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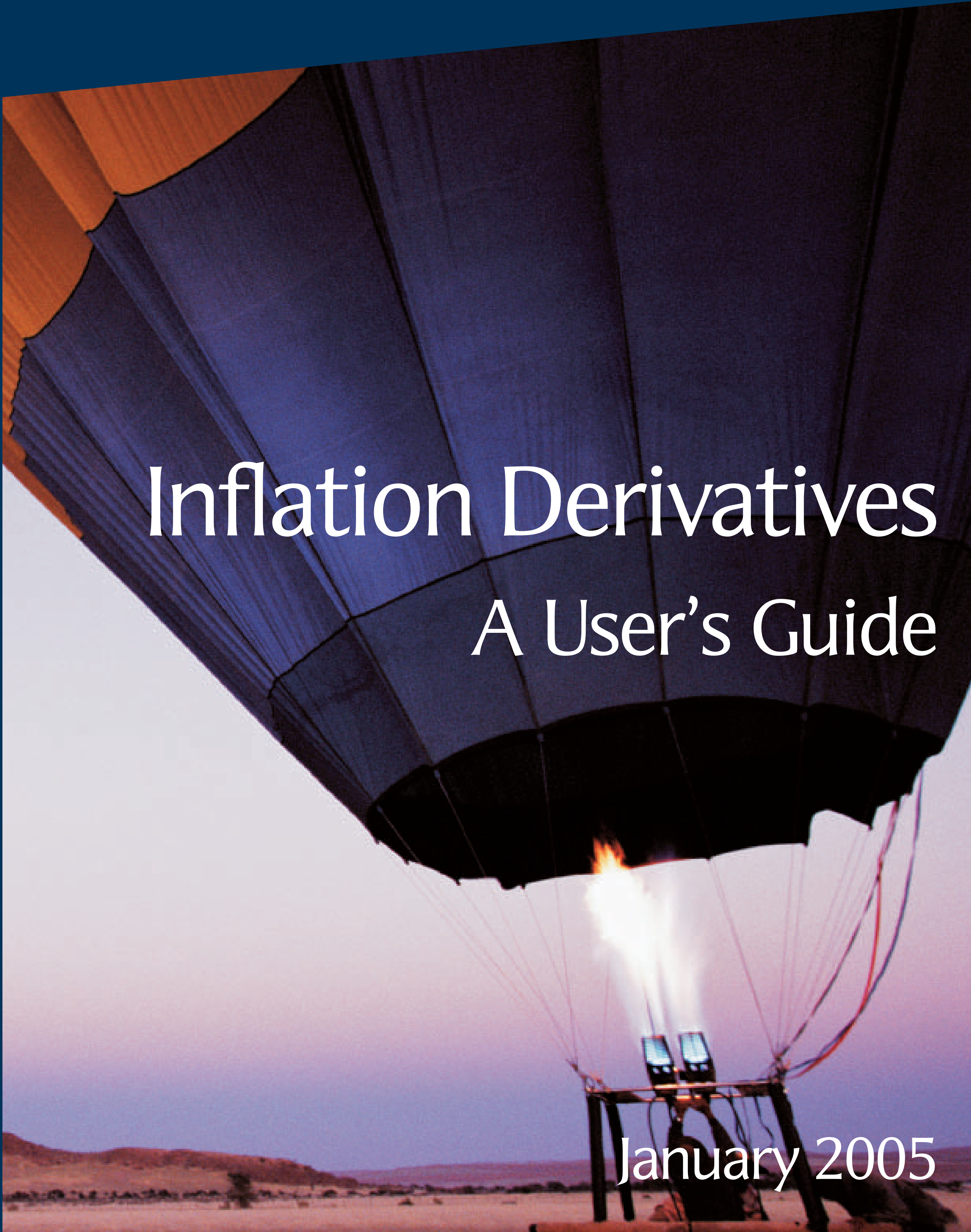

Inflation Derivatives

A User's Guide

January 2005

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Preface

While inflation derivatives are not new and Barclays Capital has traded inflation swaps for more than 10 years, it is only recently that they have moved from being an exotic offshoot of inflation-linked government bonds into the mainstream. Turnover in inflation swaps has increased more than tenfold in the past two years but the potential for further growth remains immense as the emphasis on matching real liabilities increases globally. Not that inflation swaps are independent of the still rapidly growing bond market. Asset swapping activity binds the inflation product class together, aiding liquidity on both sides. The market in real yield and inflation volatility is still in its infancy but developing rapidly, with interest in inflation options surpassing even our most optimistic projections.

We at Barclays Capital have been evangelical about linkers for many years but our faith in the asset class continues to be rewarded. While we expect the size of the Barclays Capital Global Inflation-Linked Bond Index to exceed $1trn in 2006 from $680bn at the end of 2004, inflation derivatives are the prime source of potential new developments. Out of the largest 15 countries in the world by GDP, 11 governments either have an established inflation-linked bond market or have stated an intention to issue them in 2005. In two of the remaining four countries, Spain and the Netherlands, domestic inflation swaps trade despite there being no government inflation-linked supply.

Barclays Capital offers live zero breakeven swap screens in the four most active markets via Bloomberg. Euro HICPx swaps can be seen on BISW1, French CPI on BISW2, UK RPI on BISW3 and US CPI swaps on BCAP4. We continue to commit unrivalled resources in terms of distribution, liquidity provision and market research that enable us to have unparalleled coverage of inflation product.

This guide details the structures that form the building blocks for almost all inflation swap transactions and the practicalities of inflation-linked asset swaps. It discusses the potential for forward positioning, how the market for inflation volatility can be used and is likely to expand, in addition to covering the features of the established derivatives markets in depth. We hope that you enjoy reading this publication and find that its contents further stimulate your interest in inflation products in general.

