FINCAD®

How to Discount Your Liabilities as a Quant

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TopQuants, 12th November 2014

How to Discount your Liabilities as a Quant?

- IFRS 13, FAS 157 for Financial Institutions and Corporates
  - Liabilities discounted at market rates
  - As an entity deteriorates, its credit becomes cheaper
    - "Own Credit Gain"
    - Investors do not benefit from Own Credit Gains.
    - Not really a gain, purely an accident of accounting rules.

- Solvency 2 for Insurers
  - Matching Adjustment Rule
    - "Hedged" liabilities can be discounted aggressively
    - "Unhedged" liabilities have to be discounted conservatively

Etc.

These are just "hacks".

Is there a universally good way to discount liabilities?

How to Discount your Liabilities as a Quant?

How To Model Simple Project SPVs as a Quant?

How to Discount Your Liabilities as a Quant?

How to manage ALM as a Quant?


Panasonic
Panasonic
Ideas for life
القطرية
QATAR

Project SPVs

SPV = Special Purpose Vehicle

- Limited liability company especially set up for a single project
- SPV raises equity and debt from investors
- SPV holds any assets and liabilities of the project

Advantages:

- Not on company balance sheet
- Transparent and cheap for investors

SPV Model

- Cash flow modelling
- Quantitative aspects
- Variations
- Historical examples
- Detailed Example

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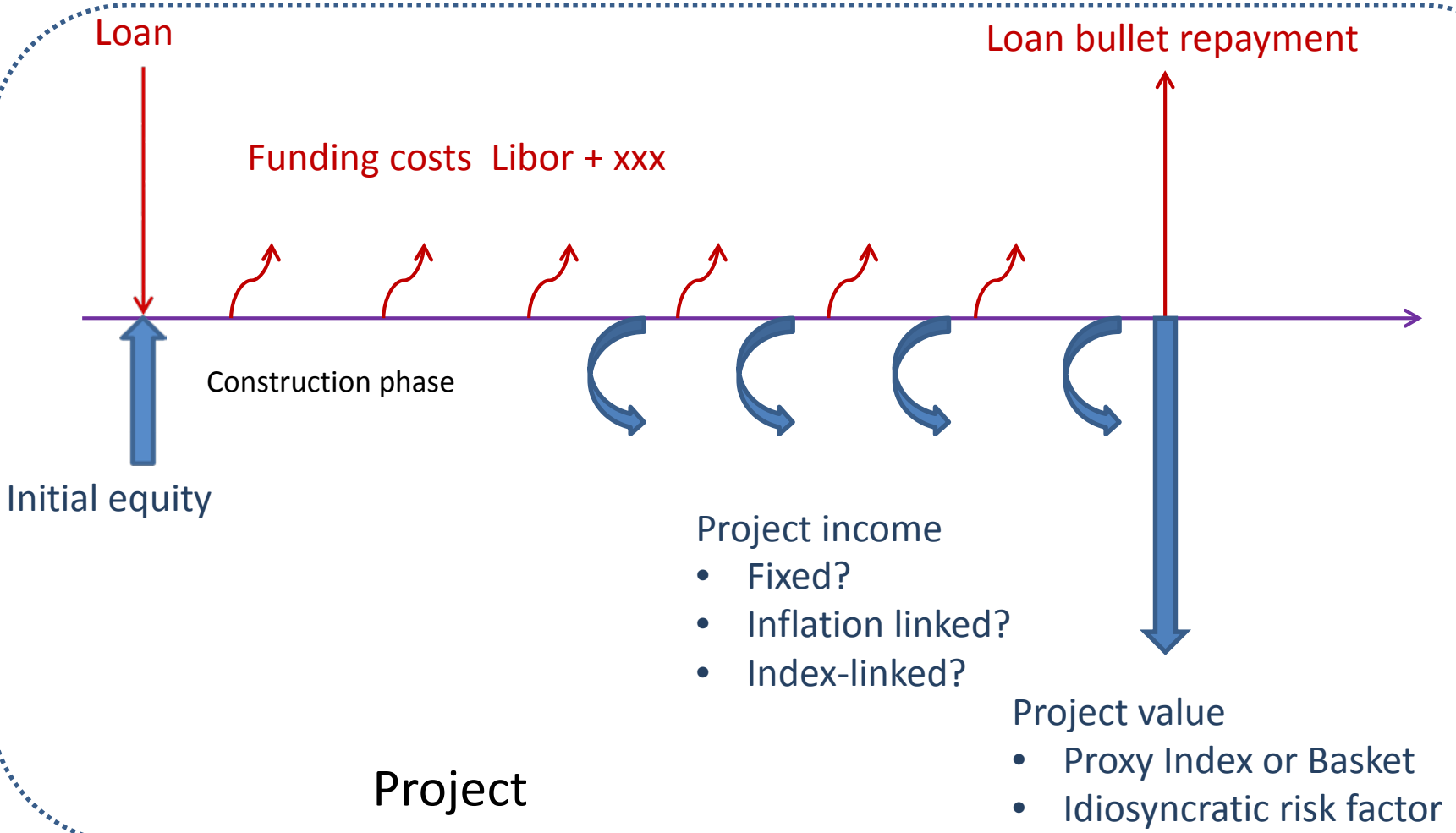
Project Risk



