



Chatham Financial



**CFA  
Institute**

# Impact of negative interest rates on hedging strategies and pricing models

Apr 16, 2016

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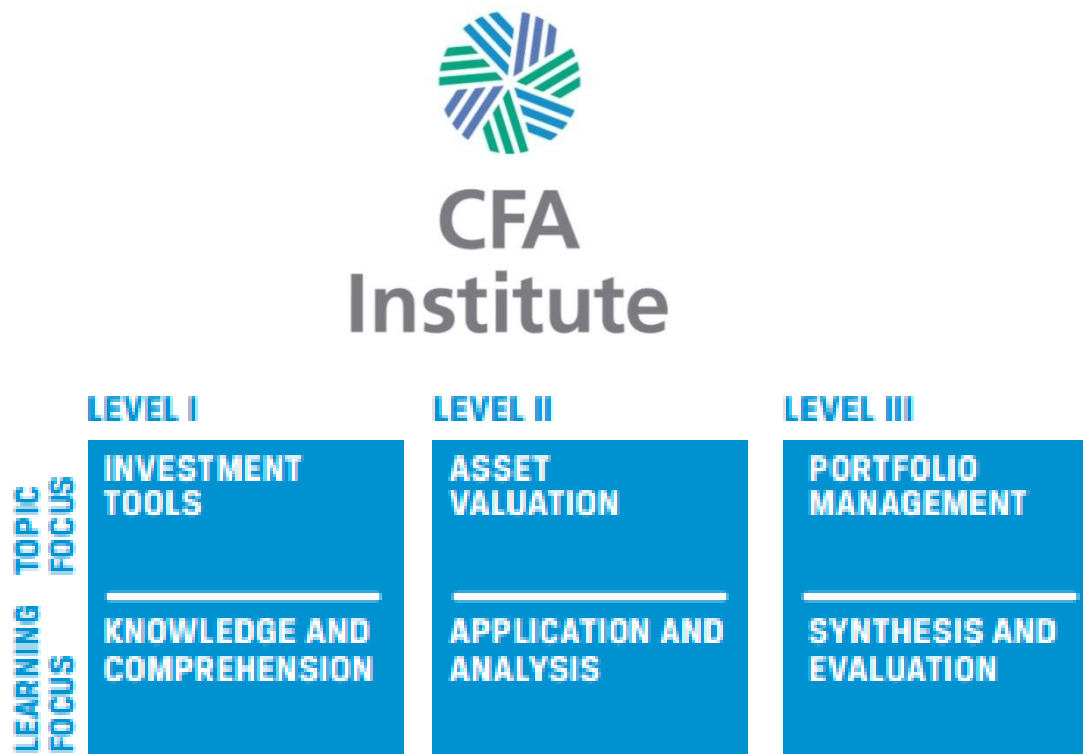
Grzegorz Bazarnik FRM

# Agenda

- About us
- Negative Interest Rates
- Impact on Hedging
- Impact on Models
- Questions?

# CFA Institute

CFA Institute is a global association of investment professionals that sets the standard for excellence in the industry.



# Chatham Overview



Chatham Financial  
at-a-glance

1,600

clients



## Private Equity

- Bain
- Blackstone
- Carlyle
- BlackRock
- JPM Asset Mgmt
- Morgan Stanley
- Oaktree
- Starwood



## Corporates

- Bacardi
- Coca Cola
- HP
- NFL teams
- Tiffany & Co.
- Royal Caribbean
- Walmart
- NBA team



## Family Offices, Sovereign Wealth & Infrastructure

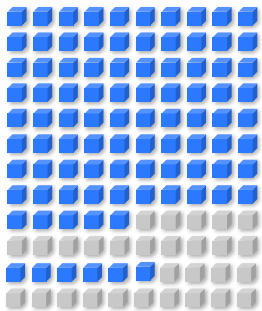
- Family Offices
- Cambridge Associates
- Alta Advisors
- Balfour Beatty
- Oman Investment Fund
- Large Middle Eastern Wealth Fund
- John Laing



## Real Estate

- Brookfield
- Forest City
- Hines
- Carlson
- Hilton Hotels
- Simon Prop.
- Starwood
- Zeller