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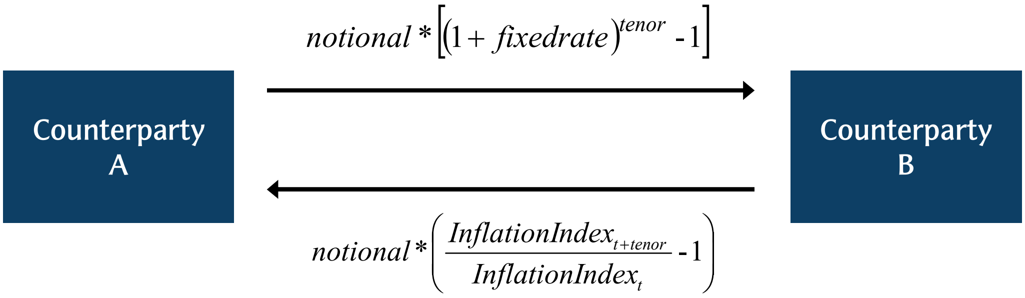
Inflation swap structures

Mike Oman

The benchmark – Zero coupon inflation swaps

The most regularly traded structure in the inflation-linked swaps market, and particularly in the inter-dealer market, is the zero coupon inflation swap. One counterparty agrees to pay the cumulative percentage increase in the price index over the tenor of the swap (with some lag on the reference index, similar to cash securities), and the other pays a compounded fixed rate. There are no exchanges until the maturity of the swap, or in other words it is a zero coupon transaction. The flows at maturity are presented diagrammatically in Figure 1.

Figure 1: Zero coupon inflation swap structure



Source: Barclays Capital.

The inflation leg is subject to a lag, and for most markets this is similar to that of the associated inflation-linked bond market. For example, the final value of the inflation leg of a Euro HICPx zero swap maturing on 1 September is going to be the notional value multiplied by the Euro HICPx index value for June divided by the base index value, which is the index value for the month three months prior to the start date of the swap.

As it is only the final and the initial index values that determine the value of the inflation leg, which might be thought of as the floating leg, there is no path dependency to cloud the market's implied inflation expectation given by the fixed rate, or breakeven. If the fixed leg on a 2yr swap is trading at 2.10% it can be said that the market expects the inflation from the base reference index to the final reference index, 24 months later, to precisely equal 2.1% on an annualised basis. This might seem obvious but this simplicity does not strictly hold for bond breakevens, which can be deflected away from fundamental inflation expectations by near-term carry fluctuations, and the extent to which duration differs from the maturity. For the final value of a zero swap it does not matter whether the rise in the inflation index to a given level occurs entirely in the first six-months or occurs gradually over the full tenor. The fixed rate of the swap is therefore a pure breakeven inflation rate, and therefore a cleaner representation of inflation expectations than can be gleaned from the inflation-linked bond markets.

The purity of the structure is one of the reasons it has become the benchmark structure. It offers the most flexibility of use, and provides the building blocks for the pricing of other structures and products. For example, the real coupon structure shown in the examples at the end of this section is simply a collection of zeros of equal notional size and with a common base index.

The concept of a daily interpolated reference index value is also seen in some, but not all, inflation swap markets. For example, the base index for French CPIx swaps settling on 15 September will be approximately halfway between the June and July index values, whereas in the Euro HICPx market it will be the same on 15 September as it was on 1 September, equal to the June index value. In the UK RPI market the index lag is shorter, with the July index used throughout September. The RPI is published reliably early in the month allowing for the shorter lag, whereas in Europe, especially in the early months of the year, inflation releases have been known to drift into the start of the next month, and therefore the market requires a longer lag.

It can be argued either way whether daily interpolation or a fixed monthly value is preferable, as interpolation avoids discrete jumps in quoted values at month-end but will impose a drift in quoted values through the month that makes interpretation of price action within the month more difficult. Perhaps more importantly, if the index is interpolated, a swap of any given tenor traded at the start of a month is a subtly different commodity from a swap of the same tenor towards the end of the month, and with the frequency of trading still relatively low and largely on full year tenors only, this can add unwanted complication to risk management by dealers. With a monthly fixed value the risk of a trade done early in the month can be exactly offset by an opposite trade later in the month, with no residual risk. If the need to hedge across month end arises, quotes on the previous month's basis are usually readily available. As trade frequency grows this advantage of the fixed monthly value will decline.

Seasonality considerations for swap breakevens lead to difficulty in interpolating for dates between quoted annual tenors, so the vast majority of trades are whole year tenors, but non-whole year tenors are increasingly quoted. More frequent two-way flow is increasing the definition of the monthly seasonal pattern as existing positions are unwound. We explore these issues in more detail in the "Inflation derivatives and seasonality" section of this guide.

Naturally, inflation swap activity in each region has gravitated toward the indices to which domestic bond markets are indexed. For example US inflation swap activity is almost exclusively in CPI-U nsa (CPURNSA <Index> on Bloomberg) and in Europe the most actively traded inflation swap markets are Euro HICP ex-tobacco and French CPI ex-tobacco. A non-seasonally adjusted index is always used to avoid the subjectivity of seasonal adjustment coming into play. Barclays Capital displays indicative prices for the major zero coupon inflation swap markets on screens accessible via the BINF page on Bloomberg.

