BNP PARIBAS
CORPORATE & INVESTMENT BANKING

Inflation-linked markets

Risk Awards 2008

BNP Paribas is Risk' Best Structured Product House of the Year 2008

EUROMONEY 2007 Awards for excellence

BNP Paribas is Euromoney's Best Structured Product House of the Year 2006 & 2007

Dec 2008

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1 – Basics on inflation

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Basics on inflation

The **Consumer Price Index,** in the UK the **Retail Price Index,** measures the nominal cost of a representative basket of consumer goods in the economy. In the Euro area, one refers to the Harmonised Consumer Price Index (HICP). In United States, one refers to the US CPI Urban Consumers NSA (US CPI).

Nominal price of basket today Index_0 Nominal price of basket at time T Index_T

The change of purchasing power is measured by the increase in the index $\frac{\text{Index}_T}{\text{Index}_0}$

However, in the "real" economy the price of the basket (which consists of real goods & services) remains constant, say $100 (these are "real $")

	Real Economy	Nominal Economy
time 0:	$100	$100
time T:	$100	$100 x $\frac{\text{Index}_T}{\text{Index}_0}$

Inflation is the rate of change of the index, usually measured annually: $\text{Inflation}_t = \frac{\text{Index}_t}{\text{Index}_{t-1}} - 1$

and so $\text{Index}_T = \text{Index}_0 \cdot (1+\text{Inflation}_1) \cdot (1+\text{Inflation}_2) \cdot \ldots \cdot (1+\text{Inflation}_T)$

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Definitions

Nominal Yield: Yield of a nominal bond or fixed-rate bond (Treasury, Gilt, OAT...)

Real Yield: Yield of an inflation-linked bond (TIPS, Indexed Gilt, OATi, OATei...)

Inflation Breakeven (or IBE): Forward inflation implied by the level of real and nominal yields

(1+Nominal Yield) = (1+Real Yield) * (1+ Inflation Breakeven Yield)

The Fisher Equation

Most of the time, the market looks at the spread, i.e. the first approximation:

IBE ~ Nominal Yield - Real Yield

The inflation breakeven is the level of future inflation required to obtain similar returns between an investment in linkers and an investment in nominal bonds over the holding period.

In theory, a risk premium is attached (the premium an investor is ready to pay in order to offset the risk on future inflation). There is no clear consensus about the value/behaviour of the risk premium.

The global inflation market at a glance

A relatively new asset class with USD 1 700bn market cap in June 2008

- All G7 countries have now issued inflation-linked bonds, with Germany the latest to join in March 2006.
- US, UK and Euro-denominated are the three biggest inflation government bond market in terms of market cap, with Euro superseding the UK market as second biggest market in terms of notional. Japanese inflation market is still relatively small.
- Euro and US are the fastest growing and most liquid inflation bond markets.
- Europe has the largest and most liquid inflation derivative market, followed by the UK, whereas the US inflation derivative market is still in its early stages.
- The Euro Inflation market has the broadest product range (sovereign issuers, government bonds, agency bonds, MTNs, swaps, options and exotics) and largest number of indices.
- The Emerging market's size is USD 230bn, mainly Latam with only South Korea in Asia.

A worldwide market

Americas

- Total: ~USD 762 bn
- United States: USD 518 bn
- Canada: USD 41 bn
- LatAm: USD 203bn

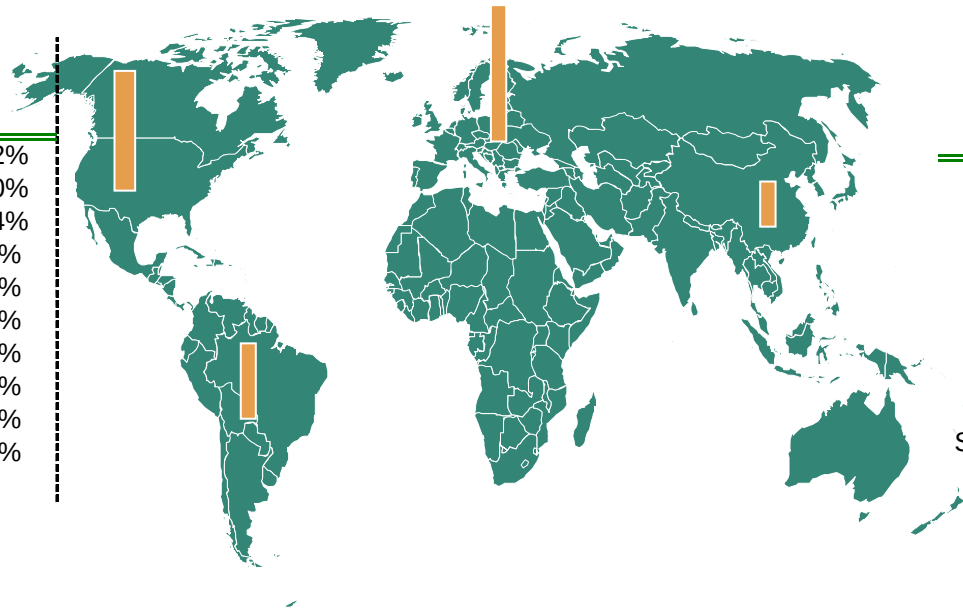
Europe

- Total: ~USD 780 bn
- France: USD 235 bn
- Italy: USD 119 bn
- Germany: USD 30bn
- Greece: USD 25 bn
- United Kingdom: USD 329 bn
- Sweden: USD 40 bn

Asia

- Total: ~USD 96 bn
- Japan: USD 84 bn
- South Korea: USD 3 bn
- Australia: USD 9 bn

USD bn	Market Cap Jun-08	
US	518.0	36.2%
UK	328.9	23.0%
France	235.4	16.4%
Italy	119.2	8.3%
Sweden	39.8	2.8%
Canada	41.2	2.9%
Japan	84.3	5.9%
Greece	25.1	1.8%
Germany	29.8	2.1%
Australia	9.1	0.6%
Total	**1,431**	
Dur	**9.5**	



USD bn	Market Cap Jun-08	
Brazil	149.1	64.6%
Argentina	16.5	7.2%
Chile	6.3	2.7%
Colombia	8.1	3.5%
Mexico	23.2	10.0%
Poland	5.4	2.4%
Turkey	7.3	3.2%
S. Africa	12.3	5.3%
South Korea	2.7	1.2%
Total	**231**	
Dur	**6.0**	

1981	1994	1997	1998 & 2001	2003	2004	2006	2007
UK first issued IL Gilts	Canada issued RRB	US issued TIPS	France issued the first OATi and OAT€i	Italy & Greece issued the first BTP€i & GGB€I	Japan issued the first JGBi	Germany issued the first BUND€i	S. Korea issued the first KTBi

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The active OECD markets

Update: Jul 08	No Lines	Notional (Local bn)	Notional (EUR bn)	Indexed Nominal (EUR bn)	Average Duration	% Indexed Debt (Notional)	% Indexed Debt (Indexed Notional)	Issued 2007 (EUR bn)	% Total Issued 2007	Expected Issues 2008 (EUR bn)	% Total Issues 2008
France	12	133	133	148	7.4	15%	17%	18	16%	20.0	16%
Italy	8	87	87	95	7.0	8.0%	8.6%	15	8%	20.0	11%
Germany	2	20	20	21	7.3	2%	2%	6	4%	11.0	7%
Greece	2	15	15	16	15.0	6%	7%	4	10%	4.0	10%
Total EMU	**24**	**254**	**254**	**280**	**7.7**	**8%**	**8.9%**	**42**	**7%**	**55.0**	**9%**
US	25	436	275	319	7.3	12%	15%	47	10%	41.0	9%
UK	14	90	113	196	12.9	22%	33%	21	20%	20.1	23%
Japan	16	9502	56	50	8.7	1%	1%	19	2%	17.7	2.4%
Sweden	6	218	23	27	8.7	23%	26%	0.8	10%	0.3	5%
Canada	5	24	15	16	15.9	9%	9%	1.5	6%	1.3	6%
TOTAL	**90**		**736**	**889**	**8.9**	**7%**	**8.9%**	**132**	**6%**	**135**	**8%**

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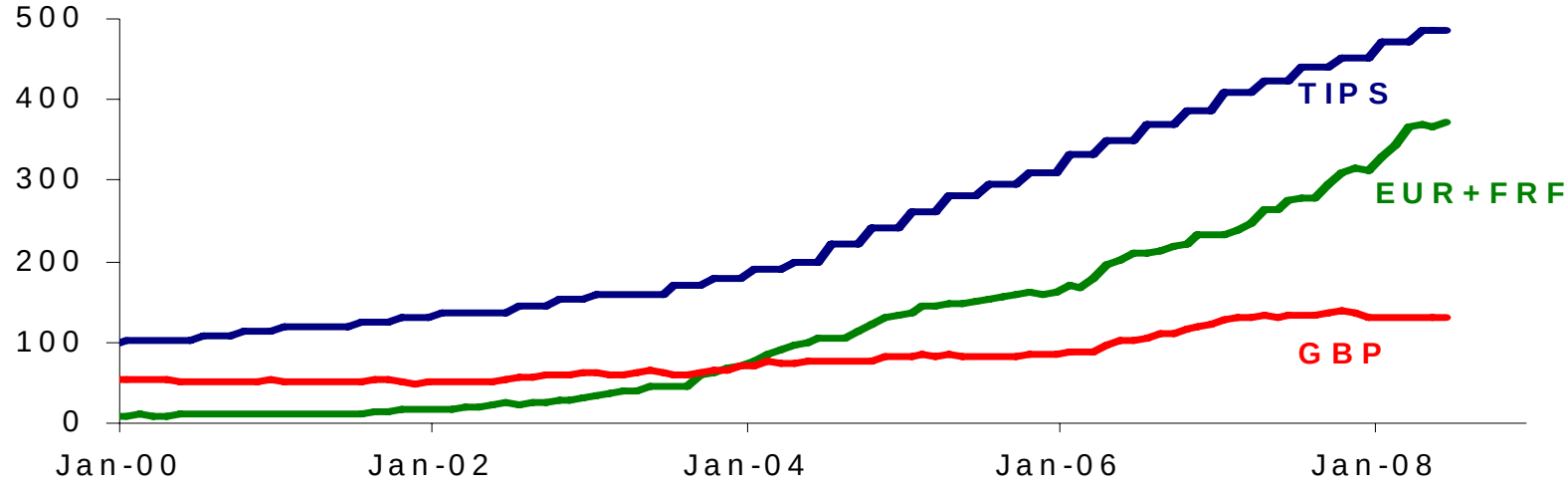
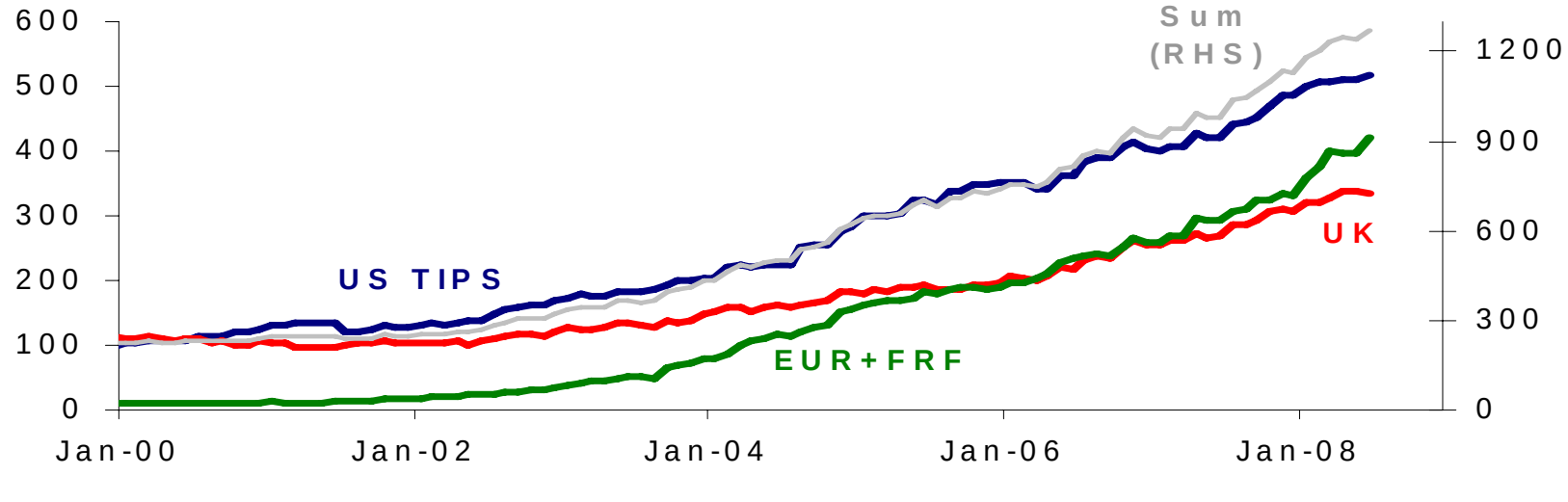
Liquidity across primary markets in the US, Europe and UK

Outstanding Inflation-linked Debt in *Nominal* Terms (USD bn)



Outstanding Inflation-Linked Debt *Market Capitalisation* (USD bn)



Source: ICAP and BNP Paribas estimates for Total

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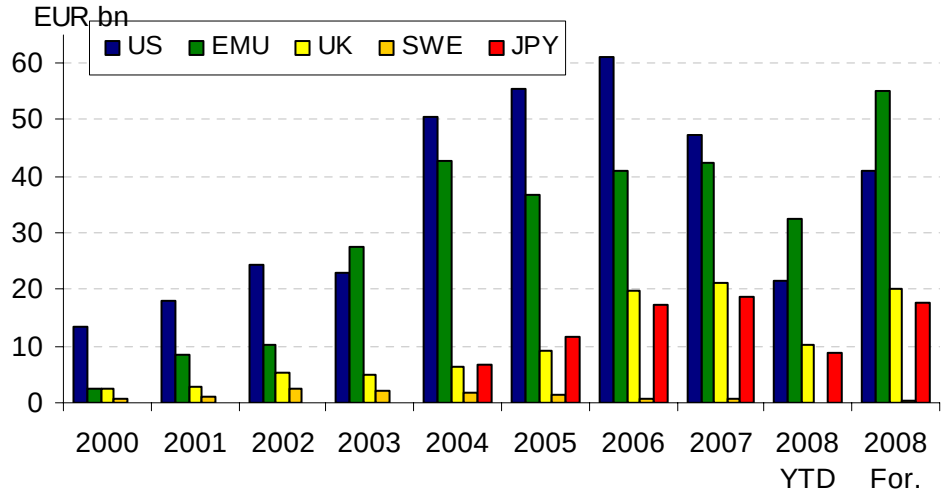
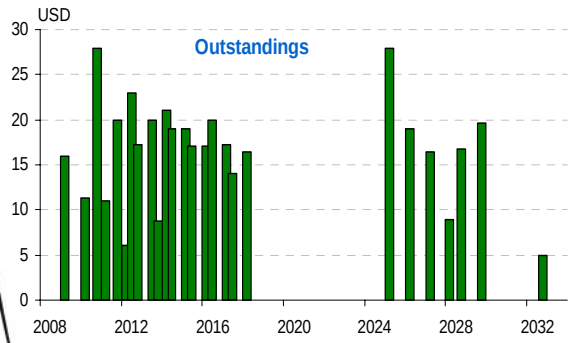
Outstanding inflation-linked bonds

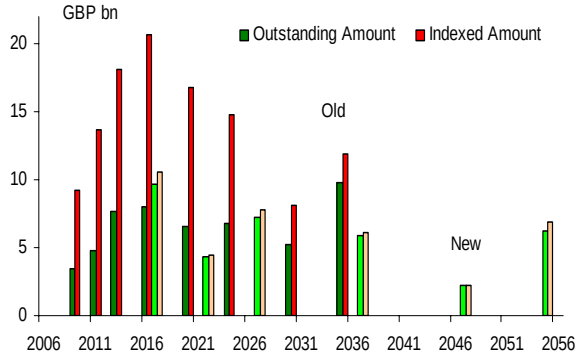
Over the years, the government issuers have increased the issuance of inflation-linked bond to create a real curve, with inflation-linked bonds across all maturities.