## Expertise



400+ Employees

100+ Technologists

30+ Accountants

6+ former FASB staff

## Scale

Half trillion

\$ of hedges executed per yr

30 million

Valuations per yr

1 million

Journal Entries per yr



# Currencies with negative interest rates

*PHP interest  
rates turn  
negative*

*CHF interest  
rates turn  
negative*

*EUR, DKK, SEK  
interest rates  
turn negative*

*JPY interest  
rates turn  
negative*

*USD interest  
rates turn  
negative?*

**Nov 2010**

**Aug 2011**

**Jan 2015**

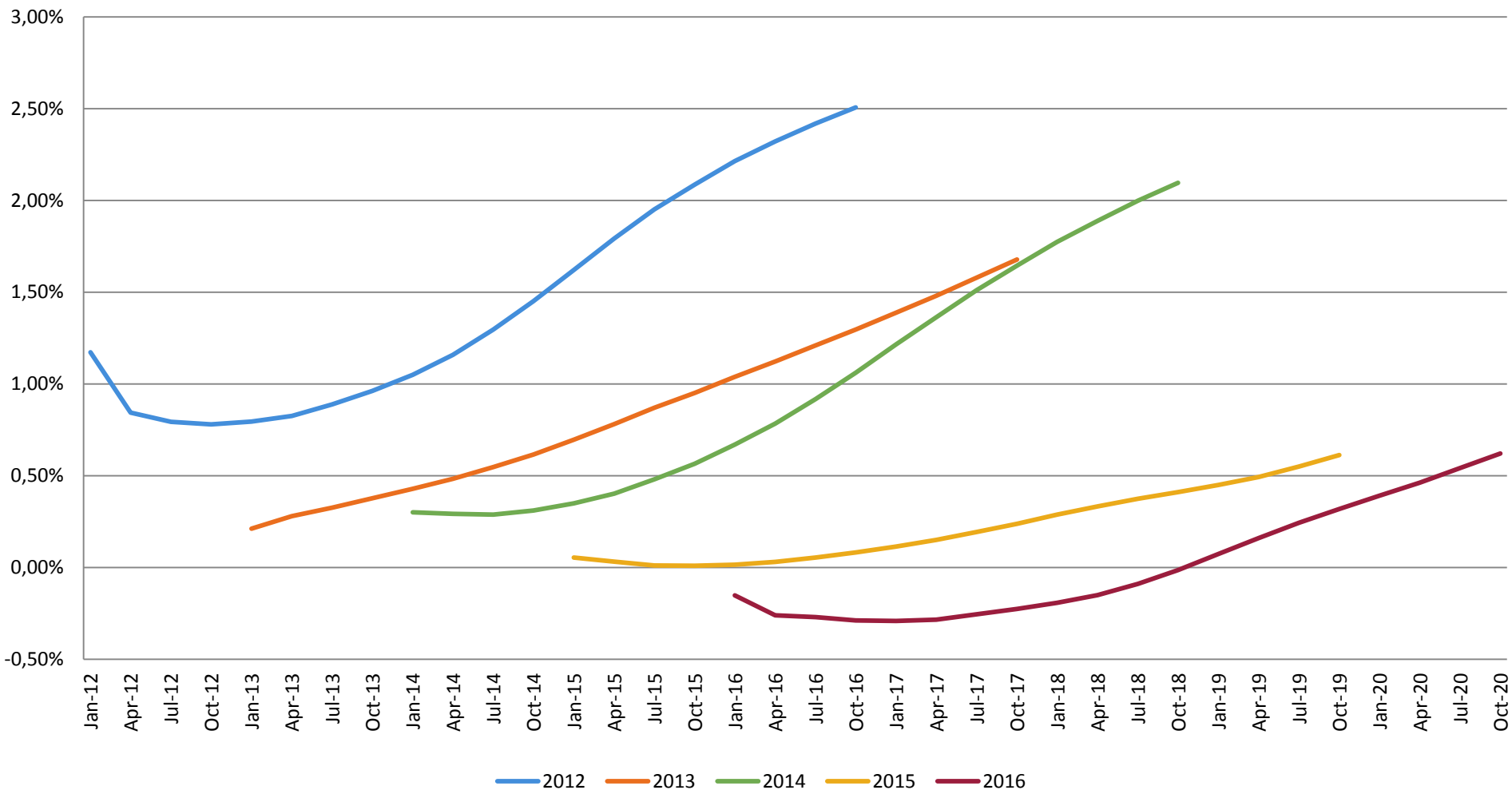
**Jan 2016**

**???**

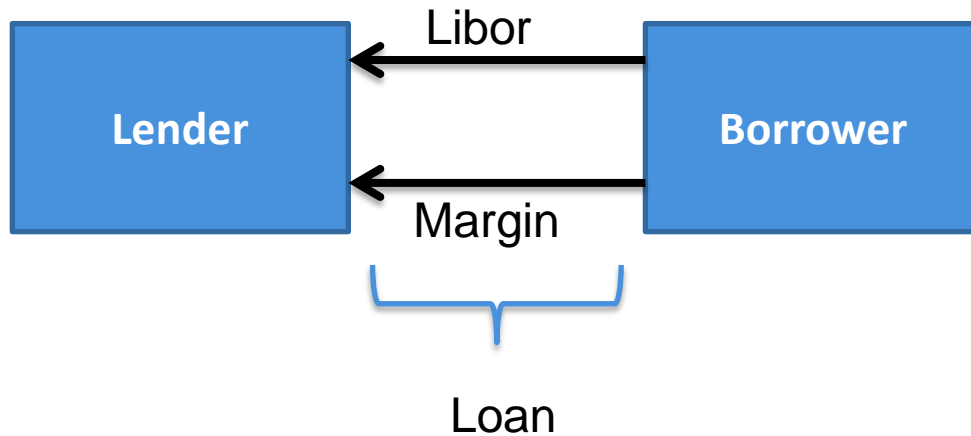
<b>YieldCurve</b>					
<b>Index Name</b>	<b>Index Type</b>	<b>Mat. Length</b>	<b>Mat. Unit</b>	<b>Market Rate</b>	
