has and whether the benefits of today's highly leveraged financial system exceed the all-too-obvious costs.

To put the point most broadly: The Modigliani-Miller theorem says leverage and capital structure are irrelevant, yet many bankers would surely claim they are central to the process of financial intermediation. A compelling question on the research agenda is to figure out who is right, and why.

COMMENT BY

JEREMY C. STEIN It is a pleasure to comment on this important and wide-ranging paper by Alan Greenspan. In light of the breadth of ground that it covers, I will have to focus my comments on just a couple of the issues that struck me as particularly interesting. The first of these concerns the central role of capital and liquidity requirements in any attempt to reform financial markets. As the paper states, "The most pressing reform, in my judgment, in the aftermath of the crisis is to fix the level of regulatory risk-adjusted capital, liquidity, and collateral standards required by counterparties." I agree with this view. Moreover, Chairman Greenspan makes a highly welcome contribution by taking this observation to the logical next step: he poses, and attempts to answer, the quantitative question of just how high capital requirements should be raised. This is a point on which most policymakers have thus far been conspicuously silent.

The paper argues for a regulatory minimum ratio of book equity to assets in the neighborhood of 14 percent. The argument has two parts. First, a rough calculation suggests that a 14 percent ratio would provide the banking sector with a buffer adequate to see it through a crisis equal in magnitude to that of the last few years. And second, another back-of-the-envelope exercise yields the conclusion that a 14 percent regulatory minimum would not be overly burdensome, in the specific sense that it would not prevent banks from earning a return on equity in line with historical averages.

In the same spirit of simple calibration, I would like to offer another approach to the second piece of the puzzle: the costs associated with raising capital requirements by several percentage points. My analysis is nothing more than an application of the standard weighted average cost of capital (WACC) machinery that is routinely taught to MBA students everywhere, which augments the Modigliani-Miller (1958) paradigm to take account of corporate income taxes. Suppose that equity capital requirements are raised very substantially—say, by 10 percentage points. Moreover, suppose that at the margin, this additional equity displaces long-term debt in the capital

structure of the affected banks. According to Modigliani-Miller, the only net effect of this change on banks' WACC (and hence on the rate they charge for corporate or consumer loans, for example) comes from the lost tax deductions on the long-term debt that is eliminated. Thus, if the displaced debt yielded, say, 7 percent, then given a 35 percent corporate tax rate, a 10-percentage-point reduction in the debt tax shield would raise the WACC by $0.10 \times 0.07 \times 0.35 = 0.00245$, or about 25 basis points. Again, this is the impact of a very large increase in the equity capital ratio, equivalent to going from a low initial ratio of 4 percent all the way up to the level suggested by Greenspan of 14 percent.

Of course, this calculation comes with a number of caveats. First, and perhaps most important, it should be thought of as capturing the long-run steady-state costs of having to *hold* more equity on the balance sheet, while disregarding the transitional flow costs associated with *raising* the required new equity. Given the adverse selection problems associated with new equity issues (Myers and Majluf 1984), these flow costs may be significant. This implies that if higher capital requirements are phased in too abruptly—so that banks have to get there through large external equity issues, rather than by gradually accumulating retained earnings—the transitional impact on their lending behavior may be much higher than my 25-basis-point figure suggests.

Another caveat is that even in a long-run steady state, taxes may not be the only relevant violation of the idealized Modigliani-Miller conditions. To take one example, Gary Gorton and Andrew Metrick (2010) and Stein (2010) argue that banks like to issue collateralized short-term debt because this debt commands a "money-like" convenience premium based on its relative safety and the transactions services that safe claims provide. If one takes a crude upper bound on this convenience premium to be 1 percent, and if capital requirements have the effect of crowding out such short-term debt at the margin, as opposed to long-term debt, this would add another $0.10 \times 0.01 = 10$ basis points to the overall effect,[1] for a total of 35 instead of 25. This logic suggests that other sensible modifications are also likely to have only a relatively small effect. FTN 1

All of this would therefore seem to reinforce—albeit with a quite different methodology—the broad conclusions in Greenspan's paper, namely, that although there are undoubtedly costs associated with significant increases in bank capital requirements, a crude estimate of these costs does not

1. Krishnamurthy and Vissing-Jorgensen (2010) estimate the convenience premium associated with Treasury securities to be on the order of 70 basis points, which suggests that my 100-basis-point number is probably a conservative upper bound.

suggest that they are prohibitive. Said differently, both his analysis and mine would appear to give significant comfort to those who worry that plausibly higher capital requirements will make bank loans much more expensive.

