaR as king, it can be quite easy for the system to drown in destructive lethality. With commonsensical steering at the helm, it can be quite difficult (if not well nigh impossible) for such a nightmarish outcome to materialize. Results that would be deemed outright lunacy under the commonsensical lens (say, 1,000-to-1 leverage in a trading portfolio that contains lots of nasty stuff) are accepted and encouraged if churned out from the analytical strainer. Recommendations that would have never been arrived at under the rule of common sense can be easily put forth when analytics reign.

The gargantuan toxic leverage that VaR did sanction and can sanction was the type of aberration that can result when common sense is dilapidated under the weight of the analytical rock. A commonsensical way of doing things would not allow the crazy, trading that VaR did and can so uniquely allow. Reckless actions by financiers and reckless policies by regulators, forbidden under commonsensical decision making, are permitted by VaR. Commonsense decision making makes terrible market crises much *less* likely. Models-based decision making makes terrible market crises much *more* likely.

It all comes down to how risk-blind VaR can be. VaR doesn't know anything about the true riskiness of an asset, only about soulless data series. Without models, we would have no option but to think about the actual risks of a portfolio. Our conclusions may not always be on the mark, but it would surely beat flying blindfolded. Any risk analysis of subprime CDOs by a flesh-and-bone trader that is at the very least slightly aware of the nature of the underlying mortgages making up the structure runs circles around an analysis based exclusively on how the security happens to have behaved of late. While past data can hide true risk, it's much more difficult for thoughtful introspection to do so. While VaR can take an obviously trashy asset and label it as risk-free, thoughtful introspection won't. By choosing common sense over VaR we at least manage to avoid such idiotic dictates from permeating the economy, and the pronounced bloodshed that would surely follow.

Shouldn't that be the main goal of risk management and prudential regulation? First and foremost, make sure that the obviously unacceptable is not possible. Then you deal with the other stuff, but first implacably forbid the dangerously unacceptable from rearing its ugly head. Any risk system that sanctions 1,000-to-1 (even 100-to-1) gearing on banks trading books is unacceptable. Any risk system that allows banks to own more super-toxic assets than their entire equity base is unacceptable. Any risk system that predicts placidity days before giant legendary banks sink into oblivion is unacceptable.

While commonsense-grounded Basel I blockaded the unacceptable, its later models-based siblings Basel II and Basel III happily permitted the unacceptable. Under Basel I, financial mandarins chose to use their brains and come up with fundamentals-based risk rankings, making sure that capital requirements rose as the nonstandard character of a particular asset family is enhanced (i.e., government bonds required less capital than claims on banks, which in turn required less capital than municipal bonds and much less capital than underdeveloped-countries debt, and so on). It's well known that those risk buckets were far from perfect, but at the very least it made it hard for illiquid, complex assets to be relatively very cheap capital-wise. Under Basel II and III, regulators put their brains under lock and key and outsourced risk control to the fancy VaR and credit models developed internally by banks. Fundamentals stopped playing any role whatsoever. This made toxic leverage suddenly economical and possible, especially because traders could now effectively calculate their own capital requirements. The old, imperfect risk buckets that discriminated between quality and trashy assets would not have allowed the 2007 crisis to take place. VaR, in contrast, is much less discriminating. By welcoming the unacceptable in, modern risk rules sealed our fates.

So let's use the latest market crisis and the latest VaR disaster to redefine risk management and risk regulation as the prospective prevention of the unacceptable. It's clear that no risk management-measurement system and no risk policing mechanism will get it right 100 percent of the time: Many exposures will be underestimated or overestimated, regulatory capital will end up being a bit too taxing or a bit too scarce. It will always be an inexact art, full of uncertainty. But we do have the capacity to ex ante identify intrinsically daring securities,

and to make them apart from naturally safer alternatives. While no one can guarantee that punting on the latter will perennially be setback-free, it seems clear that global stability is much better served if we discourage the massive accumulation of weird assets that can lose their entire value on a whim. The rule should be never to endow relevance on risk tools and policies that have even the slimmest chance of yielding such results. As simple as that. If there is a possibility that a risk mechanism can deliver toxic leverage, then such mechanism should be banned from the premises, immediately. It is true that, as was said earlier, regulators seem to have learned the key lessons from the latest market debacle (“VaR can kill,” “Metrics-based financial policing can kill,” “Toxic leverage can kill”), but their response has not been exactly the most appropriate one (as long as VaR is kept around in the regulatory capital formula it remains influential; besides, all those post-crisis add-ons to the formula could be quietly removed in the future, perhaps following a prolonged turmoil-free period that seduces policy makers into imposing less restrictive rules on bankers, essentially taking us back to the explosive precrisis VaR-only system). The current regulatory architecture still requires further, more radical tweaking, notwithstanding the reforms undertaken. Even those who are willing and able to learn some of the important lessons still have lessons to learn.

Many experts will tell you that risk management is about risk measurement and loss prevention, but those things are not attainable: We can't map markets probabilistically, and bad news will always be indelible possibilities. There's not much we can do about all this. We shouldn't be judged too harshly for not anticipating all that “day-to-day” stuff. But we should be penalized ruthlessly if we fail to do the one thing we can definitely do, and the one thing that truly matters: Make obviously reckless behavior (i.e., that which has consequences that are destined to be catastrophic with almost total, or indeed total, certainty) impossible. Crises may still happen through other conduits, but the by-far potentially more lethal paths (the insane leverage, the insane toxicity) would have been roadblocked.

(Good) bankers and (good) politicians would benefit from this proposed new risk paradigm. As many healthy financial institutions can attest, toxic leverage is not a requirement for a bank to deliver attractive results and generate investor interest; there are plenty of other,

much more system-friendly, conduits through which positive (and long-lasting) performance can be obtained. Those bankers disproportionately interested in the survival of their firms and of the financial system should welcome with open arms any risk policy that decisively curbs leverage madness. Similarly, any policy maker bent on safeguarding national stability should be in favor of rules that clamp down on destructive bank behavior, given how the latter tends to give raise to mass unemployment and unsustainable public deficits. The coalition of good bankers and good politicians should push for the banning of the unacceptable, and help make that the central target of risk policing.

There'll always be a chance that banks and other players suffer some types of setbacks in the cold hard markets; and as long as humans shape the action, those events will be pretty much unpredictable. Risk control shouldn't be judged on its capacity to eliminate or foresee such pretty unavoidable outcomes. Risk control should be about the doable task of making sure that the odds of such setbacks being destructively monstrous are not guaranteed to be 100 percent. In that light, VaR was the worst possible contribution to risk control imaginable. The number that ruled the world should never be given such powers ever again.