EC372 Economics of Bond and Derivatives Markets

Financial Intermediation, I: Fundamentals

Overview

This note provides an overview of financial intermediation, with a particular emphasis on the microeconomics of banking. It begins by reviewing the functions of financial intermediaries in section 1, followed by an analysis of banking risks from the perspective of a bank's Balance Sheet in section 2. Section 3 studies the process of securitisation creating 'asset backed securities', a process that expanded greatly in the decade prior to the onset of the crisis in 2007.

One of the main questions addressed in the theory of financial intermediation is why some capital is channeled from borrowers to lenders via marketable instruments (e.g. bonds) while some is passed indirectly from lender to borrower via an intermediary. While detailed study of the question is left for next week, section 4 discusses one approach, based on the role of banks in *screening* potential borrowers (firms) to separate those which are creditworthy from those which are not.

1. Functions of Financial Intermediaries

Here is a classification of the functions typically performed by financial intermediaries:[1]

1. *Payments system* – provides a mechanism allowing debtors to settle with creditors, i.e., a mechanism for the transfer of cash, via bank deposits.

2. *Risk sharing* – enables separate investors to hold fractions of assets that would otherwise be too risky or too large (indivisible) for any one of them.

3. *Risk pooling* – to take advantage of the 'law of large numbers', rendering predictable uncertain events (e.g., insurance contracts) the outcomes of which are, individually, open to wide prediction error.

4. *Delegated monitoring* – managing the incentives of borrowers (including potential borrowers). This function is studied in section 4 and – in depth – next week.

5. *Dissemination of information* – collecting and presenting information that might otherwise be difficult or costly to obtain, e.g., 'price discovery' that identifies prices at which assets can be traded.

Institutions that deliver some/all of these functions evolve over time – institutions adapt to changing circumstances while the functions tend to stay much the same. The commonest enduring intermediary is a 'bank', though they exist in several varieties (e.g. commercial banks, investment banks, savings banks, central banks) the functions of which tend to differ across time and location. Other financial intermediaries include insurance companies, 'shadow' banks, hedge funds, private equity funds, and many other institutions. Arguably, financial futures and options exchanges should also be classed as financial intermediaries inasmuch as they act as guarantors of trades that they process.

[1] For a fuller discussion using a similar classification, see Merton, R. C. "A Functional Perspective of Financial Intermediation", *Financial Management*, vol. 24, Summer 1995, pp. 23–41.

Banks as creators of money?

In the following sections, financial intermediaries are represented by 'banks', aspects of intermediation not normally associated with banking being noted where necessary. For many economic applications, especially introductory textbooks, banks are supposed to be unique among private sector institutions in that they alone are 'creators of money'. This highly misleading assertion means simply that a class of bank liabilities (bank deposits) are widely accepted as a medium of exchange for the settlement of debts. As such, banks can have effects that spread far beyond the banking sector (the successful operation of payments systems relies crucially on banks' decisions). Consequently, the banking sector has attracted all sorts of regulatory intervention – intervention that has in itself served to separate banks from other financial organisations. Events since 2007 (and, in fact, long before then) show, however, that banks as financial intermediaries impact on the economy in ways that go far beyond the simple-minded textbook interpretation. It is these aspects that receive particular attention below.

2. Bank risks: a Balance Sheet Approach

As pointed out above, in view of the widespread relationship between banks and most non-financial sectors, the operation of banks can have major impacts on the rest of the economy, not least because of the potential for 'contagion', when problems in one bank rapidly spread to other banks and are magnified many times over in their impact sometimes resulting in economy-wide – even global – crises. Hence, the risks associated with banking operations have become the subject of close scrutiny.

The variety of banks' risks are conveniently expressed via a simplified Balance Sheet:

Liabilities	Assets
Net Worth	Loans
Bonds (debt)	Securities
Deposits	Reserves
Total Liabilities =	Total Assets

(The reasons for the categories of assets and liabilities are explained below.)

Balance sheet analysis is of focal interest to accountants, regulators and lawyers (who typically dictate the rules for balance sheet construction). For economic analysis, however, balance sheets should be treated with caution because: (a) they provide an incomplete representation of assets and liabilities (especially liabilities); and (b) the values ascribed to each item are estimates, much more open to disagreement than might first appear – beware of grand pronouncements made on the basis of numbers reported in balance sheets.