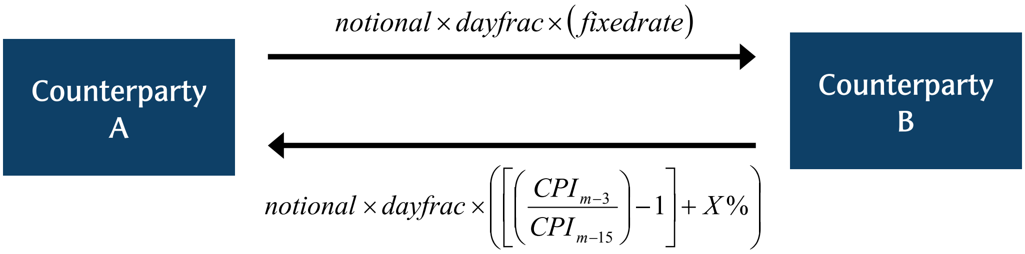
Year-on-year inflation swaps

Structures other than the zero-coupon style swap have traded. In Europe, for example, the year-on-year (Y/Y) structure has traded frequently, and was more prevalent than the zero structure in the early days of the euro market. The year-on-year structure involves one counterparty agreeing to receive an annual coupon determined by the Y/Y rate of inflation in return for paying a fixed rate. The fixed rate is the quoted rate, and is analogous to a breakeven inflation, although not in as pure a sense as the zero swap's breakeven. The yearly inflation period lags the payment dates in a similar way to the zero structure. Sometimes the non-inflation leg of the swap will be a floating Libor with a spread rather than a fixed rate, in which case the spread is quoted. In the US, Y/Y inflation swaps tend to be quoted in the monthly cash flow format, whereas in Europe the cash flow frequency will tend to be annual.

Although not quoted nearly as much on dealer screens as the zero coupon structure, indicative Y/Y rates are easily derivable from the zeros in the same way as is true for coupon interest rates from zero coupon interest rates. Year on year elements regularly feature in structured inflation products, often in the inflation-plus-X format, and sometimes with a nominal first coupon. It is for the direct hedging of these structures that the Y/Y swap is most frequently employed. For those structures with a nominal first coupon the appropriate hedge is the forward starting swap, something that we will take a closer look at in the forward inflation section.

The floating leg of a Y/Y inflation swap is equivalent to a collection of consecutive forward inflation rates, and therefore the Y/Y structure can be useful for hedging inflation caps and floors, either standalone, or as features within structured products. The development of the swap markets and caps and floors markets will go hand in hand with each other and could be enhanced by the existence of a monthly Y/Y style inflation futures contract rather than the quarterly annualised Eurodollar style contracts we have at present in the US. We will look at this in more detail later in this document.

Figure 2: Year-on-year inflation swap periodic payments



Source: Barclays Capital.

Accreting inflation bond style swaps

Some transactions have been structured to mimic existing inflation-linked bonds as a hedge for cash linker positions. Such accreting inflation bond style swaps exactly replicate the cash flow structure of the bonds matching payment dates, and matching base indices with identical lags to the index, with the other side of the swap being a fixed rate or floating Libor plus spread.

When cash bond markets were less liquid and with far fewer issues, there was occasionally the need for the derivatives markets to create hedging products, and a structure with flows identical to the bonds was the natural first port of call. As this need is now much reduced, the demand for the mimicking structure has also reduced. The linker-style structure is now traded far more commonly in another guise, as part of the inflation-linked asset swap, which is effectively a combination of the accreting bond style swap and an opposing position in the cash bond. The existence of such structures may have been a driver of early asset swap activity as it will have helped to highlight the value in the linker asset swap structure by its usual richness versus the cash securities. Asset swaps are dealt with in more depth in the asset swap section of this document.

Total return swaps

In exchange for a fixed rate or, more probably, a Libor flow, a total return swap pays the total percentage return over the reset period, minus a spread. The product lends itself to exposure to the total return index of a market index such as the Barclays Euro government inflation-linked bond index rather than a particular security and is therefore potentially a cost-effective way to have broad-based exposure to an asset class such as inflation. That said, the underlying can be one security, as has been the case with most JGBi total return swaps to date given the lack of established indices. Total return swaps may also be attractive for tax reasons. For instance Swiss investors may choose to enter a total return swap in BTP€is to avoid the withholding tax they would otherwise face on BTPs. The spread applied to the floating side of the swap is required to compensate the dealer for the balance sheet cost of holding the asset or assets underlying the swap agreement. The credit rating of the institution offering the swap will have a bearing on the pricing, with those with a lower rating potentially requiring less spread to hold the assets on balance sheet.

Total return swaps are particularly relevant to the Japanese JGBi market. It was only in December 2004 that the Ministry of Finance confirmed that from April 2005 restrictions on foreign ownership of JGBis were to be lifted. Prior to the lifting of restrictions the only method for non-domestic investors to gain exposure to JGBis was via total return swaps. In this case it has not been uncommon for the underlying to be the total return of a particular security.

Example swap structures

Figure 3: HICPx zero coupon vs compounded fixed

Amount:	*€50,000,000 (for example)*
Start Date:	*[TBD]*
End Date:	*[TBD]*
Bank Receives:	*Inflation, at maturity:*
	notional([HICPx(m-3)/HICPx(s-3)]-1)*
	Where s = month of start date, m= month of maturity date, HICPx is the Euro HICP Ex-tobacco index value
Bank Pays:	*Fixed rate, at maturity:*
	*notional** $[(1+X\%)^T-1]$ *;*
	Where T= tenor in years, X= quoted fixed rate

Note: The same structure trades for US CPI-U nsa with two-month lag.