EUR-EURIBOR-REUTERS	FixingRate	1.00	Monthly	-0.34200%	
EUR-EURIBOR-REUTERS	FixingRate	3.00	Monthly	-0.24900%	
EUR-EURIBOR-REUTERS	FixingRate	6.00	Monthly	-0.13800%	
EUR-EURIBOR swap	SwapRate	2.00	Annually	-0.16150%	
EUR-EURIBOR swap	SwapRate	3.00	Annually	-0.13450%	
EUR-EURIBOR swap	SwapRate	4.00	Annually	-0.07500%	
EUR-EURIBOR swap	SwapRate	5.00	Annually	0.00500%	
EUR-EURIBOR swap	SwapRate	10.00	Annually	0.52240%	
EUR-EURIBOR swap	SwapRate	15.00	Annually	0.86540%	
EUR-EURIBOR swap	SwapRate	20.00	Annually	0.99900%	
EUR-EURIBOR swap	SwapRate	25.00	Annually	1.05500%	
EUR-EURIBOR swap	SwapRate	30.00	Annually	1.02640%	



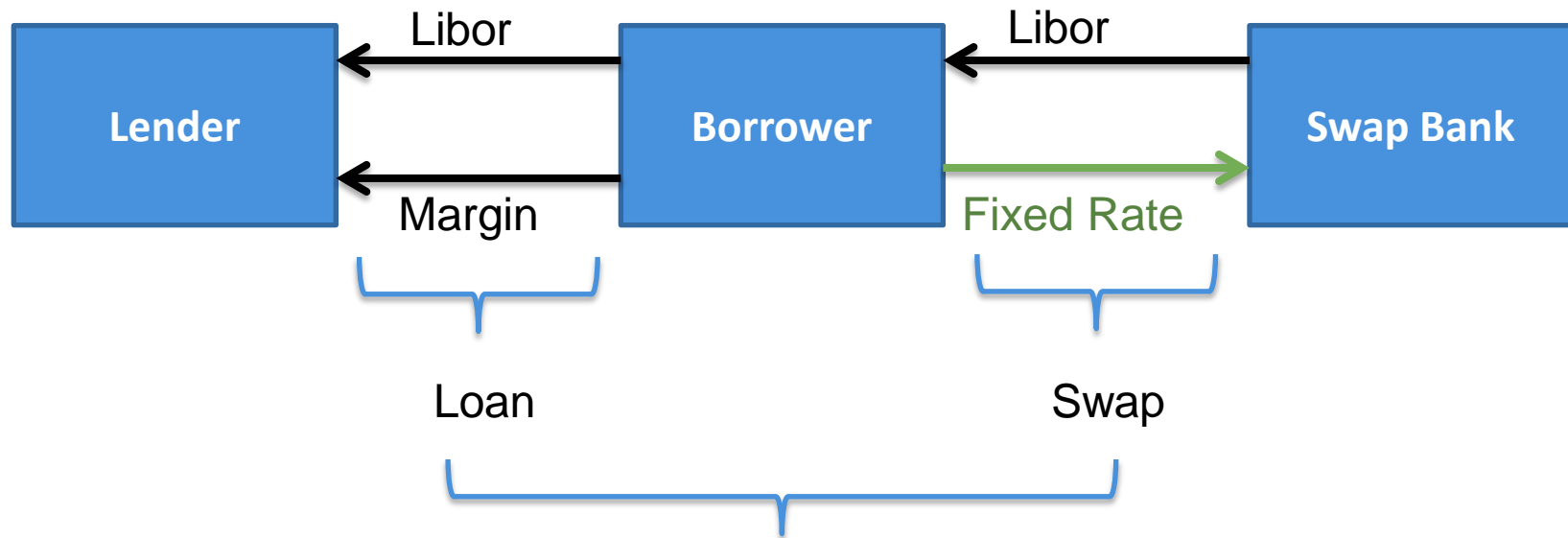
# Historical Euribor Forward Curve – Getting Lower and Flatter