Total liabilities and assets are, by definition, equal because 'Net Worth' is defined to be total assets minus total contractual liabilities. Contractual liabilities are those to non-owners of the firm, in this case Bonds and Deposits. Thus, 'Net Worth' is what belongs to the bank's shareholders, also called 'Equity'.[2] In this classification bonds are separated from deposits because bonds are typically marketable securities with terms to maturity that could span several years, in contrast to deposits, which can often be withdrawn from the bank with very short notice, commonly on demand.

On the assets side are:

Loans – made to companies or individuals, possibly for several years, non-marketable;

[2] A bank – or any corporation – is deemed to be 'insolvent' if Net Worth is negative. The securities, typically ordinary shares or common stocks, underlying any company's Net Worth are what confers ownership rights – and responsibilities.

Securities – of various terms to maturity, various degrees of riskiness, but marketable;
Reserves – cash or securities that are 'liquid' in that they can be readily turned into cash for a known value at short notice.

One of the main functions of banks is 'asset transformation' (encompassing items 2, risk sharing, and 3, risk pooling, of the list in section 1). Traditionally, this function takes the form of liabilities (e.g. demand deposits) that have a shorter time to maturity (are 'more liquid') than assets (e.g. loans, that are 'less liquid'). Banks then profit from the differential in interest rates – typically higher for longer-dated securities – but must bear the risk that deposits will be withdrawn before the loans mature. By the start of the 21st century, this interpretation had been much extended: many short term liabilities (e.g. 'wholesale' borrowing from money markets) may be more vulnerable to immediate withdrawal than deposits; and the range of assets is much broader than conventional bank loans (with longer or shorter times to maturity and bearing more or less risk).

What's missing from a bank's balance sheet? A variety of obligations by, or to, the bank are omitted from its balance sheet usually to conform with regulation or convention. Even so, sometimes these 'off balance sheet' items can be vitally important for the survival of the bank.

> *Example*: a bank may have agreed with a client that the client has the right (but not the obligation) to sell a portfolio of assets to the bank at a date in the future for a sum agreed to-day. This is a contingent liability – effectively the bank has written a put option that may never be exercised (the bank may never become liable to buy the portfolio).
>
> The bank may be allowed to omit this contingent liability from its balance sheet. But even if it must appear, how is the option to be valued? If the basis of valuation is 'historic cost' this would equal the premium paid by the client to the bank. But, especially sometime after the contract has been agreed, this may bear little relationship to whether the bank is likely to be required to buy the portfolio or of its value if it is. Perhaps the basis of valuation is 'fair market value' but there may be very little, if any, basis for comparison with any observed market price – suppose that nothing like the contract is traded in option markets. No doubt some estimate of the current value of the option could be made, though subject to a wide margin of error (and scope for legitimate disagreement).

Other examples of 'off balance sheet' obligations appear in the context of securitization (section 3 below).

Valuation of assets and liabilities: as estimates, values recorded in balance sheets are open to error (as well as misinterpretation). Hence there is more scope for legitimate disagreement than might appear (e.g. with regard to a bank's solvency). Two of the conventions (in law and accountancy) are: 'historic cost' and 'fair market value', the latter now being more commonly accepted. 'Historic cost' refers to the valuation at the time an asset or liability was acquired: with the passage of time, this value may become a very inaccurate expression of how much an asset would fetch or of the obligation associated with a liability.

'Fair market value' is straightforward to apply for marketable securities, at least when the market is 'liquid' (i.e. that the security can be bought or sold within a short period of time for a known price, or, alternatively, securities for which the bid-ask spread in price is narrow). But many of a bank's assets (e.g. loans) may not be readily marketable, or even if they are, a suitable counterparty for the trade may take sometime to find.[3] In these circumstances, the usual convention is that 'fair value' represents the price that the asset would hypothetically command *if* it were marketable and in the absence of arbitrage opportunities in comparison with securities for which reliable market prices can be found. Whether such 'fair value' estimates represent accurate valuations is open to argument.

[3] Also note that the urgency with which an asset is to be traded may substantially affect its price – a holder who can afford to wait may well expect to receive a higher price than for an immediate sale, especially in times of market turbulence.