Figure 4: OATei-style vs Euribor or fixed (accreting bond style swap)

Amount:	*€50,000,000 (for example)*
Start Date:	*[TBD]*
End Date:	*[TBD]*
Bank Pays:	*6m Euribor flat, Semi-annual Act/360*
	Or
	Fixed Rate, Annual 30/360
Bank Receives:	*Real Coupon of X%:*
	*X% * [HICP(p - 3)/HICP(s - 3)] * Dayfrac * Notional, Annual 30/360*
	Additionally, at maturity:
	*Notional * Max {0%, [HICP(m - 3)/HICP(s - 3) - 1]}*
	Where p = payment date, s = start date, and m = maturity date
	HICP (base) = HICP(s – 3)
	We use the standard 3 month lag for indexation

Note: The cash flows match those of the bond; TIPS-style will be semi-annual; BTP €i style will be semi-annual, but quoted annually.

Figure 5: Real coupon (only) vs Euribor or fixed

Amount:	*€50,000,000 (for example)*
Start Date:	*[TBD]*
End Date:	*[TBD]*
Bank Pays:	*6m Euribor flat, Semi-annual Act/360* *Or* *Fixed Rate, Annual 30/360*
Bank Receives:	*Real Coupon of X%:* *X% * [HICP(p - 3)/HICP(s - 3)] * Dayfrac * Notional, Annual 30/360* *Where p = payment date, s = start date, and m = maturity date* *HICP (base) = HICP(s – 3)* *We use the standard 3-month lag for indexation*

Figure 6: Year-on-year inflation plus spread vs Euribor flat

Amount:	*€50,000,000 (for example)*
Start Date:	*[TBD]*
End Date:	*[TBD]*
Bank Pays:	*Fixed Rate* *Annual 30/360*
Bank Receives:	*Year-on-year inflation plus spread:* *{Max[0%, [HICP(p - 3)/HICP(p - 15) - 1]] + X%} * Dayfrac * Notional, Annual 30/360* *or alternatively* *Max {0%, [HICP(p - 3)/HICP(p - 15) - 1] + X%} * Dayfrac * Notional, Annual 30/360* *(keep one of the two alternatives: 0% floored inflation rate or 0% floored total coupon)* *Where p = payment date* *HICP (base) = HICP(s – 3)* *We use the standard 3-month lag for indexation*

Inflation-linked asset swaps

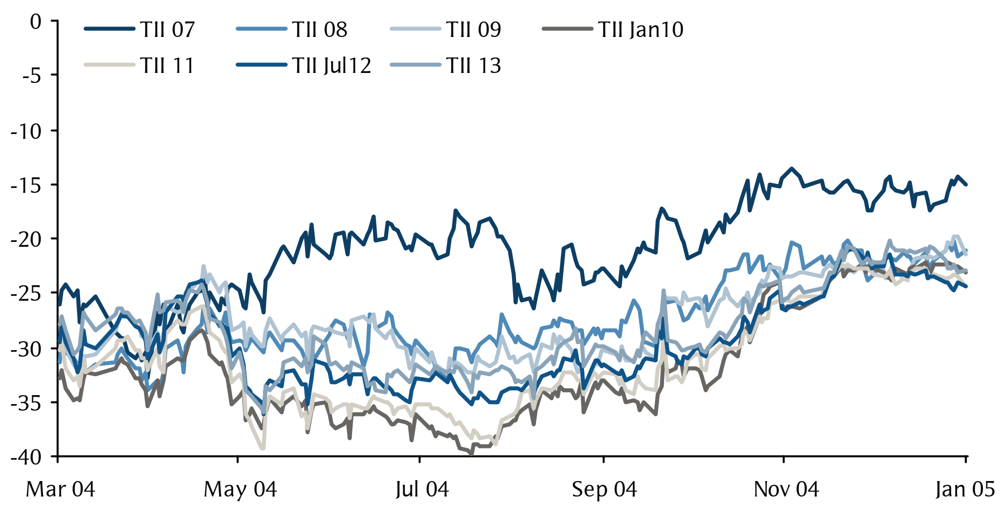
Mike Oman

Since the summer of 2003, asset swapping has been a prominent feature of the inflation market landscape. An inflation-linked bond asset swap is essentially the same thing as a nominal bond asset swap, with the future cash flows of the bond priced by the nominal swap curve of the currency concerned. It is then translated into a Libor flow, plus or minus a spread. Given that the cash flows of a linker have a floating element, an extra stage to the pricing process is required in the shape of putting a market implied nominal value on the future flows; but the development of the inflation swap curve has made that relatively easy to do.

Europe has been the quickest to develop an asset swap market as it was the first to have the combination of inflation swap liquidity sufficient to allow viable pricing, and Libor spreads attractive enough to draw interest. Once the opportunity had been highlighted by activity on the part of speculative players, the natural buyers of asset swaps (namely Libor funding financial institutions seeking Libor plus product), began to get involved. The speculative players required significant expected gains to be involved at a time when liquidity was not yet fully established, whereas natural buyers are happy to hold the position to maturity for its intrinsic value, unconcerned by ease or otherwise of exit, and so have become the more significant participants.

The supply and demand imbalance for swap inflation is the main reason why linkers have offered such attractive asset swap opportunities. Swap breakevens have traded richer than bond breakevens in general; perhaps with the exception of the some maturity sectors of the UK market, as the lack of willing inflation "payers" has been more acute. In Europe, partially thanks to relatively narrow nominal swap spreads, the difference is often large enough that when buying via an asset swap the buyer is paying away inflation at a higher rate than the relationship of the real curve and the nominal swap curve would suggest. So, when valued by the nominal swap curve the structure has a positive NPV, and therefore the possibility of achieving a running pick-up to Libor.

Figure 7: US TIPS asset swap spreads relative to nominal comparators



Source: Barclays Capital.