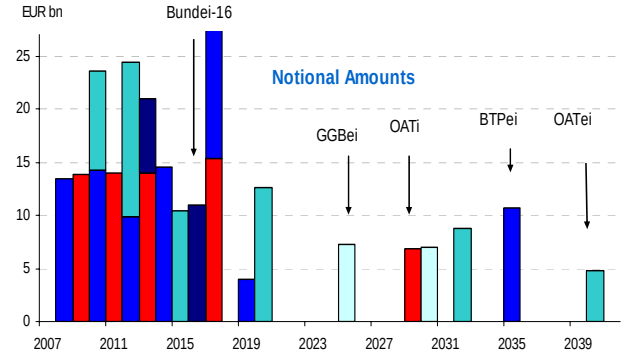
US TIPS



UK inflation-linked Gilts



EUR inflation-linked bonds



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2 – Structure of inflation-linked bonds

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Structure of inflation-linked bonds

Index-Linked (or "inflation-linked") **Bonds** aim at preserving the purchasing power of the bondholder,
i.e. compensate for inflation experienced over the life of the bond

To preserve the value of $100 notional, this notional is linked to the inflation index

i.e. the nominal notional for a payment of the bond at time t is $100 x $\frac{Index_t}{Index_0}$
where Index0 is the level of the inflation index on issue date

all coupons are paid on this indexed-notional and the indexed notional is repaid at maturity:
e.g. an Index-linked Bond with a 1.5% coupon pays

at coupon date t

$$1.5\% x \frac{Index_t}{Index_0}$$

at maturity T

$$100\% x \frac{Index_T}{Index_0}$$

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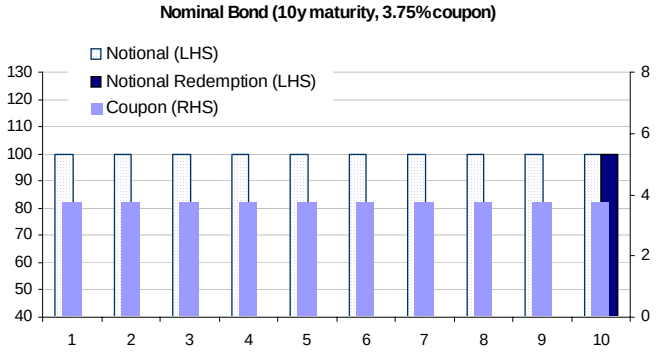
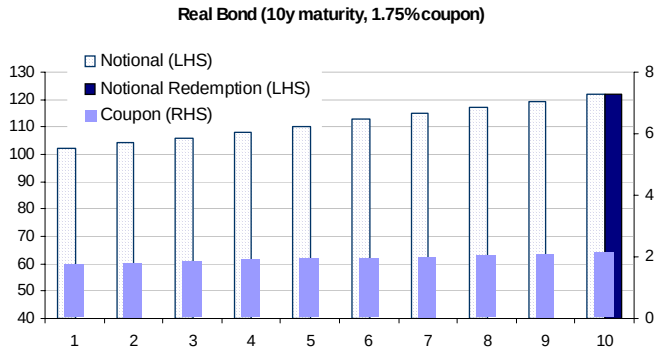
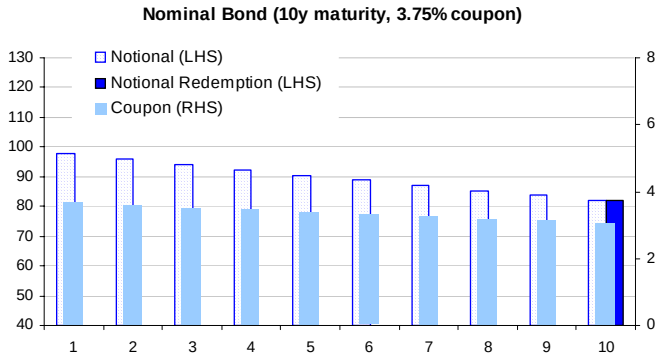
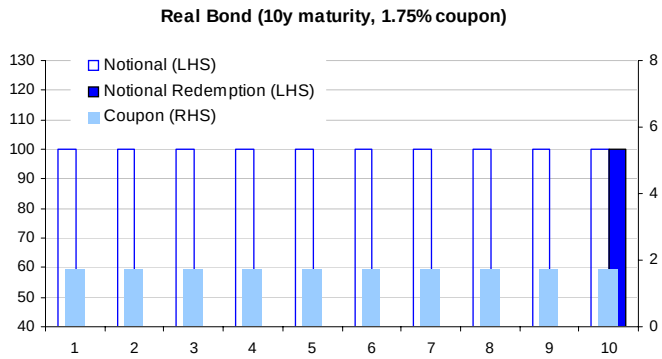
Cash Flows of inflation-linked bonds

Comparing the cash-flows of a conventional nominal bond vs. index-linked bond (assuming 2% annual inflation)









Purchasing power of both bonds

The cash-flows of an inflation-linked bonds will increase over time

in order to preserve the purchasing power of the bond holder.

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Comparison between markets

	EMU	France	US	JPY	UK *new*	UK *old*
CPI Index	Ex-tobacco HICP unrevised NSA	Ex-tobacco CPI unrevised NSA	CPI Urban Consumers unrevised NSA	Ex Fresh Food CPI unrevised NSA	RPI All Items unrevised NSA	RPI All Items unrevised NSA
Source	Eurostat	INSEE	BLS	MPM	ONS	ONS
Bloomberg	CPTFEMU <Index>	FRCPXTOB <Index>	CPURNSA <Index>	JCPNGENF <Index>	UKRPI <Index>	UKRPI <Index>
Principal	Indexation of principal at maturity					
Redemption	Minimum redemption at par			No guarantee		
Coupon	Fixed Real Coupon paid on an indexed pricinpal					
Fixing	In arrears					In advance
Lag	3-months					8-months
Frequency	Annual		Semi-annual			
Reference	Daily					Monthly
Taxation	Real rate + inflation				Real rate only	Real rate only

UK has changed to 3-month lag in arrears with a daily index for new issues since Sep 2005 (UK new)

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Comparing UK Gilt IL, Euro €I and TIPS

- **Old UK IL (issued up to Sep 2005) still offer a predetermined semi-annual coupon**:
  - Quotes are in £ vs. % for TIPS and euro linkers
  - Coupon is fixed at the beginning of the period, to which a 2-month technical lag should be added. A total of 8-month delay then is the rule.
  - Accrued interests are calculated in reference to a known coupon.
  - The reference index is the RPI, Retail Price Index, including mortgages. That creates a mechanical link between nominal rates and RPI.

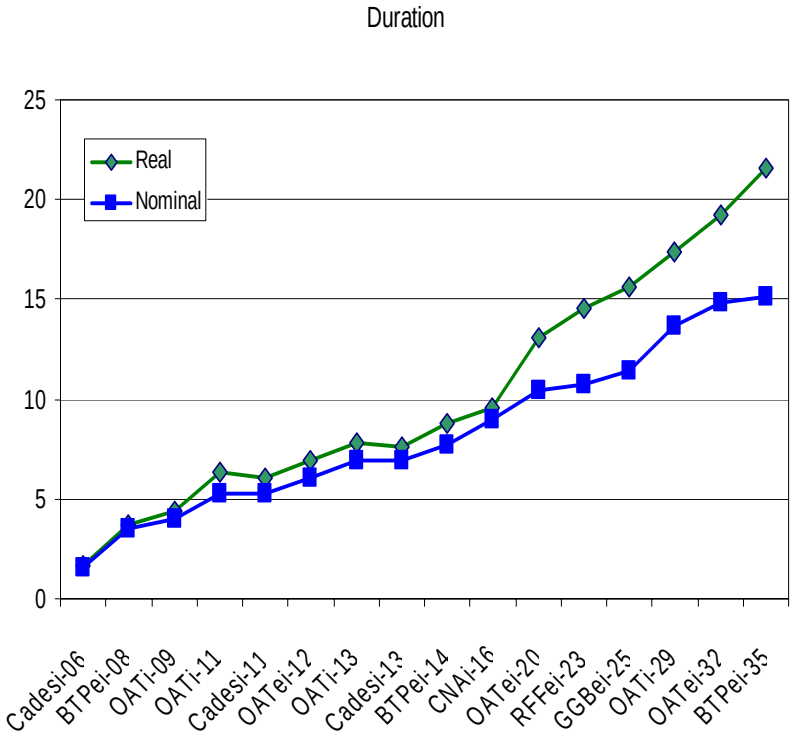
- **TIPS, Euro(€)is and new UK Gilts use a post-determined coupon.**
  - Pre-determined coupon becomes a fixed rate sensitive to inflation
  - It reduces the delay between index used and coupon payment

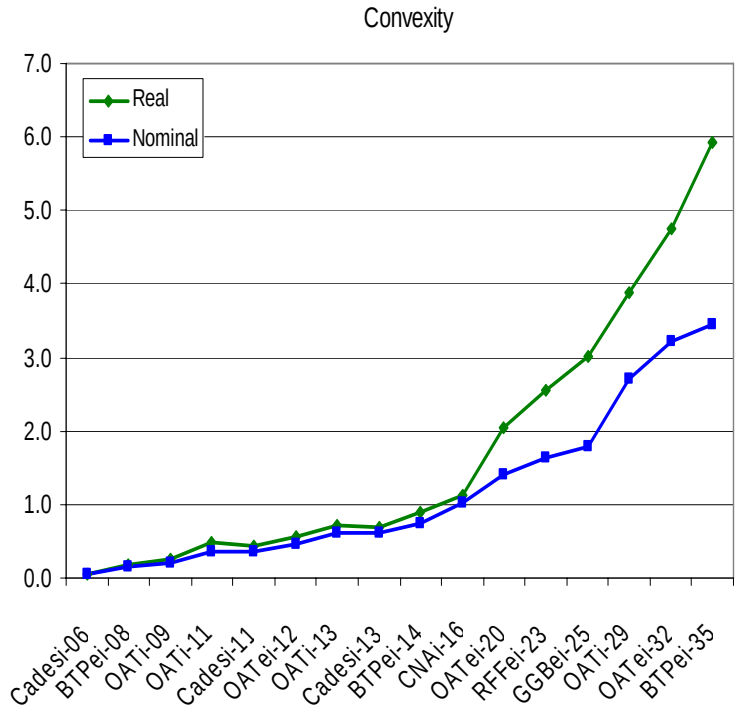
- **Advantages of post-determined coupon:**
  - It reduces the delay which remains constant (3 months) regardless of coupon frequency
  - An easy method to calculate accrued interest

Characteristics of inflation-linked bonds

Inflation-Linked Bonds have lower coupon and higher redemption payment

⇒ **higher duration and convexity than for equivalent nominal bonds**





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Characteristics of inflation-linked bonds

- **Modified Duration:**

- **DV01:**

$$\text{MDur}_{\text{Real}} = \frac{1}{\text{IR} \cdot \text{P}} \cdot \frac{\partial(\text{P} \cdot \text{IR})}{\partial \text{Y}} = \frac{1}{\text{P}} \cdot \frac{\partial \text{P}}{\partial \text{Y}}$$

$$\text{DV01} = \text{IR} \cdot \text{P} \cdot \text{MDur}_{\text{Real}} = \text{IR} \cdot \frac{\partial \text{P}}{\partial \text{Y}}$$

$$\text{IR} = \text{IndexRatio} = \frac{\text{DRI}_t}{\text{DRI}_0}$$

- **Convexity:**

$$\text{Conv}_{\text{Real}} = \frac{1}{\text{IR} \cdot \text{P}} \cdot \frac{\partial^2(\text{P} \cdot \text{IR})}{\partial \text{Y}^2} = \frac{1}{\text{P}} \cdot \frac{\partial^2 \text{P}}{\partial \text{Y}^2}$$

The DV01 is affected by the index ratio, unlike the modified duration and convexity over short periods of time

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Specifics of inflation-linked bonds

Linker Structure: CPI and DRI

CPI is published every month. As there is a delay between the month and the publication of the figure (usually published towards the end of the following month), this CPI figure cannot be used directly for the indexation of the bond. An indexation lag is then needed (8 months for old index-linked gilts, 3 months for all other bonds such as OATi, TIPS and new UK Gilts).

Accrued interest of an inflation-linked bond should not only take into account the value of the coupon but also the accrued inflation since the last payment date. Apart from the old UK index-linked Gilts, the coupon paid on all index-linked bonds is only known 3 months prior to coupon payment date.

In order to calculate accrued interest on inflation with precision, one has developed a *daily reference index*.

Calculation of a Daily Reference Index

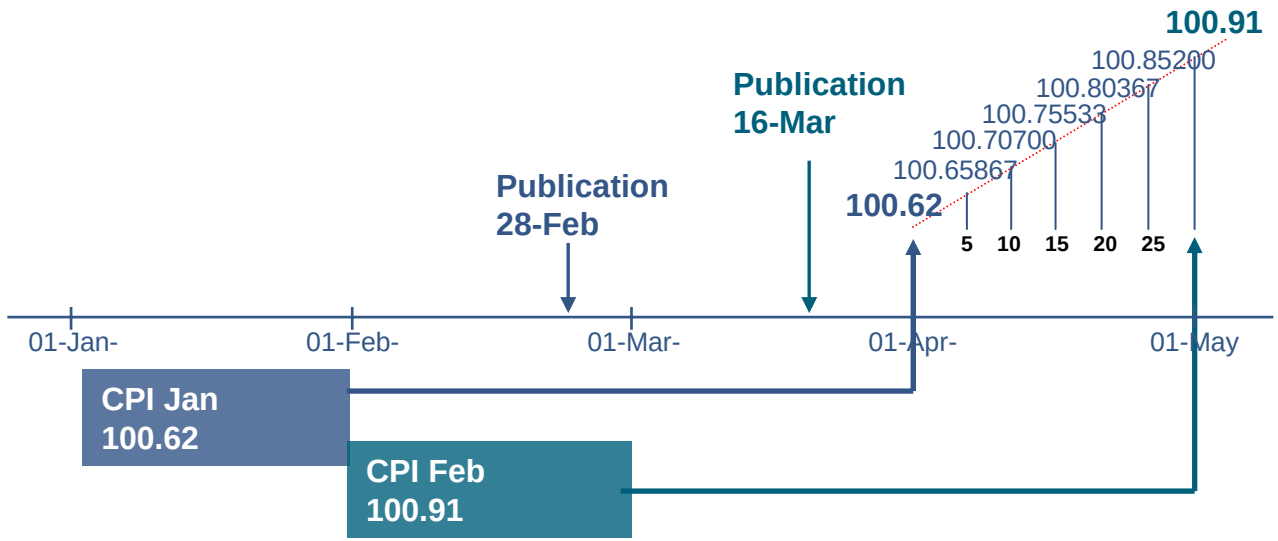
DRI - *Daily Reference Index* - is a daily figure calculated as a linear interpolation between the published CPI with a 2-month and a 3-month lag.

DRI (01-Apr-06) = CPI (Jan-06) = 100.62

DRI (01-May-06) = CPI (Feb-06) = 100.91

DRI (15-Apr-06) = linear interpolation between the 2 CPI figures

$$DRI_{ddmmyy} = CPI_{m-3} + \frac{dd-1}{ND_m} \cdot \left(CPI_{m-2} - CPI_{m-3}\right)$$



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Settlement of Index-Linked Bonds

Trading Index-Linked Bonds – all other inflation-linked bonds

OATi, TIPS and new Index-linked Gilts are quoted on a real basis, i.e. the price on screen is the real clean price

The real yield of the bond can be calculated from the quoted price in the same way as for a nominal bond,
e.g. UKTI 1 ¼ % Nov-17 trading at 98.40% has a real yield of 1.395 %

$$\text{Dirty} = \sum_{i=1}^{T} \frac{C_i}{(1+R_r)^i} + \frac{100}{(1+R_r)^T}$$

To calculate the settlement cash amount, the real clean price and the accrued interest have to be adjusted by the $IndexRatio = \frac{R.eferenceCPI_t}{BaseCPI_0}$

where Reference CPI t is the Daily Reference Index for the settlement date

and Base CPI is the Base Index for the bond

(usually the Reference Index for the first accrual date)

Settlement Price = Adjusted Clean Price + Adjusted Accrued Interest

$$Adjusted\ Clean\ Price = CleanPrice \times \frac{DRI_t}{DRI_0}$$

$$\text{Adjusted Accrued Interest} = \text{Coupon} \times \frac{n}{N} \times \frac{DRI_t}{DRI_0}$$

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Example of calculation of a settlement price

Example with OAT€i 20

Coupon	2.25 % annual on a notional indexed on CPI
Redemption	$100\% \times \frac{DRI_{Maturity}}{DRI_0}$
Maturity	25 Jul 2020
Price :	108.00 (= Real Clean Price)

Settlement Date: 5 April 2006

Reference CPI 5 April 2006 = 100.65867

Base CPI = 96.08560 $\text{Index Ratio} = \frac{DRI_t}{DRI_0}$

Index Ratio:	1.04759 (rounded to the 5 decimal places)
Accrued Interest:	254 days : 2.25% x 254 / 365 = 1.565753%
Adjusted Accrued:	1.565753% x 1.04759 = 1.640268 %
Adjusted Clean:	108.00 % x 1.04759 = 113.139720 %
Adjusted Dirty:	113.139720 % + 1.640268 % = 114.779988 %

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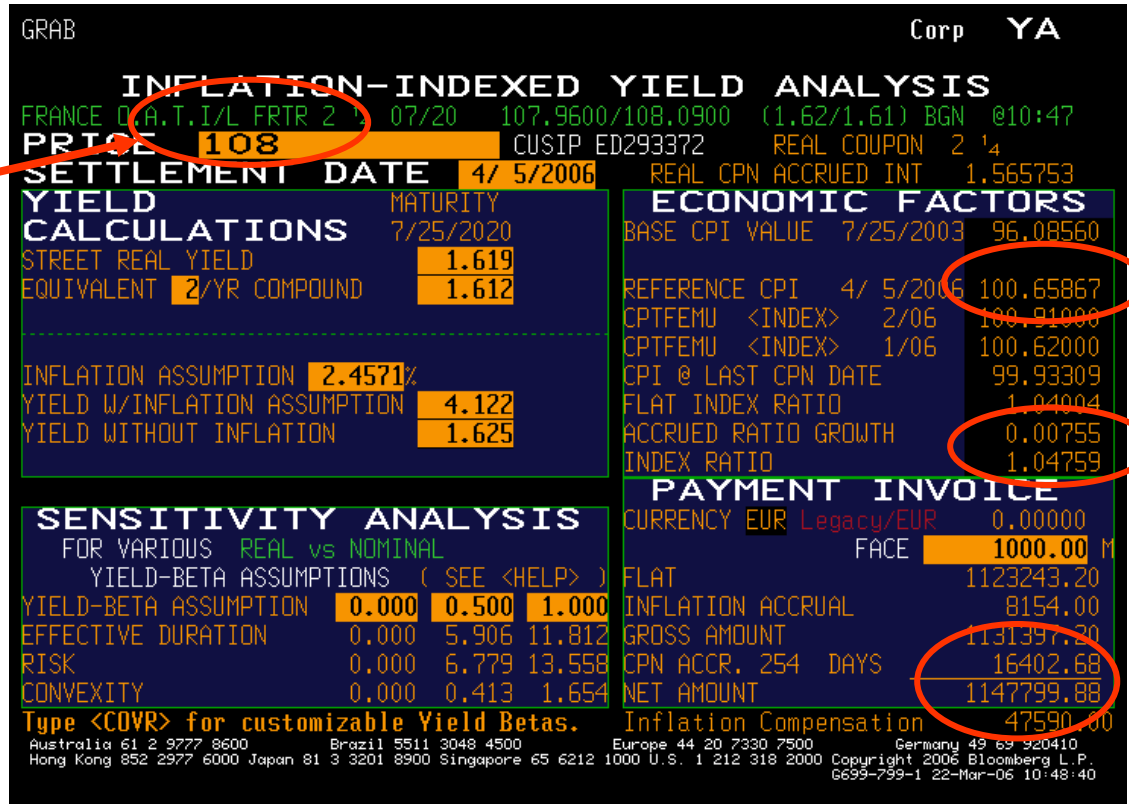
Calculation of a settlement price

OAT€i 20 using YA on Bloomberg



Real Clean Price

Ref CPI 5 April 06

$$\frac{DRI_{05\,Apr\,06}}{BaseDRI}$$

rounded to 5 decimal places

Adjusted Clean Price = Real Clean Price x Index Ratio

Adjusted Accrued:

Settlement Price = Adjusted Accrued + Adjusted Clean

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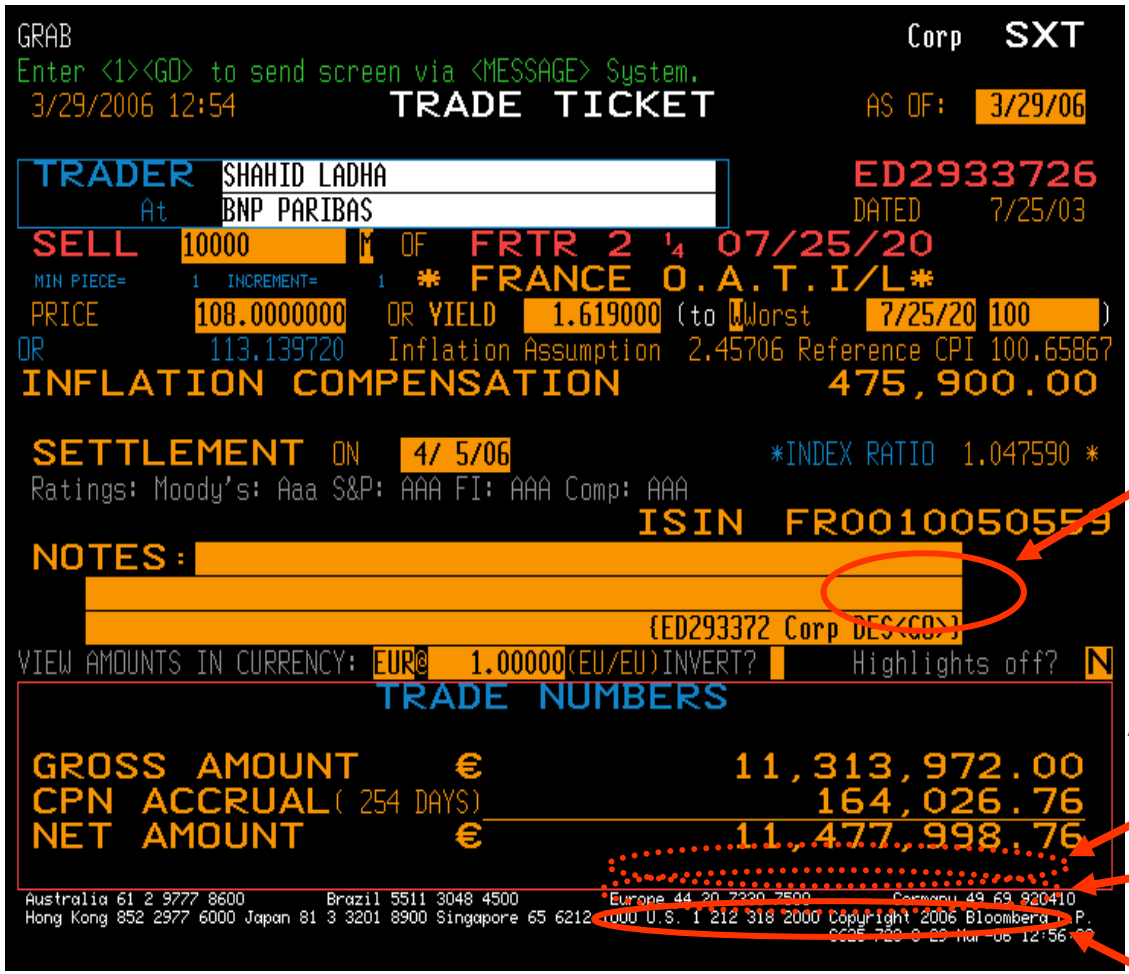
Calculation of a settlement price

OAT€i 20 using SXT BXT on Bloomberg



Index Ratio

Adjusted Clean

Adjusted Accrued

Adjusted Dirty

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Daily Reference Index & Index Ratio

DRI for EUR and FRF inflation are both published on Reuters:

	French (OATi, CADESi, CNAi)	Eurozone OAT€i, BTP€I, GGB€I, RFF€i
DRI	OATINFLATION01	OATEINDEXED01
Index Ratio	OATINFLATION02 -03-04	OATEINDEXED02-03

15:33 19APR05 AGENCY FRANCE TRESOR FR00359 OATEINDEXED01

AGENCY FRANCE TRESOR

OAT LINKED TO THE EUROZONE HARMONIZED CONSUMER PRICE INDEX EX TOBACCO
DAILY INFLATION REFERENCES
MARCH HICP:116.40000 FEBRUARY HICP:115.50000 JANUARY HICP:115.10000

01/06/05 116.40000	16/05/05 115.93548	01/05/05 115.50000	15/04/05 115.28667
31/05/05 116.37097	15/05/05 115.90645	30/04/05 115.48667	14/04/05 115.27333
30/05/05 116.34194	14/05/05 115.87742	29/04/05 115.47333	13/04/05 115.26000
29/05/05 116.31290	13/05/05 115.84839	28/04/05 115.46000	12/04/05 115.24667
28/05/05 116.28387	12/05/05 115.81935	27/04/05 115.44667	11/04/05 115.23333
27/05/05 116.25484	11/05/05 115.79032	26/04/05 115.43333	10/04/05 115.22000
26/05/05 116.22581	10/05/05 115.76129	25/04/05 115.42000	09/04/05 115.20667
25/05/05 116.19677	09/05/05 115.73226	24/04/05 115.40667	08/04/05 115.19333
24/05/05 116.16774	08/05/05 115.70323	23/04/05 115.39333	07/04/05 115.18000
23/05/05 116.13871	07/05/05 115.67419	22/04/05 115.38000	06/04/05 115.16667
22/05/05 116.10968	06/05/05 115.64516	21/04/05 115.36667	05/04/05 115.15333
21/05/05 116.08065	05/05/05 115.61613	20/04/05 115.35333	04/04/05 115.14000
20/05/05 116.05161	04/05/05 115.58710	19/04/05 115.34000	03/04/05 115.12667
19/05/05 116.02258	03/05/05 115.55806	18/04/05 115.32667	02/04/05 115.11333
18/05/05 115.99355	02/05/05 115.52903	17/04/05 115.31333	01/04/05 115.10000
17/05/05 115.96452	01/05/05 115.50000	16/04/05 115.30000	

Reference Index for TIPS and UK Gilts are published for reference only and need to be calculated

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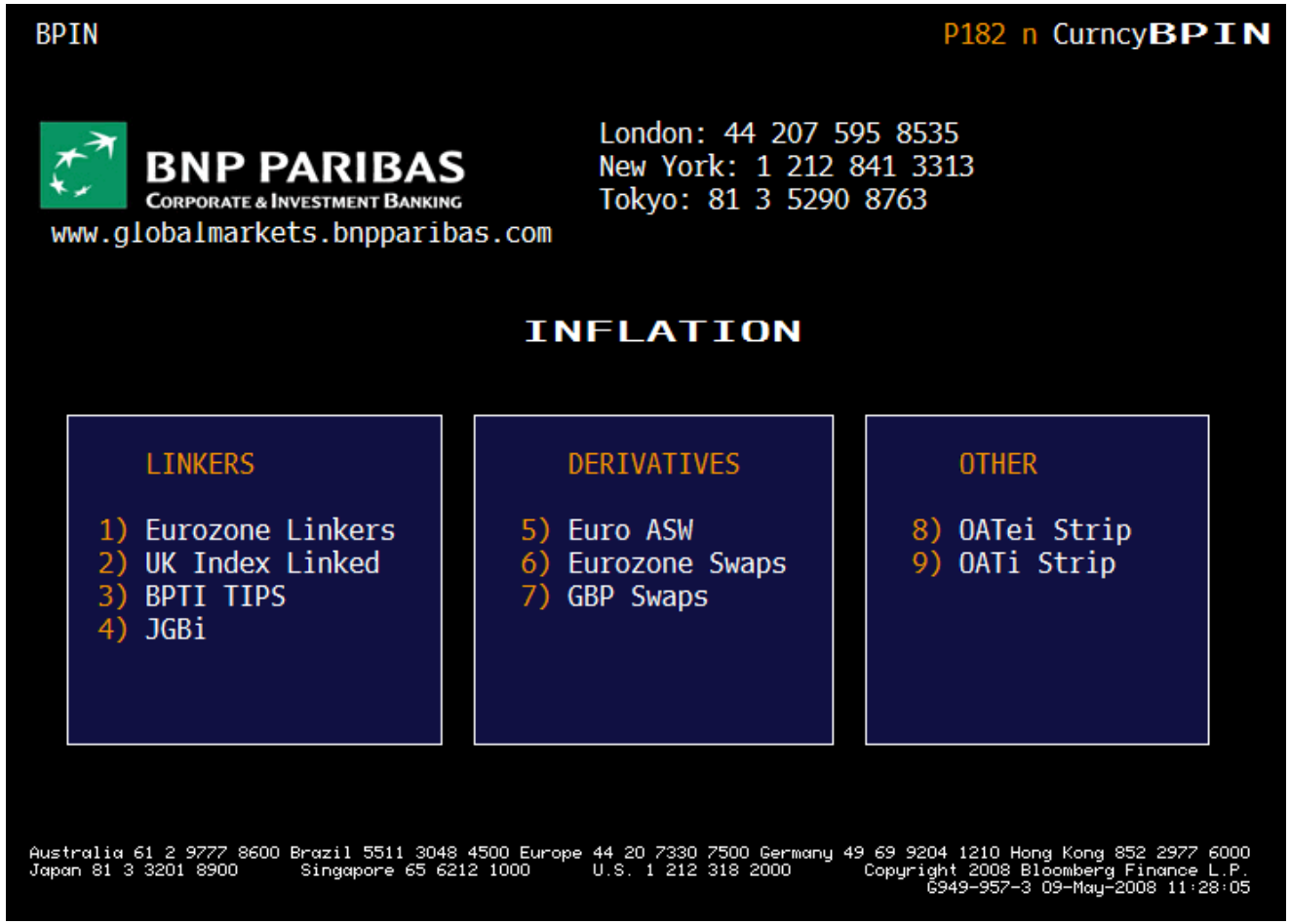
BNP Paribas Live inflation pages

Bloomberg:
BPIN<GO>

- Real time bond prices for EUR, FRF, TIPS, JGBi and UKTI.
- Indicative swap levels for EUR, FRF, UK, ITL, SP zero coupon swaps
- Indicative ASW for EUR & FRF linkers
- Link to electronic trading for Eurozone bonds

Reuters:
BNPPINFLATION
BNPPINFLATION2



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BPIN1 Live inflation pages for Europe

Reuters: BNPPINFLATION
BNPPINFLATION2

Bloomberg: BPIN1<GO>

First & Second Pages:

- real time price / yield quotes
- breakeven inflation (vs reference bond)
- nominal yield of reference bond
- daily and weekly moves of real rates and breakeven inflation

usual market price and yield

Market move:
- on a daily (D) or weekly basis (W)
- of breakeven inflation (BE) or real yields (RY)

Nominal levels, for comparison purposes

200<GO>to view this page in Launchpad P182 n CurncyBPIN
BNP PARIBAS Page 1 of 4
STATUS:OPEN- EUROPEAN INFLATION BOND TRADING +44 (0)20 7595 8656 - 10:28 GMT
09-May-08

Issue	Cpn	Maturity	Price	Yield	^d	^w	BE	^d	^w	Nom	Nom Ref
BTPei	1.65	15Sep08	100.36-66	0.140	+11	+10	3.885	-13	-8	4.024	BTP-Sep-08
OATi	3.00	25Jul09	101.79-09	1.355	+2	-4	2.685	-4	+1	4.040	OAT-Apr-09
BTANei	1.25	25Jul10	99.95-25	1.205	-1	-11	2.562	-1	+3	3.766	BTA-Jul-10
BTPei	0.95	15Sep10	98.67-97	1.470	-2	-13	2.546	+0	+3	4.016	BTP-Nov-10
OATi	1.60	25Jul11	100.16-66	1.467	+0	-10	2.325	-4	-1	3.792	OAT-Apr-11
OATei	3.00	25Jul12	105.99-39	1.468	-2	-12	2.427	-0	+1	3.895	OAT-Apr-12
BTPei	1.85	15Sep12	100.55-05	1.663	-1	-13	2.452	+0	+8	4.115	BTP-Feb-12
BOBLei	2.25	15Apr13	103.01-41	1.568	-1	-12	2.239	-2	+2	3.807	DBR-Jan-13
OATi	2.50	25Jul13	104.34-84	1.573	-2	-10	2.345	-1	-1	3.918	OAT-Apr-13
BTPei	2.15	15Sep14	102.21-61	1.755	-1	-13	2.393	+0	+6	4.147	BTP-Aug-14
OATei	1.60	25Jul15	99.50-90	1.645	-3	-14	2.378	+0	+3	4.023	OAT-Apr-15
BUNDei	1.50	15Apr16	98.28-68	1.707	-3	-11	2.279	-0	+2	3.986	DBR-Jan-16
OATi	1.00	25Jul17	92.85-25	1.827	-1	-10	2.333	-2	+2	4.160	OAT-Apr-17
BTPei	2.10	15Sep17	100.22-72	2.055	-1	-8	2.367	-0	+1	4.421	BTP-Aug-17
OATei	2.25	25Jul20	102.96-56	1.947	-2	-12	2.338	-1	+3	4.286	OAT-Apr-19
OATi	2.10	25Jul23	99.28-88	2.132	-1	-10	2.369	-2	+1	4.501	OAT-Oct-23
BTPei	2.60	15Sep23	102.83-42	2.370	-2	-9	2.299	+1	+4	4.669	BTP-Aug-21
GGBei	2.90	25Jul25	105.24-04	2.492	-1	-7	2.454	-1	+1	4.946	GGB-Mar-24
OATi	3.40	25Jul29	119.67-37	2.207	-2	-12	2.403	-0	+3	4.610	OAT-Apr-29

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Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000

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BNP PARIBAS Page 2 of 4
STATUS:OPEN- EUROPEAN INFLATION BOND TRADING +44 (0)20 7595 8656 - 10:29 GMT
09-May-08

Issue	Cpn	Maturity	Price	Yield	^d	^w	BE	^d	^w	Nom	Nom Ref
GGBei	2.30	25Jul30	95.49-28	2.545	-1	-7	2.522	-1	+2	5.066	GGB-Sep-37
OATei	3.15	25Jul32	118.26-96	2.155	-2	-9	2.484	-0	+1	4.639	OAT-Oct-32
BTPei	2.35	15Sep35	98.15-85	2.440	-1	-7	2.554	+1	+4	4.994	BTP-Aug-34
OATei	1.80	25Jul40	92.35-05	2.115	-2	-12	2.520	+0	+4	4.634	OAT-Oct-38
CADESi	3.40	25Jul11	105.38-88	1.580	+0	-10	2.226	-3	-0	3.806	OAT-Apr-11
CADESi	3.15	25Jul13	107.01-51	1.678	-2	-10	2.234	-2	-2	3.912	OAT-Apr-13
CNAi	3.90	25Jul16	114.07-57	1.927	-1	-10	2.205	-2	+2	4.132	OAT-Oct-16
CADESi	1.85	25Jul17	98.74-54	1.952	-1	-10	2.208	-2	+2	4.160	OAT-Apr-17
CADESi	1.85	25Jul19	98.13-93	1.997	-1	-10	2.287	-3	+0	4.284	OAT-Apr-19
RFFei	2.45	28Feb23	102.28-78	2.207	-2	-12	2.246	-1	+2	4.454	OAT-Apr-23

Corporate & Investment Banking

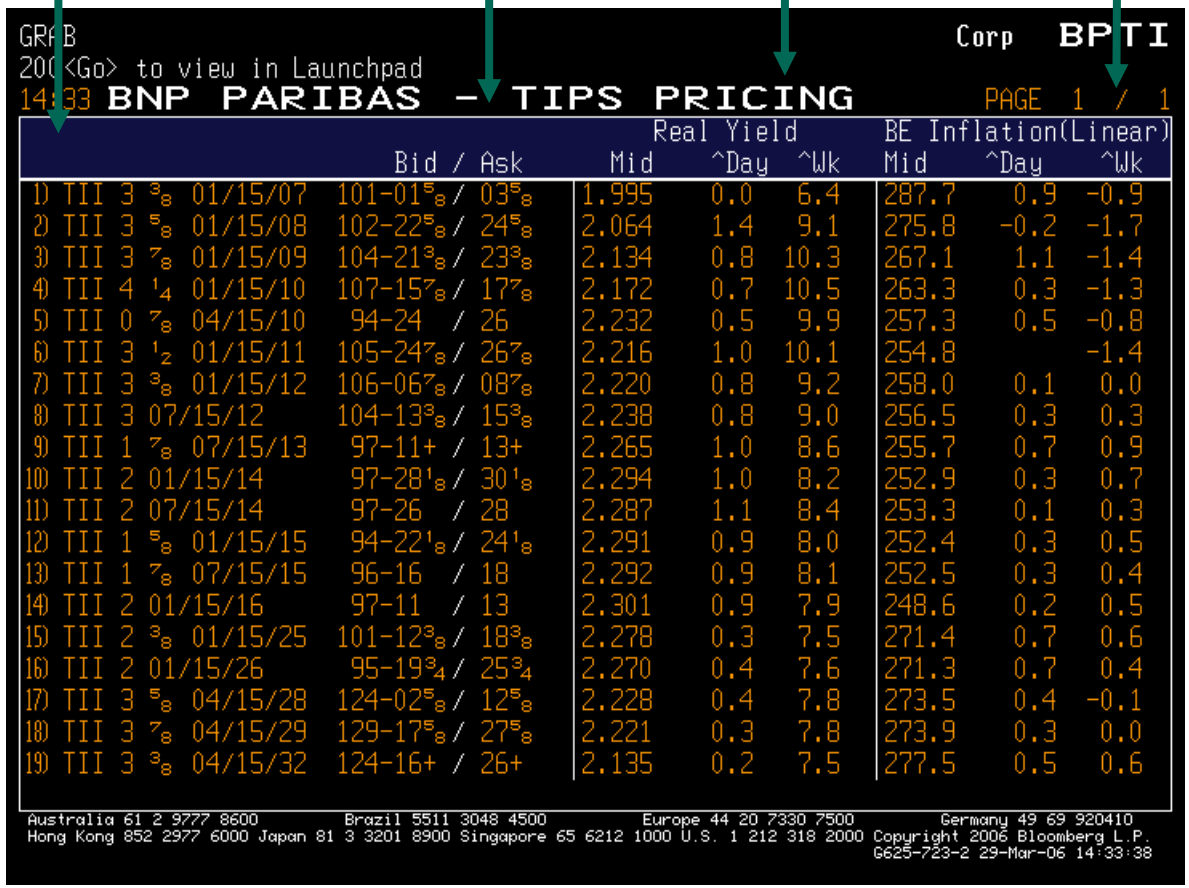
BPIN3 Live inflation pages for US TIPS

Links with Bloomberg functions

market prices

Real Yields with Daily and Weekly changes

Breakeven inflation yields with Daily and Weekly Changes



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14:33 BNP PARIBAS - TIPS PRICING PAGE 1 / 1