2a. Banking risks

Asset risks

For analytical purposes, the following classification of banks' asset risks is convenient:[4]

1. Credit risk – the risk of contractual failure, typically default on loans.
2. Market risk – the risk of fluctuations in the market prices of assets the bank holds.
3. Interest rate risk – a subset of market risks, associated with fluctuations in bond prices (hence bond yields, usually studied in the context of the term structure of interest rates).
4. Liquidity risk – the risk that a bank will incur losses as it liquidates assets in order to fulfil its obligations to repay its deposit or bond holders. Bank reserves, in the form of cash, deposits with other banks or deposits with the central bank, are held in order to mitigate liquidity risk; but reserves almost always yield lower returns than other assets and hence are unattractive to the bank.

Liability risks

The main form of liability risk is an unexpected reduction in a bank's deposits or in its capacity to borrow. A classic 'bank run' occurs when depositors withdraw funds fearing that unless they do so, the bank will cease to have access to the cash required to meet its obligations.

This illustrates a risk that stems from the 'asset transformation' described above, in which banks 'borrow short' (by accepting demand deposits at low interest rates) and 'lend long' (by making loans at higher interest rates). But the assets are typically less liquid than the liabilities.

From 2007 this 'mismatch of maturities' liability risk manifested itself with an event where a bank suddenly finds that it is unable to raise funds in the 'wholesale money market', in which banks borrow for very short terms (say, overnight) via REPO agreements with other financial institutions. This is a way in which 'contagion' can swiftly spread financial distress throughout the entire financial sector.

2b. Regulation

Aims and principles of banking regulation

State regulation of the financial sector has several objectives, including:

1. *Economic stability* – a top priority for the authorities is to preserve the integrity of the payments system (without such a system any modern economy would swiftly become paralysed). Given that this is achieved, it is generally accepted that regulation should foster the broader economic performance, effectively to promote the functions of risk-spreading and risk-pooling (essentially ensuring that banks are able to provide loans to reputable borrowers, e.g. loans to businesses).
2. *Equitable treatment*, which is really no more than a subset of broader state support for contractual honesty and the rule of law. The complexity of modern financial systems means that rules, guidelines and precepts are needed to minimise the burden of litigation.

[4] See Freixas, X. & J-C. Rochet, *Microeconomics of Banking*, second edition, ch. 8.

3. *Rent seeking*: although never admitted by any regulatory authority, it is possible (likely?) that regulatory policies are designed at least partly to benefit the regulators themselves, to serve their narrow purposes. For example, governments commonly impose restrictions that enable their debt to be financed more cheaply than otherwise (effectively a source of 'tax revenue').

   More importantly, all forms of regulation are vulnerable to 'regulatory capture', whereby special interest groups are able to acquire powers that enable them to manipulate regulations that secure, reinforce and profit their members. Financial regulation is particularly susceptible to capture because the complexity of the financial systems and contracts means that financial institutions are needed to provide expert advice in the details of regulation; moreover much of the regulation is 'self-regulation', readily open to abuse.

Although the aims of regulation are similar across the world, the principles that guide their implementation show more variation. Some countries rely more on market discipline ('Anglo Saxon' nations such as Britain and USA) than others which adopt a more statist, direct state intervention, approach (e.g. France). Within these broad groups, different jurisdictions place more or less weight on authorities that are, at least ostensibly, independent of political control (e.g. central banks that are governed by boards, the members of which are political appointees but which have security of tenure for a stated period of office).

Forms of banking regulation

Among the many and various methods adopted for regulating banks, the following deserve mention:

1. *Deposit insurance* – in most countries deposits with banks (institutions that have been granted 'deposit taker' licences) are protected by the state up to a specified amount. By averting bank runs, this is probably the single most important regulation that preserves the integrity of the payments system.

2. *Liquid reserves* – traditionally banks have been required to maintain a minimum proportion of their assets in a specified form, typically cash and deposits at the central bank. The reserves then provide a buffer stock with which banks can meet unexpected withdrawals of deposits. (Also, because the reserves yield a low, perhaps even negative, rate of return, they provide a source of 'tax' revenue for the authorities.)

3. *Capital requirements* stipulate a minimum for the ratio of a bank's net worth to its total assets. In practice, the specified 'capital ratios' are more complicated, obliging banks to hold particular types of capital ('tiers') as minimum proportions of total assets.[5] By setting minimum capital ratios, governments try to ensure that reductions in their assets are unlikely to trigger bank insolvency (unless the reductions are gigantic).