SPV Modelling

- Cash flow modelling

Incorporating all the risks of the SPV

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Defaultable Project

Equity Holder

- "Long" the "outright", "long" a "put" – i.e. "long" a "call"

Debt Holder

- "Short" a "put"
- "Long" the "recovery" (i.e. what remains after the option was exercised)

Merton-type model with American exercise.

The "option" is the option to default, any time but only once.

- Equity Holder manages this optionality to maximise his shareholders' PnL.
- Equity Holders have bought the put from debt holders
- Overall cost of credit = cost of put

Difference with Merton

Classical Merton Model

- Option to default at maturity

Merton-type Models

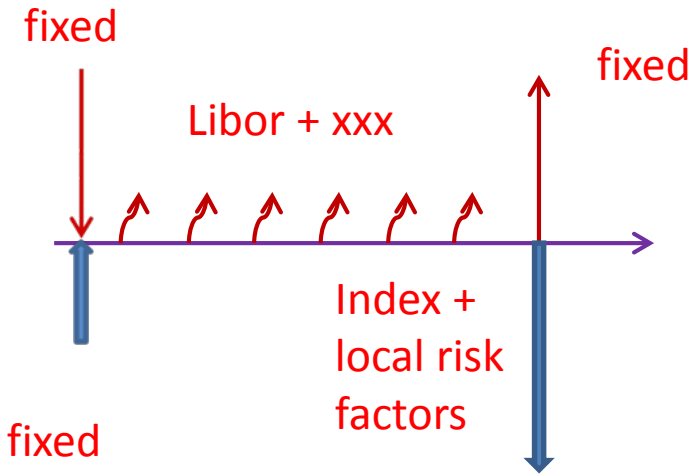
- Default if assets fall below, and/or liabilities increase beyond, given values

SPV model

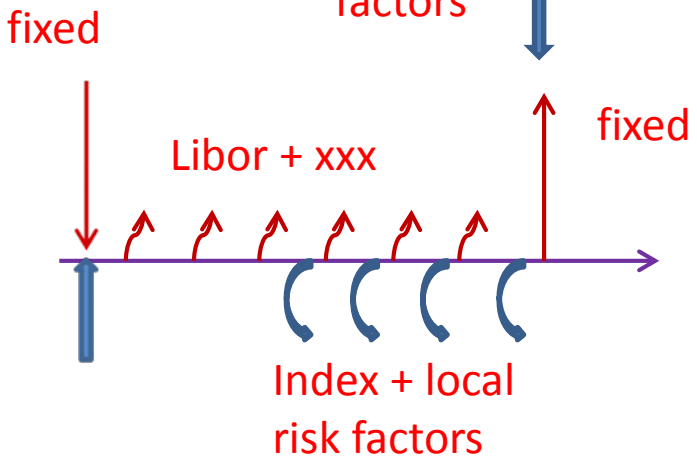
- Option to choose the time of default, at most once
- Optionality is actively managed by the Equity Holder to maximise his shareholders' PnL.
- Equity holders have bought the put from debt holders
- Cost of credit = cost of the put on the net cash flows.