And yet, there would seem to be an obvious tension here. Banks manifestly care a great deal about optimizing their capital structures, and they show a persistent tendency to gravitate toward high leverage. In contrast, most nonfinancial firms, many of which operate with dramatically lower leverage, seldom appear to be nearly as strongly drawn toward any fixed target capital structure. So although the Modigliani-Miller-plus-taxes paradigm may be adequate for capturing the relatively small benefits of debt for nonfinancial firms, one wonders, in light of their very different behavior, whether the same paradigm does not leave out something of first-order importance when it comes to financial firms. Put simply: if higher capital ratios have only a small impact on the WACC for financial firms, why do they—unlike their nonfinancial counterparts—resist them so forcefully?

My own attempt at reconciling this tension goes as follows. Perhaps the substitution of equity for debt finance does in fact have the same small effects on the WACC for financial and nonfinancial firms—say, 25 basis points for a 10-percentage-point change in the equity ratio. But what is different about financial firms are the *competitive implications* of a small cost-of-capital disadvantage. An auto manufacturer or a software firm is unlikely to be driven out of business over a 25-basis-point cost-of-capital difference; so many other factors—the quality of its product, the loyalty of its customer base, and so on—are so much more important that it can fail to fully optimize on the cost-of-capital dimension and still survive. In contrast, for a financial firm, cheap capital is the single dominant input, and it simply cannot afford to cede a 25-basis-point edge to its competitors. In this sense, high leverage is for financial firms like what a performance-enhancing drug is for elite sprinters: even if the drug is harmful to health and only adds a few hundredths of a second to their times, with all else so closely matched, they may not feel they can afford not to take it.

On the one hand, the drug analogy makes much stricter capital regulation seem like a no-brainer: if it can stop a systemically unhealthy form of competition with only a minimal impact on performance (in this case, on the cost of loans to corporations and households), then it would seem highly desirable from a social perspective. The hitch, however, is that, much like with drug testing, the same competitive forces create a powerful motive for evading the regulation. One important channel for this evasion is migration of credit creation from the regulated banking sector to the less regulated

shadow banking sector. For example, instead of keeping a consumer loan on its balance sheet, subject to the more stringent capital rules, a bank can bundle the loan with other, similar loans into a security, which winds up, say, in the portfolio of a hedge fund, which in turn finances its purchase of the security largely with overnight repo and only a very thin slice of capital.

Although such migration may leave the banks themselves safer, it is much less clear that it leaves the financial system in better shape should a crisis occur. One of the most dramatic features of the subprime crisis was the complete collapse of the market for asset-backed securities—and not just those related to subprime mortgages, but also those based on auto loans, credit card receivables, student loans, and other assets. This market collapse, which was arrested only by the Federal Reserve's intervention with the Term Asset-Backed Securities Loan Facility (TALF), played an important role in deepening the credit crunch.

The bottom line is that I do not worry too much about the effects of higher capital requirements on the cost of loans to households and firms. Based on the sorts of calculations sketched above, my best estimate is that these effects will be relatively muted. At the same time, I worry a great deal about the effects on *how and by whom* credit is provided, and the potential implications of these changes for overall systemic stability.

To be clear, I do not at all mean to suggest that capital requirements for banks should not be significantly higher. Indeed, if forced to pick a number for the required capital ratio, I might well come out somewhere in the same range as Greenspan. However, the danger of competition leading to evasion of the capital requirement suggests that the focus should not be just on banks, or even just on all bank-like institutions. Rather, an effort must be made to impose similar capital standards *across a given asset class,* no matter who winds up holding the asset. This will not be an easy task, but one tool that might be helpful is broad-based regulation of "haircuts" (that is, minimum margin requirements) on asset-backed securities that trade in the shadow banking market. Returning to the previous example, this regulation might stipulate that whoever holds a tranche of a consumer loan securitization, be it a hedge fund, a pension fund, or anybody else, would be required to post a minimum haircut against that tranche. The value of the haircut would depend on the seniority of the tranche, the underlying collateral, and so forth. If these haircut requirements are well structured, they could go a long way toward achieving harmonization across organizational forms, in that there would be no obvious advantage based on avoidance of regulation to moving the consumer loans off the balance sheets of banks and into the shadow banking sector.