   Also proposed is that banks should be required to hold a proportion of their liabilities in the form of a special sort of bonds that would automatically become equity in the event that insolvency threatens. These are the so-called 'CoCo' (Contingent Convertible) bonds, which would be more risky than non-CoCo bonds in the sense that their conversion into equity would be triggered only in circumstances that losses are likely. Many banks resist the introduction of

[5] Many countries adopt ratios that are at least as high as the ratios contained in protocols known widely as 'Basel II' 'Basel 2.5' or 'Basel III', recommended by the 'Basel Committee on Banking Supervision', which operates in conjunction with the 'Bank for International Settlements' (a consortium of central banks) located in Basel, Switzerland. Many countries now require banks in their jurisdictions to hold capital ratios substantially higher than Basel II, or even the proposed Basel III.

CoCo bonds, not least because if they are ever converted, the equity of existing shareholders would be diluted.

4. *Range of activities* – the most widely discussed restriction on the range of bank activities is that which separates 'investment' from 'commercial' banking operations, most famously via the Glass-Steagall Act, 1933, in the USA, which effectively prohibited any financial institution from doing both.[6] Although the Act was repealed, in stages, during the 1990s, the crisis of 2007/08 has led to steps towards the re-introduction of some of its restrictions on banks' activities.

   In the UK, the Vickers Committee[7] has recommended – and the Government has undertaken to implement – 'ring-fencing', whereby commercial banking operations would be separated legally and for accounting purposes from the investment banking arms of universal banks – the principle is to insulate commercial banking operations (especially the payments system) from potential insolvency as a consequence of investment banking operations (the government would stand ready to rescue the former but not the latter).

5. *Lender of last resort* – usually interpreted as a banker's privilege, the willingness of central banks to provide banks with emergency loans can be understood as a form of regulation because a penal (high) rate of interest is charged on the loans. The interest rate (and other conditions on the loan) can thus be used to punish banks and thereby influence (indirectly regulate) their behaviour.

3. Securitisation

3.1. Securitisation & Asset Backed Securities

Securitisation is a process by which marketable securities (bonds) are created from non-marketable instruments, e.g. mortgages, corporate loans, car loans. The result is that the securitised illiquid assets are made more liquid – at least, *potentially* more liquid – because they can be routinely bought and sold. Banks (and other financial intermediaries) responsible for securitisation are motivated ultimately by profit, partly from fees generated in process of creating new, marketable securities, partly by transforming assets in such a way as to expand profitable activities (e.g. initiating loans) at the same time as complying with regulatory requirements (particularly requirements that specify how much equity the bank must have in order to support its operations).

Securitisation creates a class of assets known as 'Asset Backed Securities' (ABSs) the most well known of which are 'Collateralised Debt Obligations' (CDOs). CDOs are bonds, the backing for which are the illiquid assets that provide collateral for the bonds and the income from which generates the funds needed to fulfil the bond indenture (typically payment of coupons and repayment of principal at maturity).

Commonly ABS created – 'originated' – by banks are separate legal entities, known as 'Structured Investment Vehicles' (SIV). SIVs are stand-alone companies, typically not owned by (and hence not a liability of) the originator, although though originating banks often administer (for a fee)

[6] Commercial banks, commonly known as 'retail banks', exist to accept deposits that are typically used to make short-term loans to companies or individuals (as well as holding reserves of cash and deposits at the central bank. Investment banks conduct a much wider range of activities, including the purchasing and issuing financial instruments that are regarded as riskier than those of commercial banks. Universal banks combine both commercial and investment banking operations. Originating in Germany during the 19th century, universal banks became common in the USA and UK only in the late 20th century, following the liberalisation of the financial sector.

[7] Formally titled the 'Independent Commission on Banking',the committee issued its final report in September 2011 (available online at http://bankingcommission.independent.gov.uk/).

the SIVs they create. Thus the process is essentially that banks create separate companies (SIVs) that issue ABSs, such as CDOs, the collateral (and income source) for which are bank assets (such as loans) that the originating bank formally sells to the SIV. Thus the bank has been able to off-load the assets, at a price and for a commission fee, to a company that it may not own, though the bank may arrange to manage the SIV.