# Impact on IR Hedging



# Impact on IR Hedging



Result: Pay Fixed Rate + Margin



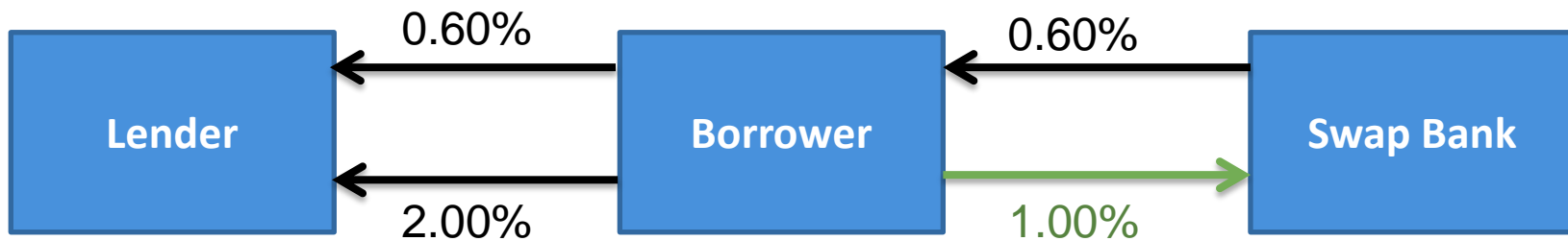
# Impact on IR Hedging – Example of Positive Libor

Assumptions:

Libor: 0.60%

Fixed Rate on Swap: 1.00%

Margin: 2.00%



<b>Loan:</b>	<b>0.60% + 2.00%</b>	<b>= 2.60%</b>
<b>Swap:</b>	<b>1.00% - 0.60%</b>	<b>= 0.40%</b>
<b>Net:</b>	<b>1.00% + 0.60% - 0.60% + 2.00%</b>	<b>= 3.00%</b>

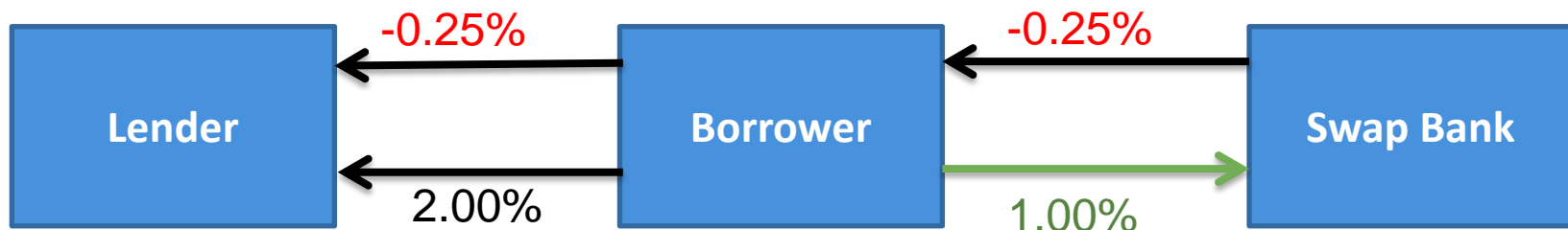
# Impact on IR Hedging – Example of Negative Libor (no 0% Floor)

Assumptions:

Libor: -0.25%

Fixed Rate on Swap: 1.00%

Margin: 2.00%

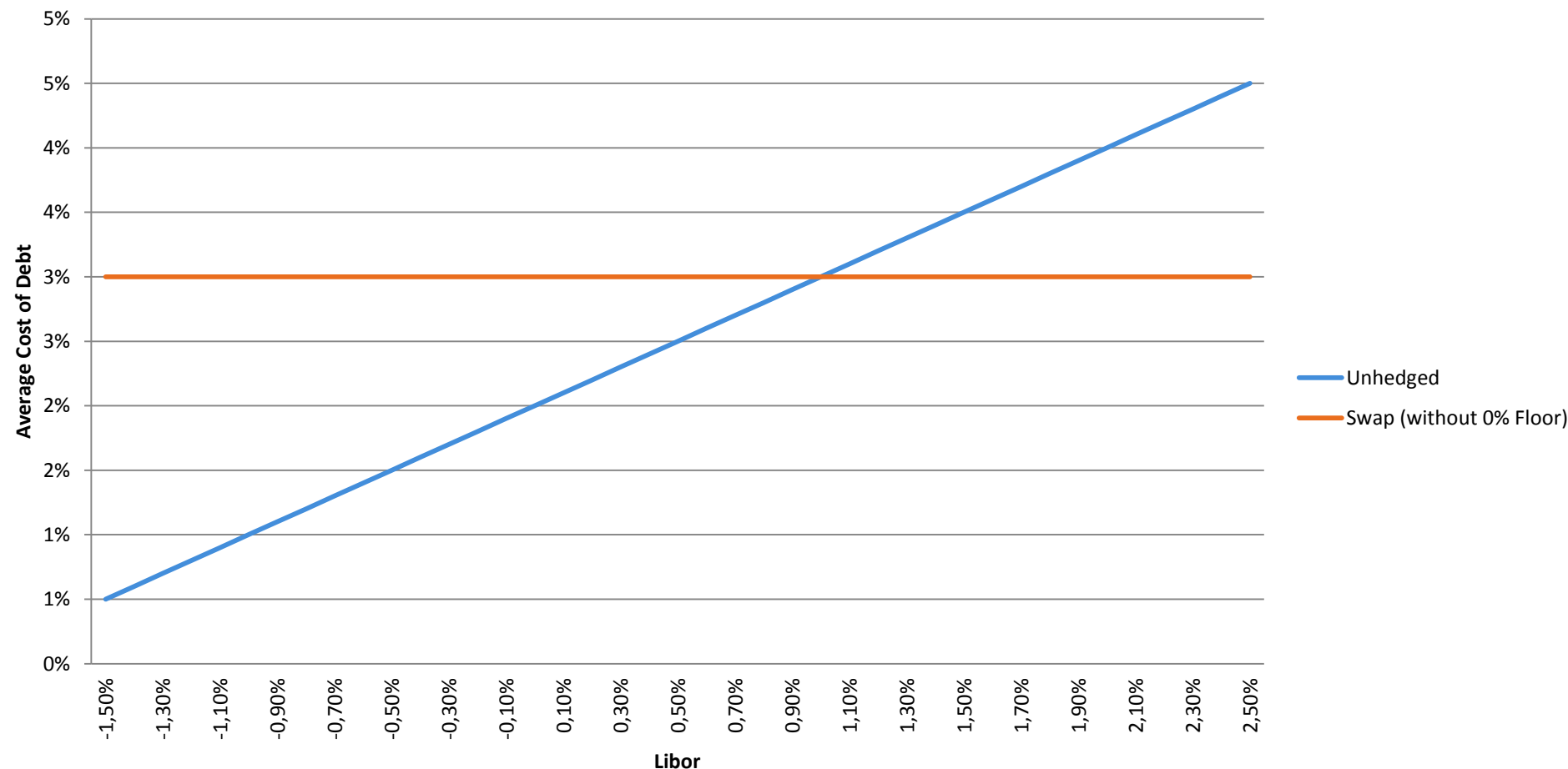


**Loan:**  $(0.25\%) + 2.00\% = 1.75\%$

**Swap:**  $1.00\% + (0.25\%) = 1.25\%$

**Net:**  $1.00\% + (0.25\%) - (0.25\%) + 2.00\% = 3.00\%$

# Average Cost of Debt



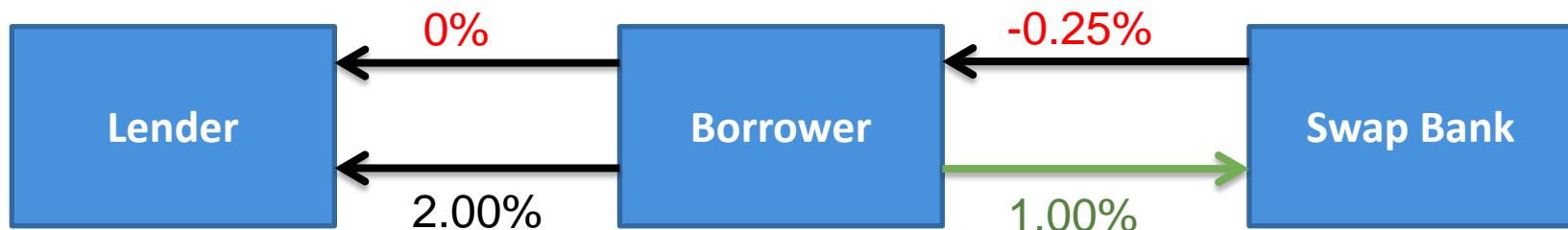
# Impact on IR Hedging – Example of Negative Libor (0% Floor)

Assumptions:

Libor: -0.25%

Fixed Rate on Swap: 1.00%

Margin: 2.00%

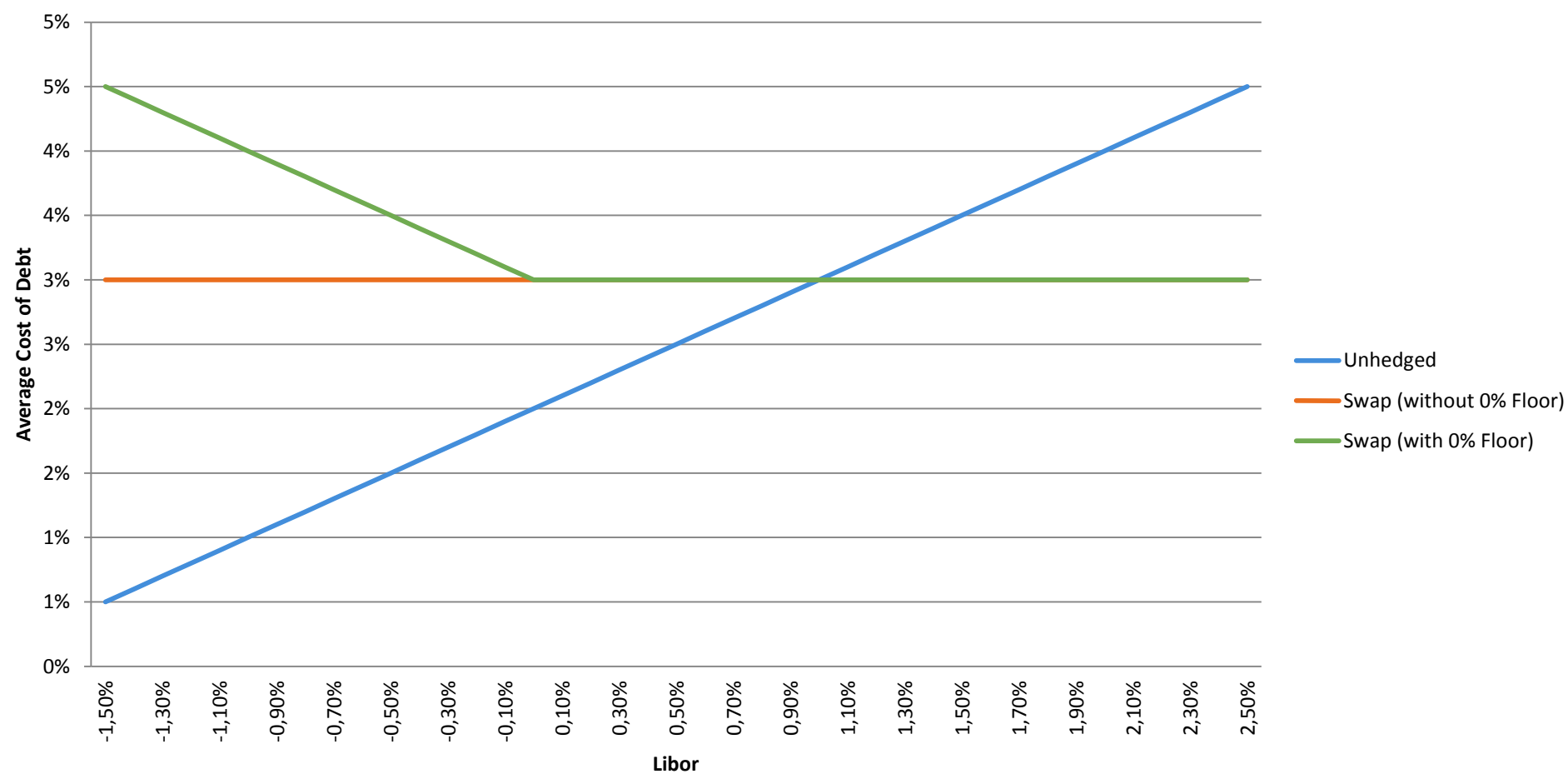


**Loan:**  $0\% + 2.00\%$  = 2.00%

**Swap:**  $1.00\% + (0.25\%)$  = 1.25%

**Net:**  $1.00\% + 0\% - (0.25\%) + 2.00\%$  = 3.25%

# Average Cost of Debt



## Impact on Models - Interest Rate Swap valuation

### Fixed Leg Values

Start Date	End Date	Notional	Rate	Discount Factor	Coupon	Cashflow PV
04/18/2016	10/18/2016	10,000,000.00	0.50000%	100.19%	-25,277.78	-25,324.87
10/18/2016	04/18/2017	10,000,000.00	0.50000%	100.37%	-25,138.89	-25,231.64
04/18/2017	10/18/2017	10,000,000.00	0.50000%	100.64%	-24,722.22	-24,879.83
10/18/2017	04/18/2018	10,000,000.00	0.50000%	100.87%	-25,000.00	-25,216.55

### Floating Leg Values

Start Date	End Date	Notional	Rate	Discount Factor	Coupon	Cashflow PV
04/18/2016	10/18/2016	10,000,000.00	-0.13826%	100.19%	-7,028.22	-7,041.38
10/18/2016	04/18/2017	10,000,000.00	-0.15438%	100.37%	-7,804.77	-7,833.56
04/18/2017	10/18/2017	10,000,000.00	-0.17935%	100.64%	-9,116.96	-9,175.37
10/18/2017	04/18/2018	10,000,000.00	-0.16602%	100.87%	-8,393.23	-8,466.11

# Impact on Models - Interest Rate Floor valuation

European  
Option