		Bid / Ask	Real Yield Mid	Real Yield ^Day	Real Yield ^Wk	BE Inflation(Linear) Mid	BE Inflation(Linear) ^Day	BE Inflation(Linear) ^Wk
1)	TII 3 3/8 01/15/07	101-01 5/8 / 03 5/8	1.995	0.0	6.4	287.7	0.9	-0.9
2)	TII 3 5/8 01/15/08	102-22 5/8 / 24 5/8	2.064	1.4	9.1	275.8	-0.2	-1.7
3)	TII 3 7/8 01/15/09	104-21 3/8 / 23 3/8	2.134	0.8	10.3	267.1	1.1	-1.4
4)	TII 4 1/4 01/15/10	107-15 7/8 / 17 7/8	2.172	0.7	10.5	263.3	0.3	-1.3
5)	TII 0 7/8 04/15/10	94-24 / 26	2.232	0.5	9.9	257.3	0.5	-0.8
6)	TII 3 1/2 01/15/11	105-24 7/8 / 26 7/8	2.216	1.0	10.1	254.8		-1.4
7)	TII 3 3/8 01/15/12	106-06 7/8 / 08 7/8	2.220	0.8	9.2	258.0	0.1	0.0
8)	TII 3 07/15/12	104-13 3/8 / 15 3/8	2.238	0.8	9.0	256.5	0.3	0.3
9)	TII 1 7/8 07/15/13	97-11+ / 13+	2.265	1.0	8.6	255.7	0.7	0.9
10)	TII 2 01/15/14	97-28 1/8 / 30 1/8	2.294	1.0	8.2	252.9	0.3	0.7
11)	TII 2 07/15/14	97-26 / 28	2.287	1.1	8.4	253.3	0.1	0.3
12)	TII 1 5/8 01/15/15	94-22 1/8 / 24 1/8	2.291	0.9	8.0	252.4	0.3	0.5
13)	TII 1 7/8 07/15/15	96-16 / 18	2.292	0.9	8.1	252.5	0.3	0.4
14)	TII 2 01/15/16	97-11 / 13	2.301	0.9	7.9	248.6	0.2	0.5
15)	TII 2 3/8 01/15/25	101-12 3/8 / 18 3/8	2.278	0.3	7.5	271.4	0.7	0.6
16)	TII 2 01/15/26	95-19 3/4 / 25 3/4	2.270	0.4	7.6	271.3	0.7	0.4
17)	TII 3 5/8 04/15/28	124-02 5/8 / 12 5/8	2.228	0.4	7.8	273.5	0.4	-0.1
18)	TII 3 7/8 04/15/29	129-17 5/8 / 27 5/8	2.221	0.3	7.8	273.9	0.3	0.0
19)	TII 3 3/8 04/15/32	124-16+ / 26+	2.135	0.2	7.5	277.5	0.5	0.6

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
Hong Kong 852 2977 6000 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2006 Bloomberg L.P.
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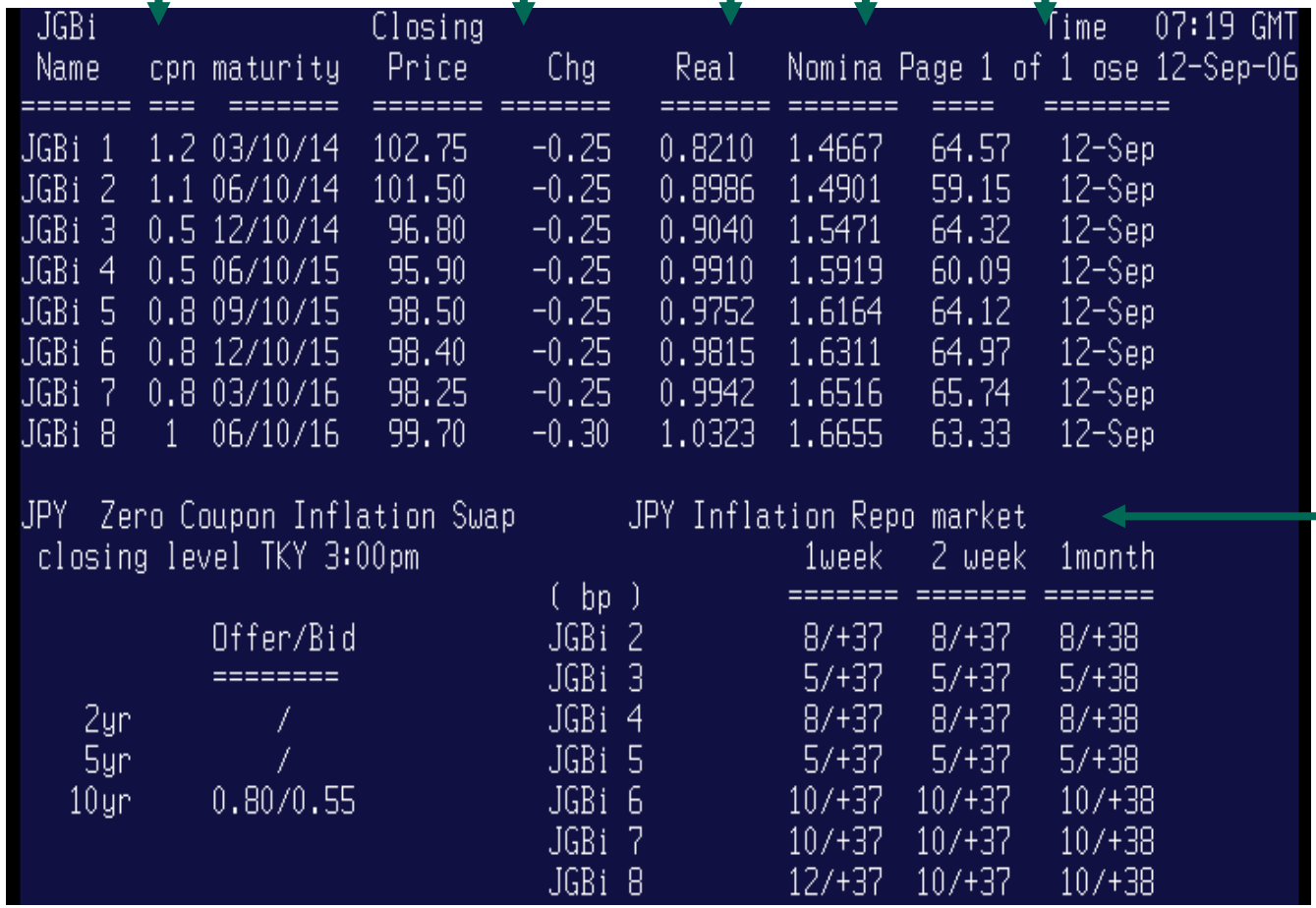
Corporate & Investment Banking

BPIN4 Live inflation pages for JGBi

Outstanding JGBi

Bond prices and daily change

Real, Nominal and Breakeven inflation yields



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 JGBi                    Closing                                      Time   07:19 GMT
 Name    cpn maturity    Price      Chg      Real    Nomina Page 1 of 1 ose 12-Sep-06
======= ===  =======   =======  =======   =======  =======  ====   ========
JGBi 1   1.2 03/10/14   102.75    -0.25    0.8210   1.4667   64.57   12-Sep
JGBi 2   1.1 06/10/14   101.50    -0.25    0.8986   1.4901   59.15   12-Sep
JGBi 3   0.5 12/10/14    96.80    -0.25    0.9040   1.5471   64.32   12-Sep
JGBi 4   0.5 06/10/15    95.90    -0.25    0.9910   1.5919   60.09   12-Sep
JGBi 5   0.8 09/10/15    98.50    -0.25    0.9752   1.6164   64.12   12-Sep
JGBi 6   0.8 12/10/15    98.40    -0.25    0.9815   1.6311   64.97   12-Sep
JGBi 7   0.8 03/10/16    98.25    -0.25    0.9942   1.6516   65.74   12-Sep
JGBi 8    1  06/10/16    99.70    -0.30    1.0323   1.6655   63.33   12-Sep

