Bank Bailouts and Aggregate Liquidity

*By Douglas W. Diamond and Raghuram G. Rajan*

Governments sometimes bail out banks by recapitalizing them, or by offering to insure their liabilities. The government’s goal may be to rescue borrowers, bankers, or depositors, and economists have developed rationales why each of these constituencies may merit protection (e.g., Diamond, 2001). These potential benefits have to be weighed against the costs of a bailout, which are typically thought to be the damage to long-run incentives that such intervention engenders. In this paper, we present a different effect of bank bailouts: Bank bailouts alter the availability of aggregate liquidity in the economy. While a well-targeted bailout can help rescue an otherwise collapsing banking system (see Diamond and Rajan, 2001a), a poorly targeted bailout can even tip a banking system into a systemic crisis. This (ex post crisis) cost of bank bailouts, to the best of our knowledge, has not been examined elsewhere and is the focus of this paper.

I. The Framework

We consider a world with entrepreneurs, investors, and lenders. The economy lasts for two periods and three dates: date 0 to date 2. There are two kinds of goods in the economy: consumption goods and machinery. Each entrepreneur has a project, requiring one unit of consumption good at date 0, which the entrepreneur then converts to machinery. The machinery will produce \( C = 1.6 \) units of the consumption good either “early” (at date 1) or “late” (at date 2). Once a machine produces consumption goods, it becomes worthless.

Entrepreneurs have no money and need to borrow to invest. Each entrepreneur has access to a lender with knowledge about local entrepreneurs. This “relationship” lender can replace the entrepreneur when the project is about to produce and generate \( \gamma C = 1.28 \) from it; the lender knows a second-best use of the asset that does not require the entrepreneur’s human capital. Since borrowers cannot commit to use their future human capital on behalf of lenders at the time the loan is made, this is the amount that the lender can force the entrepreneur to pay when the project matures, leaving \( (1 - \gamma)C = 0.32 \) in the hands of the entrepreneur (as in Oliver Hart and John Moore [1994]). The relationship lender (or entrepreneur) can also restructure the project at any time to yield \( c = 0.4 \) in consumption goods immediately (and nothing on other dates).

It is convenient (but not essential) to assume that the relationship lender himself has no funds and that projects exceed available funds with investors. The potential lender has to raise money from investors, who have consumption goods at date 0 and can consume only at date 1 (they demand date-1 liquidity). The only new source of consumption goods at date 1 is production from early projects at date 1. Anyone can store goods, implying that the gross real rate of return between dates 1 and 2, \( r \), must be at least one \( (r \geq 1) \). Everyone is risk-neutral.

While the relationship lender has the aforementioned ways of recovering payment from the entrepreneur, outside lenders have none. The problem then is that having obtained investors’ money, the relationship lender can threaten to hold back his collection skills unless investors make concessions. The relationship lender has to find a way to commit to using his skills on behalf of investors, or else he will not be able to raise much against the loan he has made.

The way for the relationship lender to finance illiquid loans is to become a banker by issuing uninsured demand deposits (see Diamond and Rajan, 2001b). Because of the “first come, first served” aspect of uninsured demand deposits, no depositor would want to make a concession if the bank still has assets. Instead, each depositor could force the bank to sell assets to pay his

* Both authors are at The University of Chicago Graduate School of Business, 1101 E. 58th Street, Chicago, IL 60637, and also affiliated with the National Bureau of Economic Research. We are grateful for financial support from the National Science Foundation and The University of Chicago Center for Research in Security Prices.
claim in full (until the bank runs out of assets). In other words, demand deposits are virtually impossible to renegotiate down because depositors are liable to run if they ever apprehend that they will be paid less than their due. In a world without uncertainty, the bank can commit to pay all it expects to collect in the future, so that demand deposits are the most easily issued form of finance for the bank when it has the ability to pay.

Of course, an all-deposit-financed bank would be extremely fragile, in that deposits would run whenever bank asset values fell below the level of deposits. The bank can also issue some capital as buffer. The advantage of capital is that payments to it adjust to the value of the bank. Thus, if there is uncertainty about bank asset values, the bank can avoid destructive runs if it issues some capital in lieu of deposits. The disadvantage is that the banker will absorb some rents, unlike the case with deposits only. Trading off the destruction in value from runs against the loss in value because the banker retains rents, we find that when bank asset values are uncertain the banker may be able to pay out the most in expectation at a nonzero level of capital (see Diamond and Rajan, 2000). It will suffice for our purposes that there is a requirement that capital finance at least \( k = 0.3 \) of total assets (either because of unmodeled uncertainty or because of regulatory requirements), so that at date 1 the banker can commit to pay out only \( \gamma C/(1 + k) = 1.28/1.3 = 0.985 \) at date 2 (for a derivation, see Diamond and Rajan, 2001a). The banker absorbs the rest of the amount collected from a project maturing at date 2 \( (=1.28 - 0.985 = 0.295) \) as a rent at date 2.