Modelling

- “Value”-type Project

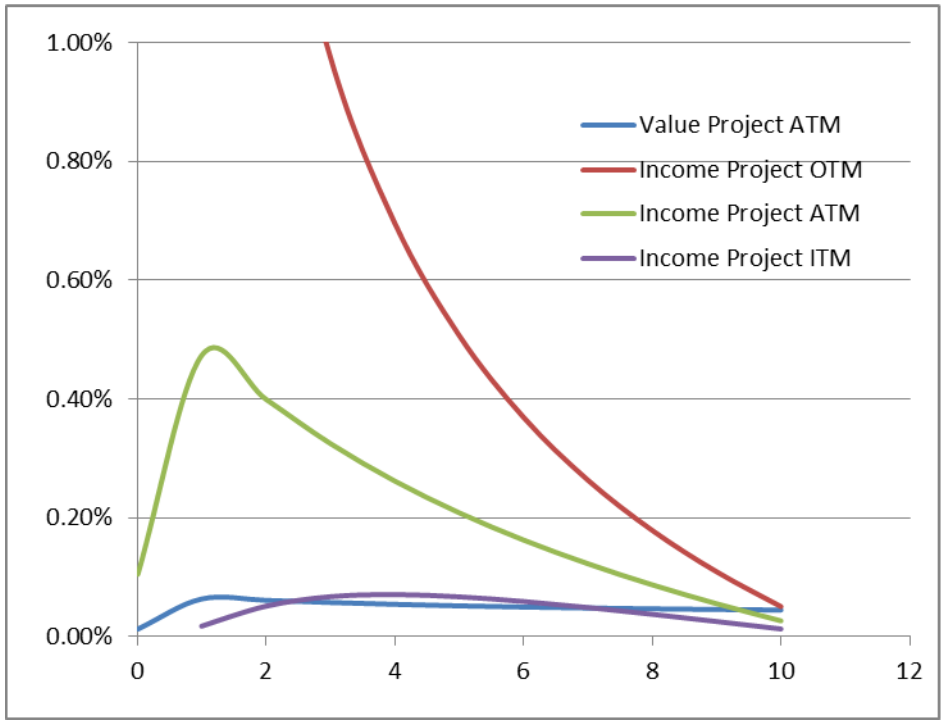


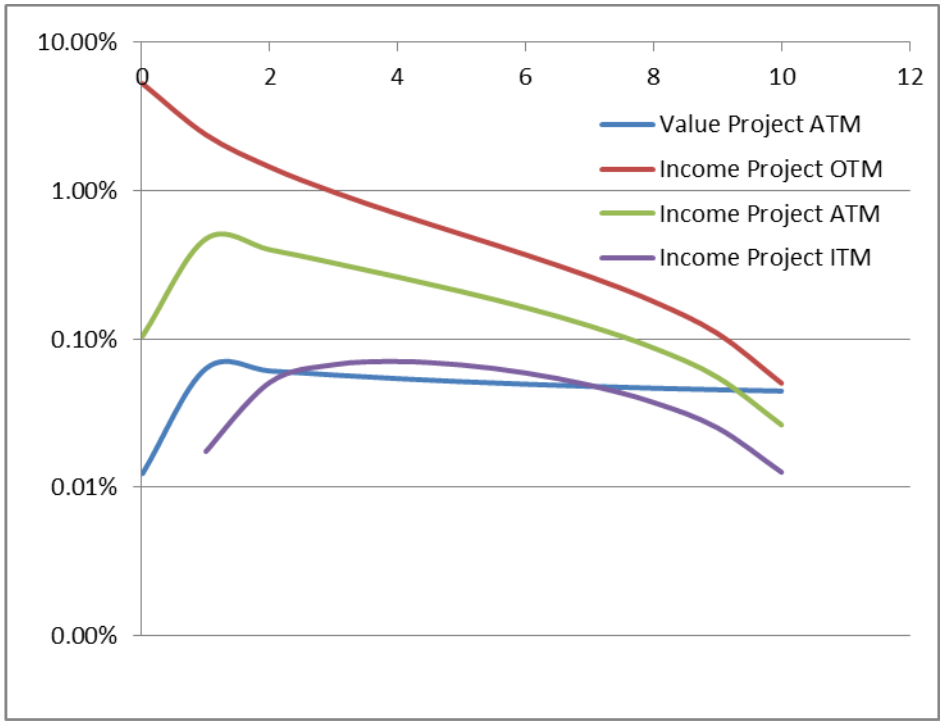
- “Income”-type Project



Modelling

Implied credit curves:





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- Quantitative aspects — **Consistent with market standard models**
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Variations

Notional structures:

- Bullet vs amortization

Cross currency funding:

- Loan, project income and project resale value in different currencies

Construction risk:

- Additional idiosyncratic risk factors driving the start and amounts of project income and resale value.