In the dollar market nominal swap spreads have been too wide to result in a positive Libor spread for TIPS asset swaps even though the swap-bond breakeven differential has at times been wider than seen in Europe. That said, the US inflation-linked asset swap market, although developing later, has also seen significant activity. This is due to investors capitalising on the asset swap spread being lower than the Libor-GC spread by buying the bond on asset swap, repo-ing it out at GC, and investing the proceeds at Libor, picking up the net spread as positive carry. TIPS asset swaps have gradually widened towards the GC Libor spread, and we see little reason yet for a move significantly beyond that valuation. Figure 7 above illustrates how TIPS asset swap spreads have richened relative to comparable maturity nominal Treasury asset swap spreads. The relative spread in some issues had been as wide as 40 bp in mid-2004.

Asset swapping leaves the dealer with a long inflation swap exposure, and so is effectively a welcome source of swapped inflation paying. Given that there is a structural lack of natural payers of inflation, the influence of asset swapping has been to help mitigate the mismatch of supply and demand; thereby reducing the spread between swap and bond breakevens, narrowing bid-offers and generally boosting liquidity.

Pricing

As ever the pricing of the structure is driven by the price of the hedge for the dealer. The emergence of the zero-coupon structure as the benchmark structure has simplified the process of finding the market value of the inflation hedge for each of the linked cash flows. In practice, all of the cash flows are not likely to be individually hedged by dealers as this is prohibitively costly, but the pricing will be determined on that basis.

Using a curve bootstrapped from the zero inflation market, the implied market expectation for the future path of the linking index can be found and used to calculate the implied nominal market value of the bond's coupon flows. From that point onwards the process of determining the asset swap spread is the same as it is for a regular nominal security, except that the cash flows being valued are not uniform in magnitude, but instead grow (or shrink potentially) in line with the projected inflation index.

Figure 8: Par/par asset swap pricing example based on BTP€i08

Bond base inflation index		112.607			
Bond price		106.42			
Cash flow date	Real coupon	Notional	Inflation swap breakeven index	Nominal cash flow	Nominal swap discount factor
23 Nov 04			115.053		1.000
15 Mar 05	0.825%		115.990	0.850%	0.993
15 Sep 05	0.825%		117.407	0.860%	0.981
15 Mar 06	0.825%		118.160	0.866%	0.969
15 Sep 06	0.825%		119.969	0.879%	0.955
15 Mar 07	0.825%		121.047	0.887%	0.940
15 Sep 07	0.825%		122.835	0.900%	0.925
15 Mar 08	0.825%		123.884	0.908%	0.909
15 Sep 08	0.825%		125.736	0.921%	0.892
15 Sep 08	100%	-100%	125.736	11.659%	0.892
		A	PV bond cash flows		17.08%
		B	PV Libor flat leg		10.77%
		C	Bond price - 100		6.42%
		A-B-C = D	PV ASW at Libor flat		-0.11%
		E	Nominal Swap PV01		3.65
		D/E	**Asset Swap Spread**		**-0.03%**

Source: Barclays Capital.

Figure 8 is a par/par asset swap example based on the BTP€i08, but the principle holds for all Canadian style linkers. In Europe, par/par is the most regularly quoted structure but in the US and UK a proceeds asset swap is the default. The choice of the proceeds structure is particularly understandable in the UK where bond prices deviate more significantly from par. In the par/par example shown, the index used is the path of the HICPx index implied by HICPx zero inflation swap breakevens, and the discount factors are of the Euribor curve. Being par/par it is necessary to net out the deviation from par of the bond's dirty cash price, from the PV of the par priced bond flows, and the PV of the Libor leg to find the PV of the asset swap assuming no spread to Libor. Via the swap PV01, the necessary spread to give the overall structure a PV of zero can be found, which is the mid or fair-value asset swap spread, in this case -3 bp assuming negligible value to the embedded inflation floor.

Seasonality of monthly inflation, and more importantly the seasonality model used to price the uplift of the bond's cash flows, is likely to have a bearing on the pricing of the asset swap. The seasonality influence may reduced at times of the year when the reference index month of the bond's cash flows coincide with the currently quoted base month in the inflation swaps market as market prices for the hedge will be readily available. The reduced uncertainty at those times of the year may result in tighter pricing, and therefore more activity. A further issue to be aware of is that conditions of high current inflation accretion may impact bond breakevens more than swap breakevens due to carry strength in the bonds. This is likely to have an impact on the spread but this is a pricing issue rather than an indication of changing fundamental valuation.

The mismatch between the accreting bond flows and the non-accreting swap used in the par/par structure has a distorting effect on the quoted asset swap spread. The absolute value of the spread, be it positive or negative, will tend to be amplified in comparison to that of a nominal asset swap of equivalent value over the life of the bond. The distortion has a relationship to duration and becomes clearly noticeable beyond 10 years. For example the quote for the TII25 has generally been only 2 bp less negative than that of the comparator Treasury, while at shorter maturities a 20+ bp deviation is more common, with little to choose between the relative value of the asset swaps of the shorter and longer TIPS. The fair value GGB€i25 asset swap has been quoted at around +21 bp, with the GGB 5.9% 2022 at the same time quoted at +15 bp, and while offering a higher running pick-up the linker asset swap has very similar overall value.

