Financial Markets & Risk

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Session 5

Credit Risk II

- The Agencies
- Mortgage pass-through securities
- Mortgage-backed securities (MBSs)
- Collateralised Mortgage Obligations (CMOs)
- Asset-backed securities (ABSs)
- Collateralised debt obligations (CDOs)
- Summary

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The Agencies

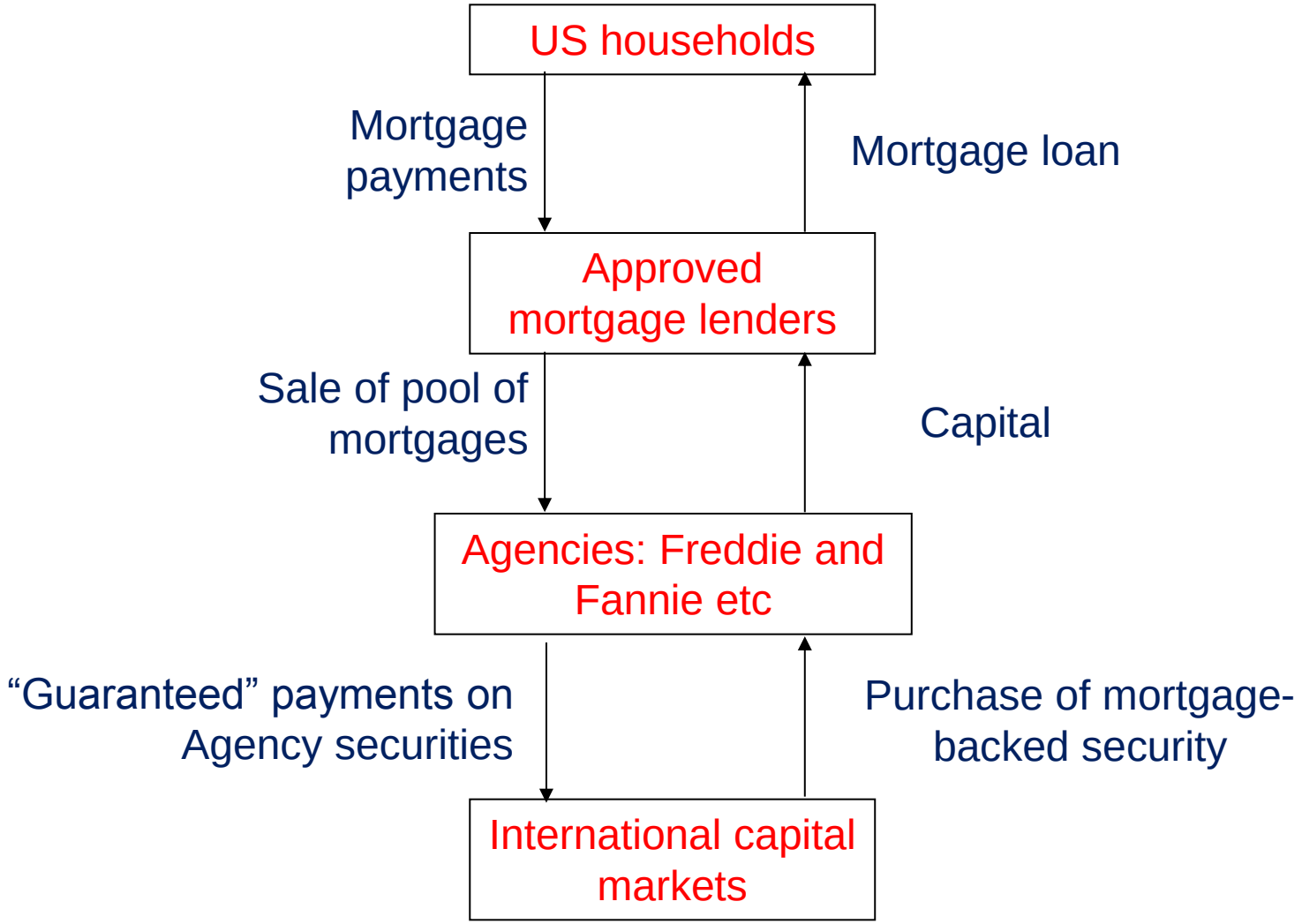
Many different types of fixed income security that are backed by other financial assets and cashflows. However, one of the oldest and largest markets is for repackaged US residential mortgages

Central to market are the agencies - Federal National Mortgage Association, known as Fannie Mae, and the Federal Home Loan Mortgage Corporation, known as Freddie Mac

Fannie Mae is the oldest of these agencies, being established in 1938. Freddie Mac was created in 1970, with much the same remit, and the capital markets also equate lending to Freddie Mac with lending to the US government

They are now THE mortgage market in the US

The agencies and the capital markets



Why did the agencies get into trouble?