We are now ready to provide an example of how recapitalization can affect aggregate liquidity and hence the health of the banking system. Let many \textit{ex ante} identical banks have made project loans at date 0. Each financed itself with identical quantities of demand deposits and capital. Let the quantity of demand deposits per loan for each bank be \( d_0 = 1 \). At date 0.5, we learn the maturity of each project, or more generally, when a bank’s portfolio of projects matures. We examine a state of nature where there are two \textit{ex post} types of banks. A fraction 0.4 of banks are type L and 0.6 are type H. Type-L banks have only borrowers with late projects (\( \alpha^L = 0 \)). Type-H banks have a mix of borrowers with early and late projects, where a fraction \( \alpha^H = 0.65 \) are early and the rest are late. The survival of each type of bank depends on whether it can refinance itself at date 1.

The intuition for the point we will now make is quite simple. Assuming all the up-front cash is lent to projects (and we can show that this will be the case if loans are worth making; see Diamond and Rajan, 2001a), the fraction of projects maturing early determines the natural aggregate supply of consumption goods. The aggregate demand comes from investors who have deposit claims and capital.

One potential problem in the banking sector is that some banks may be insolvent. This is a bank-specific problem. Even though the total amount collectible on projects is the same, regardless of when they mature, banks can raise money only against a fraction of the payments to be collected from late projects. As a result, a bank with a disproportionate fraction of late projects will not be able to raise enough to pay depositors at date 1. Anticipating this, depositors of such banks will run at date 0.5 itself, when they apprehend this scenario.

The run forces insolvent banks to restructure all projects and collect \( c = 0.4 \) immediately. This affects the aggregate supply of liquidity in two ways. If a bank’s projects are all late, the run enhances the aggregate supply because a late-maturing cash flow is converted to immediate cash. If a bank’s projects are all early, a run reduces the aggregate supply because a potential cash flow of \( C = 1.6 \) at date 1 is collapsed into cash of 0.4 at date 0.5, simply because depositors cannot wait. Runs also have demand-side effects, but we can abstract from these for now.

The second potential problem is that the aggregate supply of liquidity may fall below aggregate demand. The interest rate between dates 1 and 2 will then have to go up to make the production of immediate liquidity through restructuring late projects more attractive. A higher interest rate will also make more banks insolvent, which will affect the aggregate supply of liquidity as discussed above.

Absent intervention, insolvent banks are the ones with late-maturing projects: those that are most intrinsically illiquid and contribute least to the aggregate supply of liquidity. As they are run in a situation of aggregate liquidity shortage, the imbalance between liquidity demand
and supply narrows. If, however, these banks are recapitalized, liquidity has to be obtained somewhere to satisfy the inelastic demand of depositors. If there is no fresh source of liquidity, and illiquid banks are being propped up through government guarantees, more-liquid banks will eventually have to fail as real interest rates get bid up. In failing, these banks may subtract liquidity from the system rather than add it. Thus, the only outcome if the government has a limited purse with which to recapitalize the illiquid banks is a failure of the entire system. In other words, the kind of recapitalization that comes naturally, if conducted without taking due note of aggregate liquidity budget constraints, can make matters much worse. Now let us see this in an example.

II. The Example

The maximum amount that a bank can raise at date 1 is the present value of what it can collect and commit to pay to outsiders at date 2 plus what it collects at date 1. In this example, this amount is given by 

\[ v(\alpha^L, r) = \alpha^L \gamma C + (1 - \alpha^L) \max [c, \gamma C/(1 + k)r]. \]

The first term is that amount collected from early projects; the second term is the maximum of the amount obtained from restructuring late projects or raising money against them.

A type-L bank with \( \alpha^L = 0 \), can raise 

\[ \gamma C/(1 + k)r = 0.98/r < d = 1. \]

If this bank tried to remain solvent by restructuring all projects, it would be worth only \( c = 0.4 \). Type-L banks cannot survive at any feasible interest rate \( r \geq 1 \).

A type-H bank with \( \alpha^H = 0.65 \) can raise 

\[ 0.65 \times 1.28 + 0.35 \times \max [0.4, 0.9846/r]. \]

Note that this bank can pay off deposits, \( d_0 = 1 \), for all \( r < 2.05 \). Moreover, it raises more liquidity at date 1 by issuing claims against late projects \((= 0.9846/r)\) than by restructur- ing them \((=0.4)\) so long as \( r < 2.48 \). This means that the H bank, if solvent, will never restructure late projects on its own volition.