And many more.

Additional Factors

Long term lease / offtake agreements?

- Asset is solid, Lessee defaults

  → Lessee can be replaced

- Asset is under water, Lessee is solid

  → Lessee still pays

Last-to-Default of Asset and Lessee

Correlation between Asset and Lessee is important.

Additional Factors

Swaps, forwards, hedges?

- If done well, may decrease volatility
- If not done well, may also increase volatility
- Counterintuitively, high volatility makes the option to default more valuable
  - Higher chance of recovery in the future
  - Even if the asset is underwater, the option may be worth holding on to

→ Hedging is not always good for Equity holders.

→ Hedging is **really** good for Debt holders.

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Example

1 Basinghall St (London Offices)

- Loan: GBP 207 mln over 20 years, bullet
- Equity: 10%
- Rate: Libor + 300
- Rent link: UK RPI, floor 3%, cap 8%
  - annual review after year 5
- Notional link: UK IPD All Sectors
- Swap: Inflation + Libors
- Origination: 2009

Example

Sheremetyevo Terminal 2 (Moscow Airport)

- Loan Amount: USD 222 mln over 12 years, amortising
- Equity: 20%
- Rate: Libor + 350
- Rent link: US CPI unfloored, uncapped
- Swap: Structured
- Origination: 2008

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Incorporating all the risks of the SPV

Consistent with market standard models

Able to handle complex situations

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Modelling Example (Fincad F3)

Simplified example:

- Real estate asset
- Purchase price EUR 100 mln
- Loan EUR 90 mln, 5y bullet, Euribor6m + 2.00%
- Rent 10 mln / year, annual increases linked to HICPxT
- Tracking index for resale value is EPRA/NAREIT Europe

Modelling Example (Fincad F3)

Funding Leg:

CreateSingleCurrencyFloatingLeg			
ProductName	Funding Leg		
RollSchedule	14/02/2014	5y	Euribor6m
FloatingRateIndex	Euribor6m		
Margin	2.00%		
Notionals	90,000,000.00		
Currency	EUR		
PayRec	Pay		
Index	UnitConstant		
	Funding Leg		

Modelling Example (Fincad F3)

Loan Bullet:

CreateSingleCashflowProduct	
ProductName	LoanBullet
RollDates	14/02/2019
Index	UnitConstant
Notional	90,000,000.00
Currency	EUR
PayRec	Pay
	LoanBullet

Modelling Example (Fincad F3)

Income Leg:

CreateSingleCurrencyFloatingLeg			
ProductName	InflationLeg		
RollSchedule	14/02/2014	5y	SwapEURAnnualFixed
FloatingRateIndex	OccupancyFactor * max(0, HICPxT / HICPxT_initial - RentRiskFactor)		
Margin	0.00%		
Notionals	10,000,000.00		
Currency	EUR		
PayRec	Rec		
Index	UnitConstant		
	InflationLeg		

Modelling Example (Fincad F3)

Idiosyncratic risk factors - Occupancy Factor:

OccupancyFactor	Expected
0b	40%
1y	40%
5y	60%
10y	66%
20y	70%
30y	60%
50y	50%

OccupancyFactor	Volatilities
1y	10%
5y	10%
10y	5%
20y	5%
30y	6%
50y	8%

Modelling Example (Fincad F3)

Project Sale:

CreateSingleCashflowProduct	
ProductName	ProjectSale
RollDates	14/02/2019
Index	EPRA / EPRA_initial + SaleRiskFactor
Notional	100,000,000.00
Currency	EUR
PayRec	Rec
	ProjectSale

Modelling Example (Fincad F3)

SPV Cash Flows:

CreatePortfolioProduct	
ProductName	Project
WeightedConstituents	Funding Leg
	InlfationLeg
	LoanBullet
	ProjectSale
	Project

Modelling Example (Fincad F3)

Additional swaps, offtakes etc:

CreatePortfolioProduct	
ProductName	ProjectWithHedges
WeightedConstituents	Funding Leg
	InlfationLeg
	LoanBullet
	ProjectSale
	Swap1
	Swap2
	Swap3
	Offtake1
	ProjectWithHedges

Modelling Example (Fincad F3)

SPV With Option to Default:

CreateCancellableProduct	
ProductName	ProjectWithDefault
UnderlyingProduct	Project
CancellationStartDate	14/02/2014
CancellationEnd	14/02/2019
CancellationMarketConvention	Euribor6m
CancellationPayoff	ZeroConstant
ChooseBest	TRUE
BuySell	Buy
	ProjectWithDefault

Modelling Example (Fincad F3)

Pricing:

- Multi-factor, cross asset American Monte Carlo
- Universal Risk Technology ™ - adjoint differentiation
  - Analytical 1st order exposures to all market and project risk factors
- Detailed Cashflow reports

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- Detailed Example — **Straightforward to model in commercially available libraries**

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SHARD


SHARD
mace

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How To Model Simple Project SPVs as a Quant?

Assets - Liabilities + Option to Default

How to Discount Your Liabilities as a Quant?

How to manage ALM as a Quant?

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Assets – Liabilities + Option to Default

How is this different than IFRS 13?

Own Default Probability = Exercise Probability

How is this different than IFRS 13?

It isn’t.

Own Credit Gains appear if Own Default Probability is applied only to Liabilities, and not to the Assets

→ Liabilities deteriorate, Assets remain the same

→ Accounting gains

IFRS 13 is incomplete – it doesn’t address the resulting mismatch between Assets and Liabilities.

But why should Own Default Probability Apply to Assets?

Surely the value of any Assets is independent of who owns them?

It is. Our assets will have the same value regardless of whether we default or not.

They just won't be ours any more, if we default.

Why should Own Default Probability Apply to Assets?

When we sell our Assets, all we are doing is converting them to Cash.

→ shortening the duration of the Asset side

We are not actually doing anything to change the PnL.

Price of Everything, Value of Nothing

There is a fundamental difference between the **Price** and the **Value** of our Assets

Price = what **somebody else** would pay for them (objective)

Value = what they are worth to **us** (subjective).

Value = Price * Own Default Probability

(naïve)

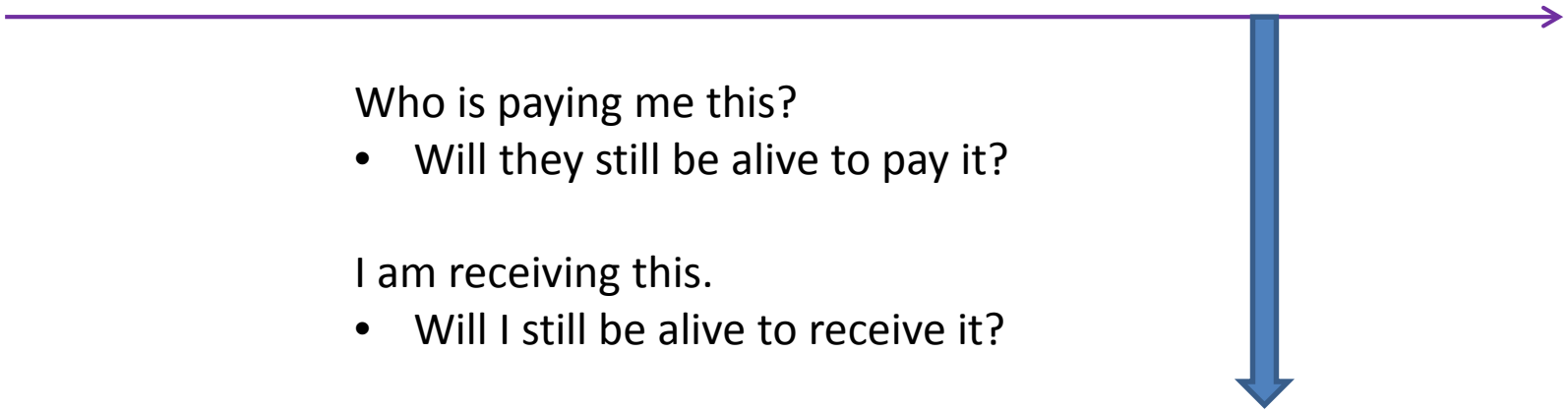
How to Discount your Liabilities as a Quant?