**Bought Floor @ 2.00000% (USD)**

Start	End	Notional	Strike	Forward Rate	Volatility	Discount Factor	Floorlet Value
04/18/2016	10/18/2016	10,000,000.00	2.00000%	0.00901	0.00%	99.65%	55,660.30
10/18/2016	04/18/2017	10,000,000.00	2.00000%	0.01026	44.98%	99.24%	48,999.71
04/18/2017	10/18/2017	10,000,000.00	2.00000%	0.01118	43.80%	98.77%	45,670.94
10/18/2017	04/18/2018	10,000,000.00	2.00000%	0.01180	46.82%	98.27%	44,904.06

## Black-Scholes Model

$$put = [K \times N(-d_2) - FR \times N(-d_1)] \times DF \times Notional \times DC$$

where

$$d_1 = \frac{\ln\left(\frac{FR}{K}\right) + 0.5 \times \sigma^2 \times T}{\sigma \times \sqrt{T}}$$

$$d_2 = d_1 - \sigma \times \sqrt{T}$$

# Impact on Models - Interest Rate Floor valuation

## 1. Shifted Lognormal Model

$$put = [(K - \theta) \times N(-d_2) - (FR - \theta) \times N(-d_1)] \times DF \times Notional \times DC$$

where

$$d_1 = \frac{\ln\left(\frac{FR - \theta}{K - \theta}\right) + 0.5 \times \sigma^2 \times T}{\sigma \times \sqrt{T}}$$

$$d_2 = d_1 - \sigma \times \sqrt{T}$$

and

$$\theta - \text{shift size}$$
$$\theta < 0$$



# Impact on Models - Interest Rate Floor valuation

## 2. Normal Model

$$put = [(K - FR) \times N(-d) + \sigma \times \sqrt{T} \times N'(d)] \times DF \times Notional \times DC$$