If there is no intervention, type-L banks will be insolvent. They will be run at date 0.5, and the lucky depositors who get to the bank before it runs out of assets collectively get the value of its restructured projects, \( c = 0.4 \). The bank raises no new deposits and sells no other assets.

As a result, the run on the L bank generates a zero excess demand for date-1 liquidity.

The type-H banks can collect \( 0.65 \times 1.28 \) from their loans to early projects. This will pay down deposits to \( 1 - (0.65 \times 1.28) = 0.168 \). The banks need to borrow this residual amount at date 1 (through fresh deposits and capital). They can issue these to early entrepreneurs (who each have \( (1 - \gamma)C = 0.2 \times 1.6 = 0.32 \) in date-1 cash to invest). Since there are 0.65 early entrepreneurs per project financed, they have a total of \( 0.65 \times 0.32 = 0.208 \) to reinvest. There is enough liquidity at date 1 to more than pay depositors (and, it turns out, capital) at H banks, implying that the interest rate will be the return on storage, or \( r = 1 \). The type-H banks are solvent, generate their own liquidity both directly (from collections) and indirectly (from cash borrowed from the early entrepreneur), and can remain in operation, calling none of their loans.

III. Equilibrium with Type-L Banks Recapitalized

Suppose now that type-L banks are recapitalized: They are granted gifts of date-2 value in order to survive. The simplest method would be for the government to guarantee all their deposits. As a result, the type-L banks will be able to raise sufficient deposits to survive (they can raise 1 at date 1). If both types L and H are to survive, the date-1 demand for liquidity is 1. The supply is less than this, and this will lead to a liquidity shortage at date 1, and a spike in interest rates.

Aggregate supply of liquidity if no late projects are restructured (per type of bank) is calculated as follows. From the H type we get 

\[ 0.65 \times C = 0.65 \times 1.6 = 1.04, \]

and from the L type we get 0 (because all projects are late). Thus aggregate liquidity is given by 

\[ 0.6 \times 1.04 = 0.624. \]

At any interest rate that the type-H banks could pay (remember, the H type can pay up to \( r = 2.05 \)), there would be insufficient liquidity for both types of banks to survive. If only type-L banks were recapitalized (but not the type H, type L would outbid type-H banks, until they push the interest rate to the point that type-H banks become insolvent. Once type-H banks are insolvent, their failure causes a large reduction in aggregate liquidity, to 0.4, as all of
the early projects are restructured in response to a run on type-H banks. In other words, because both liquidity supply and liquidity demand are relatively inelastic, the bailout of the illiquid L banks will only transfer the problem to the more-liquid H banks. The failure of the liquid H banks will be more harmful to aggregate liquidity since, instead of adding to liquidity, failure will subtract liquidity.

If this interest-rate spike were to occur, it is likely that the government would recapitalize the type-H banks as well. At very high interest rates, banks would choose to restructure their late projects to raise liquidity. However, even in that case, there would be insufficient liquidity.

IV. Liquidity with a Generalized Recapitalization

With a generalized recapitalization, we could get from type H, at most, $0.65 \times 1.6 + 0.35 \times 0.4 = 1.18$. From type L, we would get $c = 0.4$. Thus aggregate liquidity is given by $0.4 \times 0.4 + 0.6 \times 1.18 = 0.868$, which is less than aggregate deposits of 1. As a result, even if both types of bank are recapitalized, the liquidity constraint will bind. The market will not clear, and if the only available tool is the guarantee or gift of future value, any amount of future value will be insufficient. Of course, the government budget constraint will eventually bind, and the banks will both fail.

V. Discussion and Conclusion

The critical point made by Diamond and Rajan (2001a) is that, while it is well understood that aggregate liquidity conditions can affect bank solvency, it is less well understood but equally important to note that bank solvency can affect aggregate liquidity. Depending on the characteristics of the banks that are in danger of failing, their failure can either subtract from the aggregate pool of liquidity or add to it. As we show here, it may be possible that the natural sequence of bailouts (weakest and most illiquid banks first) leads to an escalating set of bailouts, which culminates only when the government has no more resources to infuse. More generally, bailout decisions that increase the excess demand for liquidity can cause further insolvencies, and indeed, a meltdown of the entire system, where contagion is spread via the common pool of liquidity. In short, while the appropriate intervention is by no means clear if the regulator can observe only crude public data, an improper bailout of some banks can cause a system that would otherwise stabilize with a few bank failures, to collapse completely. These possibilities should temper both regulatory zeal and inertia and should prompt further research.

REFERENCES