Discounting liabilities at market is fine.

The actual question is How to Discount your Assets as a Quant?

Have to reflect the fact that your shareholders no longer benefit from your Assets when you Default.

How to Discount your Liabilities as a Quant?



Who is paying me this?

- Will they still be alive to pay it?

I am receiving this.

- Will I still be alive to receive it?

First-to-Default of **me** and **Payer**

We are no longer discounting **Assets** at market rates.

IFRS 13 – right or wrong?

It is a trick question.

It is **right** to discount **Liabilities** at Market.

It is **wrong** to discount **Assets** at Market.

→ have to incorporate Own Default Probability.

Solvency 2 – right or wrong?

Solvency 2 Matching Adjustment Rule is trickier.

Liabilities that are closely matched to Assets can be discounted heavily.

Makes sense?

No!

- Low Default Probability.
- Liabilities should be expensive!
- Assets improve too.
- PnL still improves, but not because Liabilities are cheap.

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Assets - Liabilities + Option to Default

How to Discount Your Liabilities as a Quant?

At your own funding rates.
But also discount your Assets at First-To-Default of You and Counterparty.

How to manage ALM as a Quant?

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Does any of this have any implications to Portfolio Construction?

How to Construct Your Portfolio as a Quant

Example:

- Long dated Asset

← subject to Own Default Risk
Longer we wait, less likely are we to be still alive when it pays.

- Short dated Liability

How to Construct Your Portfolio as a Quant

Example:

- Short dated Asset
- Long dated Liability

← subject to Own Default Risk
Longer we wait, less likely are we to be still alive when we have to pay it.

How to Construct Your Portfolio as a Quant

Shortening the Duration of Assets and lengthening the Duration of Liabilities

→Improvement in Pnl from the standpoint of Own Default Risk

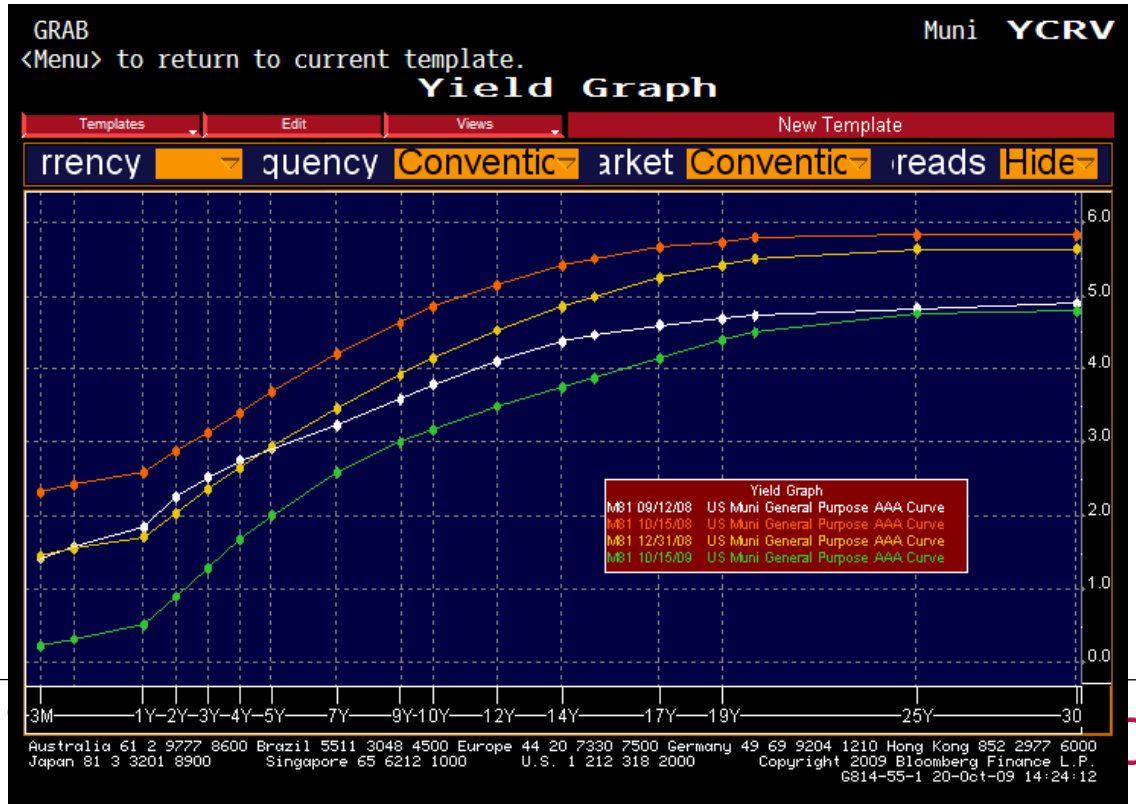
?

