Lecture 10:  
Credit Risk, Payments

In our discussion of risk management we have now come to credit risk. We begin with a general discussion of the background for measuring credit risk (something that we have already discussed) and in particular the background for the emergence of many new methods for this measurement.

We then proceed to a discussion of the theoretical background for the credit risk models used in practice. These models are usually subdivided in two classes:

- structural models
- reduced models

It is easier to begin with the second type, the reduced models, so this is what we do. The inspiration comes from survival theory dealing with events which occur randomly but subject to some probabilistic regularity, a field which is particularly wellknown in medical statistics and insurance. Here the event which may happen is a total or partial loss of assets, that is loans that should otherwise have been paid back. In the simplest version, where loans are lost with a certain constant intensity independent of past performance, the performance of the loans are described by a Poisson process, and the parameter can be given an interpretation as a spread, an add-on to the interest rate which covers the additional risk.

The structural models are based on the approach initiated by Merton, where loans are seen as the combination of two transactions, namely (1) the purchase by the bank of the assets of the firm and (2) giving the firm an option on buying back these assets (by paying back the loan). The value of the loan can then be found by assessing each of the two parts, that is the value of the assets of the firm and the value of the option. The section uses option pricing and the formalism may be somewhat tough. You are not supposed to memorize the formulas, what matters is understanding basic principles of the Merton approach and the difference between this and the reduced model approach. In Sections 3.2, we are only interested in the first part which express the spread in the Merton model, which now depends on the details of the lone (thus differing from the Poisson case just treated). We skip Section 3.3.

We then turn to the regulation of credit risk, where the main point is the distinction between standardized and internal ratings-based approaches. The latter was introduced in Basel II and makes it possible for the bank to use its own data to assess their assets, using methods approved by the financial authorities. When this possibility was opened up, the banks wanting to use it had to set up a suitable model,
and the types of models which were put into use fell into the categories which we outline briefly. Each of them was proposed by consulting firms offering their services to the banks. The first two of the models, KMV and CreditMetrics, use the structural approach, the last one with reliance on a Markov model using credit ratings, while the two others use a reduced form approach, the first one through a Poisson-type model and the second using econometric formulations.

There is a final section in the chapter dealing with consumer credit risk, which is treated in its own way, here the main problem is whether to accept or reject a new customer. I leave it to possible individual reading, it is not in the curriculum.

We then move to another topic and another chapter, namely Ch.10 on payments, one of the traditional sources of income for banks. Payments can take many different forms, and the chapter covers only some of these – actually, this is a field where a five year old textbook runs a serious danger of being outdated. We skip first two sections, dealing mainly with interbank payments, something which is not a central concern for us, and read only sections 3 and 4 (which comes in the next lecture).

Section 10.3 deals with payment cards. The model considered, due to Rochet and Tirole, represents the standard approach to the theory of payment cards, so we go into considerable detail with it. Much of it looks more like industrial organization than banking, and the clue comes only at the very end, so late that one usually thinks that all has been done and therefore pays no attention to it (look below where we point it out once more).

The background for the model is the picture in Figure 10.1 with the four parties involved, a buyer and a seller at the bottom and their respective banks above. For the model, what matters is the fee structure: The buyer’s bank (here called the issuer) demands a fee \( f \), and then again demands a fee, the interchange fee, for transferring money to the seller’s bank (the acquirer) to which the seller has to pay a fee. There is no fee payment from buyer directly to seller (or the other way, for that matter), following the standard rules in the early days of payment cards.

Notice that what is done below is all related to a single transaction (the buyer needs to buy something from the seller to the price \( p \)), so what the model is studying is a sort of use-only-once payment card, not quite corresponding to reality. This occurs since the fees are all per transaction, something which holds for some but not all of the fees, usually the buyer pays a fixed fee for the card independent of its turnover. We shall have to live with this feature, and you might later reconsider the model to see what happens if for example \( f \) is not charged per transaction but as a one-time fee.

Don’t be scared away by the fancy formalism on p.209. It tells us only that buyers differ in how much they like to pay by card, and if the fee \( f \) gets larger, more and more buyers turn to cash instead of card. The fee itself is determined by the issuer(s) in a way which is not analysed in the model, it is assumed that when the interchange
fee goes down, then the costumer fee goes up (since the cost and perhaps a profit must be covered by these two fees). The acquirer is assumed to pass all its costs to the merchant in the form of its fee.

Before proceeding, it is useful to determine a particular value \( \tilde{a} \) of the interchange fee \( a \) (later we shall use this in the welfare assessment of the whole arrangement), namely the value for which the subjective benefit of the average card-using costumer exactly equals the net cost on the merchant side, that is the transaction cost minus the benefit to the merchant of card payment rather than cash (this benefit has become more manifest in the actual corona-situation).

Now comes the industrial-organization ghetto of the model: We assume that there are two merchants, and that their competition can be described by the classical Hotelling model with transportation cost for costumers spread even on a straight line between the two merchants (this is of course a very particular model, but it has the advantage that one can trace the workings of competition, both in prices and in card acceptance, and find the exact consequences).

The proposition tells us that there is an equilibrium (with both charging the same price and both accepting cards) if the interchange fee is no greater than \( \tilde{a} \). The first part is easy, namely a check that as long as both accept cards, one can find an equilibrium in the way which is standard in Hotelling models (and we shall actually see it again in the next chapter), namely with price equal to marginal cost plus the transportation cost (firms can charge price this even though costumers pay the transportation cost, since moving to a competitor would entail at least as high and possibly higher transportation cost).

The tricky part is to check that no merchant wants to depart from the equilibrium by ceasing to accept cards. In this case, the fee payments are reduced, and the merchant may lower prices and capture costumers from the other merchant. You don’t need to work yourself through the computations on pp.210-11, try instead an intuitive approach: Assume that \( a \leq \tilde{a} \). Then the fee is rather high, so the average benefit of costumers paying with card is higher than the net cost of the merchants. In order just to keep the costumers previously using cards the price must be reduced with more than the savings, and therefore it is not possible to increase profits by this strategy.

Now (last half of p.211) comes what was the point of the whole story, and the reason why we became engaged in it: How can or should the payment card industry be regulated? In our simple model there is only one parameter, which is subject to government regulation, namely the interchange fee \( a \), and it should be used to achieve an efficient working of the system of payment card payments. Since we can express welfare of the parties (buyer and merchant) as benefits and costs, it is clear
that in the optimum, marginal benefits should equal marginal cost, which is

\[ f + b_S = c_l + c_A \]

with \( f \) being the benefit of the marginal card user. Now it is crucial whether case (i) or (ii) on p.212 holds, since in case (ii) an increase of \( a \) beyond \( \bar{a} \) has result in the market breaking down, since the merchants cease to accept cards.

We read: Chapter 7 except sections 3.2-3, 6, Chapter 10, section 3.