Many US homeowners defaulting on mortgages

The agencies have to pay up in spite of losses

The Agencies need to raise capital to cover these losses

But investors are now unwilling to lend at low rates

Shareholders fear the agencies will be nationalized and they will lose all capital

Were an agency to fail, this could be catastrophic for some institutional investors and would lead to a credit crunch of almost unimaginable proportions in the US mortgage market

Mortgage pass-throughs (MBS)

Created when mortgage issuers pool mortgages and sell "certificates/shares" in the pool

US is the largest market

Various US agencies – Ginnie Mae, Freddie Mac, Fannie Mae – can guarantee these issues, effectively buying from the mortgage originators

Guaranteeing:
Only timely payment of interest (modified pass through)
Timely payment of interest and principal payments (fully modified)

Cashflow characteristics

Directly based on *cashflow* of underlying mortgages:

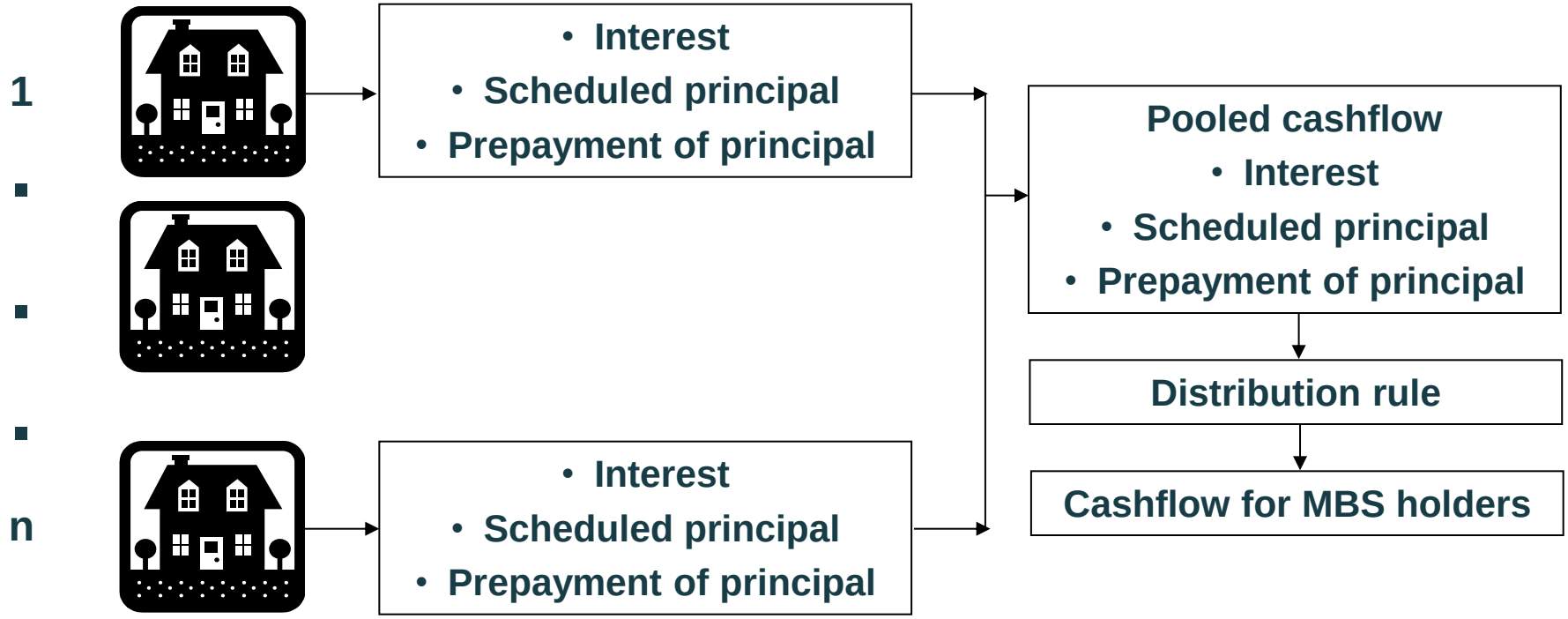
- Interest payments
- Scheduled principal payments
- Prepayment of principal

Minus:

- Servicing fees
- Cost of any guarantees
- Other fees etc

Net *cashflow* then distributed on a pro-rata basis

Cashflow characteristics



WAC – weighted average coupon (mortgage interest rate)

WAM – weighted average maturity of mortgages

Non-agency MBSs

Not all pass-throughs are issued by US agencies

Commercial banks, specialist mortgage lenders can also issue

These issues do not benefit from the implicit state guarantee, so credit risk is a more important consideration

Issuers use a range of techniques to "credit enhance" their issues – usually a higher rating than the issuer

External credit enhancement

External credit enhancement is a kind of third party guarantee that usually takes care of pre-specified first loss to a maximum amount

- corporate guarantee
- letter of credit
- bond insurance (AMBAC, American Municipal Bond Assurance Corporation, MBIA, Municipal Bond Insurance Association, etc)

Rating of third party has to be at least as high as rating required for issue

The obvious danger is that the issue is susceptible to a downgrade in the guarantors (sponsors) credit quality

Internal credit enhancement

Internal guarantees do not rely on a the credit quality of a third party:

- creation of reserve funds, created from underwriting fees and from excess interest income
- over-collateralisation, for example, principal amount of mortgages is $520m, but principal of bond is $500m
- senior/subordinated structures

The latter is the basic principle behind CMOs (Collateralized Mortgage Obligation)

Prepayment

We need to project the cashflow from the mortgage pool to value it, this is easy for a normal bond.