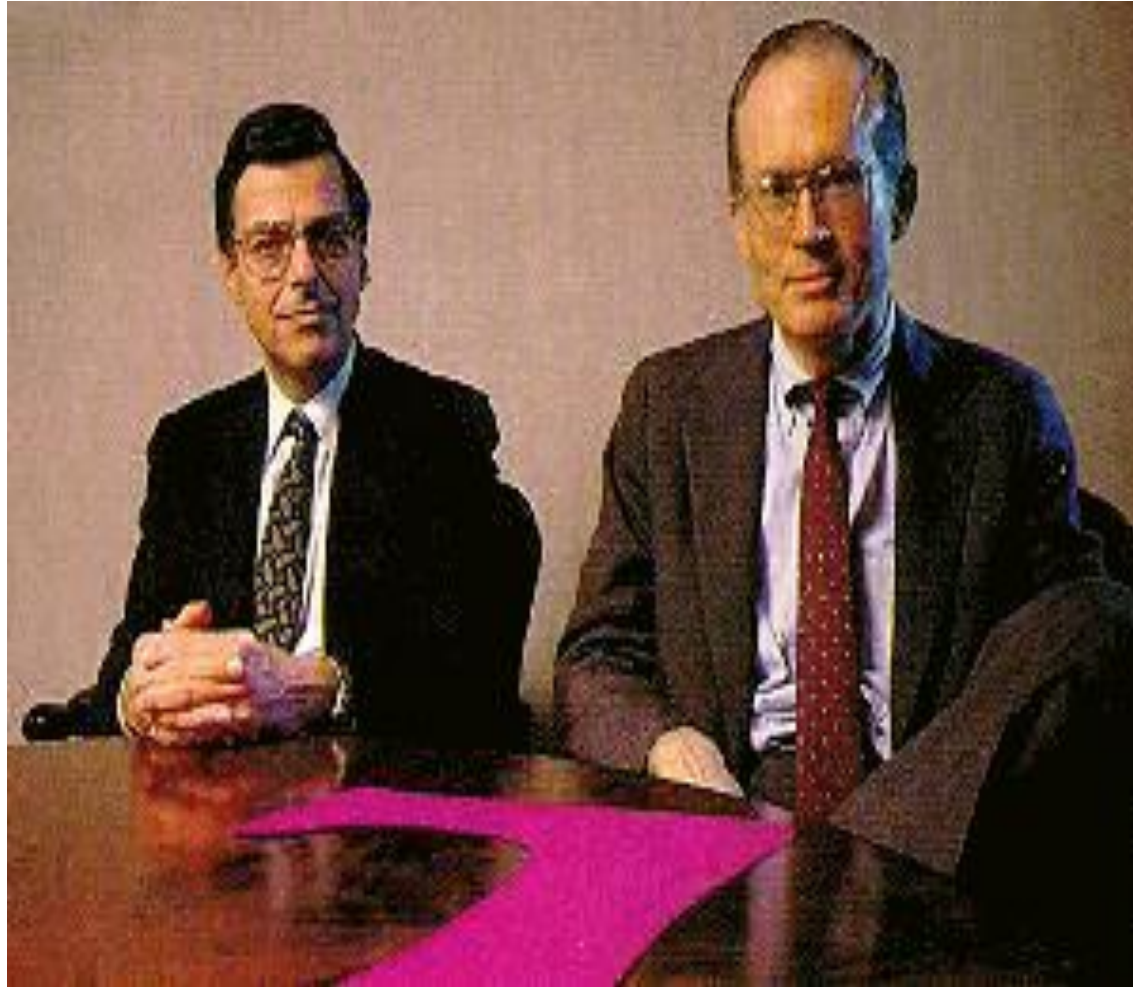
where

$$d = \frac{FR - K}{\sigma \times \sqrt{T}}$$

Bought Floor @ 0.00000% (EUR)							
Start	End	Notional	Strike	Forward Rate	Volatility	Discount Factor	Floorlet Value
04/18/2016	10/18/2016	10,000,000.00	0.00000%	-0.13826%	0.00%	100.19%	0.00
10/18/2016	04/18/2017	10,000,000.00	0.00000%	-0.15438%	10.00%	100.37%	7,826.49
04/18/2017	10/18/2017	10,000,000.00	0.00000%	-0.17935%	10.00%	100.64%	9,125.04
10/18/2017	04/18/2018	10,000,000.00	0.00000%	-0.16602%	10.00%	100.87%	8,495.81

# Fischer Black and Myron Scholes

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# Questions?