JPY  Zero Coupon Inflation Swap       JPY Inflation Repo market
 closing level TKY 3:00pm                                    1week   2 week  1month
                                 ( bp )                     =======  =======  =======
           Offer/Bid             JGBi 2                      8/+37    8/+37    8/+38
           ========              JGBi 3                      5/+37    5/+37    5/+38
   2yr         /                 JGBi 4                      8/+37    8/+37    8/+38
   5yr         /                 JGBi 5                      5/+37    5/+37    5/+38
  10yr     0.80/0.55             JGBi 6                     10/+37   10/+37   10/+38
                                 JGBi 7                     10/+37   10/+37   10/+38
                                 JGBi 8                     12/+37   10/+37   10/+38
```

Repo rates

Corporate & Investment Banking

BPIN5 Live inflation pages for UK index-linked Gilts

Index-linked Gilts

Bond prices

Real price for new index Gilts

Real Yields with Daily changes

Breakeven inflation yields with Daily Changes

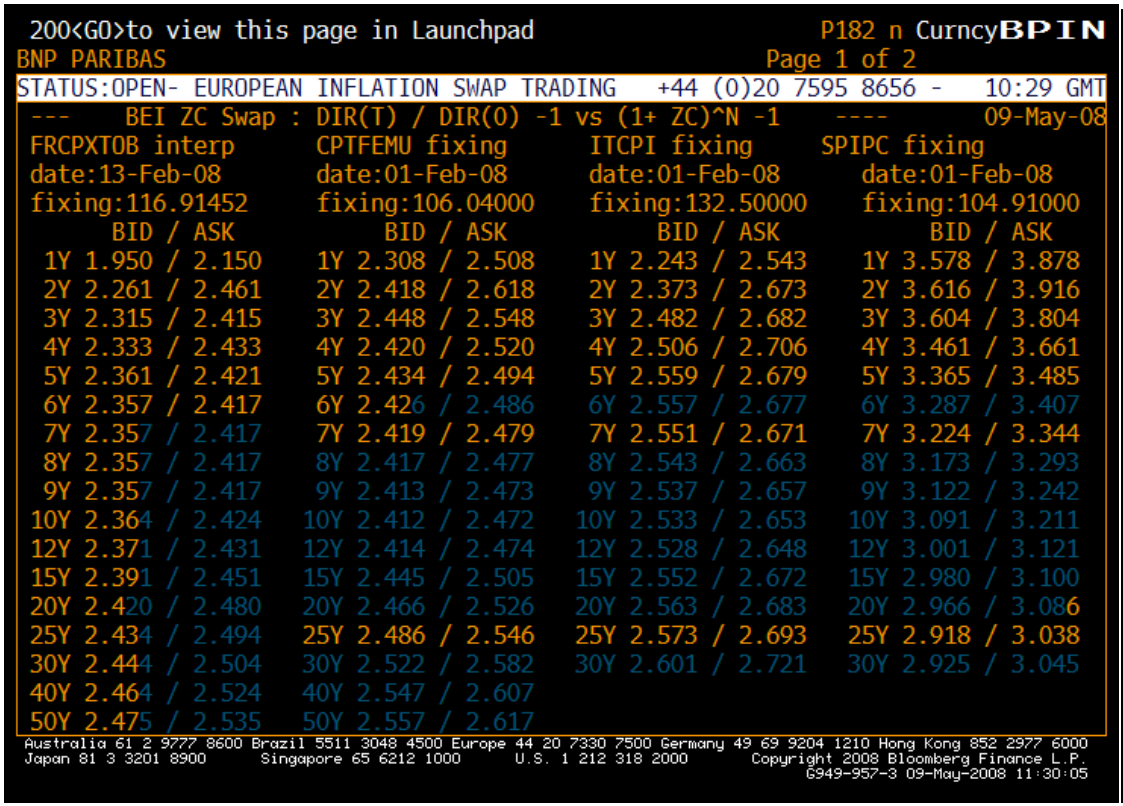
Index BPGT

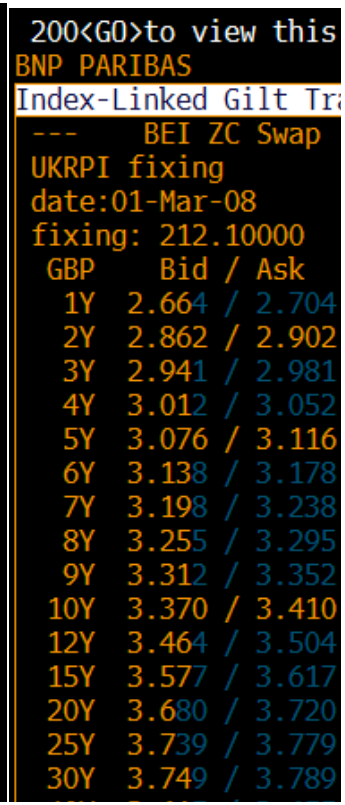
BNP PARIBAS

Index-Linked Gilt Trading +44 (0)20 7595 8266 Page 1 of 1 15:41 GMT

Issue	Cpn	Mat	Price	(chg)	Yield	(chg)	BE	(chg)	12-Sep-06
UKTI09	2.500	20-May-09	253.16	-0.16	1.733	+2.7	3.145	+2.6	
UKTI11	2.500	23-Aug-11	271.17	-0.44	1.771	+3.7	3.022	+1.6	
UKTI13	2.500	16-Aug-13	230.91	-0.47	1.680	+3.2	3.060	+2.0	
UKTI16	2.500	26-Jul-16	259.96	-0.82	1.557	+3.7	3.077	+0.5	
UKTI17	1.250	22-Nov-17	97.59	-0.34	1.485	+3.5	3.122	+0.7	
UKTI20	2.500	16-Apr-20	267.09	-1.03	1.419	+3.4	3.132	+0.5	
UKTI24	2.500	17-Jul-24	238.98	-1.18	1.282	+3.4	3.133	+0.4	
UKTI27	1.250	22-Nov-27	101.21	-0.62	1.185	+3.2	3.230	+0.6	
UKTI30	4.125	22-Jul-30	234.09	-1.22	1.154	+3.0	3.078	+0.4	
UKTI35	2.000	26-Jan-35	138.75	-1.04	1.049	+3.4	3.125	-0.1	
UKTI55	1.250	22-Nov-55	117.17	-1.72	0.825	+3.9	3.144	-0.9	

BPIN6 & BPIN7 Inflation Swap pages for Europe





Corporate & Investment Banking

BPIN Inflation ASSET SWAP pages for Europe

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BNP PARIBAS Page 1 of 5

STATUS:OPEN- EUROPEAN INFLATION P/P ASW TRADING +44 (0)20 7595 8656 09:58 GMT

09-May-08

Issue	Cpn	Maturity	BID/ASK vs 6m Eur	Nom Ref	Mid	Discount
BTPei	1.65	15Sep08	130.7 / 146.7	BTP-Sep-08	-81.3	-57.4
OATi	3.00	25Jul09	-58.0 / -74.0	OAT-Apr-09	-71.8	+5.8
BTANei	1.25	25Jul10	-42.2 / -58.2	BTA-Jul-10	-59.6	+9.4
BTPei	0.95	15Sep10	-24.0 / -40.0	BTP-Nov-10	-35.5	+3.5
OATi	1.60	25Jul11	-27.4 / -37.4	OAT-Apr-11	-53.1	+20.7
OATei	3.00	25Jul12	-15.8 / -25.8	OAT-Apr-12	-38.7	+17.9
BTPei	1.85	15Sep12	+1.6 / -8.4	BTP-Feb-12	-17.7	+14.3
BOBLei	2.25	15Apr13	-23.8 / -33.8	DBR-Jan-13	-45.5	+16.7
OATi	2.50	25Jul13	-13.9 / -23.9	OAT-Apr-13	-34.3	+15.4
BTPei	2.15	15Sep14	+3.6 / -6.4	BTP-Aug-14	-15.3	+13.9
OATei	1.60	25Jul15	-9.0 / -19.0	OAT-Apr-15	-29.6	+15.6
BUNDei	1.50	15Apr16	-19.2 / -29.2	DBR-Jan-16	-35.7	+11.5
OATi	1.00	25Jul17	-10.2 / -20.2	OAT-Apr-17	-25.6	+10.4
BTPei	2.10	15Sep17	+17.1 / +7.1	BTP-Aug-17	-1.1	+13.2
OATei	2.25	25Jul20	-8.8 / -18.8	OAT-Apr-19	-22.9	+9.1
OATi	2.10	25Jul23	-4.7 / -14.7	OAT-Oct-23	-17.8	+8.1
BTPei	2.60	15Sep23	+28.2 / +18.2	BTP-Aug-21	+2.8	+20.4
GGBei	2.90	25Jul25	+46.1 / +36.1	GGB-Mar-24	+24.6	+16.5
OATi	3.40	25Jul29	+1.6 / -8.4	OAT-Apr-29	-12.1	+8.7

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Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2008 Bloomberg Finance L.P.
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Corporate & Investment Banking

3 – Inflation derivatives

Corporate & Investment Banking

Derivatives have improved the liquidity of ILB

- In EUR, the development of the bond market has been driven by derivatives and by the interaction of derivatives and bonds. In the UK, the launch of the UK Gilt 1 ¼% 2055 has triggered massive interest for inflation derivatives.
- In EUR, the initial incompleteness of inflation markets had to be completed by dealers through the use and adaptation of existing models to the inflation world (CPI / Real / Nominal or Nominal / Inflation)
- Anomalies have disappeared as the market becomes mature, as it has been the case for the 5y area and EMU/FRF spreads
- Inflation cash is more and more traded by derivatives traders, as implemented by BNP Paribas

- **Similarly to nominal derivatives, inflation derivatives offer**
- Balance sheet and accounting alternatives
- A wide possibility of transactions
- Tailor-made solutions
- Appropriate timing and critical size

Additional advantages of derivatives

- Derivatives breed liquidity where there are no linkers, eg. ITL, ESP inflation markets
- Derivative prices give indication and opportunities for the future issuance of inflation-linked bonds
- Relative value tools for the linkers
- Offer a different way to play strategies
- Allow to correct local imbalance of the flows (cf. EUR FRF spread)
- Risk premia (or discount), relative value opportunities

Bond holding vs. swap

Inflation-linked bond:

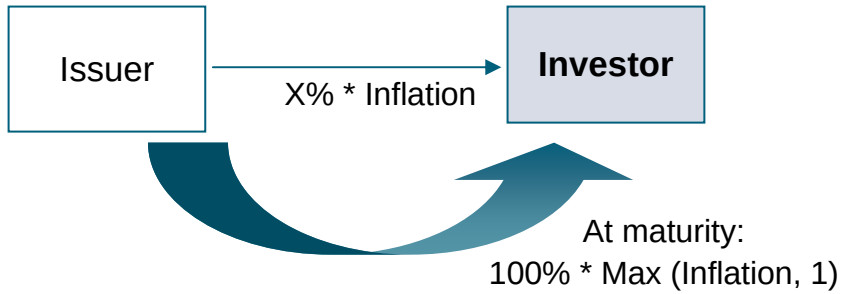
Investment with an initial cash-flow

Inflation exposure through indexation.

Rationale for a swap

Some dealers are interested by the inflation exposure but not by the balance sheet position resulting from this acquisition

Some investors, such as asset managers, can be attracted by the cheapness of the linkers but not by the inflation exposure

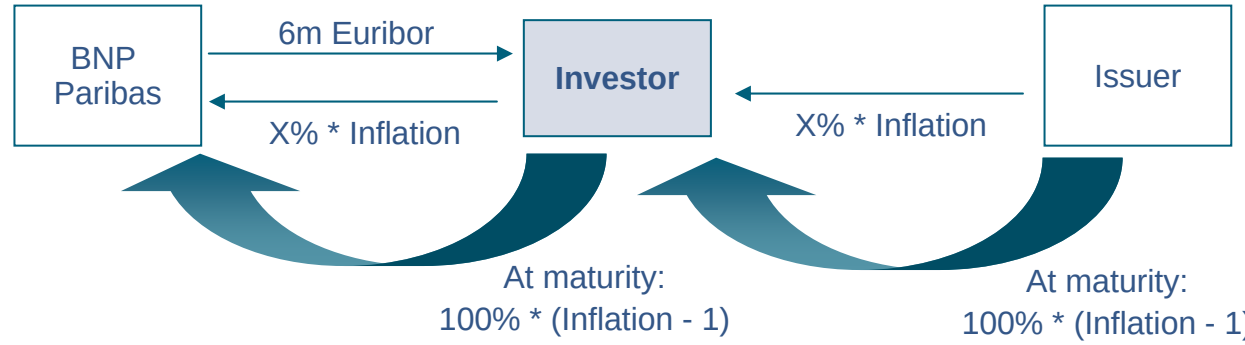


Corporate & Investment Banking

Inflation asset swap

Inflation-linked bonds can also be asset-swapped to allow investors to buy a bond without keeping the inflation exposure.

Any cash flow out of the bond (including the balloon inflation payment at redemption) is passed on to the swap counterparty. In return, the investor receives a money market rate (or a fixed rate) on his investment.



Asset swap is a relative value tool

The asset swap is the natural link between the (inflation) bond world and the (inflation) swap.

Imbalance on the derivative market lead dealers to paying inflation through their derivatives activity. Their natural hedge is to buy linkers to cover their inflation exposure. Later, dealers will reduce their balance sheet exposure by offering the paper in asset swap form thus keeping the inflation hedge

Inflation-linked bonds are still cheap versus swap

Real asset swaps are more attractive than nominal one (swap BE are higher than bonds BE), so that dealers account for balance sheet exposure, maturity and coupon mismatch.

Shorting BEI via swap is then more attractive than via bonds.

03-Dec-08 TIPS	Maturity	Yield	ASW R	OIS/Swap	ASW/OIS
TIIJAN09	**15-Jan-09**	**16.182**	**(113.1)**	**188.1**	**75.0**
TIIJAN10	15-Jan-10	6.481	(11.4)	132.0	120.6
TIIAPR10	**15-Apr-10**	**6.425**	**(5.0)**	**122.1**	**117.0**
TIIJAN11	15-Jan-11	5.231	(1.9)	98.6	96.6
TIIAPR11	15-Apr-11	4.778	(8.0)	92.7	84.6
TIIJAN12	15-Jan-12	4.232	74.9	79.6	154.5
TIIAPR12	15-Apr-12	3.050	(12.0)	76.0	64.0
TIIJUL12	15-Jul-12	3.922	93.4	72.7	166.2
TIIAPR13	**15-Apr-13**	**1.724**	**0.5**	**64.4**	**64.9**
TIIJUL13	15-Jul-13	3.719	78.0	62.0	140.0