My reading of Greenspan's paper is that he is fundamentally sympathetic to this approach, and indeed that he has something very much along these lines in mind when he refers to the need to "fix the level of. . . . collateral standards required by counterparties." If so, I hope that other policymakers will pay careful attention to his advice.

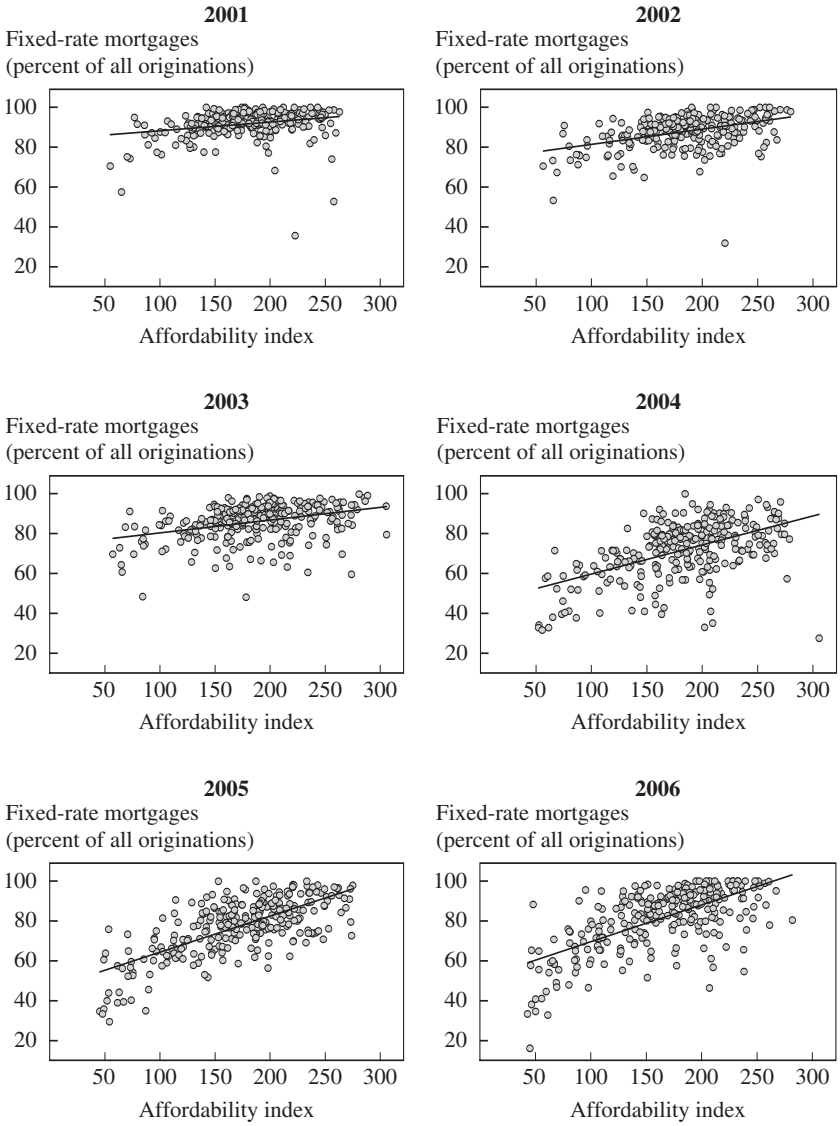
On a different note, I am inclined to be more skeptical of Greenspan's analysis when he downplays the role of low short-term interest rates in the initial years of the housing boom. He writes, "The global home price bubble . . . was a consequence of lower interest rates, but it was *long-term* interest rates that galvanized home asset prices, not the overnight rates of central banks, as has become the seeming conventional wisdom." My own suspicion is that short-term rates did play an important independent role, by reducing the required monthly payments for borrowers taking out adjustable-rate mortgages (ARMs), whose rates are tied to short-term market rates. This hypothesis presumes that some of these borrowers were either myopic or liquidity constrained, so that their initial monthly payment—as opposed to the expected payments over the life of the loan—was decisive in their choice. Although this presumption may not accurately characterize the behavior of the majority of borrowers in normal real estate markets, perhaps it rings more true as a description of the recent subprime boom.