ABSs inherit the credit risks of the assets on which they are based. Typically, however, each SIV issues several tranches of ABS, each with a different credit rating, e.g. AAA, BBB+, BB−.

Asset Backed Securities

A simple SIV might be created with three tranches of ABSs:

- *Senior* trache, has first call on the backing assets' payoffs and is least risky.
- *Mezzanine* tranche, for which payoffs are conditional on first fulfilling obligations to the senior tranche. Hence they are riskier than the senior tranche, though not necessarily very risky depending on the proportion of the SIV funded by the third tranche.
- *Equity* tranche, which form bonds with the residual claims on backing assets' payoffs The SIV's originator often holds some portion of these risky securites. It is these which would become 'toxic' first if the backing assets default or fall in value, though the other tranches may become toxic too, depending on the severity of the collapse.

  The holders of equity tranche securities can be understood to be the 'owners' – 'residual claimants' – of the ABS, or rather of the SIV that issues them: the distinction between the SIV and its ABS's becomes blurred. Inasmuch as SIVs are legal entities separate from their creators, the originating banks have limited liability (limited, that is, to their holding of equity tranche securities). However, in the crisis beginning in 2007 originating banks tended to take financial responsibility for their SIVs – another example of an off-balance-sheet liability.

In the creation of ABSs there are incentives for originators and investors too:

- The originator obtains immediate funds (by selling backing assets, such as loans or mortgages, that are typically illiquid and held to maturity). The cash generated for the originator can then be used to make new loans, which could form the backing for new ABSs, and so on.
- 'Regulatory arbitrage': the originator avoids the obligation to hold (costly) capital that may be legally required to back loan portfolios.
- Investors in the senior tranche have access to low-risk, liquid, bonds that may yield higher returns than other similar investments, say in government debt.

Ambitious financial engineering (motivated by ever greater gain) resulted in a variety of 'Multi-layered products'. For example, the backing assets for an ABS may comprise bonds from another ABS thus leading to a cascade of bonds, each layer being backed by bonds, themselves backed by bonds. In the years before 2007, many of these became so complicated that reliable estimation of the risk of default was rendered problematical, both for investors and – as it turned out – for credit rating agencies.

Yet another offshoot of the securitisation process was the creation of 'synthetic' ABSs from *Credit Default Swaps* (CDSs): the originator could use the funds from the sale of ABSs to buy a

portfolio of assets at the same time as selling CDSs. The CDSs would then generate a stream of returns that are channeled to fulfil the contractual payoffs on the ABSs. Of course, there is the risk that one or more credit events would trigger payoffs to the holders of the CDSs; these payments, however, could be made from funds held in the portfolio of assets purchased when the ABSs were issued. In this way ABSs can be engineered to mimic the payoffs on almost any selection of bonds, even though the ABS does not hold the bonds. Their riskiness, however, rapidly becomes opaque because it will depend on the value of the portfolio of assets that the ABS (or rather its parent SIV) really does hold – and this may not be transparent.

Asset Backed Securities: some consequences

An attraction of ABSs is that they enable risk *pooling* and *spreading*:

- ABSs pool risks of the many different assets that back them. Pooling is likely to be effective, however, only if the if backing assets' payoffs are uncorrelated with one another.
- ABSs enable risk-spreading inasmuch as different tranches differ in their riskiness.

Attractive though they became, the payoffs on ABSs turned out to be less reliable than appearances suggested:

- Most financial companies, including SIVs, are required to report their assets at 'fair market value' (by marking them to market), a process that is particularly hazardous for rarely traded securities, such as the equity tranches of ABSs. Moreover if the ABS's backing assets are held to maturity the stream of returns generated by these assets may bear little relationship with current market values (which reflect uncertainty that the stream of returns will actually be forthcoming – e.g. if mortgagees default on their contractual repayments).
- Many investors during and after 2007 were surprised at the unreliability of credit ratings, especially the ratings for ABSs. Such unreliability has been attributed to several sources: (i) as estimates, credit ratings are inevitably prone to statistical error (they always have been and always will be); (ii) the composition of ABSs was often complex, rendering the assessment of risk particularly difficult; (iii) ratings agencies receive their fees from the bonds for which they issue ratings (with a resulting conflict of interest as ABS originators are more likely to seek a rating from an agency more likely to rate the created ABSs more favourably).