It is harder when households can pre-pay principal on their mortgages as a result of:

- sale of their home (moving, divorce etc)
- general economic environment
- level of prevailing interest rates
- seasonality

“Modelling” prepayment

Assume some portion of principal is repaid every month known as a conditional prepayment rate (CPR)

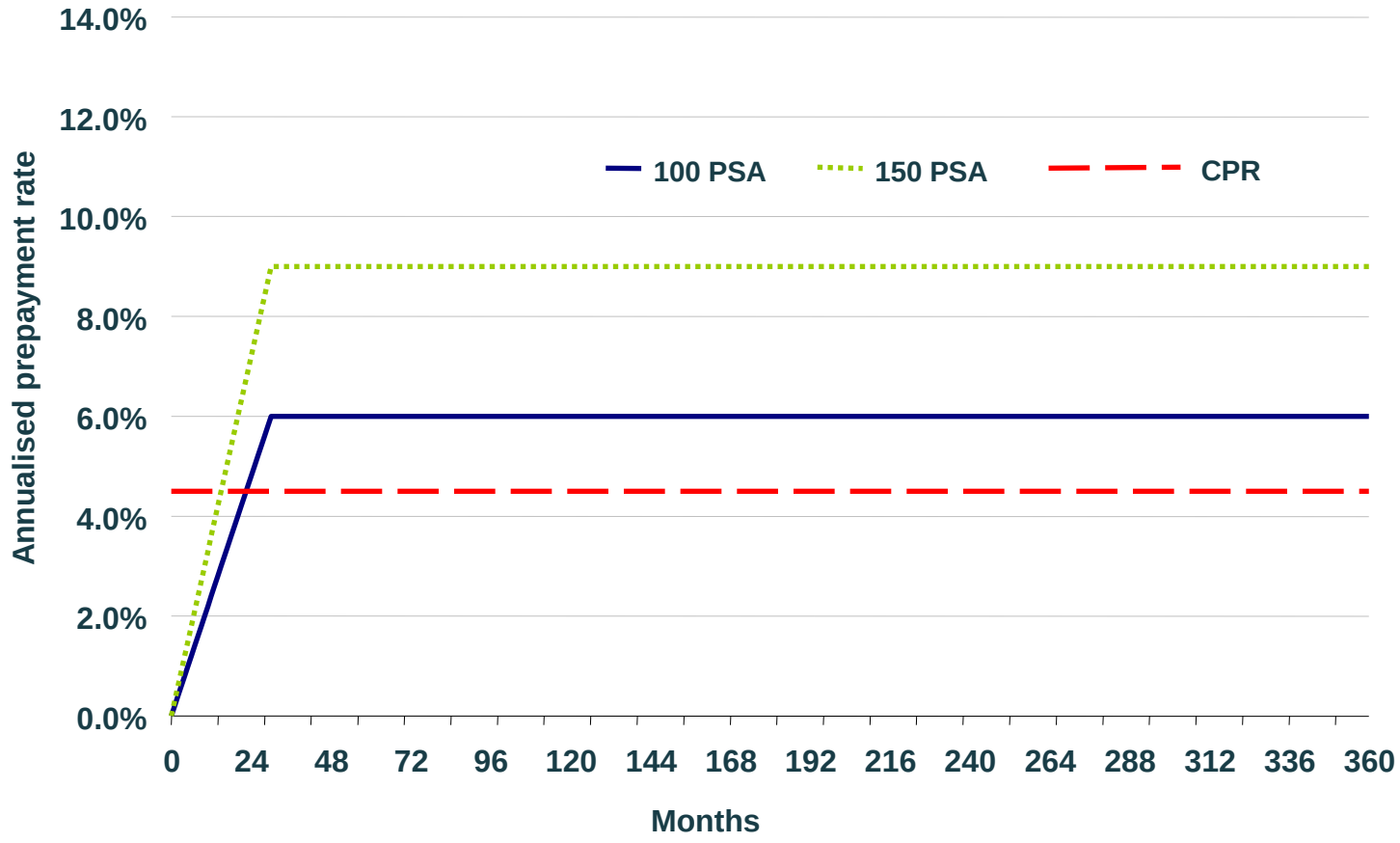
Typically, CPR is expressed as a percentage. For example, a pool of mortgages with a CPR of 8% would indicate that for each period, 8% of the pool's remaining principal outstanding will be paid off.

The PSA (Public Securities Association) produce a prepayment benchmark based upon historic experience

This benchmark is changed according to the characteristics of the mortgage pool, but in a very simplistic manner

The prepayment schedules look like this …

CPR and PSA prepayment



CPR and PSA prepayment

One of the most notable prepayment models is the PSA Prepayment Model by the Securities Industry and Financial Markets Association. The PSA model assumes increasing prepayment rates for the first 30 months and then constant prepayment rates afterward.

The standard model, referred to as 100% PSA or 100 PSA, assumes that prepayment rates will increase by 0.2% for the first 30 months until they peak at 6% in month 30.

