Lecture 14:
Operational Risk, Bank Runs I

We begin with another quick dive into the topics of risk management. Chapter 13 deals with Operational Risk, which is in many respect very different from what we have seen earlier, but it would take us too far to go into much detail so we read only the sections 13.1 and 13.4. This type of risk doesn't quite follow the standard scheme of our treatment (identifying risk factors, setting up a model of how the risk factors give rise to losses, and then finding loss distributions), since operational risks can take very many forms, and indeed operational risk is risk that doesn't fall into any of the well-defined categories (market risk, credit risk and – to be treated soon – liquidity risk). Consequently, formal methods are not as well developed as they are for the other risk types, and the standard approaches relying on fixed percentages are in widespread use. The main feature of the standard approach is that the capital ratio (proportion of capital which should have the form of equity set aside so that operational losses do not touch the deposits or other loans to the bank) should depend not on assets, which do not by themselves give rise to operational losses, but on activity, measured as average (over recent periods) gross income. Once again, Basel II allows for a more sophisticated approach using the internal data of the bank.

Having considered (minor) irregularities in the previous lecture, we now move to major troubles in Chapter 14 dealing with liquidity problems and bank runs. For this, we first take a closer look at this using the tools that we have already developed, namely the Diamond-Dybvig model from Chapter 1, the first of the many models of banking that we have been considering. The model was constructed with the specific purpose of studying bank runs, we have so far only used its by-products, namely a detailed description of the fundamental banking contract, where depositors have the right to get their deposits back at request although the bank has only a fraction of it ready for such payments.

We saw in Chapter 1 that this form of fractional banking works fine under normal conditions (which were those spelled out in the model): Banks keep sufficient liquidity to pay the average impatient depositors, using the rest to create surplus paid out to both patient and impatient as interest, and everybody is happy. However, if for some (yet unexplained) reason, the patient depositors at date 1 start to doubt whether the bank will have enough money to pay them their due share at date 2, then they will show up pretending to be impatient, getting somewhat less but at least getting their money back with some interest rate. But the bank has only money to pay the truly impatient, and having promised every depositor payment at any time, it will default.

So, as it turned out, the suspicious patient depositors were right, the bank could not deliver at date 2. The situation is what is known as a *sunspot equilibrium* in economic theory: There is uncertainty which is *intrinsic* (not derived from anything related to the utilities or the investment, people have expectations about the uncertain events, and in equilibrium the expectations are confirmed by what actually happened (The term "sunspot equilibrium" has historical roots, it is due to a conjecture by Jevons around 1880 that the business cycle could be connected with the occurrence of sunspots which has a similar cyclicity, a theory which didn't hold but has not resurrected in a new form).

Setting aside fancy theory, we return to the problem of banks in troubles. Bank runs caused by subjective panics have occurred for centuries, and several ways of avoiding them have been proposed. We discuss a few in Section 14.1: *Suspending payments* will work fine in our model – if everybody knows that the bank will pay out only the fraction π at date 1, then there is no problem for the patient in waiting, since the money is there. Fine that this sounds, it works less well if the world is not a copy of the Diamond-Dybvig model – how can we know whether the fraction π is the right one? and how do the investment rounds of different periods interfere with the outpayments? Similarly the idea of transforming deposits to equity is nice but not really a solution. Check the computations, which are not complicated – if the dividend is fixed in the right way, then the "deposit certificates" work as well as deposits would have done, and surely there is no need for a run, everyone can just sell the certificates if need arises. Unfortunately, we again need to know π in order to get the perfect substitute, and on our way to improve fractional banking we have done away with it, moving towards a primitive form of shadow banking.

The idea behind *narrow banking* as outlined in Section 14.2 appears as very unreasonable, but this is partly due to the very simplicity of the formulation of the proposals of narrow banking. What is proposed is rather a separation of financial intermediation, so that some banks take deposits but invest only in very liquid securities, whereas other banks are engaged in risky lending but are funded in other ways. The old ideas of narrow banking are slowly filtering into the way in which the financial sector is being reformed or perhaps into which it transforms itself, with shadow banking taking over some of the functions of the risky loan business.

We proceed in Section 3 with a short treatment of *liquidity risk*, discussing a model for the determination of the optimal liquidity reserve in a bank (notice that the liquidity reserve is another concept than the capital ratio, the latter deals with equity, but a bank can have a large fraction of equity but no liquidity reserve – as well as having liquidity but very small fraction of equity). The model uses a classical model from operations research, determining the optimal inventory, but the result is not quite convincing, suggesting that something is missing in the model. Read the first page and skip the rest, anyway the model is of limited interest. The Basel regulation of liquidity was introduced by Basel III and falls somewhat outside the standard forms of regulation, we return to this in Chapter 18.

The story now goes on with the Bhattarachya-Gale model of the interbank market. We arte still discussing possible remedies for liquidity problems in banks, and an obvious way of solving an acute liquidity problem would be by a loan from another bank. Before the 2007-8 crisis there was a very active interbank market where banks could borrow and lend at short notice and without any form for collateral. This was largely spoiled by the bank defaults taking place during the crises, the interbank market still exists but the former days did not return, loans are usually given against collateral and turnover is small.

The formal model looks much more impressive than it is. Basically there are several Diamond-Dybvig banks, each having their own characteristic parameter π, the fraction of impatient depositors. Since the depositors all prefer to have as little risk as possible, the best contract would be the one based on average impatience. But with this common contract, some banks will be short of liquidity at date 1, others will have too much. This can however be taken care of by loans from surplus liquidity banks to deficit liquidity banks, and since the contract was based on average, this can all be paid back at date 2. Feel free to skip the tedious details, in particular the computation of the interbank repayment rate, this is not terribly important anyway. The point of this model (which comes from the years before the financial crises) is that the interbank market is a way of making overall the system work while avoiding liquidity crises. What is not taken into consideration is that banks may ask for liquidity not only because they have more impatient depositors than the average, but also due losses on too risky assets.

We skip for the moment Section 14.5 and discuss the HHH(Heider-Hoerova-Holthausen)-model in Section 14.6. Although this may not be seen immediately, this model is basically a variant of the Battarachya-Gale model in 14.4, what has been added is that investments are no longer absolutely sure (as in the Diamond-Dybvig model), so that the outcome R will be obtained only with some (presumably high, but nevertheless..) probability. This probability is revealed to the investors only at $t = 1$, and if the probability is low and the bank is a net borrower in the internet market, then there is a possibility that the lender will not get the money back at $t = 2$.

The analysis of this model has two steps, in step 1 it is assumed that all banks observe all the success probabilities, so there is full information. In this case the market works fine, there will clearly be different terms for the bad borrowers than for the good borrowers, and the interest rates can be found in the same way as in the B-G model. Don't waste too much time on this, once you have understood that this is essentially the same model only with a few more details.

In step 2 we assume that there is asymmetric information, only banks know only the success probabilities of their own investments. This causes much more trouble, and the formalism may be tedious, but skip it and follow the intuition: Lenders in the interbank market cannot observe the quality of their borrowers, so they need at least the return corresponding to the borrowers that they actually get. Since this leads to high interest rates, some of the borrower banks – those with good investments – may prefer to liquidate part of their investments rather than paying the high rates to the lender banks. This type of adverse selection (good borrowers stay away) has as result that there are only bad borrowers in the market, and the consequence may be that the lenders do not want to supply funds to the interbank market (this is just as we saw in Chapter 6 – even high interest rates may not be enough to secure the supply of credits). As a result, the interbank market ceases to do business, and this was largely what happened during the financial crisis.

We read: Chapter 13, sections 1 and 4. Chapter 14, sections 1-4.