4. A Screening Model of Bank Lending

This section studies a model of financial intermediation in which banks screen potential borrowers before deciding whether to grant a loan. The focus is on borrowing from a bank (financial intermediation) as an alternative to issuing a bond (marketable debt). It is a very simple model, intended to highlight the role of screening and to raise further questions that should be addressed in analysing the role of intermediated debt relative to marketable debt.[8]

There are three groups of economic agents – all of which are assumed to be risk-neutral – in this model:

- Firms: have zero initial wealth, and seek to borrow in order to finance a risky investment project. Firms differ in their 'quality', i.e. the probability that the project in which they invest

[8]The model described here is essentially that of problem 2.8.2 in Freixas, X. & J-C. Rochet, *Microeconomics of Banking*, second edition, p. 50. Watch out for notational mistakes in the solution on pp. 55–57.

will be successful. Firms will borrow from banks or issue bonds, choosing the source with the lower borrowing cost.

- Investors: invest in firms' bonds, which are risky because the firm may default, or in a risk-free asset with a zero rate of interest.[9] Investors, when deciding whether to buy a firm's bond do not know the firm's quality thus implying that, from an investor's perspective, bonds issued by different firms are *homogeneous*.
- Banks: lend only to firms with a high probability of success (i.e. high quality and thus not likely to default) but must pay a screening cost in order to determine the firm's quality. Banks randomly select firms to screen and must pay the screening cost whether or not a high quality firm is identified. Banks, like investors, face a zero risk-free interest rate (at which they obtain funds).

Firms

The continuum of firms is divided into two groups, 'good' and 'bad', in proportions ν_H and ν_L (exogenously given) according to the probability of success in the investment project. Each firm undertakes a project that costs one unit of resources, with payoff X if it succeeds, otherwise zero. The probability of success for good firms is θ_H and for bad firms θ_L. Thus:

$$\text{Initial investment} = 1 \longmapsto \left\{ \begin{array}{lcc} \text{Payoff} & \text{Good firms} & \text{Bad firms} \\ \hline \text{Success: } = X & \theta_H & \theta_L \\ \text{Failure: } = 0 & 1-\theta_H & 1-\theta_L \\ \hline \text{Proportion of firms:} & \nu_H & \nu_L \end{array} \right. \qquad (\nu_H + \nu_L = 1)$$

Assumptions:

A.1 $\theta_H > \theta_L$: good firms have a higher chance of success – that's what makes them 'good'.

A.2 $\theta_H X > 1$ and $\theta_L X < 1$: good firms have positive expected payoff; negative for bad firms.

A.3 $\overline{\theta} X > 1$ where $\overline{\theta} \equiv \theta_H \nu_H + \theta_L \nu_L$, the probability of success from a unit of investment allocated to a randomly chosen firm. In words the assumption states that a random unit of investment among all firms has a positive expected payoff.

4a. Screening equilibria

Outcomes (equilibria, i.e. solutions of the model) in this simple world fall into three categories: (i) bonds only (no bank loans); (ii) loans only (no bonds); (iii) both loans and bonds.[10] Denote the proportion of good firms that issue bonds by γ, where $0 \leq \gamma \leq 1$. (Remember that bad firms will issue bonds if they borrow at all – no bank would ever lend to them.) Thus, in terms of γ, the three sorts of equilibria are:

Banks only: $\gamma = 0$

Bonds only: $\gamma = 1$

Both banks and bonds: $0 < \gamma < 1$.

BEWARE: it will be shown below that the model may have multiple equilibria: the value of γ may not be uniquely determined.

[9] The assumption of a zero risk-free interest rate is just a convenient device to save on notation.

[10] Later it should become clear that the assumptions rule out the case no lending at all.

Banks only: $\gamma = 0$

Banks incur a cost C per firm screened. C is a sunk cost that cannot be recovered if the bank decides not to lend.

Given the assumptions about firms, banks will lend only to good firms. Why? Because the expected payoff from bad firms must be negative. However, a bank cannot know the firm's type until it is screened.

Denote the bank loan interest rate by R_L, per unit of investment. R_L is the amount the firm pays the bank if the project is successful; zero otherwise, i.e., if the firm defaults.

The probability that a bank encounters (screens) a good firm and hence invests is ν_H. As the probability of success for a good firm is θ_H, the expected revenue from screening equals $\nu_H \theta_H R_L$.