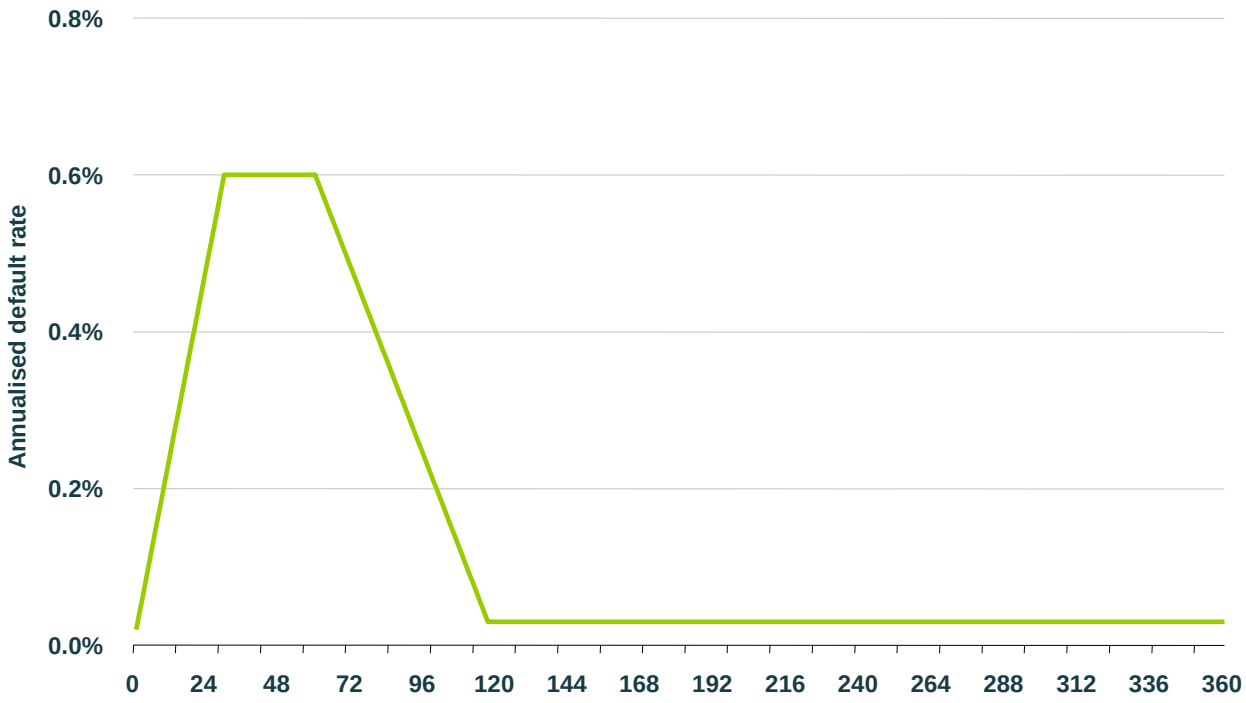
150% PSA would assume 0.3% (1.5 x 0.2%) increases to a peak of 9%

200% PSA would assume 0.4% (2 x 0.2%) increases to a peak of a 12% prepayment rate.

Default risk for non-agency MBSs

Must also assume a default rate on the pool, clearly based upon the pools basic characteristics

Again there are standard industry assumptions (SDA) analogous to the standard pre-payment schedules



Prepayment risk

Suppose an investor buys a 7% coupon Fannie Mae, when mortgage rates are close to 7%

Now suppose that mortgage rates fall to 4%

- Price of bond rises, but there is a ceiling to the increase, as households re-mortgage (call the debt back)
- This is called “contraction risk” as the average maturity of the bond falls

Investors looking to use the bond to hedge longer-duration liabilities would therefore not like this risk

Prepayment risk

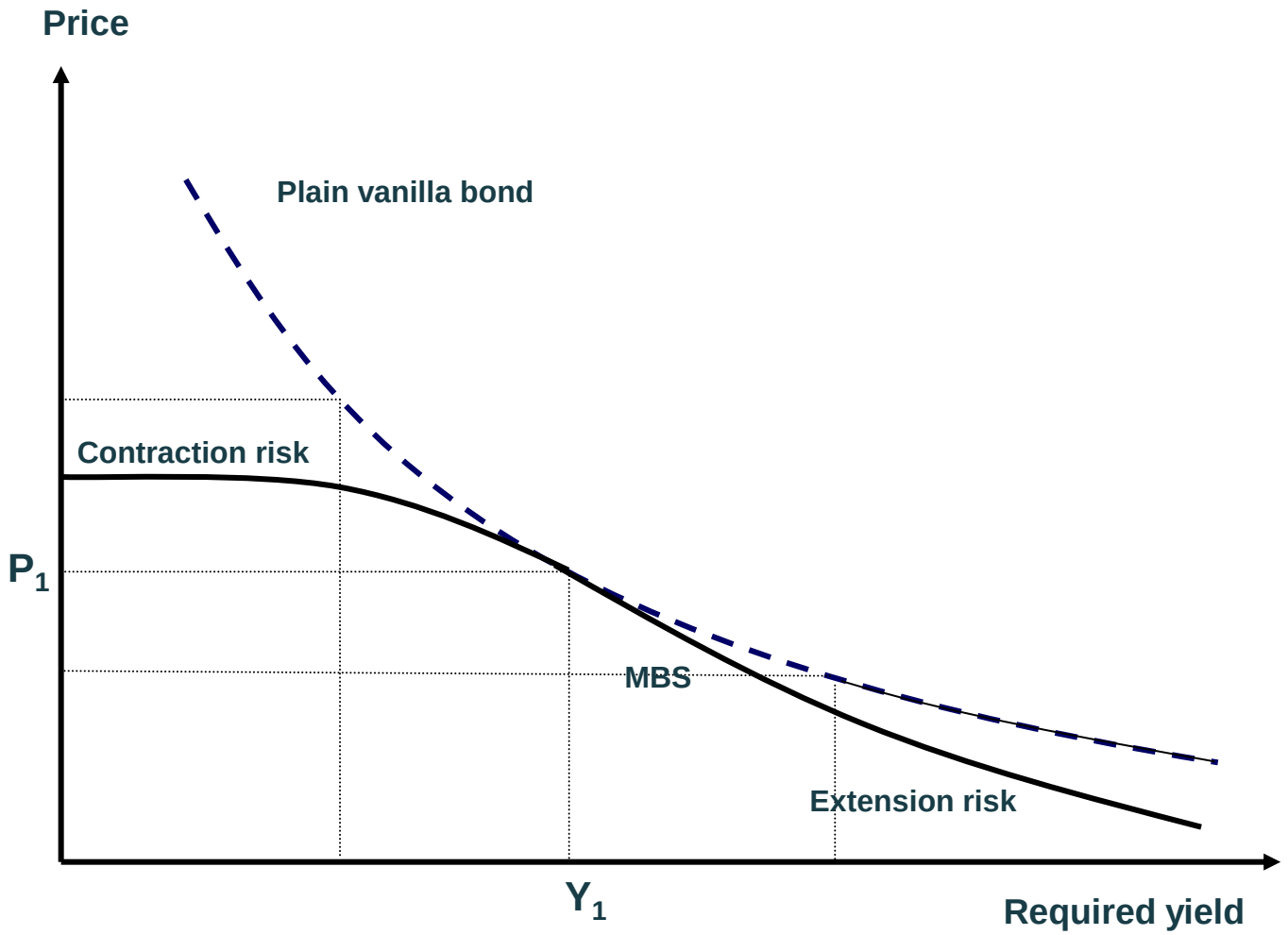
Suppose an investor buys a 7% coupon Fannie Mae, when mortgage rates are close to 7%