FIG. 1

In any case, although I do not have conclusive evidence for my hypothesis, I can offer one suggestive set of plots. Figure 1 plots, each year from 2001 through 2006, the share of fixed-rate mortgages in total mortgages initiated in each of 269 metropolitan statistical areas (MSAs) against an affordability index for that MSA. The affordability index is from Moody's Economy.com and is based on the median family income in an MSA relative to the monthly mortgage payment on a median-priced home in that MSA (assuming a conventional fixed-rate mortgage loan). Higher values of the index correspond to greater affordability, that is, to higher ratios of incomes to home prices.

The figure conveys two key messages. First, throughout the period, ARM use is more prevalent in more expensive cities, where liquidity constraints are presumably more likely to be binding on homebuyers. Second, this relationship becomes strikingly more pronounced between 2002 and 2004, when the federal funds rate was bottoming out and home prices began to rise dramatically. This latter effect is consistent with the key mechanism underlying my hypothesis, namely, that the short-term rate works through its ability to reduce the monthly payments for income-constrained borrowers who finance their homes with ARMs.

Figure 1.



Source: Benjamin Iverson, Harvard Business School, and James Vickery, Federal Reserve Bank of New York, using data from Moody's Economy.com and the Monthly Interest Rate Survey from the Federal Housing Finance Agency.

a. Each observation is for a single MSA. The affordability index is based on the ratio of median family income in an MSA to the monthly payment on a conventional fixed-rate mortgage for a median-priced home in that MSA. Higher values of the index indicate greater affordability (that is, a higher ratio of median income to mortgage payment). Lines are fitted regression lines.

Again, this evidence is only suggestive, and more work would be required to support the story I have in mind with any real degree of confidence. Nevertheless, at a minimum, I believe that the role of short-term rates in the recent housing bubble remains an important open question.

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GENERAL DISCUSSION Several panelists expressed thanks to Chairman Greenspan for his service to the nation and for his candor in stating that the events of the last few years had led him to revise some long-held views.

Gregory Mankiw agreed with Jeremy Stein that in the presence of taxes there is a preference for debt over equity, to which banks may well respond more than other firms. If that is the case, then the policy prescription is clear: reform the tax code to eliminate the preference for debt.

Alan Blinder pointed to what seemed an incipient consensus on there being two types of bubble, although this may oversimplify what might really be a continuum. Bubbles of the first type, which includes the tech stock bubble of the late 1990s, are based on equity rather than leverage and credit, whereas those of the second, which include the recent crisis, are based on excessive leverage. The Greenspan-Bernanke mop-up-after view of how to deal with crises continues to make sense for the first type but not for the second. One reason is that the Federal Reserve has informational advantages in the credit system, especially the banking part. If the Federal Reserve were designated an explicit systemic risk regulator over the entire financial system, that informational advantage would become even larger.

Blinder agreed with Greenspan that more equity capital in the financial structure of financial institutions has to be part of the solution, but he was unsure whether it is the whole solution. There is potentially an intermediate course of action between forced bankruptcy, as in the case of Lehman Brothers, and bailout, as in the case of AIG. The government can step in and grab hold of the reins, fire management, wipe out the shareholders, impose some losses on creditors, and then take the failed firm into either receivership or conservatorship. Authority to undertake such resolutions will be an important part of any reform—not because it will prevent bubbles, but because it will mitigate the fallout and the cost to taxpayers when they happen. Related to this is the need to require more collateral behind purchases of over-the-counter derivatives—the capital markets analogue to increasing bank capital. One could go further and more or less force derivatives transactions onto organized exchanges, by imposing a higher capital requirement for derivatives not traded on exchanges. Reform should also include doing something about the go-for-broke incentives that were rampant in financial markets in the run-up to the crisis.