How to Construct Your Portfolio as a Quant

We make Asset Yield – Liability Yield

Banking 101

Low yield



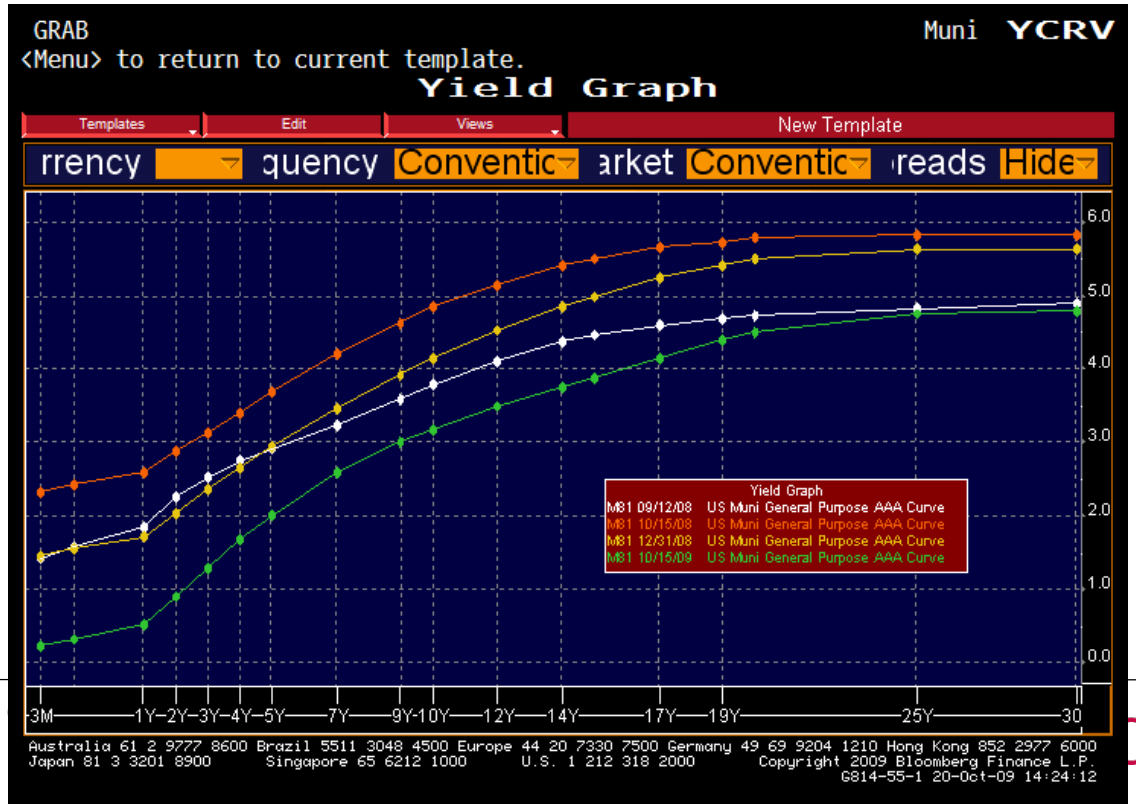
High yield

How to Construct Your Portfolio as a Quant

If Assets are shorter dated than Liabilities, we just lose money.