Now suppose that mortgage rates rise to 9%

- Price of bond falls, and households prepayments slow up since they will not remortgage and they may be struggling financially
- The bond's maturity rises, and since long maturity bonds fall by more than short-maturity bonds when interest rates rise it falls at an increasing rate
- This is called "extension risk" as the average maturity of the bond increases

Investors looking to use the bond to hedge shorter-duration liabilities would therefore not like this risk

Contraction/extension risk



Collateralised mortgage obligations

Some investors do not like the extension and/or the contraction risk

The answer is to create a structure such that at least some of the investors are protected from this risk, passing it on to those that don't mind

CMOs are structured to redistribute this prepayment risk

This is done via a "class" structure – creating tranches

Basically, principal payments are used to retire tranches on a priority basis

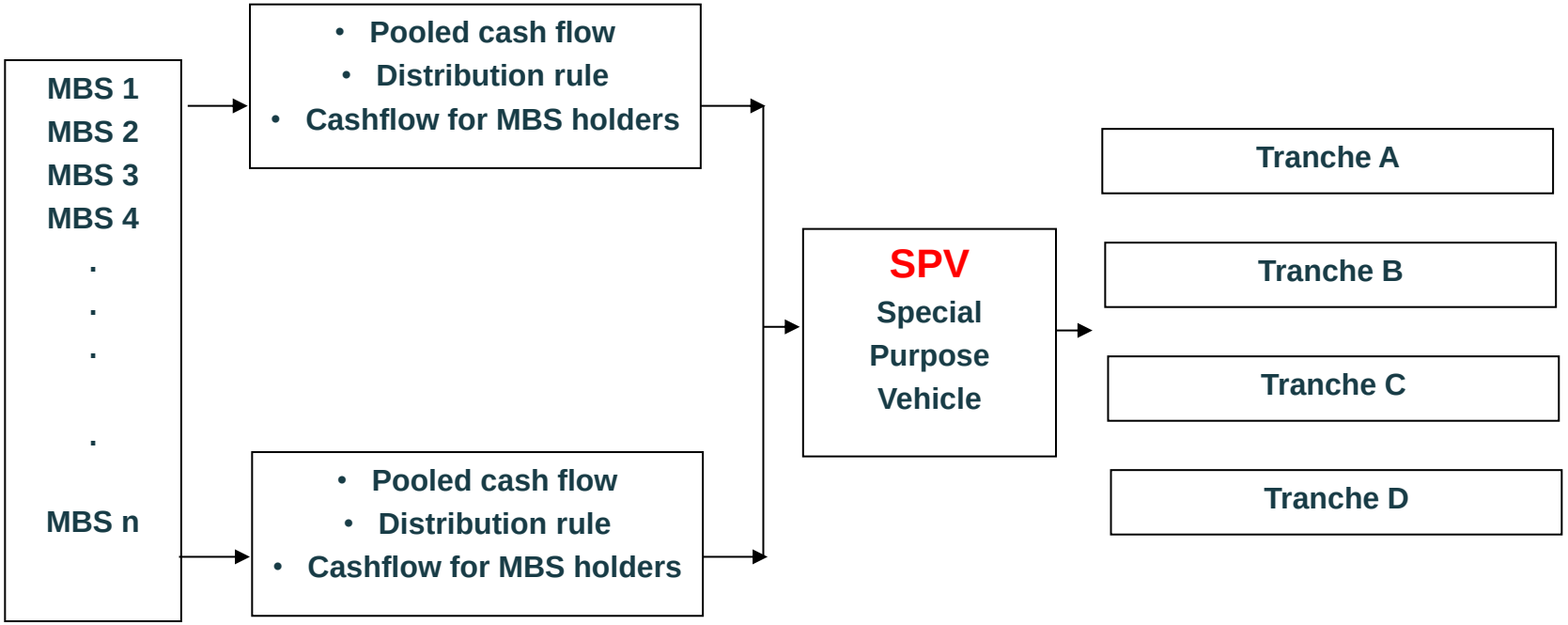
Underlying CMO collateral

Can comprise of a pool of:

- MBSs
- stripped MBSs (cash flow that derives exclusively from interest payments or principal payments on the underlying mortgages. That is, the underlying asset of a stripped MBS is interest or principal paid on debt securities, rather than both together. Stripped mortgage-backed securities are extremely sensitive to changes in interest rates, allowing investors to choose either an interest strip or a principal strip depending on the expected direction of interest rates.
- mortgage loans

Complexity and variety of structures is quite wide

Cashflow characteristics



Tranch A is senior to tranche B, and tranche B is senior to tranche C etc, etc

Tranche D is likely to be an “accrual tranche” (no interests/receives amortized principal back in one lump sum)

CMO payment structures

Sequential pay structures:

- Disburse coupon to each tranche based on principal. Disburse principal to tranche A until A is fully paid back; then disburse to tranche B etc etc. Tranches are retired sequentially.

