

## 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 ten years old textbook runs a serious danger of being outdated. We skip the first two sections, dealing mainly with interbank payments, something which is not a central concern for us, reading only sections 3 and 4 (which comes in the next lecture).

Section 10.3 deals with payment cards, discussing the almost-classical model of Rochet and Tirole. A central problem here is whether or not consumers will use payment cards, a question which by now, 20 years and so later, seems completely outdated. It could however as well be applied to other payment methods (using the mobile phone, face recognition etc.), so it makes sense even today.

The background for the model is the picture in Figure 10.1 with four parties involved, a buyer and a seller at the bottom and their respective banks above. 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.

The first step is to determine a particular value  $\bar{a}$  of the interchange fee  $a$  such that the subjective benefit of the average card-using customer 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. Then comes the industrial-organization part of the model which deals with the connection between card fee and pricing. The proposition tells us that there is an equilibrium with card use if the interchange fee is no greater than  $\bar{a}$ . The first part of the proof is easy, it is just checking that with card use one gets the standard equilibrium in Hotelling models. The tricky part is to make sure that no merchant wants to depart from the equilibrium by ceasing to accept cards. You don't need to work yourself through the computations on pp.210-11, we rely on an intuitive approach: Assume that  $a \leq \bar{a}$ . Then the fee is rather high, so the average benefit of customers paying with card is higher than the net cost of the merchants. In order just to keep the customers 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.

The final part of the section deals with the welfare aspects of the interchange fee, showing that care should be taken in regulation.

If time permits, I add some comments on clearing payments (see the note on the homepage). We return to it when we discuss systemic risk.

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