Reducing the mismatch to the profile of the swap and the uplifted bond cash flows may be desirable to reduce the distortion to spreads. Using a proceeds asset swap structure is likely to mitigate the distortion when prices deviate from par significantly, as in the case of most UK linkers or seasoned Canadian model linkers, but only in a small way. We see a potential advantage in moving towards structures that involve accreting notionals on the swap side. Clearly the accretion cannot be variable, with inflation for instance, as that would not make it possible to price the spread, unless it was a spread to *real* Libor, which is neither available, nor useful for users of inflation asset swaps. A potential solution is to price the asset swap given a fixed accretion of the notional of the swap at a rate in line with a market implied breakeven inflation rate, the best-guess rate of inflation that will occur over the life of the structure. The distortion to the Libor spread across maturities may be much reduced by this approach. Also, so long as inflation does not wildly disappoint the implied expectation, we would expect the cash flow profile of such a swap to be more balanced through time than is potentially the case for structures featuring non-accreting swaps.

Figure 9: Example asset swap term sheet

BTP€i08 Asset swap term sheet	
Counterparty A:	XXX
Counterparty B:	BARCLAYS
Notional Amount:	EUR 150,000,000
Note: Bond details	Bank B sells EUR150mn face value of reference bond for value date to Bank A for a dirty price of EUR 150mn
STAGE 1:	
Trade Date:	03/11/2004
Value Date:	08/11/2004
Counterparty A:	Pays Notional Amount
Counterparty B:	Sells Notional Amount of Reference Security (as defined below)
STAGE 2:	
Trade Date:	03/11/2004
Settlement Date:	08/11/2004
Maturity Date:	15-Sep-08
Reference Security:	BTP I/L 1.65% 15 September 2008
	ISIN CODE:IT0003532915
Counterparty A Payments:	
Running	1.65% * CPI RATIO * Notional Amount
	where:
	CPI RATIO = the Daily Inflation Indexation Coefficient corresponding to the Reference Security Coupon Payment Value Date. These Daily Inflation Indexation Coefficients can be currently viewed on www.dt.tesoro.it.
	A Full First Payment will be due on the anniversary date of the bond (accrual period according to bond coupon payment frequency)
	A Full First Payment will be due on 15 March 2005 (accrual period from 15 September 2004 to 15 March 2005)
Payment Frequency	Semi-annual every 15 September and 15 March on a Act/Act basis, unadjusted
	For the avoidance of doubt, it is intended that all Counterparty A Running Payment Amounts (included the Full First Payment, as defined above), shall match coupon amounts (including the Full First Coupon) on the Reference Security (as defined above), with a Principal Amount identical to the Notional Amount of this Transaction
At Maturity	Notional Amount * MAX {CPI RATIO ; 1}
	where:
	CPI RATIO = the Daily Inflation Indexation Coefficient corresponding to the Reference Security Coupon Payment Value Date. These Daily Inflation Indexation Coefficients can be currently viewed on www.dt.tesoro.it.
	For the avoidance of doubt, it is intended that Counterparty A Maturity Payment Amount shall match Redemption Amount on the Reference Security (as defined above), with a Principal Amount identical to the Notional Amount of this Transaction
Counterparty B Payments:	
Running	The first payment will be Euribor 4m +/-XX%
	Thereafter;
	Euribor 6 months +/- 0.XX% reset in advance paid on the Notional
Payment Frequency	Semi-annual, Act/360 basis , adjusted, modified following
At Maturity	Notional Amount

Source: Barclays Capital.

Inflation futures

Mike Pond

Previous attempts to build futures markets on US inflation variables or inflation-linked products have failed due to a lack of liquidity and demand, but the growing demand to hedge inflation risks and the associated exponential growth of global inflation swap markets raises the probability that well-designed contracts thrive.

The Chicago Mercantile Exchange launched US CPI futures contracts in February 2004. This came at a time when the US CPI swap market was only just beginning to flourish, and consequently initial trading volumes were relatively low and fairly sporadic. The contract has survived however, although volumes have remained low. Despite the activity levels, the CPI futures strip has been valuable in examining market inflation expectations. We believe the US CPI futures contracts will become more useful for both risk management and relative value-trading going forward, as increasing volumes of existing CPI swap agreements near maturity (thereby posing more pressing reset risks for dealers) and as more TIPS securities age sufficiently so that all their remaining cash flows fall within the maturity range of the strip. As a result, we believe that the US CPI futures contracts stand an increasingly good chance of developing a depth of activity well beyond the required critical mass.

It appears increasingly likely that demand for European inflation products will result in the launch of a euro inflation futures strip of some variety. We think this would not only broaden the awareness of the concept and uses of inflation futures, but would also open up the possibility of cross-market inflation futures trading, adding much-needed speculative interest to the inflation futures world.

US CPI futures (CME)

Structure

The pricing structure of US CPI futures is similar to that of Eurodollar interest rate futures. The underlying inflation index is the non-seasonally-adjusted CPI-U as used by TIPS (Bloomberg code: CPURNSA <Index>). The contract price subtracted from 100 represents the implied annualised inflation over the three-month period prior to the contract date. So, if expected inflation rises, the price of the contract goes down and vice versa. Therefore, an investor wanting a long inflation exposure would go short the future.

The minimum price fluctuation is half a tick, or 0.005. So, since the contract is valued at $2,500 times the price ($100,000 notional size in annualised terms for only three months, and priced in percentage terms), each half tick is worth $12.50. Unlike Eurodollar futures, prices on CPI futures can trade above 100 if deflation is expected over the three-month period.