Accrual tranches:

- In sequential structure there is usually one tranche that receives no interest/regular coupon, a kind of zero coupon bond
- Interest that would have gone to this tranche used to pay down other tranches more rapidly
- This tranche usually receives its ammortised principal back in one lump sum

CMO payment structures

Floating rate/inverse floating tranches

Lots of institutions prefer floating rate tranches, but this clearly exposes issuer to interest rate risk

Answer is to split a tranche into two, creating a floating rate tranche and in inverse floating rate tranche

As interest rates rise the interest to FR tranches rises, but the interest payable to the IFR tranches falls by the same cash amount (by design), and vice versa off course.

$$Total\ Coupon = X\% \times [Libor + 0.5\%] + (1 + X\%) \times [Y - Z(Libor)]$$

CMO payment structures: Example

Floating rate tranches pays: Libor+50bp (Principal value of $75m)

Inverse Floating tranche: 26.5% - 3×Libor (Principal value of $25m)

Principal combined tranches: $100m

Total coupon available to this tranche is $7.0 per year (coupon rate of 7%).

$$Total\ Coupon\ Rate = 75\% \times [Libor + 0.50] + (1 - 75\%) \times [26.5\% - 3 \times (Libor)]$$

Suppose LIBOR is 6% then the coupon rates for the 2 tranches will be:

$$Floating\ Tranche = \$4.875m = 6.5\% \times \$75m$$
$$Inverse\ Floating\ Tranche = \$2.125m = 8.5\% \times \$25m$$

$$and\ \$4.875m + \$2.125m = \$7.0\text{m}$$

CMO payment structures: Example

Now suppose that LIBOR rises to 7%, then the coupon rates for the two tranches will be:

$$Floating\ Tranche = \$5.625m = 7.5\% \times \$75m$$
$$Inverse\ Floating\ Tranche = \$1.375m = 5.5\% \times \$25m$$

$$and\ \$5.625m + \$1.375m = \$7.0\text{m}$$

Finally suppose that LIBOR falls to 5%, then the coupon rates for the two tranches will be:

$$Floating\ Tranche = \$4.125m = 5.5\% \times \$75m$$
$$Inverse\ Floating\ Tranche = \$2.875m = 11.5\% \times \$25m$$

$$and\ \$4.125m + \$2.875m = \$7.0\text{m}$$

Regardless of the level of LIBOR the total amount of cash flow which is allocated to the 2 tranches is the same, although the relative amounts naturally change.

CMO payment structures

Planned ammortisation class tranches (PAC)

Even with *tranching* prepayment risk still exists, though it has shifted to lower tranche levels

With *PAC bonds* the principal and interest schedule is guaranteed for the highest tranches, shifting all prepayment risk to the lower tranches

Because of this *PAC tranches have no extension/contraction risk at all*

These tranches are therefore popular with those that wish to avoid these risks

CMO payment structures

Interest only (IO) or principal only (PO) tranches

As the names suggest IO tranches receive no principal, and PO tranches receive no interest

But how do you pay interest on a tranche that has no principal ?

Answer – allocate notional principal to this tranche

Stripped CMOs

Principal is allocated to one tranche (PO) and interest (IO) to another

Both are exposed to prepayment risk

If prepayment rises return/yield on PO rises since income is received sooner

If prepayment rises return/yield on IO falls, because interest on principal sinks

So if you expect interest rates to rise (prepayment to fall) buy IO tranches, and if you expect interest rates to fall buy PO tranches

Asset-backed securities

MBS and MBOs are all backed by assets – mortgage loans (both residential and commercial (RMBS and CMBS)

But the term ABS is usually applied to bonds that are backed by assets other than these instruments

- David Bowie's publishing royalties
- municipal parking revenues/fines
- film royalties
- Chuckle Brothers back catalogue, etc etc

More common ABSs – car loans, credit card receivables, small business loans

Credit risk and ABSs

Collateral quality

- What is the credit standing of the ultimate borrowers?
- How concentrated is the pool ? Are there a few large debtors in the pool (concentration risk) ?

Depending upon the credit quality the issuer will seek to enhance that quality again by using either external or internal enhancement methods (just as with non-agency MBSs)

Credit risk and ABSs

Quality of originator/issuer/servicer

- How experienced is the issuer ?
- What sort of underwriting standards have been applied ?
- What competition does the originator in particular face ?

(Sub-prime lenders clearly used very careless standards that few seemed to worry about at the time)

Credit risk and ABSs

Cashflow and stress testing

- Can the assets service the cashflow ?
- Rater (the one that establishes a rating) makes assumptions about losses, delinquencies and prepayment (not always applicable)
- Must stress test various interest rate environments

Of course the usefulness of the stress testing is limited if the scenarios are relatively benign

Collateralised debt obligations (CDOs)

What is a CDO ?