The bank's expected cost equals $C + \nu_H$, i.e. the screening cost plus the opportunity cost of funds loaned (note that the screening cost must be incurred but loans are made only to good firms). Thus banks will lend only if:

$$\nu_H \theta_H R_L - C - \nu_H \geq 0 \quad \text{(expected revenue is no less than cost)} \tag{1}$$

If the banking sector is perfectly competitive, expected net profit is zero, so that

$$R_L = \frac{1}{\theta_H} + \frac{C}{\nu_H \theta_H} \tag{2}$$

Notice that firms will only ever seek to obtain a bank loan if $R_L \leq X$. Thus a 'banks only' equilibrium exists only if $R_L \leq X$, which from (2) is:

$$R_L = \frac{1}{\theta_H} + \frac{C}{\nu_H \theta_H} \leq X \tag{3}$$

This condition may or may not hold: for a given X, it depends on the cost of screening C, the proportion of good firms in the economy, ν_H, and the probability of success for a good firm, θ_H.

Also, notice that bonds may also be issued: a 'banks only' equibrium is not necessarily the only outcome because the bond market could be viable too.

Bonds only: $\gamma = 1$

The interest rate on bonds, denoted by $R_B(\gamma)$, will depend on the proportion of good firms that issue bonds (a proportion $(1-\gamma)$ of good firms obtain bank loans).

For a bonds-only equilibrium to exist two conditions must be satisfied: $R_B(1) \leq X$ and $R_B(1) \leq R_L \leq X$ — in words: the bond interest rate is no greater that the payoff from a successful project; and the bond interest rate is no greater than the bank loan rate (otherwise no firms would issue bonds).

Begin with $R_B(1) \leq X$. Then the probability of success for a unit investment in bonds equals $\overline{\theta}$ (note that investors cannot distinguish between good and bad firms). Thus, investors – who are risk-neutral – will purchase bonds if and only if $R_B(1)\overline{\theta} \geq 1$ ("1" is the opportunity cost of funds, assuming a zero risk-free interest rate).

Notice also that, given the assumption (above) that $\overline{\theta}X > 1$, both investors and firms can earn a non-negative net payoff, i.e. $R_B(1) < X$. It is this condition that rules out the case in which no lending takes place at all: if banks do not lend, then a bond market is viable (in the world of this simple model).

Given competition among investors, their risk-neutrality and an assumed risk-free interest rate of zero, the expected rate of return on bonds also equals zero, so that: $R_B(1)\overline{\theta} = 1$ and $R_B(1) = 1/\overline{\theta}$.

Thus a bonds-only equilibrium is feasible but will exist only if the second condition, $R_B(1) \leq R_L \leq X$, is satisfied too. If $R_L > X$, bank lending is zero anyway, so this possibility can be ignored. It's $R_B(1) \leq R_L$ that has force in allowing the possible existence of a bonds-only equilibrium. Hence, a bonds-only equilibrium requires:

$$\frac{1}{\overline{\theta}} \leq \frac{1}{\theta_H} + \frac{C}{\nu_H \theta_H} \tag{4}$$

In words: a 'bonds only' equilibrium requires that the banks' screening cost is so high (for given values of the other parameters) that banks could not survive.

Both banks and bonds: $0 < \gamma < 1$ (an 'interior' equilibrium)

Now suppose that some good firms obtain bank loans. The hypothetical mechanism is as follows: a proportion $(1-\gamma)$ of *all* firms initially seek bank loans; of these, the good firms are successful and the bad firms are rejected. Thus proportion γ of good firms issue bonds. All the bad firms issue bonds (those that the banks screened and were rejected as well as those that were not screened). Hence the proportion of *all* firms that issue bonds equals: $\gamma\nu_H + \nu_L$. Similarly, the probability of a successful bond investment equals $\gamma\theta_H\nu_H + \theta_L\nu_L$ (only a proportion γ of good firms issue bonds).

