Discussion of "Capital Regulation and Tail Risk"

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During the recent financial crisis, the notion of "tail risk"—exposure to very unlikely yet massive losses—rapidly became the foremost concern of regulators, banks, and other market participants alike. Perotti, Ratnovski, and Vlahu (this issue) analyze how the presence of such risks affects the relationship between bank capital and bank risk taking. With policymakers looking to revamp capital regulations so as to prevent a similar crisis from occurring, there is no question that this is a very timely paper indeed.

Perotti, Ratnovski, and Vlahu argue that tail risk differs from the "normal" risks modeled in the banking literature because it can wipe out any amount of bank capital. As a result, the presence of tail risk weakens the effectiveness of capital in reducing risk-shifting incentives. Moreover, when capital is costly to raise, the combination of tail risk and less-catastrophic ("non-tail") risk can complicate the relationship between capital and risk shifting, making it non-monotonic: although an increase in bank capital from low levels tends to deter risk shifting, at even higher levels the bank may start taking risks again, only to revert to a safer strategy if capital is sufficiently high. This possible reversal arises from the fact that regulatory capital requirements apply not only ex ante but also to the bank's condition after risks have materialized. The reversal becomes stronger as the probability of tail risks increases. The upshot is that capital regulation is even less effective in the presence of tail risk.

This paper makes a number of innovations, including not only the distinction between tail and non-tail risk but also the impact of risk realizations on ex post capital adequacy and how, in the presence of recapitalization costs, this in turn feeds back into initial risk choices. Nevertheless, I think there are several aspects in which it could be

improved. The result that tail risk makes capital less effective is not unique to this model. Also, the way in which tail risk affects the bank's risk-shifting opportunities is somewhat at odds with the factors that helped lead to the recent financial crisis. The robustness and applicability of capital's non-monotonic effects on risk shifting could be explored in more depth. Finally, some examination of the impact of tail risk on social welfare and optimal capital regulation would greatly increase the paper's contribution. Before discussing these points at more length, I will summarize the authors' model and results.

1. Summary

In the model, there are three dates. At date 0 a risk-neutral bank begins with exogenous capital C and insured deposits D, and chooses between safe and risky assets. At date 1, date 2 asset returns become known to all. The bank must meet a minimum capital ratio $c_{\min} > 0$ or be closed, with bank shareholders receiving nothing in the event of closure; if it chooses to, the bank can raise additional capital at a fixed cost T. Finally, at date 2, the asset returns are realized, depositors are paid, and bank shareholders receive any surplus.

Safe assets yield a constant gross return $R_S > 1$ at date 1. Risky assets have a yield that depends on the state of the economy at date 1: they return $R_H > R_S$ with probability p (the high-return state); they return R_L, where $1 > R_L > 0$, with probability $1 - p - \mu$ (the low-return state); and they return 0 with probability μ (the tail-return state). The expected return on the safe asset is higher than that on the risky asset, so the safe asset is the efficient choice.

Following well-known arguments, sufficiently low bank capital levels will give the bank incentive to prefer the risky asset even if there is no cost to raising capital (proposition 1). If the safe return R_S is too high, this situation only occurs if capital is very low—low enough that the bank would default even in the low-return state. Otherwise, the bank may prefer the risky asset even if the bank would only default in the tail-return state. The rest of the paper concentrates on the latter case.

Comparative statics show that a mean-preserving increase in tail risk causes the initial minimum capital level required to prevent risk shifting, $c^{T=0}$, to increase at a rate that is inversely proportional

to the square of the probability μ that the tail-return state occurs. Perotti, Ratnovski, and Vlahu interpret this as showing the diminished effectiveness of capital at preventing risk shifting when the bank has access to assets with tail risk.

The authors then turn to the case where raising additional capital at date 1 is costly. Now, two effects come into play in determining how initial capital levels affect the bank's risk-taking incentives. The first is the deterrent effect already noted: with more initial capital, the bank has more to lose in the event of realized tail risk, so risk shifting is less attractive. The second is new: more capital means that the bank is less likely to have to raise additional capital to meet the required capital level $c_{\min}$ in the low-return state. (Recall that, by assumption, the bank does not default in this state, so capital exceeds zero, but it might still fall short of $c_{\min}$.)

Proposition 2 establishes that if the return on the safe asset is neither too high nor too low, the bank's asset choice depends on which of four regions its initial capital level falls into.[1] For low capital, the bank takes the risky asset; for somewhat higher capital, it chooses the safe asset so as to avoid having to recapitalize or abandon its equity position in the low-return state. Nevertheless, for even higher capital levels, the bank will choose the risky asset because it does not have to recapitalize in the low-return state, making the net effect of risk shifting (in the tail-return state) positive. Finally, for sufficiently high initial capital, even risk shifting through the tail-return state is unattractive, and the bank chooses the safe asset. Mean-preserving increases in tail risk expand the third region, where the bank takes on tail risk because it has enough capital to avoid recapitalization in the low-return state.