A CDO is a security backed by pool of debt obligations:

- Investment or sub-investment grade bonds
- Asset backed securities
- Bank loans (secured and unsecured)
- Emerging market bonds
- CDSs (synthetic)
- CDOs ('CDO Squared', 'CDO cubed')

CBO = Collateralised bond obligation

CLO = Collateralised loan obligation

Most long-only fund managers invest in CDOs

Arbitrage cash CDO tranches

From the underlying pool of assets, CDO creates and issues other fixed income assets

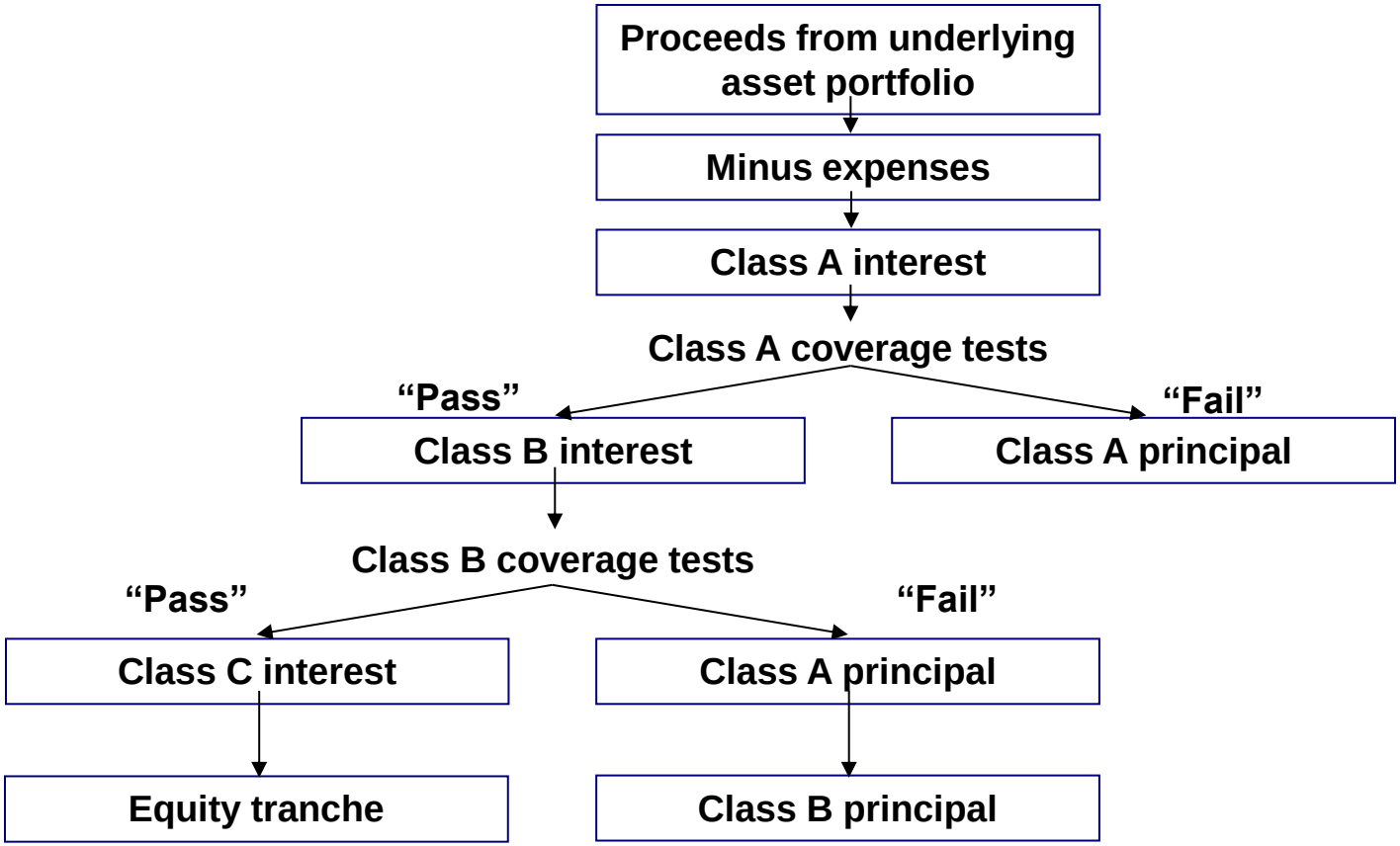
Typically three types of tranche:

- AAA (“Class A”)
- Mezzanine tranches (with lower ratings) (“Class B”)
- Equity tranche (“first loss”)

