Lecture 5: Non credit risks

Following the previous lecture where we gave an overview and discussed credit risk, this lecture will be spent examining interest rate and liquidity risk, before concluding with broader systemic risks

Interest rate risk

"Optional", due to market price changes plus mismatch in balance sheet

Theories of the term structure

Term structure or "yield curve" – relation among yields of different bonds – determines scope of interest rate risk

(1) Derivation under certainty
Derivation under certainty – assumption of no riskless arbitrage

$$\left(1+i_0^2\right)^2 = \left(1+i_0^1\right)\left(1+i_1^1\right),$$

$$\left(1+i_0^2\right) = \sqrt{\left(1+i_0^1\right)\left(1+i_1^1\right)}.$$

Inverting,

$$\frac{1}{\left[1+i_0^2\right]^2}=\frac{1}{\left[1+i_0^1\right]\left[1+i_1^1\right]}$$

Expectations hypothesis - implied forward rate equals future spot rate to preclude riskless arbitrage

(2) Derivation under uncertainty
Importance of risk aversion affecting yields to maturity
Use of a probabilistic approach and no arbitrage – so can analyse problem as if investors risk neutral
Expectations hypothesis under uncertainty, assessing two investment strategies and applying subjective probabilities (theta hat)

$$\frac{1}{\left[1+i_0^2\right]^2}=\frac{\hat{\theta}}{\left[1+i_0^1\right]\left[1+i_1^1(+)\right]}+\frac{\left[1-\hat{\theta}\right]}{\left[1+i_0^1\right]\left[1+i_1^1(-)\right]}$$

$$\hat{\theta}=\frac{u-r}{u-d}$$

where

$$u = [1 + i_0^2]^2/[1 + i_0^1(-)]$$

$$d = [1 + i_0^2]^2/[1 + i_1^1(+)]$$

u is 1+one period return from buying a two period bond now and selling next period after price has moved up and d is analogous value when price has moved down

(3) Unbiased expectations hypothesis – unbiased forward rate equals expected future spot rate
But inconsistent with absence of riskless arbitrage – under uncertainty forward rate cannot be equal to expected value of future spot rate

(4) Term premium/liquidity preference
Investors demand a risk premium for holding long term bonds, owing to risk aversion against the undiversifiable risk of interest rate changes, which compounds over time and hence affects longer term bonds most. Does not imply longer term bonds are less liquid

(5) Preferred habitat theory
Yield to maturity on bonds of different maturities depends on investment horizon, which may be specific for individual investors.

Duration

Average number of years a holder must wait to recoup his investment
Shorter duration, lower price volatility
Distinguish duration and maturity (bonds, zeros, FRNs)
Capture timing of all cash flows

$$D = \frac{\left\{\left[C_1/\left(1+i_0^1\right)\right]\times 1+\left[C_2/\left(1+i_0^2\right)^2\right]\times 2+---+\left[C_N/\left(1+i_0^N\right)^N\right]\times N+\left[B_N/\left(1+i_0^N\right)^N\right]\times N\right\}}{\left\{\sum_{t=0}^{N}\left[C_t/\left(1+i_0^t\right)^t\right]+\left[B_N/\left(1+i_0^N\right)^N\right]\right\}}$$