TIIJAN14	15-Jan-14	3.750	87.5	58.0	145.5
TIIJUL14	15-Jul-14	3.757	108.0	54.6	162.6
TIIJAN15	15-Jan-15	3.537	108.1	51.8	159.9
TIIJUL15	15-Jul-15	3.465	124.9	49.5	174.3
TIIJAN16	15-Jan-16	3.307	120.0	47.4	167.4
TIIJUL16	15-Jul-16	3.287	133.0	45.7	178.7
TIIJAN17	15-Jan-17	3.133	128.7	44.1	172.8
TIIJUL17	15-Jul-17	2.909	116.9	42.8	159.7
TIIJAN18	15-Jan-18	2.663	106.9	41.6	148.5
TIIJUL18	**15-Jul-18**	**2.264**	**79.0**	**40.5**	**119.5**
TIIJAN25	15-Jan-25	2.886	182.9	32.6	215.6
TIIJAN26	15-Jan-26	2.844	185.4	32.0	217.4
TIIJAN27	15-Jan-27	2.737	176.5	31.4	207.8
TIIJAN28	**15-Jan-28**	**2.559**	**170.0**	**30.8**	**200.8**
TIIAPR28	15-Apr-28	2.820	163.9	30.7	194.6
TIIAPR29	15-Apr-29	2.822	163.2	30.2	193.4
TIIAPR32	15-Apr-32	2.595	150.0	29.0	179.0

Asset Swap Discounts

Corporate & Investment Banking

Linkers cheap or derivatives expensive?

More buyers but cheap bond: where is the contradiction?

- There is no contradiction, the cheapness is versus the swap market where buyers are more influent
- Inflation-linked bonds are still considered as structured bond, requiring more attention, thus all asset swaps will be done at a discount to equivalent nominal bonds

Why are swap breakevens higher than bond breakevens?

- Because of imbalance between supply and demand on inflation swap
- Because of mismatch risks carried by derivatives houses

Which bond market is the most attractive?

- In EUR, some government bonds are cheap on an asset swap basis or comparative to the nominal curve.
- Some TIPS are 50 to 100bp cheaper than nominal
- No indexed Gilt because of the structural imbalance of the market

Why are tips level and inflation swap dislocated?

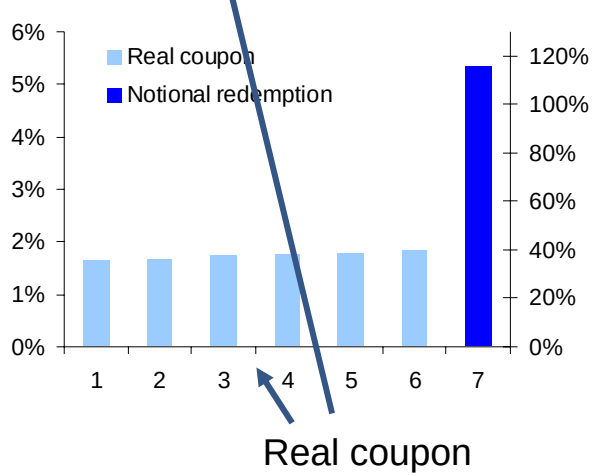
- Dealer position: investors usually buy inflation with floor protection, leaving dealers short vol at zero to negative strikes.
- Gamma hedging activities: as ZC swap moves to negative regime, all the floors cross the strikes. Gamma approaches its peak when getting close to the money. Dealers would be forced to hedge the change in delta and thus push the underlying to more extreme levels. Ex: 1y ZC swap can move 300bp in just a few days

Alternative derivatives to offset negative carry

Index-linked bonds have a specific cash-flow format that might suit issuers and some investors but doesn't offer the proper carry profile for retail investors.

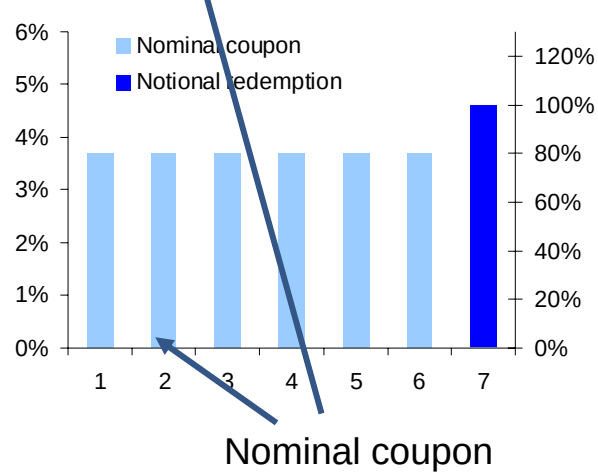
Eg. With OATi-13 = 1.62% OAT-13 = 3.71% BE = 2.09%

Payment date	CPI	Coupon	Redemption
25-Jul-07	102.09	1.65%	
25-Jul-08	104.22	1.69%	
25-Jul-09	106.40	1.72%	
25-Jul-10	108.63	1.76%	
25-Jul-11	110.90	1.80%	
25-Jul-12	113.21	1.83%	
25-Jul-13	115.58	1.87%	115.58%



Real coupon

Payment date	Coupon	Redemption
25-Jul-07	3.71%	
25-Jul-08	3.71%	
25-Jul-09	3.71%	
25-Jul-10	3.71%	
25-Jul-11	3.71%	
25-Jul-12	3.71%	
25-Jul-13	3.71%	100%



Nominal coupon

Payment Date	Coupon deficit	Redemption gain
25-Jul-07	-2.06%	
25-Jul-08	-2.02%	
25-Jul-09	-1.99%	
25-Jul-10	-1.95%	
25-Jul-11	-1.91%	
25-Jul-12	-1.88%	
25-Jul-13	-1.84%	15.58%

1.95% deficit on the cashflows

15% gain on the redemption

Corporate & Investment Banking

Cash-flow match, no more negative carry

Instead of paying the sum of the annual inflation at the end.....annual inflation is paid every year

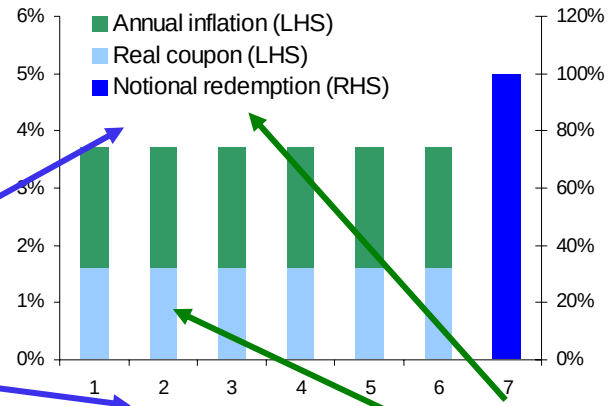
No more cash-flow carry mismatch

Eg. With OATi-13 = 1.62% OAT-13 = 3.71% BE = 2.09%

Payment date	Coupon	Inflation	Redemption
25-Jul-07	1.62%	2.09%	
25-Jul-08	1.62%	2.09%	
25-Jul-09	1.62%	2.09%	
25-Jul-10	1.62%	2.09%	
25-Jul-11	1.62%	2.09%	
25-Jul-12	1.62%	2.09%	
25-Jul-13	1.62%	2.09%	100.00%

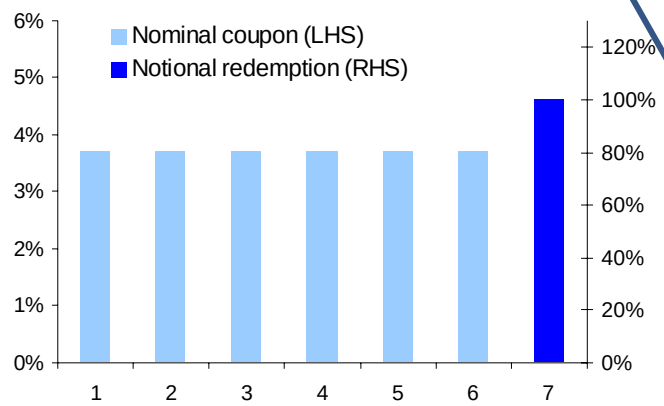
Payment date	Coupon	Redemption
25-Jul-07	3.71%	
25-Jul-08	3.71%	
25-Jul-09	3.71%	
25-Jul-10	3.71%	
25-Jul-11	3.71%	
25-Jul-12	3.71%	
25-Jul-13	3.71%	100%

Payment Date	Coupon deficit	Redemption gain
25-Jul-07	0.00%	
25-Jul-08	0.00%	
25-Jul-09	0.00%	
25-Jul-10	0.00%	
25-Jul-11	0.00%	
25-Jul-12	0.00%	
25-Jul-13	0.00%	0.00%



Real coupon

Annual Inflation



No more mismatch

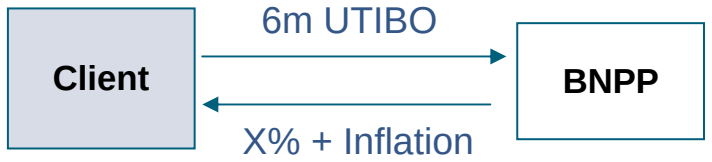
Corporate & Investment Banking

Additive Inflation Swap

Rationale

The coupon is linked to annual inflation and the principal redemption at maturity is 100%.

Inflation can be floored at 0% or only coupon can be floored at 0%



Quick Terms: Additive Swap

Notional	USD 10,000,000
Effective Date	[ ] September 2006
Termination Date	[ ] September 2016
BNPP pays	1.70% + Max (Inflation, 0), annual, 30/360
Inflation	$\frac{Index(t)}{Index(t-1)} - 1$
Index	CPI NSA
Index (t)	CPI NSA (each June)
Client pays	6M UTIBO

Coupon or Inflation floored at 0%

Market Convention: Index published for the month 3 month (2 month in the UK and US) before coupon payment date

Index can also be fixed earlier or before coupon start date

Corporate & Investment Banking

Zero-coupon inflation swap

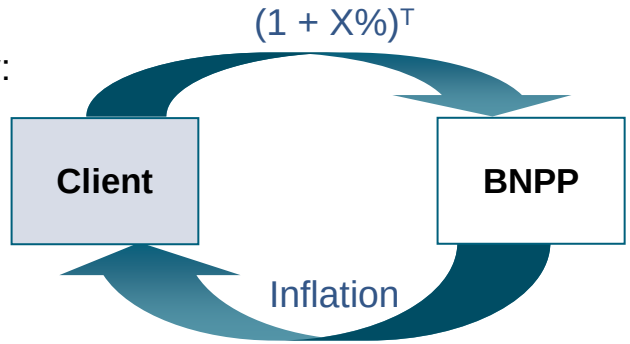
Rationale

In a Zero Coupon inflation swap, there is only one payment at maturity:

BNPP pays Inflation, payable at maturity

Inflation $\frac{Index(T)}{Index(0)} - 1$

Client pays $(1+X\%)^T - 1$, payable at maturity



Inflation-linked annuity swap

An inflation-linked annuity swap is equivalent to a string of zero coupon swaps, with the fixed rate being the same for all payment dates. Although the Notional of each cash flow seems small, the inflation position can be huge since it is replicated for every payment date.

Maturity	50 years	Payment Dates	Annually
BNPP pays	USD 10,000,000 x Inflation_t	Inflation_t	$\frac{Index(t)}{Index(0)} - 1$
Client pays	USD 10,000,000 x $\left[(1+3.05\%)^t - 1\right]$		

Corporate & Investment Banking

Inflation options

Cap and Floor on annual inflation

A company whose costs are indexed on inflation wants to ensure that costs will not exceed a specified level. It buys a cap on inflation to receive funds if annual inflation exceeds the strike.

I.e.: [Max ($\frac{Index(t)}{Index(t-12)}$ - 1, 0)] x coverage x notional

Call and Put on cumulative inflation

A pension fund investing in a fund wants to ensure protection of the notional value in terms of purchasing power. At maturity, it receives the inflation weighted appreciation of the notional, floored at zero.

I.e.: Max ($\frac{Index(T)}{Index(0)}$ - 1, 0) x notional

4 – Stripping the Inflation Curve

Corporate & Investment Banking

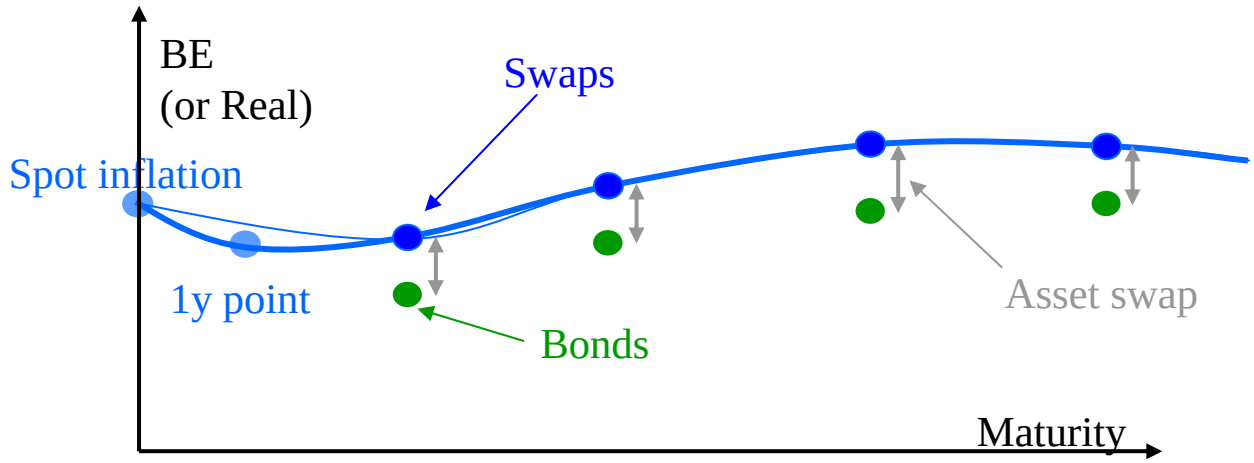
Choice of Stripping

- How to create an inflation curve
  - Instruments for Stripping: Discount Curve, TIPS, TIPS Asset Swap, ZC Inflation Swap
- Choice of Discount Curve
  - Nominal Swap, OIS, etc
- Given Discount Curve, choice to strip CPI
  - Strip CPI through TIPS (real yield), TIPS Asset Swap
  - Strip CPI through ZC Inflation Swap directly
- Seasonality Impact on Stripping
  - Inflation Seasonality
  - Impact of shock on seasonality

How to create an inflation curve?

Main points not to be missed (independent of model used)

The bonds	liquidity
The asset swaps	link between cash and discount curve
The starting point(s)	shortest bond is often too far
The forwards	common sense should prevail
The seasonality	to reproduce the CPI pattern