The price (or reference index) is calculated as follows:

- Price (ref index) = 100 – [400 x ((CPI t /CPI t-3) -1)]

So more specifically:

- Mar CPI Future = 100 - [400 x ((Feb CPI-U/Nov CPI-U)-1)]
- Jun CPI Future = 100 - [400 x ((May CPI-U/Feb CPI-U)-1)]
- Sep CPI Future = 100 - [400 x ((Aug CPI-U/May CPI-U)-1)]
- Dec CPI Future = 100 - [400 x ((Nov CPI-U/Aug CPI-U)-1)]

For example, a 97.91 price on the March 2005 contract implies a 2.09% annualised rate of inflation from the November NSA CPI to the February 2005 NSA CPI. Once the November CPI number is known, the March contract price gives the implied market expectation for the February index number. In this example, with the November 2004 NSA CPI already known at 191.0, the implied February NSA can be imputed as follows:

CPI NSA Feb 2005 = ((1 + ((100 – March Contract Price) / 400)) * CPI NSA Nov) or

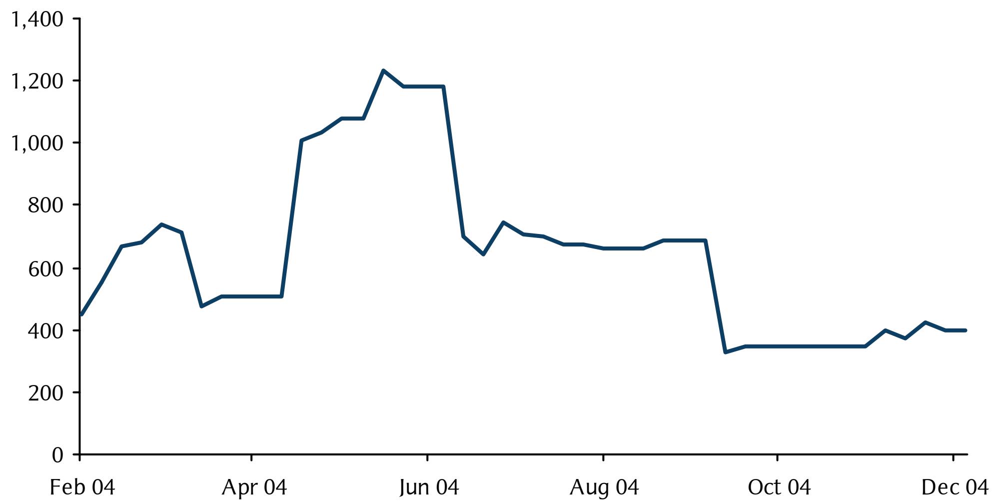
192.0 = ((1 + ((100 – 97.91) / 400)) * 191.0)

Note that the NSA CPI is rounded to one decimal place, while the contract price is rounded to four decimal places at settlement.

Currently, there are 12 consecutive quarterly contracts, so investors can trade inflation out to three years. Given the seasonal nature of inflation, the March and June contracts tend to price in higher-than-expected inflation outturns compared to September and December. So, if one were looking to hedge underlying inflationary trends, rather than specific CPI prints, trading 1-year, 2-year or 3-year CPI futures strips might be more appropriate.

Thus far, trading in CPI futures has been rather slow to develop. Open interest started off on a positive note and was on the rise into summer 2004. However, Figure 10 illustrates that open interest has since been declining to stagnant at best. Similarly, trading volume in the launch month of February 2004 was nearly 1,400 contracts, but has averaged only just over 400 contracts per month since. Below, we discuss factors that may increase trading in CPI futures and potential changes in the structure that could facilitate increased use.

Figure 10: CPI futures open interest



Source: Barclays Capital.

Uses of CPI futures

Investors can use CPI futures to express an outright view on inflation, hedge inflation exposure and create synthetic securities. The simplest concept of these is to express a view on a near-CPI print. Continuing from the example above, if the March 2005 contract was pricing in an implied-February NSA CPI of 192.0, investors expecting the print to be 192.1 would go short the contract as they would expect the settle price to be 97.6963 rather than 97.91. The final settle price is computed as:

Contract Price = 100 – (400 * ((Feb NSA / Nov NSA) – 1))

97.6963 = 100 – (400 * ((192.1 / 191) – 1))

If this were realised, since each 0.005 change in the price is worth $12.5, investors would have a gain of $534.25 per contract:

$$\$534.25 = ((97.91 - 97.6963) / 0.005) * \$12.5.$$

Another use for CPI futures is to hedge the inflation accretion on TIPS positions. For example, investors who are long $100mn TII '07s and concerned about P&L variation due to inflation carry through April can lock in the NSA CPI implied by futures by going long 129 March contracts to give equivalent notional exposure in the bond and the future. Then, if inflation is lower than the market-implied rate, the gain in the futures should offset the lower-than-expected accretion on the TIPS position, and vice versa if inflation is higher than expected. Note that such investors would not be hedged against changes in longer-term inflation expectations (breakevens), only against near-term inflation accretion. Equally, investors could hedge inflation accretion on relative value trades such as real or breakeven curve trades. This would be particularly useful in conditions of short-term volatility inflation indices – eg, when there are significant swings in energy prices.

Along the same lines as hedging inflation accretion on TIPS, the existence of CPI futures enables the creation of tradable forward real yields. We find that the forward rates presented in our daily inflation-linked report are helpful in relative value analysis, but their usefulness is limited in that they are only based on our inflation forecasts and are not tradable. To get a real forward rate a real repo rate is required. Using the combination of CPI futures and nominal repo, investors can lock in the current "real" term repo rate. Similarly, we can think of this process as using CPI futures to lock in TIPS carry to a forward date, which essentially creates a nominal security to that date which can then be combined with a nominal repo rate to create a forward real yield. One could then take this concept of a forward real yield one simple step further to create tradable forward breakeven rates.