Benjamin Friedman observed that strengthening capital requirements is also about accounting reform. Often what matters is not just the specific percentage by which assets must be backed by equity, but also the specification of the asset total by which that percentage gets multiplied. For example, the chief problem at Citibank was the $100 billion in assets that were off the balance sheet, and therefore against which the bank held zero capital. The comparable off-balance-sheet amount at Lehman Brothers was $50 billion. In each case the needed reform is not choosing a new percentage but requiring that capital be held against a much more inclusive specification of the firm's assets.

Friedman also thought the Modigliani-Miller perspective, which had been suggested by both discussants, was interesting but led to a troubling conclusion. The standard Modigliani-Miller theorem assumes not only no taxes, but also no bankruptcy. If the banking system as a whole is operating at one level of leverage, then any one bank that is forced to make do with less leverage is at a competitive disadvantage. If the banking system requires some minimum amount of leverage to do business, this implies some probability of any bank (or even all of them) failing, and this in turn requires either a public sector subsidy or the possibility of a taxpayer bailout. If that is so, it is troubling, because it means there cannot be a banking sector unless the banks collectively have a leverage ratio high enough to put the taxpayer at risk.

Finally, Friedman posed a question for Greenspan on the choice between regulation by public institutions and regulation by creditors. Before the crisis, Greenspan had argued forcefully and articulately that the latter was superior. The paper, however, was as sharply critical of one as of the other. Friedman therefore wondered whether the experience of the crisis had changed Greenspan's thinking on the relative advantages of the two.

Olivier Blanchard followed up on Mankiw's remarks regarding maturity transformation. In the aggregate, most savers probably have a longer horizon than the firms to which they lend. Much of this saving is for retirement or other long-term purposes, whereas much physical capital has a life of about 10 years. Thus, at the macro level, the transformation of short-term saving into long-term investment does not seem that important, yet many institutions are involved in precisely that process.

Martin Baily laid out two views prevalent among noneconomists of what caused the crisis: one is that it was all about greedy bankers, whose actions produced a market failure of the worst kind. The other is that it was a government failure, either of the regulators or of housing policy. For those who think the culprit was federal policy, the answer is to change the policy—to get the government out of the way and let the market work. For those who think the problem was market failure, the answer is to strengthen regulation. But in Baily's view the crisis was caused by both market failure and government failure, and therefore to some extent both things have to be done—some mix of less government in some areas and more government in others is needed.

Baily agreed that bubbles cannot be forecast precisely, but that does not mean that nothing can or should be done when one sees a bubble forming—if you know you have high cholesterol, you may not know whether or when you will have a heart attack, but it is still a good idea to take anti-cholesterol medication. When policymakers—both financial regulators and monetary authorities—observe a highly leveraged increase in asset prices, they should do something, even though they risk being wrong in their diagnosis. It is worth taking out the insurance policy of at least leaning against that particular wind. It would also be a good idea for the Federal Reserve to have another tool that it presently lacks, namely, the ability to adjust margin requirements or capital requirements of all kinds—for example, to set minimum down payments for mortgages in the event of an incipient mortgage bubble.

Baily agreed, to some degree, that a large moral hazard had been created. There were good reasons to protect debtors in the heat of the crisis, but doing so also created a danger: investors might believe that the regula-

tors will not regulate the next time either. On the other hand, the moral hazard problem can be overstated. The managers of financial institutions have certainly taken a hit: almost all the institutions that got into trouble have replaced their managers. Shareholders have taken a big hit as well. The problem is mainly on the debtors' side, and it needs to be dealt with through the living wills and other resolution mechanisms that Greenspan mentioned, to make sure that the debtors cannot walk away unscathed.

Christopher Carroll called the Panel's attention to the fact that Robert Shiller, in a December 1996 speech at the Federal Reserve, had warned of a bubble emerging in the stock market, and that in January 2004, speaking again at the Federal Reserve, Shiller had warned of a bubble emerging in the housing market. Perhaps when Robert Shiller enters the precincts of the Federal Reserve Board, he takes on supernatural powers that give him intuition on this subject that others lack. But if one or at least a few respected economists have strong intuitions that a bubble is in the process of forming, that does seem an appropriate time for regulators to think about becoming more vigilant.