Thus in a banks-and-bonds equilbrium, the bond interest rate, $R_B(\gamma)$, satisfies:

$$(\gamma\theta_H\nu_H + \theta_L\nu_L)R_B(\gamma) = \gamma\nu_H + \nu_L \quad \text{or} \quad R_B(\gamma) = \frac{\gamma\nu_H + \nu_L}{\gamma\theta_H\nu_H + \theta_L\nu_L} \tag{5}$$

In words: the expected payoff from a unit investment in bonds, $(\gamma\theta_H\nu_H + \theta_L\nu_L)R_B(\gamma)$ equals the expected opportunity cost of a unit of investment,[11] $\gamma\nu_H + \nu_L$.

For an interior equilibrium it must be that firms are indifferent between issuing a bond or obtaining a bank loan, i.e., $R_B(\gamma) = R_L$, or:[12]

$$\frac{\gamma\nu_H + \nu_L}{\gamma\theta_H\nu_H + \theta_L\nu_L} = \frac{1}{\theta_H} + \frac{C}{\nu_H\theta_H} \tag{6}$$

Given the set-up of the model, the crucial parameter that determines the type of equilibrium outcome is cost of screening, C, relative to the chance of success, as expressed by $\nu_H\theta_H$. Formally, combine equations (3) and (4) as:

$$\frac{1}{\overline{\theta}} \leq \frac{C}{\nu_H\theta_H} + \frac{1}{\theta_H} \leq X \tag{7}$$

Expressed in rates of return, (7) states simply: $R_B(1) \leq R_L \leq X$. If the first inequality is violated, $R_B(1) > R_L$, screening is so low-cost (conditional on the other parameters) that all the good firms would succeed in obtaining bank loans, and the bond market would fail to exist: only bad firms would issue bonds, and no investor would choose to hold them because the expected payoff would be negative: $R_B(0) = 1/\theta_L > X$. (Remember the assumption that $\theta_L X < 1$: bad firms have negative expected payoff.)

If the second inequality is violated $R_L > X$, screening is so costly that no bank could survive to make loans.

[11] Remember that the risk-free interest rate is assumed to be zero.

[12] Notice that the loan rate R_L is the same as in the 'banks only' equilibrium. The reason is that a proportion $(1-\gamma)\nu_H$ of all good firms seek bank loans. They are successful, so that banks invest $(1-\gamma)\nu_H$. Screening costs are incurred only for the proportion $(1-\gamma)$ of firms that seek bank loans (some of the firms are bad, and do not obtain loans). Hence, R_L must satisfy:

$$(1-\gamma)\nu_H\theta_H R_L - (1-\gamma)C - (1-\gamma)\nu_H = \nu_H\theta_H R_L - C - \nu_H = 0$$

which is exactly the same condition as in the 'banks only' equilibrium (the factor $(1-\gamma)$ cancels out).

4b. Implications and questions

1. The model highlights the role of screening costs in determining the viability of bond markets and financial intermediation: the higher are screening costs, the more likely it is that firms will have to rely on the bond market to raise investment funds.

   This implication depends, of course, on the 'givens': the proportion of good and bad firms, and their probabilities of success.

2. It can be seen that if an equilibrium exists with both banks and bonds, then so also does an equilibrium with banks only. If some good firms (a proportion γ) issue bonds, a unique value of γ results (it can be calculated from (6)).[13] But, in such circumstances, $\gamma = 0$ is also an equilibrium: all good firms borrow from banks (and the bond market fails because only bad firms seek to issue bonds. A weakness of the model is that it is silent about which equilibrium will occur (but it may give some hints about the factors that could determine which equilibrium would be observed – see this week's exercises).

3. Efficiency: by calculating the total expected output, net of investment cost, it is possible to compare the three equilibria.

   The 'bonds only' equilibrium has social costs inasmuch as bad firms issue bonds that yield a negative expected payoff.

   With 'banks only', bad firms are not financed but there is a cost to society because all firms are screened: the cost of screening all firms may exceed the negative expected payoff from bad firms that would have issued bonds if the market had existed.

   With an interior equilibrium (both banks and bonds), there is a trade-off: fewer firms are screened, thus saving the screening costs of firms that go directly to the bond market, but this saving is offset – at least partially – by the negative expected payoff on bonds issued by bad firms.

*****

[13] Let γ^* denote the equilibrium value of γ that satisfies (6). If $\gamma > \gamma^*$, the bond rate exceeds the bank loan rate: good firms would prefer bank loans to issuing bonds. If $\gamma < \gamma^*$, the bank loan rate exceeds the bond rate: good firms would prefer to issue bonds rather than obtain bank loans.