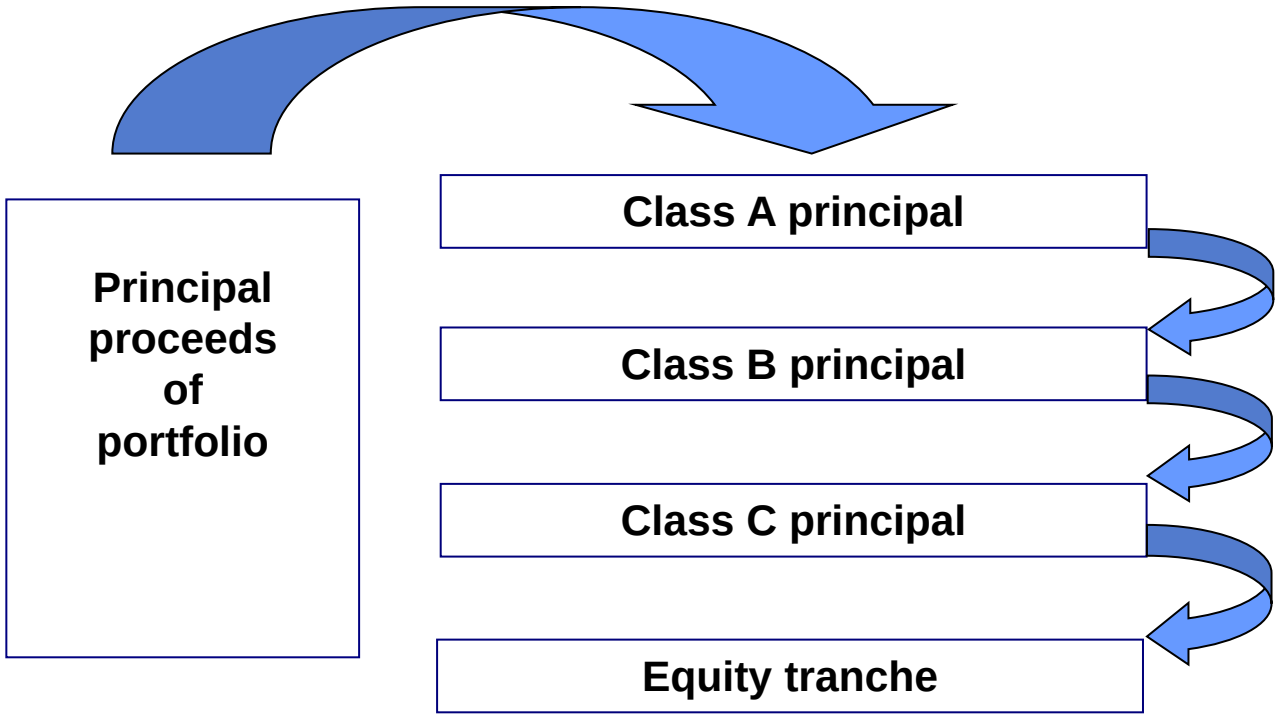
As name suggests the AAA tranche has least risk while the lower the rating the higher the risk

Highest risk tranche is the equity tranche – this tranche receives payments once all other classes have been paid and receives any residual value in the CDO

Interest rate cash flow “waterfall”



Principal cashflow “waterfall”



The economics of CDO construction

The main aim

Key to economic feasibility is the return that can be created for the equity or first loss tranche

Most CDO issuers aim to keep this bit of the CDO's structure for themselves

Traditional, long only bond fund managers see it as a way of generating additional income

Seen as a way for Life funds to increase returns on funds under management too

Technically pension funds could do it too (are they allowed?)

CDO example: the collateral

Fund manager buys £100m of high yield bonds

Decides to use them as collateral for CDO

Bonds all:

- mature in ten year's time
- have a fixed coupon payment
- yield 4.0% over current ten-year gilt

These bonds generate income for the CDO tranches …

CDO example: the collateral

There will be three CDO tranches, with the following par values and coupon rates:

Tranche	Par value	Coupon type	Coupon rate
Senior	£80,000,000	Floating	LIBOR + 0.70%
Mezzanine	£10,000,000	Fixed	Gilt + 1.0%
First loss	£10,000,000	-	-

Floating rate exposure can be protected via an interest rate swap agreement

Protection from interest rate risk

The Senior tranche pays floating – which means the issuer is exposed to possible higher interest rates

The answer is to enter into an interest rate swap

Swap details:

- Notional: £80,000,000
- Ten year swap spread: 1.0%
- Receive: LIBOR

If ten-year gilt is 5% then:

- Pay 6.0% fixed on £80,000,000
- Receive LIBOR on £80,000,000

Interest received

Two sources of income received (if LIBOR = 4.5%):

Interest from collateral = £100,000,000 x (5% + 4%) = £9,000,000

Interest from swap = £80,000,000 x LIBOR
Interest from swap = £80,000,000 x 4.5% = £3,600,000

Interest paid

Three sources of income paid (if LIBOR = 4.5% and ten-year gilt = 5.0%):

- Senior tranche = £80,000,000 x (LIBOR + 0.70%)
- Senior tranche = £80,000,000 x 5.2% = £4,160,000

- Mezzanine tranche = £10,000,000 x (gilt + 1.0%)
- Mezzanine tranche = £10,000,000 x (6.0%) = £600,000

- Swap = £80,000,000 x (gilt + 1.0%)
- Swap = £80,000,000 x (6.0%) = £4,800,000

Total flows

Interest received	
Interest from collateral	£9,000,000
Interest from swap counterparty	£3,600,000
Total interest	£12,600,000

Interest paid out	
Interest to senior tranche	£4,160,000
Interest to mezzanine tranche	£600,000
Interest to swap counterparty	£4,800,000
Total interest	£9,560,000

Net	£3,040,000
Less fees	£634,000
Amount for equity	**£2,406,000**

Return to equity holder

With no defaults the return to the equity holder is:

$$\frac{£2{,}406{,}000}{£10{,}000{,}000} = 24.06\%!$$

This is the sort of “return” that CDO creators are looking for

Caveats

Main one of course: assumed no defaults

Admin fees etc

Assumed no repayment of principal

Systems required to issue CDO beyond some potential issuers

Summary

Credit derivatives, fastest growing derivatives market

CDSs allow:

- leveraged access to credit exposure
- short credit positions

CDOs can be used:

- by fund managers in portfolios
- to enhance returns on assets under management
- free capital for certain entities (banks, insurance companies)