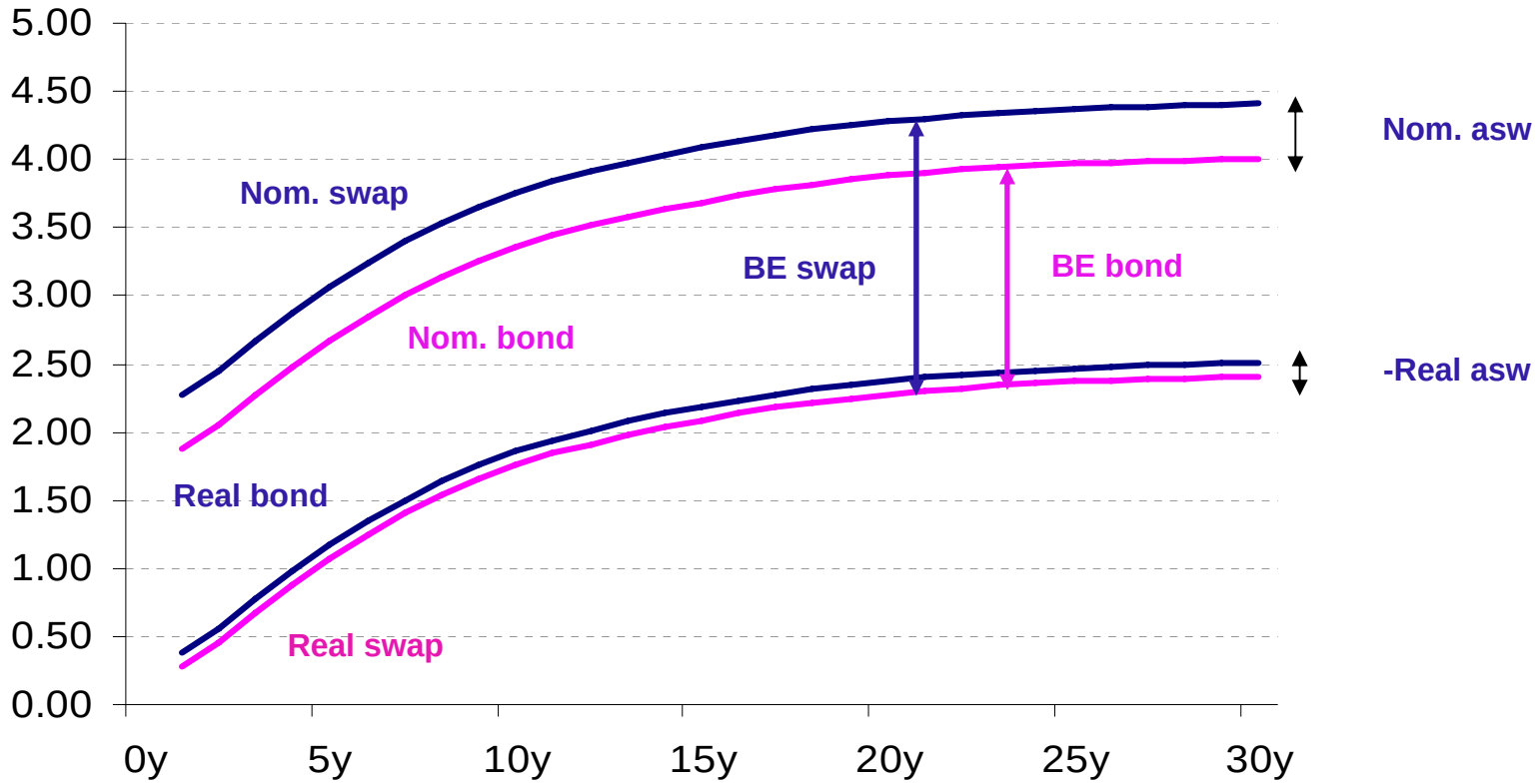


Need to look at short and long term determinants

- Long-term determinants
  - Economic activity
  - Inflation forecasts
  - Market direction and beta
  - Demand and supply
- Short-term determinants
  - Inflation carry
  - Rich Cheap Analysis
  - Demand and Supply

Corporate & Investment Banking

Asset swap



Corporate & Investment Banking

Choice of Discount Curves

TIPS	Maturity	OIS	OIS DF	Swap+spread	Swap+Spd DF
TIIJAN09	15-Jan-09	0.3729	0.9996	1.4661	0.9983
TIIJAN10	15-Jan-10	0.5823	0.9935	1.8383	0.9798
TIIAPR10	**15-Apr-10**	**0.6677**	**0.9909**	**1.8454**	**0.9754**
TIIJAN11	15-Jan-11	1.0051	0.9789	1.9507	0.9599
TIIAPR11	15-Apr-11	1.1014	0.9742	1.9523	0.9553
TIIJAN12	15-Jan-12	1.3871	0.9575	2.9521	0.9133
TIIAPR12	15-Apr-12	1.4746	0.9513	2.1181	0.9319
TIIJUL12	15-Jul-12	1.5607	0.9447	3.1830	0.8929
TIIAPR13	**15-Apr-13**	**1.7956**	**0.9238**	**2.4470**	**0.8998**
TIIJUL13	15-Jul-13	1.8663	0.9166	3.0885	0.8690
TIIJAN14	15-Jan-14	1.9938	0.9019	3.2359	0.8495
TIIJUL14	15-Jul-14	2.0989	0.8873	3.4890	0.8248
TIIJAN15	15-Jan-15	2.1922	0.8727	3.6047	0.8051
TIIJUL15	15-Jul-15	2.2669	0.8586	3.8349	0.7796
TIIJAN16	15-Jan-16	2.3334	0.8446	3.8295	0.7652
TIIJUL16	15-Jul-16	2.3872	0.8311	4.0100	0.7411
TIIJAN17	15-Jan-17	2.4349	0.8178	4.0242	0.7258
TIIJUL17	15-Jul-17	2.4717	0.8050	3.9437	0.7165
TIIJAN18	15-Jan-18	2.5047	0.7925	3.8714	0.7071
TIIJUL18	**15-Jul-18**	**2.5300**	**0.7805**	**3.6160**	**0.7106**
TIIJAN25	15-Jan-25	2.6187	0.6522	4.6039	0.4839
TIIJAN26	15-Jan-26	2.6130	0.6363	4.6417	0.4597
TIIJAN27	15-Jan-27	2.6063	0.6209	4.5431	0.4469
TIIJAN28	**15-Jan-28**	**2.5998**	**0.6060**	**4.4687**	**0.4333**
TIIAPR28	15-Apr-28	2.5981	0.6024	4.4255	0.4321
TIIAPR29	15-Apr-29	2.5925	0.5879	4.4206	0.4142
TIIAPR32	15-Apr-32	2.5819	0.5460	4.3130	0.3726

Corporate & Investment Banking

Strip FWD CPI from TIPS, TIPS Asset Swap, Nominal Swap

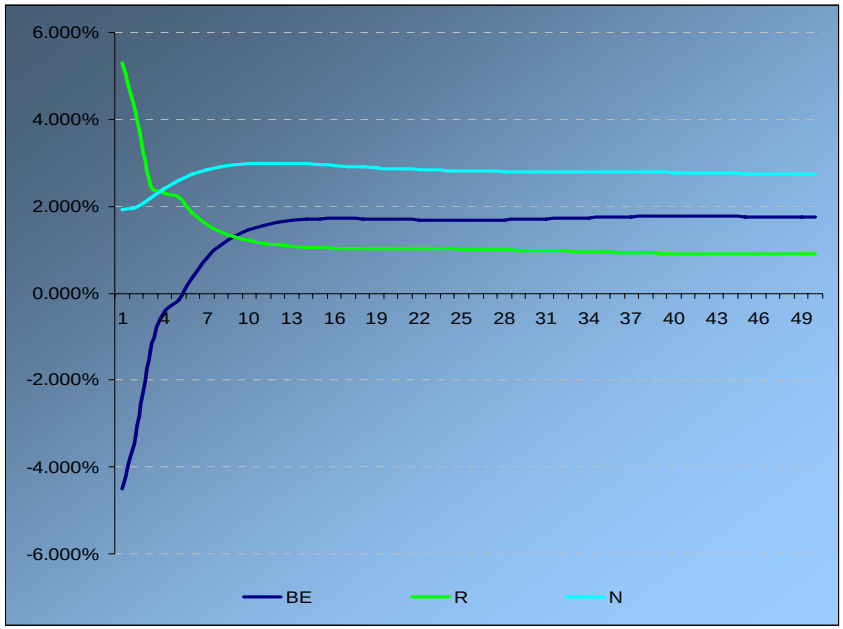
- TIPS, ASW, Nominal, Discount Curves

$$TIPSDirtyPrice = \frac{DRI(sett)}{DRI(ref)}\left[\sum_{i=1}^{T} c \cdot DF_R(t_i) + DF_R(T)\right] + PVFloor(T) - PVASW$$

- Analogy to Fwd FX

$$FwdDRI(t) = DRI(0) \cdot E\left[\frac{DF_R(t)}{DF_N(t)}\right] = DRI(0) \cdot \frac{E[DF_R(t)]}{E[DF_N(t)]} \cdot convadj_{R,N}$$

$$FwdFX(t) = FX(0) \cdot E\left[\frac{DF_D(t)}{DF_F(t)}\right] = FX(0) \cdot \frac{E[DF_D(t)]}{E[DF_F(t)]} \cdot convadj_{D,F}$$



Years	Date	ZC	R	N
0	5-Dec-08			
1	5-Dec-09	-4.506%	5.301%	1.912%
2	5-Dec-10	**-3.278%**	4.155%	1.978%
3	5-Dec-11	-1.306%	2.471%	2.183%
4	5-Dec-12	-0.445%	2.297%	2.406%
5	5-Dec-13	**-0.169%**	2.211%	2.596%
6	5-Dec-14	0.347%	1.859%	2.739%
7	5-Dec-15	0.804%	1.582%	2.839%
8	5-Dec-16	1.108%	1.409%	2.907%
9	5-Dec-17	1.308%	1.297%	2.950%
10	5-Dec-18	**1.451%**	1.216%	2.974%
11	5-Dec-19	1.552%	1.156%	2.986%
12	5-Dec-20	1.622%	1.113%	2.988%
13	5-Dec-21	1.669%	1.082%	2.982%
14	5-Dec-22	1.696%	1.061%	2.971%
15	5-Dec-23	1.710%	1.047%	2.955%
16	5-Dec-24	1.716%	1.036%	2.938%
17	5-Dec-25	1.716%	1.029%	2.919%
18	5-Dec-26	1.713%	1.023%	2.900%
19	5-Dec-27	1.707%	1.020%	2.883%
20	5-Dec-28	**1.700%**	1.018%	2.868%
21	5-Dec-29	1.693%	1.018%	2.854%
22	5-Dec-30	1.687%	1.018%	2.843%
23	5-Dec-31	1.684%	1.017%	2.833%
24	5-Dec-32	1.683%	1.014%	2.825%
25	5-Dec-33	1.683%	1.011%	2.817%
26	5-Dec-34	1.684%	1.006%	2.811%
27	5-Dec-35	1.687%	1.001%	2.804%
28	5-Dec-36	1.690%	0.996%	2.798%
29	5-Dec-37	1.694%	0.989%	2.793%
30	5-Dec-38	**1.699%**	0.982%	2.788%

Strip FWD CPI from ZC Inflation Swap

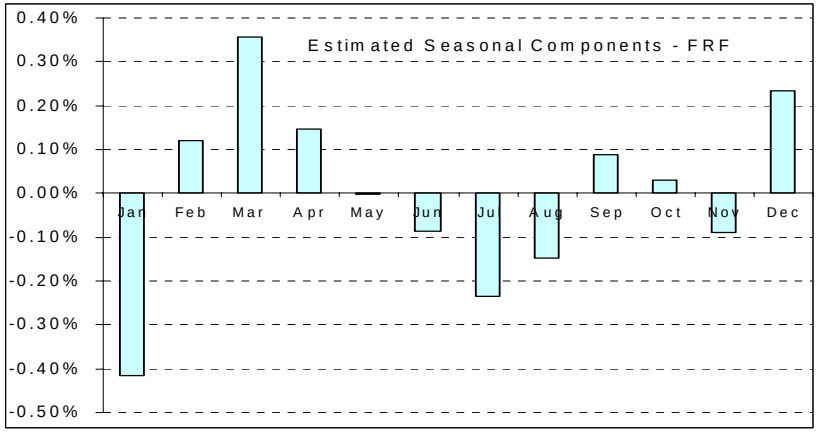
- Fwd CPI can be stripped directly from ZC Inflation Swap

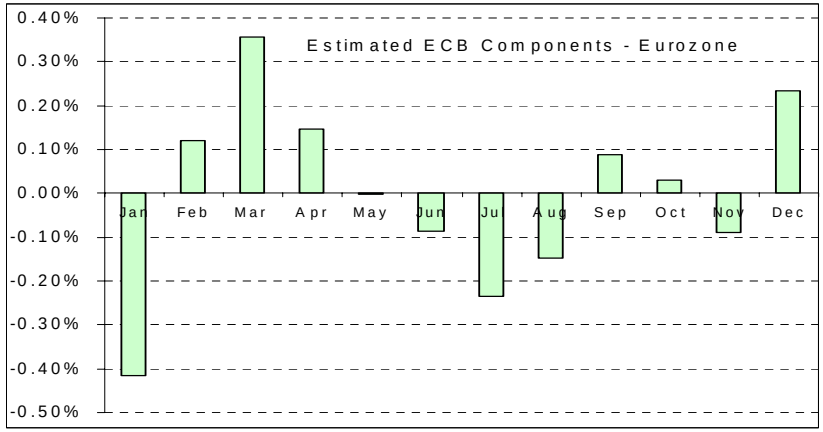
$$ZC\,(t) \approx \left[\frac{FwdDRI\;\;(t)}{DRI\;(0)}\right]^{\frac{1}{t}} - 1$$

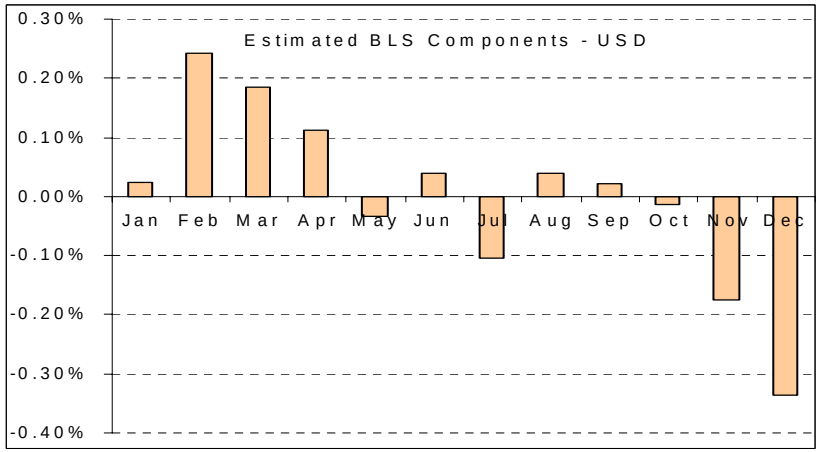
$$FwdDRI(t) \approx DRI(0)\cdot\left[1+ZC(t)\right]^{t}$$

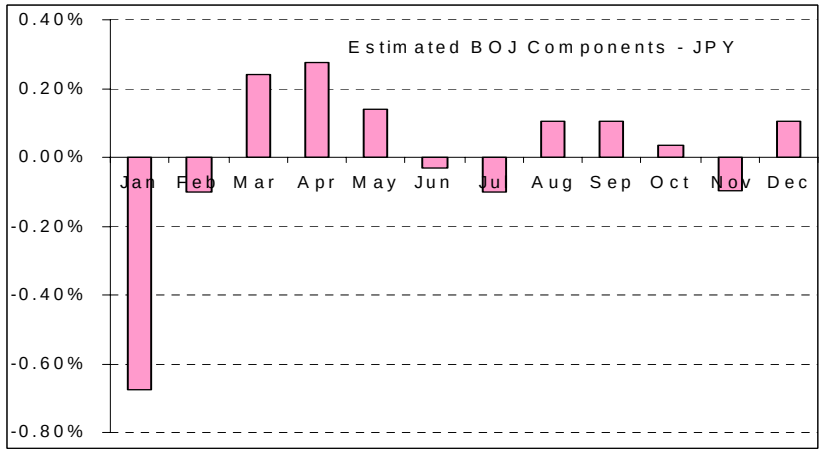
Type	Tenor	Rate	Pay Date
ZCINFL	1Y	-3.816%	01Jan10
ZCINFL	2Y	-2.758%	01Jan11
ZCINFL	3Y	-0.809%	01Jan12
ZCINFL	4Y	-0.203%	01Jan13
ZCINFL	5Y	-0.028%	01Jan14
ZCINFL	6Y	0.489%	01Jan15
ZCINFL	7Y	0.951%	01Jan16
ZCINFL	8Y	1.259%	01Jan17
ZCINFL	9Y	1.464%	01Jan18
ZCINFL	10Y	1.605%	01Jan19
ZCINFL	12Y	1.763%	01Jan21
ZCINFL	15Y	1.813%	01Jan24
ZCINFL	20Y	1.795%	01Jan29
ZCINFL	25Y	1.801%	01Jan34
ZCINFL	30Y	1.804%	01Jan39
ZCINFL	40Y	1.825%	01Jan49
ZCINFL	50Y	1.434%	01Jan59
ZCINFL	60Y	1.233%	01Jan69

Seasonality of inflation









Corporate & Investment Banking

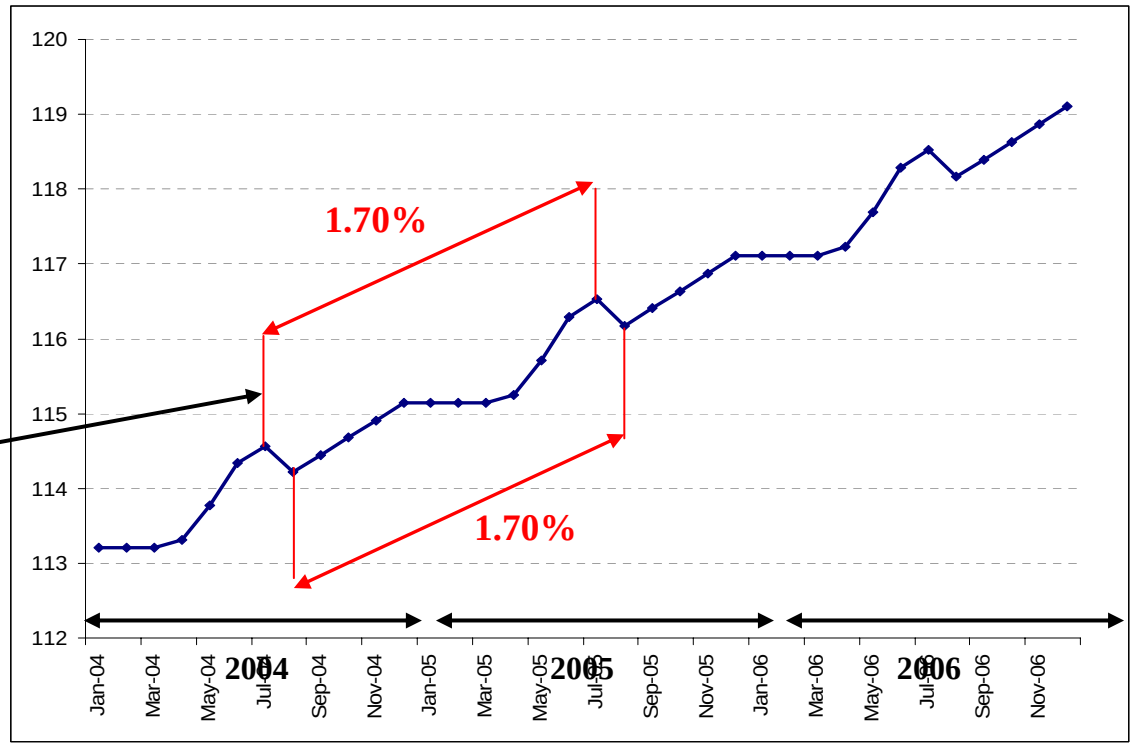
Impact of seasonality

There is historical seasonality on the CPI monthly fixings

But how does it impact the stripping ?

If the expected seasonality in future is the same as the one of last year, the impact on inflation is very limited

Month	Seas.	Last year
1	0.00%	0.00%
2	0.00%	0.00%
3	0.00%	0.00%
4	0.10%	0.10%
5	0.40%	0.40%
6	0.50%	0.50%
7	0.20%	0.20%
8	-0.30%	-0.30%
9	0.20%	0.20%
10	0.20%	0.20%
11	0.20%	0.20%
12	0.20%	0.20%
sum	1.70%	1.70%



Same pattern on CPI = no seasonality on BE inflation

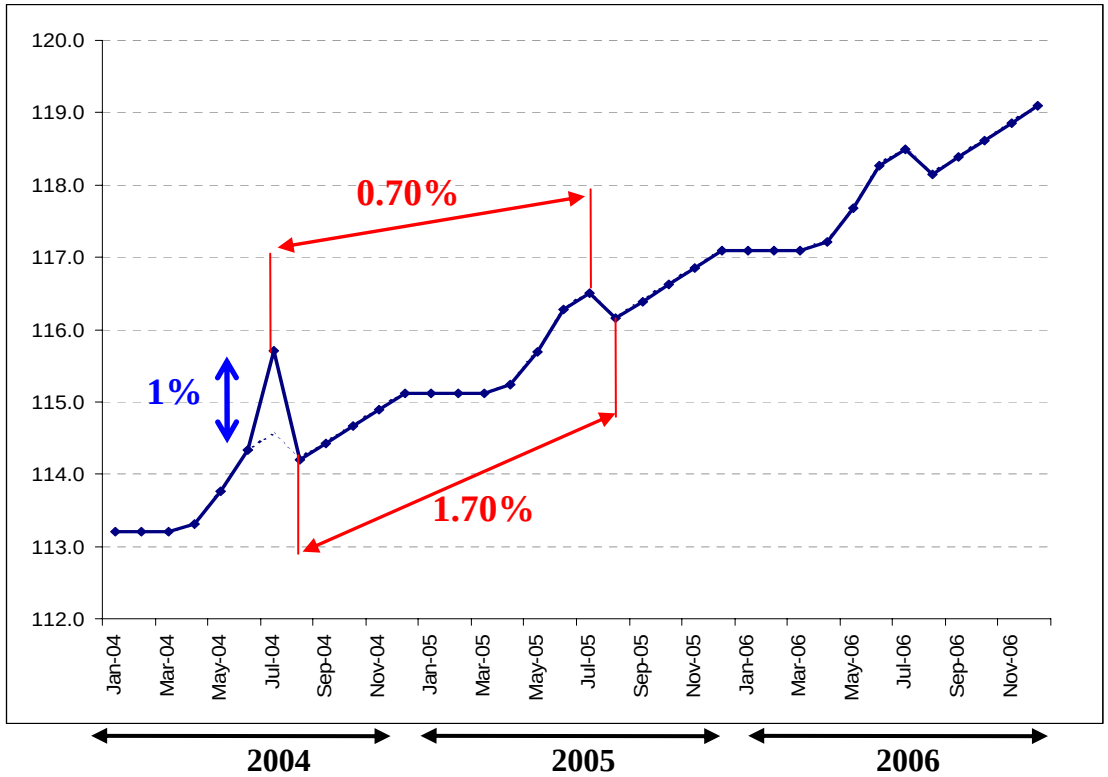
Impact of seasonality in case of shock

1% shock on July-04 fixing and -1% on Aug-04 fixing (i.e. the July-04 is higher but Aug-04 unchanged)

No impact on 1y inflation Aug-05 /Aug-04

1% impact on 1y inflation Jul-05 /Jul-04

Month	Seas.	Last year
1	0.00%	0.00%
2	0.00%	0.00%
3	0.00%	0.00%
4	0.10%	0.10%
5	0.40%	0.40%
6	0.50%	0.50%
7	0.20%	1.20%
8	-0.30%	-1.30%
9	0.20%	0.20%
10	0.20%	0.20%
11	0.20%	0.20%
12	0.20%	0.20%
sum	1.70%	1.70%



Divergence between past fixings and expected seasonality = seasonality on BE inflation

Corporate & Investment Banking

Transmission of shock in a seasonal pattern

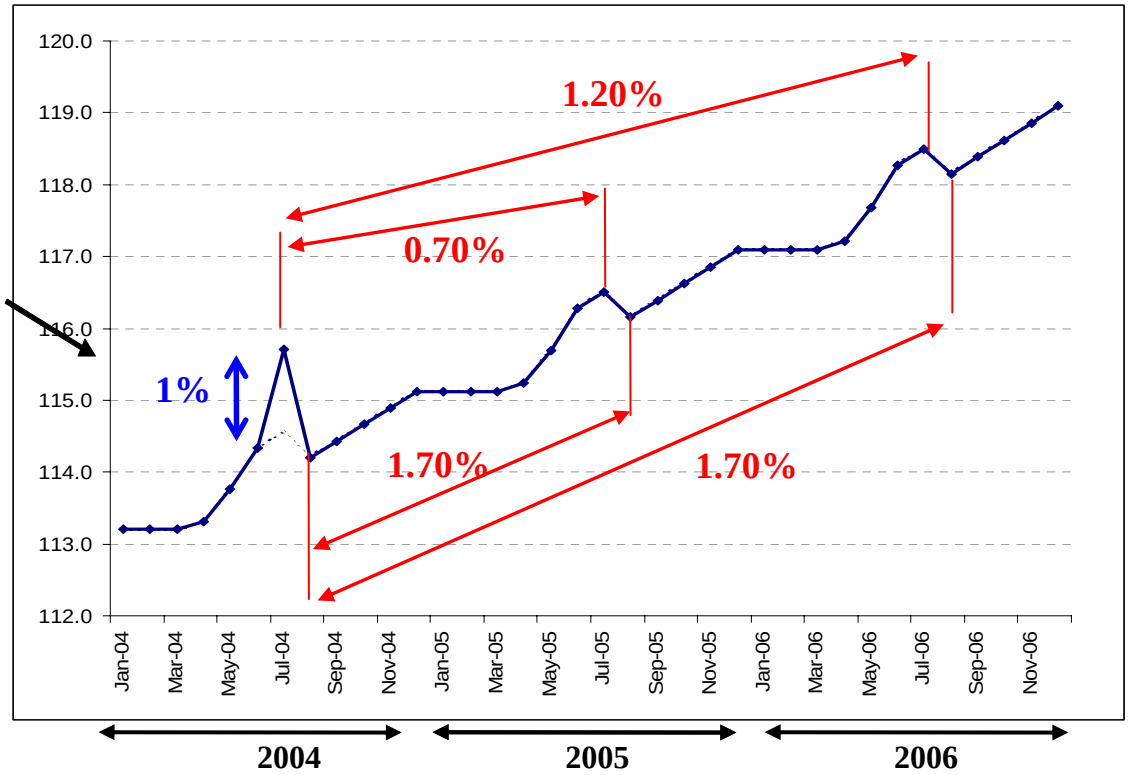
The seasonality impact is a function of the difference between the expected seasonality and the last 12 months' fixings... AND is a function of the maturity of the inflation swap

A 1% shock on a particular CPI fixing,
will have 1% impact on 1y swap,
0.50% on a 2y swap and
0.10% on a 10y swap...

Divergence between past fixings and expected seasonality divided by maturity =

Month	Seas.	Last year
1	0.00%	0.00%
2	0.00%	0.00%
3	0.00%	0.00%
4	0.10%	0.10%
5	0.40%	0.40%
6	0.50%	0.50%
7	0.20%	1.20%
8	-0.30%	-1.30%
9	0.20%	0.20%
10	0.20%	0.20%
11	0.20%	0.20%
12	0.20%	0.20%
sum	1.70%	1.70%

BE inflation seasonality over time



Corporate & Investment Banking

Seasonality and swap curve

Can one interpolate from any given curve to generate an inflation swap curve ?

The market standard is annual BE zero coupon swaps:

On French inflation: DRI (final) / DRI (Initial) – 1 (base changes every day)

On Euro inflation: CPI (mmm-yy) / CPI (mmm-initial) – 1 (base changes once a month)

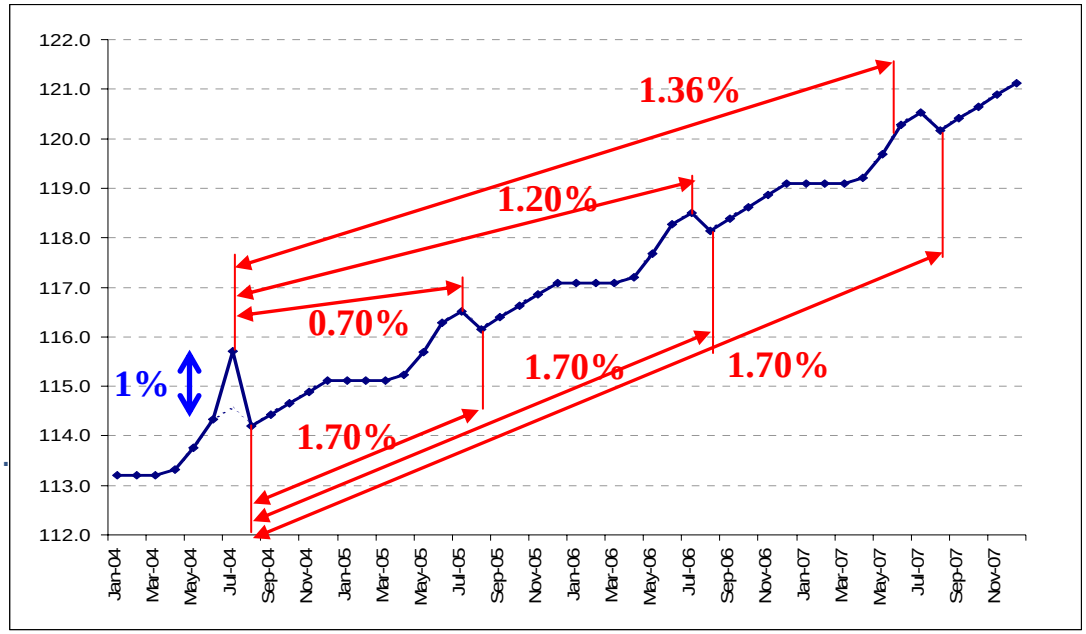
Imagine a EUR flat curve 1.70% on 1y, 3y, 5y August fixing

Where is the 2y August fixing ?

And the 2y July fixing ?

From one specific fixing to another one, the linear interpolation alone is useless..

… it becomes worse if you are working on non annual inflation



Corporate & Investment Banking

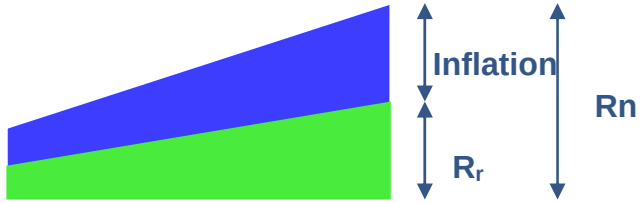
5 – Beta

Corporate & Investment Banking

Move of the Market

During a rally, yields are decreasing on both linkers and nominal bonds.

