What assets should banks be allowed to hold?

Appendix A-3

Efficient monitoring in the Calomiris-Kahn model

Here we explain this basic idea using the Calomiris-Kahn (1991) model. In their model, the authors imagine a world where investing is fraught with moral hazard. For simplicity, assume that there are only three people, all of them risk neutral: A banker who has no apples, but does have access to a project (a loan opportunity), and two investors, each of whom has one apple. The first investor will be labeled the "sophisticated" investor and the second the normal investor. Further assume that the project needs two apples to start up.

The project yields $Y1$ or $Y2$ apples ($Y1 < Y2$) in the following manner: First, with probability π the project becomes a good project (and with probability $(1-\pi)$ it becomes a bad project). Good projects yield $Y2$ with probability pg, and bad projects yield $Y2$ with probability $pb < pg$. So before it is known whether a project is good or bad, it yields $Y2$ with probability $\pi \, pg + (1-\pi) \, pb$.

What makes the project perilous is that (1) only the banker can see whether $Y1$ or $Y2$ actually occurs and (2) the banker can abscond with a portion of the resulting apples. In particular, after $Y = Y1$ or $Y2$ is realized, the banker can abscond with $A \times Y$ apples (where $A < 1$) and the other $(1-A) \times Y$ apples are simply destroyed. The fact that only the banker can see whether the good outcome $Y2$ or the bad outcome $Y1$ occurred implies that the payment from the banker to the investors can't depend on which outcome occurs. Call these payments PS and PN (for sophisticated and normal). To

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keep the banker from absconding if the outcome is Y, it is necessary that $Y - PS - PN$

$>= A \times Y$, or that the payoff to the banker if the bad outcome occurs is better than the

banker's outcome from absconding. (Note that if $Y1 - PS - PN >= A \times Y1$, then $Y2 - PS$

$- PN > A \times Y2$, since $Y2 > Y1$ and $A < 1$, or, in words, if the banker doesn't want to

abscond when the project outcome is bad, then the banker also doesn't want to

abscond when the project outcome is good.) Finally, assume each of the investors can

simply store his apple in a riskless asset that returns S apples.

Suppose that $Y2 = 4$, $Y1 = 2$, $A = 1/10$, $\pi = .9$, $pg = .9$ and $pb = .1$. That is, the

project yields four apples (from an investment of two apples) 82 percent of the time

(since $.9 \times .9 + .1 \times .1 = .82$). Otherwise, the project simply returns the invested two

apples. Given these numbers, investing in the project is socially useful. The expected

outcome if two apples are invested in the risky project is $.82 \times 4 + .18 \times 2 = 3.64$ apples,

while if the investors put their apples in the safe asset, the two apples become three

apples.

But that it is socially useful does not imply investment in the project. Given the

ability of the banker to abscond, the best the investors can do given these assumptions

is to assume that the banker will abscond when $Y = Y1$ and set $PS + PN$ to the highest

amount such that the banker won't abscond when $Y = Y2$, which implies $PS + PN = Y2$

$\times (1 - 1/10) = 3.6$. But since they receive this payment with only 82 percent probability,

they receive, in expectation, $3.6 \times .82 = 2.952$ apples in return for their investment of

two apples. But the investors can, on their own, transform their original two apples into

three apples with no chance of the banker absconding. For these example numbers, the

investors won't invest in the risky project (again, even though it dominates the safe investment in terms of expected return).

But now suppose that the sophisticated investor has another option. In particular, suppose that after it is determined whether the project is good or bad, but before the outcome of the project is realized, the sophisticated investor can, privately and at a cost $c > 0$, research the bank's investment. That is, if the sophisticated investor chooses to pay this cost, he gets to privately see whether the project is good or bad. Further, after seeing whether the project is good or bad, the sophisticated investor can call for the liquidation of the bank. If the investor does so, the bad outcome $Y1$ is ensured, but the banker can't abscond.

For these assumptions, investment is now possible. Now let the sophisticated investor research and call for liquidation if he sees the project as being bad. This changes the outcomes as follows. Before, there were two possible outcomes: (1) the good outcome occurred (with probability .82), allowing the investors to collect 3.6 apples, and (2) the bad outcome occurred and the banker absconded (with probability .18), giving the investors zero apples. Now, with the possibility of liquidation, there are three possible outcomes: (1) the project is liquidated (with probability .1), allowing the investors to collect 2 apples, (2) the good outcome occurs (with probability .81), allowing the investors to collect 3.6 apples and (3) the bad outcome occurs (with probability .09), giving the investors zero apples. This implies that the investors will, in expectation, collect 3.116 apples for their two-apple investment (which is greater than the three apples they can together receive if they invest in the safe asset).

What is left to be determined is how many apples each investor gets under liquidation and the good outcome. Since the expected return on the risky project (to the investors) is 3.116 apples, while both investing in the safe asset yields a total of three apples, as long as $c < .116$, there is always a way to split the apples collected such that the sophisticated investor finds it worthwhile to invest in the risky project and pay the research cost (rather than invest in the safe project or invest in the risky project but not research) and the normal investor finds it worthwhile to invest in the risky project as well, but not necessarily by a rule that splits these apples evenly.

That is, suppose that $c = .1$, the investors split the 3.6 apples in the good outcome evenly and, under liquidation, the investors split the two apples available given liquidation evenly. Then the expected payoff to the sophisticated investor is $(.81 \times 1.8 + .1 \times 1 + .09 \times 0) - .1 = 1.458$. He would prefer the safe asset. But suppose the sophisticated investor gets more than an even split in liquidation. In particular, suppose the sophisticated investor receives 1.5 apples if he calls for liquidation and the normal investor receives .5 apples. Then the expected payoff to the sophisticated investor is $(.81 \times 1.8 + .1 \times 1.5 + .09 \times 0) - .1 = 1.508$, and the payoff to the normal investor is $(.81 \times 1.8 + .1 \times .5 + .09 \times 0) = 1.508$. Since the payoff for each is over 1.5, each will be willing to invest in the risky asset.