Christopher Sims cited the paper's observation that the private sector did not seem to price systemic risk very well leading up to the crisis. This suggests the presence of an externality: just because private agents do not take account of the risks they impose on the system does not mean that systemic risk does not exist. That the markets did not seem to react to this risk in advance raises the question of whether regulators could do better. There is some chance that the right kind of regulators could do better, through aggressive information collection or examination of accounting practices, for example. Then the question becomes how to avoid regulatory capture. In the years leading up to the crisis, it had become politically difficult to suggest tighter regulation. One argument for assigning more responsibility for systemic regulation to the Federal Reserve rather than some other agency is that the Federal Reserve has a dedicated revenue source and its governors serve 14-year terms. These things go a long way toward making regulators independent and allowing them to avoid capture.

George von Furstenberg interpreted the paper's message to private financial institutions as "Go ahead and spill it—we will mop it up." Yet this policy, he argued, has already led to enormous underpricing of risk and subsequent socialization of enormous losses. This was indeed the opposite of central planning—it was central bungling. In other words, what produces a deviation from market models is to let markets be perceived as failing in an egregious way. Therefore, it is important to take precautions and buffer the system against the destructive effects of bubbles. If bubbles

are not preventable, then much greater precautions are necessary. Some of these have absurdly kicked in after the fact: now the Federal Housing Administration and the GSEs have increased their lending standards; now firms like AIG are subject to special margin requirements. There are many things that can be done to reduce the vulnerability of the system to bubbles, if bubbles there must be. If you know that hailstorms exist but cannot predict them, you do not have to stand outdoors bareheaded. There are ways to reduce your exposure. Certainly the only course is not just to mop up afterward—a strategy that in this case has been anything but market directed, and has been very incomplete and extremely costly to the taxpayer.

Richard Cooper agreed with Greenspan that banks, at a minimum, should be subject to higher capital requirements, and perhaps other financial institutions should as well. He wondered why that general point is not even more broadly applicable—why not, for example, impose minimum down payment requirements on homebuyers? The Federal Reserve had full authority to require the institutions it regulated to impose such requirements; in the spirit of Baily's anti-cholesterol metaphor, imposing such requirements in 2003 and 2004 might have prevented the heart attack, given what was known at the time.

Cooper also agreed with Friedman on the need for accounting reform, and specifically for bringing structured investment vehicles and the like onto banks' consolidated balance sheets. He was at least as interested, however, in the principles governing the valuation of assets and liabilities, particularly when regular markets do not exist (for venture capital, for example) or when they have frozen, as happened in late 2008. In this country, accounting rules are left to an entirely private body called the National Accounting Standards Board, which operates under the principle that all information that can conceivably be brought onto the financial statements should be. Transparency and bringing things onto the balance sheet are two different things, however. Cooper wondered whether the process for setting accounting standards in general ought to be reviewed, or whether a set of regulatory accounting standards ought to be established that would be used for setting capital requirements, rather than relying on mark-to-market rules, particularly when the market valuations have to be artificially simulated or taken from a few distress transactions.

Robert Hall noted that Martin Baily had prescribed anti-bubble medication as if a best-selling medication of that type already existed. But the paper's argument was that the interest rate controlled by the central bank is not an effective anti-bubble medication, at least with respect to real

estate. Prospective investors capitalizing the value stream from a piece of real estate look far into the future, yet the central bank's influence is limited to a relatively short horizon. Hall pointed out that many countries that did not have ARMs—and the great majority do not—also had huge housing bubbles. The evidence points to low long-term interest rates as what matter when valuing housing, and therefore suggests that it was low global long-term rates, not short-term rates, that caused what became a worldwide bubble.

Hall went on to note that the other anti-bubble medication, suggested by Richard Cooper, involves introducing frictions into financial markets by regulating down payments or margins. There is nothing intrinsically wrong or dangerous about making risky loans, provided that the institutions holding the loans are not huge, highly leveraged, and systemically important. Getting a much more robust financial system is the solution to this problem, not anti-bubble medication. The economy rode through the equity bubble that popped in 2000 without any financial crisis. It should be able to ride through a real estate bubble just as well.

Justin Wolfers noted that the paper was largely silent on the shadow banking system and hoped for more discussion of that topic in the final draft.