Nominal, real and inflation are correlated. Usually, all three rates are moving in the same direction:



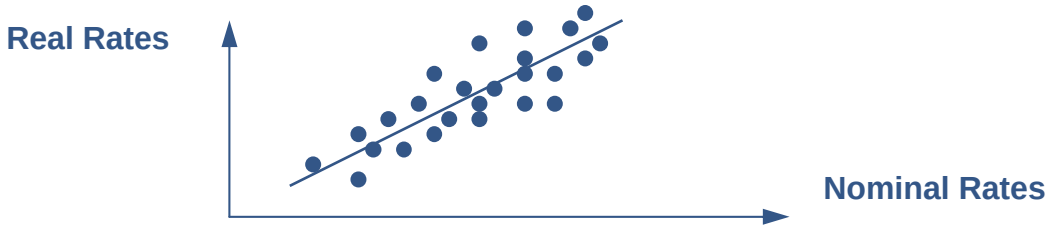
$$R_n = R_r + \text{Inflation}$$

A regression shows the relation between 2 rates:

$$Beta = 60\%$$

$$\Delta R_{Inflation} = 40\% \cdot \Delta R_{Nominal} + cst'$$

$$\Delta R_{Real} = 60\% \cdot \Delta R_{Nominal} + cst$$



One would expect the real rate to decrease less than the nominal rate as the inflation break-even should narrow as well. As a consequence, when the market rallies, the nominal bonds are usually outperforming the linkers (on a 1-for-1 hedge ratio).

Beta

Linkers are often compared to nominal bonds:

- Arbitrage
- Risk management

Even though the relationship is unstable, real and nominal yields are correlated

In order to run portfolios including real and nominal bonds, the concept of beta is widely used

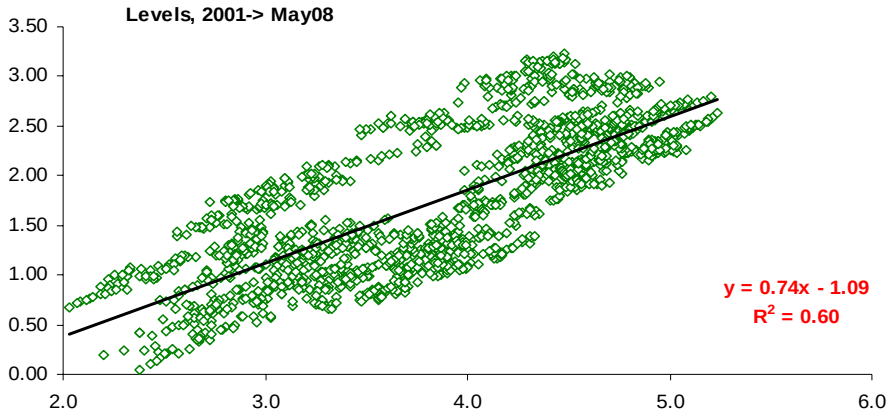
Choice of the Beta

- Historical Beta or Implied Beta ?
- Regression on 1m, 3m, 6m, 1y or 5y historic
- How to distinguish between beta move due to nominal
- move and out/under-performance ?
- Beta per (fixed) maturity ?
- Beta on Levels, changes or total return ?

Not stationary **No CPI information**

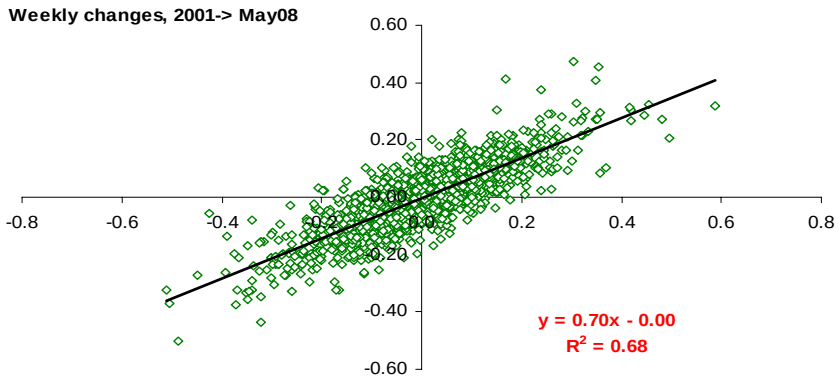
Corporate & Investment Banking

Which beta? 5y Generic TIPS Since 2001



Levels:

Beta = 74%



1w Changes:

Beta = 70%

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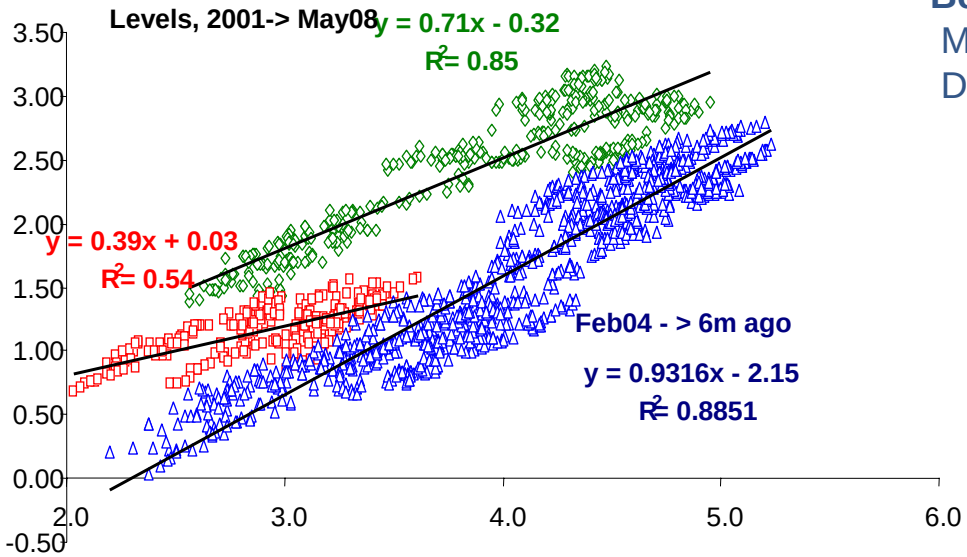
5y TIPS: Regression in levels shows many regimes



Betas unstable: Depends on:
Macro and micro factors
Demand & supply

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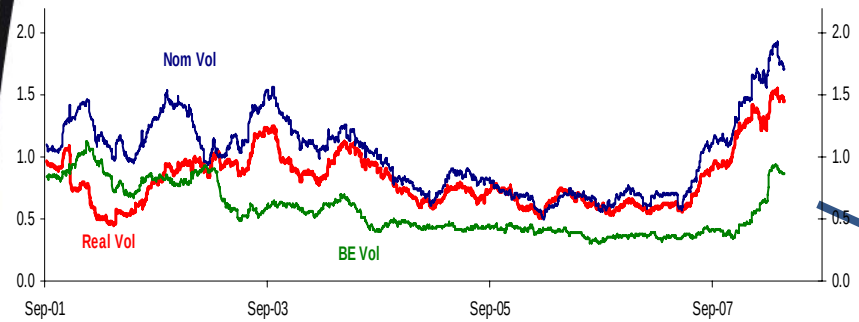
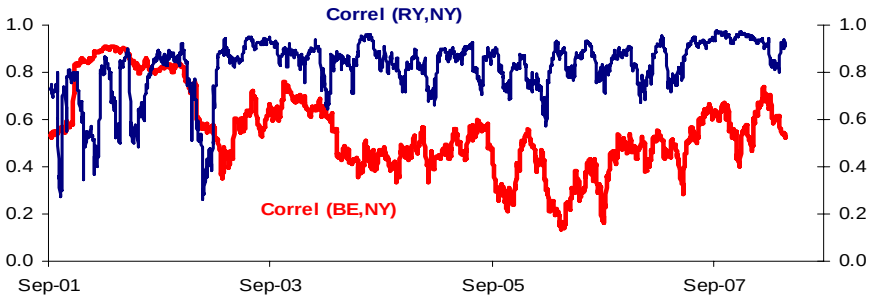
What is the beta ? Volatility Ratio * Correlation

3M (annualised) Rolling Volatilities

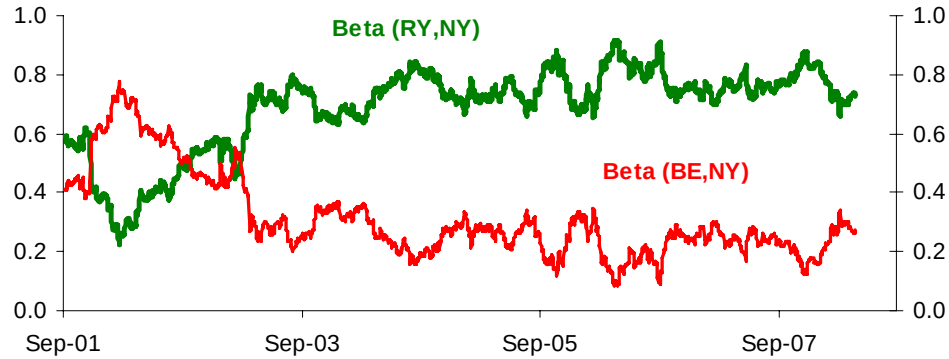


3m Rolling Correlation and Ratio of Vol



$$Beta_{Real} = \rho_{Real,Nominal} \cdot \frac{\sigma_{Real}}{\sigma_{Nominal}}$$

Beta



The beta is the result of both effect (volatility and correlation)

$$Beta_{BE} = \rho_{BE,Nominal} \cdot \frac{\sigma_{BE}}{\sigma_{Nominal}}$$

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Where is the risk?

The hedge ratio is the amount of nominal needed to hedge a certain amount of TIPS.

Hedge ratio = $DV01_{TIPS}$ * Index Ratio * Yield Beta / $DV01_{Nominal}$

Long 100m OAT	Nominal
Long 100m OATi	Real
Long 100m OATi and Short 100m OAT	BE
Long 100m OATi and Short Beta x 100m OAT	Beta

In normal situations,	the Nominal position is the most volatile.
By construction,	the Beta hedge is designed to be market independent.

The two other trades depend on the Beta :

Beta > 0.5	the Real is moving the most
Beta < 0.5	the BE is moving the most

For short maturities, as the CPI is released on a monthly basis with potential jumps, inflation can move more than the Nominal (i.e. beta >100%).

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Beta: A positive convexity

The beta exhibits a positive convexity. At least in theory.

Assuming a 80% beta hedge, the actual beta should be higher in a rally and lower in a sell off.

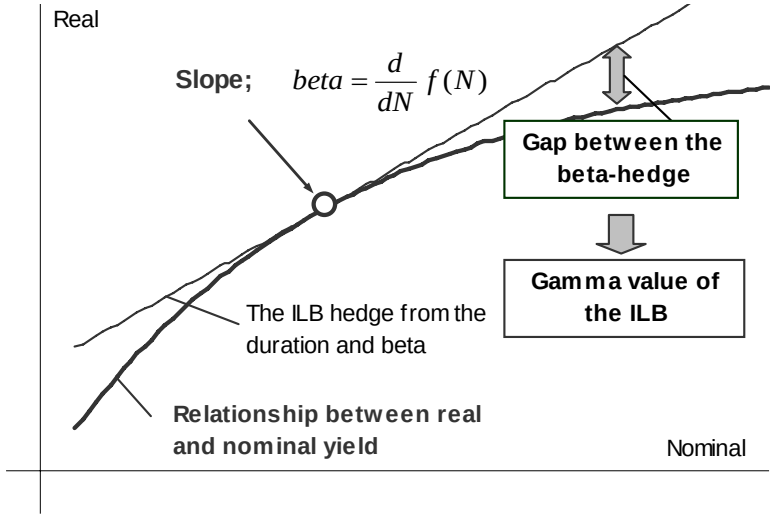
In practice, this has worked only during rally phases.

$$\Delta R \approx \frac{dR}{dN}\cdot\Delta N + \frac{1}{2}\frac{d^2R}{dN^2}(\Delta N)^2 \quad \approx beta\cdot\Delta N + \frac{1}{2}\frac{d^2R}{dN^2}(\Delta N)^2$$

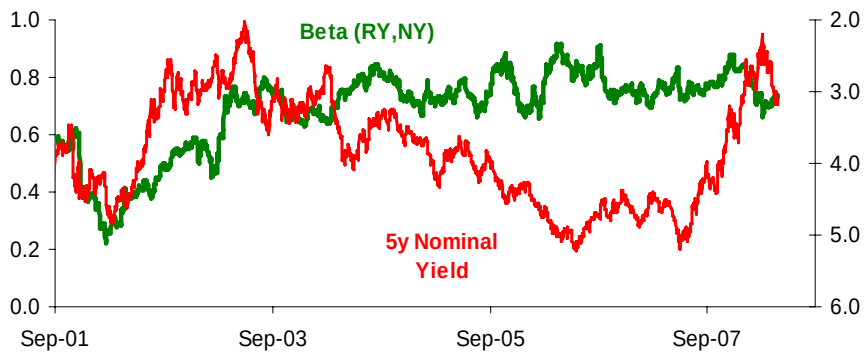
$$\Delta ILB.Price \approx \Delta R\cdot Mod.Dur + \frac{1}{2}Cvx\cdot(\Delta R)^2$$

$$\approx beta\cdot\Delta N\cdot Mod.Dur + \frac{1}{2}beta^2\cdot Cvx\cdot(\Delta N)^2 \quad + \frac{1}{2}\frac{d^2R}{dN^2}\cdot ModDur\cdot(\Delta N)^2$$

$$Convexity.Value = \frac{1}{2}\frac{d^2R}{dN^2}\cdot Mod.Dur\cdot(\Delta N)^2$$



5y generic TIPS: The beta rose when yields rallied (1999->2003) but stayed high in spite of the sell off



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Beta Regime Change

- Simply using historical data for regression would be misleading
- Even using the complete historical data set will not be sufficient as economic fundamental continues to evolve
- Fundamental analysis needed to determine beta regime

6 – Carry

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Carry

- The level of past, current and future inflation prices is necessary to determine the carry profile of the inflation-linked bond. Real coupons are usually lower than nominal coupons; this has a negative impact on the carry profile. But the increase in the inflation ratio may largely offset this loss.

- Due to the structure of inflation-linked bonds (notional accreting with the index ratio), the nominal notional and therefore the dirty price of inflation-linked bonds fluctuates with the monthly changes in the CPI (with the appropriate 3-month lag).

- Part of the carry profile for linkers is known as soon as the CPI is published (the index ratios for the following calendar month are fixed). Beyond that, future expectations of CPI evolution will determine the carry and therefore the value of linkers.

  - **FP(T) = GP(0)*(1+repo*T/360) - Accrued(T) for nominal note**
  - **FP(T) = GP(o)*CPI(0) /CPI(T)*(1+repo*T/360) -Accrued(T) for TIPS and OATis**

  with FP = Forward Price, GP = Gross Price, CPI = CPI index (taking into account the lag)

- Furthermore, distribution of fwd CPI needed for carry calculation or the carry can be approximated through the expected fwd CPI values.

Carry: simplified example

- assuming the following market:
  - inflation-linked bond: 1.80% real coupon, duration = 8
  - nominal bond: 4.20% coupon, duration = 7.5
  - both bonds trading at par inflation $\Rightarrow$ breakeven = 2.40%
  - repo rate for both bonds: 2.10%

1-month carry for nominal bond: (4.20%-2.10%) / 12 = 0.175%,

or 0.17% / 7.5 = **2.3bp**

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Carry: simplified example

- **Scenario 1**: DRI: +0.4% m/m

  1-month carry for real bond: (1.80%-2.10%) / 12 + 0.4% = -0.025% + 0.4% = 0.375%,
  or 0.375% / 8 = **4.7bp**

- **Scenario 2**: DRI: -0.2% m/m

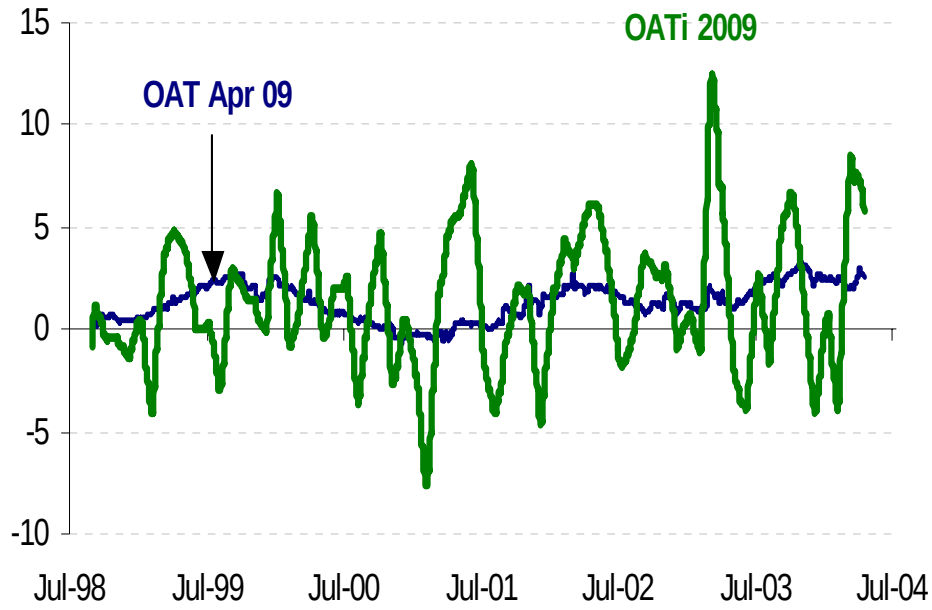
  1-month carry for real bond: (1.80%-2.10%) / 12 - 0.2% = -0.025% - 0.2% = -0.225%,
  or -0.225% / 8 = -**2.8bp**

- Breakeven carry:
  - Scenario 1: 4.7bp - 2.3bp = 2.4bp
  - Scenario 2: -2.75bp - 2.3bp = -5.1bp

  to have flat breakeven carry, we need the DRI increase to be equal to 0.175% + 0.025% = 0.2%,
  which is an annualised breakeven of 2.40%

Real carry more volatile than nominal carry

Rolling 1m carry for the OATi 2009 and OAT 2009



This shows that breakeven inflation (to maturity) is not the only variable to consider. Short-term, the inflation carry will influence the market strongly.

1m carry between Sep 98 and May 2004				
bp	Average	Lowest	Highest	Std Dev.
OATi 09	1.34	-7.8	12.8	3.23
OAT 09	1.33	-1.1	3.7	0.96

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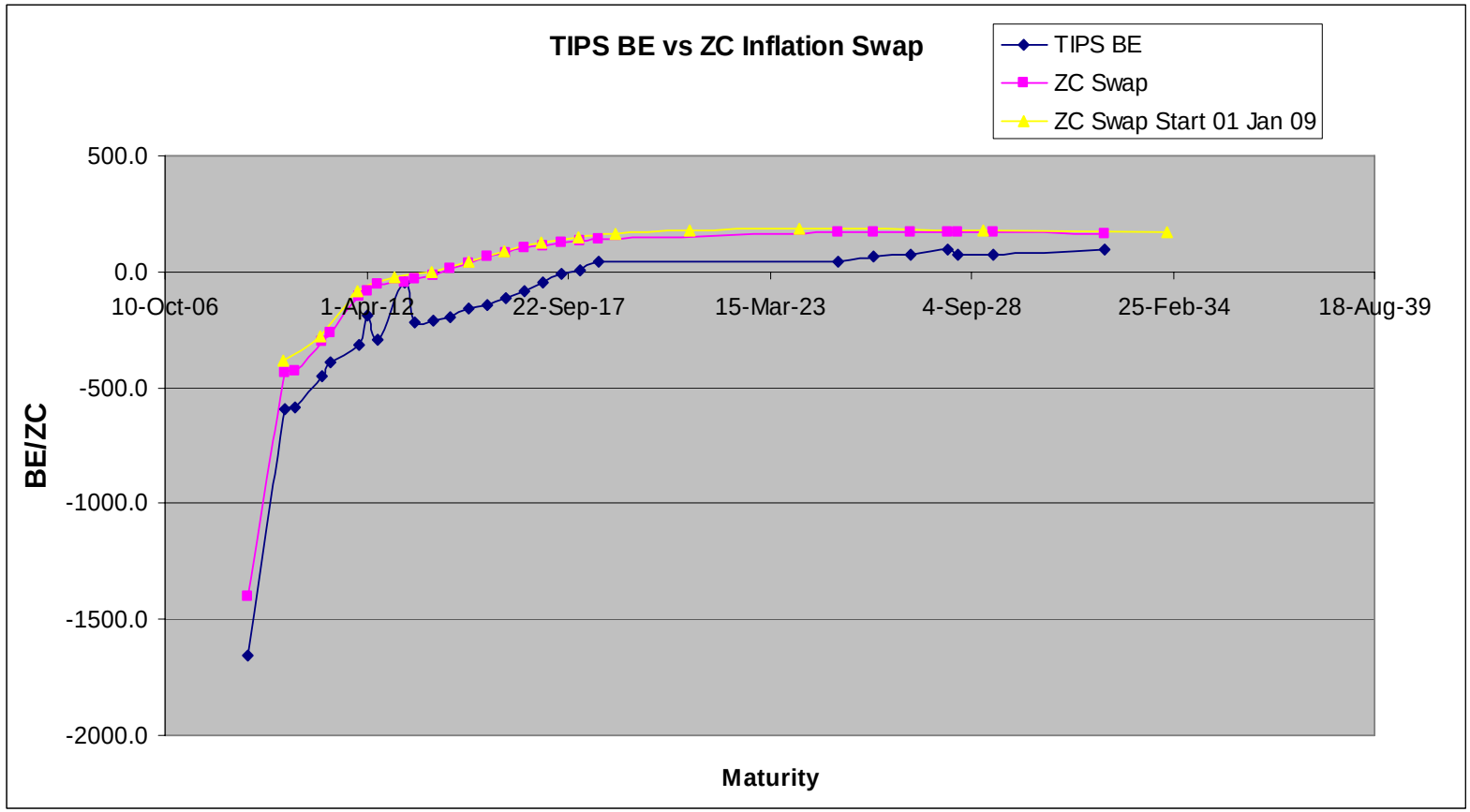
TIPS BE vs USD ZC Swap

Measuring Inflation: TIPS BE and ZC Inflation Swap



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