Low yield

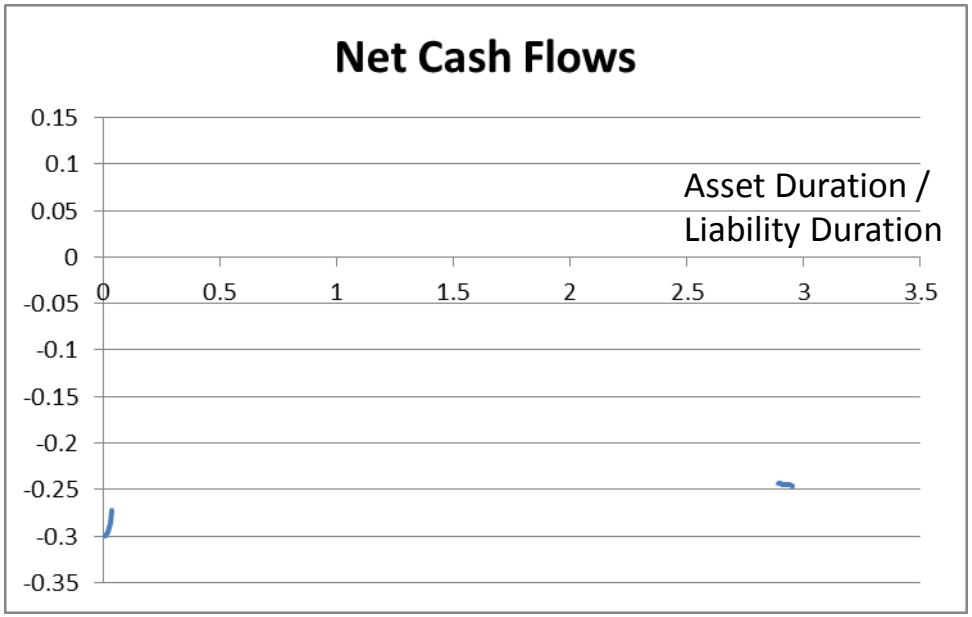
High yield



How to Construct Your Portfolio as a Quant

Short Assets,
Long Liabilities

We pay the steepness of the curve



Long Assets,
Short Liabilities

We pay
Own Default
Probability

How to Construct Your Portfolio as a Quant

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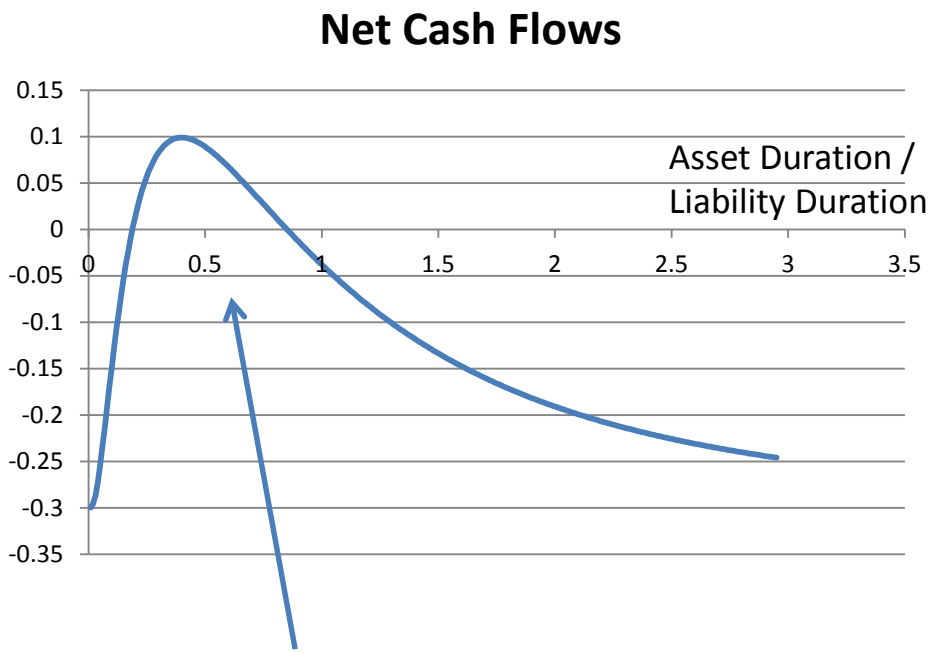

Sweet Spot
We make money

Long Assets,
Short Liabilities

We pay
Own Default
Probability

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Assets - Liabilities + Option to Default

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How to manage ALM as a Quant?

There is an optimal ratio of Asset Duration to Liability Duration which maximises the PnL.
It Depends on Own Default Probability.
Own Default Probability in turn depends on the Asset/Liability mix.

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Thank you