$$W_t \equiv C_t/(1+i_0^t)^t \text{ for all } t=1,\ 2,---N-1$$

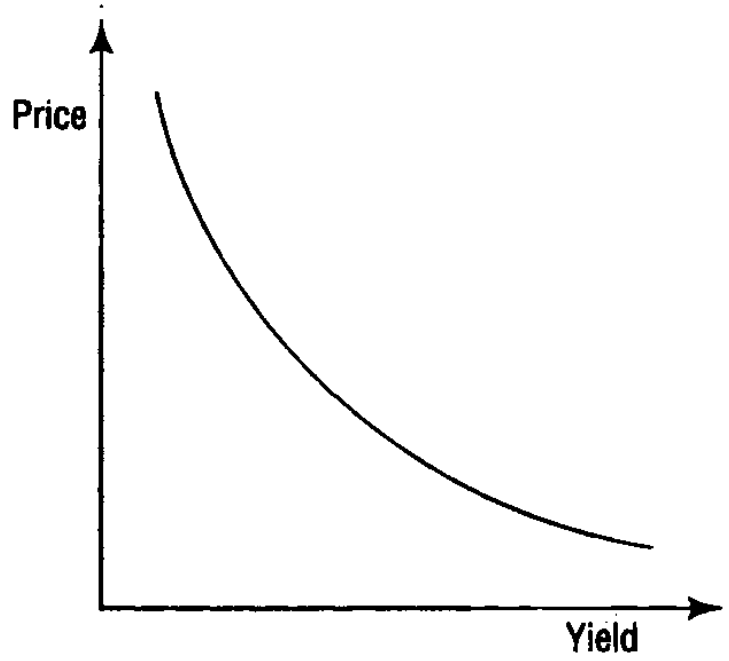
$$D = \frac{\left(w_1+2w_2+3w_3+\ ---\ +Nw_N\right)}{\hat{P}_0^N}$$

$$D = \sum_{t=1}^{N} t\,\hat{w}_t$$

(Weighted portfolio) duration matching and immunisation

Convexity

Price/yield curve of a plain vanilla bond is convex - rate price declines as yield falls, declines



Formula for convexity

$$\text{Convexity } C = \frac{100}{P} \times \frac{d^2P}{di^2}$$

Causes of variations
Need for portfolio management

Measuring interest rate risk

Shift in the term structure affects assets and liabilities differently if duration differs
Measuring interest rate risk by gapping over given periods
Shortcomings of the maturity gap – fails to measure interest rate risk
Duration gap over equities (weighted duration of assets less WD of liabilities) - need for specifying stochastic elements in term structure (see next slide)

Why take on interest rate risk?

Interest rate risk is a function of QAT
Mismatch is deliberate to profit from expectations of interest rate changes/term premia
Reward for risk neutrality of banks (function of capital, safety net)
Tradeoff with credit risk

Example of interest rate exposure and duration gaps

Item	Weighted Duration	Duration Gap	Interest Rate Exposure
Short-term asset	$0.5 \times 1 = 0.5$	$-0.75 + 0.5 = -0.25$	Institution hurt if short rates rise.
Short-term liability	$-0.75 \times 1 = -0.75$		
Long-term assets	$0.5 \times 2 = 1$	$1 - 0.25 = +0.75$	Institution hurt if long rates fall.
Long-term liabilites	$-0.125 \times 2 = -0.25$		
Equity	$0.75 - 0.25 = 0.5$ or $1.5 - 1 = 0.5$	—	Institution hurt if entire yield curve moves up.

Example of interest rate risks – initial difficulties of the US Savings and Loans

Maturity mismatch crisis and loan quality crisis
Former linked to interest rate ceilings and disintermediation
Easing of ceilings led to mismatch of assets and liabilities
Deregulation allowing diversification - and forbearance
Risk taking on asset side and deposit insurance to protect deposits
Eventual need for a bailout and regulatory tightening

Liquidity risk and the deposit contract

- Alternative definition – risk of being unable to satisfy claims without impairment of financial or reputational capital
- Possibility of bank runs if not adequately controlled (Lecture 7)
- Interactions of information asymmetry about default and interest rate risks with liquidity risk
- Possibility of interest rate risk with duration matched book
- Interaction of liquidity and interest rate risks (shock to term structure, deposit interest ceilings)
- Defining liquidity mathematically: $L_1=P_i/P^*$; $L_2=\sum_{i=0\ldots n} P_i/P^*$, $L_3=E(P)/P^*$ where P* is full value price and Pi is realised price

Protecting against liquidity risk

- Holding liquid assets (net defensive position – cost in terms of lower profitability)
- Dissipating withdrawal risk by diversifying funding sources
- Lender of last resort

- The key role of diversification in diminishing liquidity risks (liability management – Lecture 6) despite extra costs

Example of liquidity risks - Continental Illinois

Loan problems from LDC debt and weak energy prices
Reliance on wholesale deposits and international markets
Run occurred despite blanket deposits guarantee
Sizeable interbank exposures (179 banks vulnerable)
Major public rescue operation