2. Remarks

This paper makes a nice contribution by showing that, in some cases, costs of recapitalization can make higher bank capital levels have a counterintuitive effect, increasing risk-shifting incentives. As Perotti, Ratnovski, and Vlahu note in their introduction, others

[1] If the return on the safe asset is either sufficiently low or sufficiently high, there are only two relevant capital regions, with the risky asset being chosen if initial capital is low and the safe asset being chosen if initial capital is high.

have shown that higher bank capital requirements can have counterintuitive effects on risk-taking behavior. What distinguishes the current paper is the emphasis on higher *initial capital levels* (as opposed to capital requirements) and their interaction with future return realizations and recapitalization in the presence of tail risk. Nevertheless, the contribution is somewhat less than the authors claim, and more could be done to establish and extend the results.

First, Perotti, Ratnovski, and Vlahu's interpretation of proposition 1 and the comparative statics results that follow is somewhat misleading. That lower returns on the safe asset increase the initial capital needed to deter risk shifting is not new, nor is it new that increases in the probability of (very) bad returns increase the amount of initial capital needed to deter risk shifting. Also, the finding that mean-preserving increases in the probability μ of tail returns cause the risk-deterring capital level $c^{T=0}$ to rise at a rate proportional to μ^{-2} actually suggests that, as tail risk becomes more likely, less additional capital is needed to restore incentives. This is not surprising, since higher initial bank capital means that less of any tail loss is shifted to depositors, so that a further increase in the probability of this happening has a smaller impact on the attractiveness of risk shifting. Finally, all of these results can be obtained in a model with only two return realizations, undercutting the notion that tail risk differs from the impact of low returns in general.[2]

Another issue has to do with the nature of the risk-shifting choice facing the bank. Taking the model literally, a completely safe asset has to have a positive net return that also exceeds the expected return on an asset with exposure both to low returns and to tail risk. One difficulty here is that there are relatively few completely safe assets with positive net present value (NPV); most of the assets banks hold that are likely to have positive NPV also have some risk exposure. Indeed, one partial cause for the recent crisis was institutions' desire for safe AAA assets with above-normal returns—a desire that was met with securities that proved to have considerable tail risk. This suggests that a more realistic and topical approach to

[2]In particular, if case (b) of proposition 1 holds, so that the bank fails in the low-return state as well as the tail-return state, then increases in the combined probability $1 - p$ of either state occurring cause the risk-deterring level of capital to increase at a rate proportional to the inverse square of this probability.

tail risk would be to give the bank a choice between "risky" assets that return $R_H > 1$ in the high-return state and $R_L < 1$ in both the low-return and tail-return states, and "safe" assets that return $R_S > 1$ in the high- and low-return states and 0 in the tail-return state. Examining how capital levels affect this choice might yield interesting insights into the recent crisis and how to prevent a recurrence.

Turning to the results with costs of raising capital, my first comment concerns robustness. Perotti, Ratnovski, and Vlahu show that the results are robust to the bank having a franchise value that is lost on default and to having both fixed and variable costs of raising capital. A natural question is the extent to which the results depend on having three discrete states, with capital shortfalls in the low-return state traded off against potential risk shifting in the tail-return state. Intuitively, if returns are continuously distributed, there will still be regions where capital is wiped out, where recapitalization is an issue, and where recapitalization is not necessary. It seems reasonable that a riskier asset that shifts the return density in the right way will lead to similar results on the effects of capital increases, but it would be nice to work out just what sort of density shift is needed and how likely this is to occur in practice. My previous comments about the nature of tail-risk assets seem applicable here as well.

A related issue has to do with the timing of recapitalization and resolution of uncertainty. In the model, the recapitalization decision occurs after future returns are known with certainty; yet, in reality, policymakers and researchers have been concerned with residual uncertainty at the time of the recapitalization decision and the debt overhang problem this creates. Some discussion of how residual uncertainty and debt overhang are likely to affect the model's results would be useful.

Another facet of applicability has to do with the parameter restrictions that are required for the results of interest: those that guarantee risk shifting only takes place through tail risk, and those that guarantee an interesting trade-off between risk-shifting concerns in the tail-return state and recapitalization concerns in the low-return state. In order to assess the importance of these results, it would be helpful to know what real-world situations correspond to these parameter restrictions and how likely they are to occur in practice.

Finally, the analysis takes initial capital and capital requirements as costless and exogenous and ignores questions of how tail risk affects the broader economy. Since even initial levels of capital may involve private and social costs (Diamond and Rajan 2000, Gorton and Winton 2000, and Hellmann, Murdock, and Stiglitz 2000), and regulatory responses during the crisis focused on possible externalities from tail-risk-induced bank failure, incorporating some notion of these costs of capital and bank failure and their effect on social welfare would greatly increase the paper's impact.

3. Conclusion

Perotti, Ratnovski, and Vlahu demonstrate that recapitalization costs can have counterintuitive effects on the relationship between bank capital and risk shifting, particularly in the presence of tail risk. Although I have suggested some ways in which the analysis can be extended and deepened, the paper is intriguing and the topic is well worth further study.

References

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