Market liquidity risk

Can apply “liquidity insurance” and bank run concept
Issue of liquidity of markets and not just institutions
Run can occur from a market similarly to an institution
The issue of uncertainty about market prices
The role of market makers and asymmetric information
Harsh consequences for those requiring liquidity of their claims or rollover of their liabilities

Example of market liquidity risks - Russia/LTCM

Long bull period preceded crisis
Apparent lack of effect of Asia on US securities markets
Prices peaked in July 1998
Turbulence followed Russia moratorium and LTCM rescue
Flight to quality, collapse of issuance and liquidity - even in the deepest of markets
Evidence of “herding” among investors and traders – lack of “macro portfolio diversification”
Simultaneous price and liquidity shifts in markets previously uncorrelated
Also feedback from Value-at-Risk models (lecture 6) may have been damaging

Systemic risk and the theory of financial instability

Macroeconomic counterparts to individual bank/market failures
Number of theories all helping to understand financial instability – need to synthesise Key justification for regulation (Lectures 7 and 8)
- “**debt and financial fragility**", which suggests that over indebtedness and banking crises are a normal feature of the cycle;
- "**monetarist**" that bank failures impact on the economy via a reduction in the supply of money;
- "**uncertainty**" as opposed to risk as a key feature of financial instability, linked closely to confidence, and helps explain the at times disproportionate responses of financial markets in times of stress;

- "**disaster myopia**" that competitive, incentive-based and psychological mechanisms lead financial institutions and regulators to underestimate the risk of financial instability;
- "**asymmetric information and agency costs**" that these well-known market failure of the debt contract help to explain the nature of financial instability e.g. credit tightening as interest rates rise and asset prices fall;

and complementing these,
- "**bank runs**" (cf. “liquidity insurance”) that panic runs on banks (which may follow the various stimuli identified by the above theories) link to the maturity transformation they undertake, and the relatively lesser liquidity of their assets; such theory can also be applied to securities market liquidity;

- "**herding**" among institutional investors as a potential cause for price volatility in asset markets, driven e.g. by peer-group performance comparisons, that may affect banks and other leveraged institutions;
- "**industrial**" that effects of changes in entry conditions in financial markets can both encompass and provide a supplementary set of underlying factors and transmission mechanism to those noted above.

Recent episodes of systemic risk 1

Date	Event	Main feature	Main risk
1970	US Penn Central Bankruptcy	Collapse of market liquidity and issuance	Market liquidity
1973	UK secondary banking	Bank failures following loan losses	Credit
1974	Herstatt (Germany)	Bank failure following trading losses	Credit – payments system
1982	Ldc debt crisis	Bank failures following loan losses	Credit, sovereign
1984	Continental Illinois (US)	Bank failure following loan losses	Credit, liquidity
1985	Canadian Regional Banks	Bank failures following loan losses	Credit
1986	FRN market	Collapse of market liquidity and issuance	Market liquidity
1986	US thrifts	Bank failures following loan losses	Interest rate, credit
1987	Stock market crash	Price volatility after shift in expectations	Market
1989	Collapse of US junk bonds	Collapse of market liquidity and issuance	Credit, liquidity
1989	Australian banking problems	Bank failures following loan losses	Credit
1990	Swedish commercial paper	Collapse of market liquidity and issuance	Credit

Recent episodes of systemic risk 2

1990-1	Norwegian banking crisis	Bank failures following loan losses	Credit
1991-2	Finnish banking crisis	Bank failures following loan losses	Credit
1991-2	Swedish banking crisis	Bank failures following loan losses	Credit
1992-6	Japanese banking crisis	Bank failures following loan losses	Credit
1992	ECU bond market collapse	Collapse of market liquidity and issuance	Market liquidity
1992-3	ERM crisis	Price volatility after shift in expectations	Market
1994	Bond market reversal	Price volatility after shift in expectations	Market
1995	Mexican crisis	Price volatility after shift in expectations	Credit, sovereign
1997	Asian crisis	Price volatility following shift in expectations and bank failures following loan losses.	Market, credit, sovereign
1998	Russian default and LTCM	Collapse of market liquidity and issuance	Market liquidity