Figure 11: Contract specifications

Reference index	Contract based on Consumer Price Index, US city average for all urban consumers, all items, not seasonally adjusted (CPI). The "Reference Index" is calculated as 100 less the annualised % change in CPI over past three months or $100 - [400 \times ((CPI_t / CPI_{t-3}) - 1)]$ The RI may be quoted at values either greater than or less than 100.
Contract size	Contract valued at $2,500 x Reference Index (RI)
Minimum price fluctuation or tick	0.5 bp or 0.005%, which equates to a value of $12.50 (= $2,500 x 0.005)
Contract months	"March Quarterly Cycle" of March, June, September and December. 12 contracts to be quoted initially.
Final settlement date	Cash settlement on the last day of trading. At the initial listing of a contract month, if the scheduled date of the release of the CPI for the contract month is undetermined, the Last Trading Day shall be tentatively set to 7:00 am Chicago Time on the first business day following the contract month. Upon the announcement of the CPI release schedule for the contract month, the Last Trading Day shall be reset to 7:00 am Chicago Time on the scheduled day of CPI release.
Position limits	5,000 contracts net position in all contracts

Source: CME, Barclays Capital.

CPI futures can also be used to create synthetic securities. Combining TIPS with CPI futures can produce a synthetic nominal treasury. The motivation may be to profit from an arbitrage opportunity if the synthetic security is cheap or rich to the cash security, or to temporarily transfer real exposure into nominal exposure. Clearly, the flipside is that synthetic real yields can be created from nominal bonds or even Eurodollar futures.

Short positions along the CPI futures strip could be used to simply go long or short three-year breakevens, capture opportunities versus cash TII08 breakevens, or be combined with nominals or Eurodollar futures to go long or short a synthetic TII '08 real yield. In early January 2005 the mid-implied inflation from November 2004 to November 2007 on CPI futures was 2.75% compared to a breakeven on the TII '08s of 2.60%. With improved liquidity, arbitrage-style opportunities could exist. To ascertain the appropriate number of contracts to combine with a Treasury position to create a synthetic TII '08 position, it is necessary to project the nominal cash flow of the January 2008 TIPS note to each coupon date based upon the forward CPI curve. Cash flows are then discounted using the Libor curve so that the present value of the nominal cash flows equal the full accreted (gross) price of the TIPS for a given date. We further look at the change in the bond's value along with the change in the contracts value for each 0.10 change in the NSA to derive an appropriate hedging strip.

Probably the most likely source of growth for CPI futures usage is the CPI swap market. Dealers may begin to utilise CPI futures more often to hedge their shorter tenor positions instead of hedging with TIPS, just as nominal swaps are hedged using Eurodollar futures. One advantage of using futures over cash is to reduce seasonality basis risk. For example, the seasonal impact on a swap maturing mid-year can be better matched using quarterly futures rather than with TIPS which mature in January. We look at such risks in the "Inflation derivatives and seasonality" section of this guide.

Potential changes and developments

It is becoming increasingly possible that the CME changes the structure of CPI futures from quarterly contracts based on annualised quarterly inflation to monthly contracts based on Y/Y inflation. The motivation for this change would be to encourage more active trading. Particularly, because of seasonality, hedging to a specific date (other than the end of the month following the expiration of a contract) cannot be done. Monthly contracts would eliminate this problem and provide a tool for more accurate hedging. Additionally, because each contract is based on the annualised quarterly inflation, even small changes in inflation expectations can create large swings in position market value. Moving to a Y/Y basis would likely serve to reduce price volatility and encourage more active participation in the programme. The Y/Y basis would also serve to eliminate seasonality from the way CPI futures are quoted without hindering its trading.

We see it likely that an inflation future for euro HICPx is launched at some stage; more than one exchange has considered the possibility of listing such a contract. The relative importance of inflation swaps in Europe and the explicit inflation ceiling of the ECB both encourage such a listing. As is true in US markets, the most immediate demand for such a future stems primarily from those looking to smooth out their short-term inflation derivative exposure, reducing risk towards expiry and resets of existing positions as well as better defining seasonality for longer-term mark-to-market. We would expect any such future to trade monthly contracts stretching out for at least a year to achieve this hedging function. It is likely that such a contract trades on the basis of a Y/Y inflation rate rather than the annualised quarterly specification of the existing US CPI future, as inflation is much more commonly considered as a Y/Y variable in Europe than the US, with the ECB inflation aim framed as such.

Elsewhere, the Brazilian Mercantile and Futures Exchange, known as the BMF, recently announced the creation of futures and options contracts linked to the official inflation rate and to government bonds indexed to the official inflation rate.

Inflation derivatives and seasonality

Alan James

Seasonality of price indices makes the marking to market of inflation swaps relatively tricky. The major traded inflation indices are all non-seasonally adjusted and exhibit significant seasonal trends. Thus, while several inflation swaps markets have easily observable annual inflation points, building a curve cannot rely on simple interpolation between these points. Models of seasonality are not consistent across the market though, so perceptions of how the gaps on the curve should be filled out can vary, sometimes wildly. The screen-based markets which trade a standard base month, even the relatively liquid Euro HICP ex-tobacco market, often have a price discovery period of two or three days over month end when the base month changes. Non-standard months do trade OTC in the more liquid markets, but brokers will usually quote overlapping months only for a week or so before and after the standard switch at month end. In markets where inflation swaps normally trade on a daily interpolated basis, it is relatively rare to see any other dates quoted apart from those for asset swaps.

Seasonality is only one feature of inherently volatile short-term inflation factors. At sub one year maturities in particular, it is likely that more precise expectations of monthly price developments will intertwine with seasonal factors. Ultimately, the final valuation of a swap held to maturity depends on the final inflation index fix. This means that the risk of an inflation swap declines far less quickly than a conventional swap as it nears maturity: the final valuation will always be highly sensitive to any inflation spike at the final fix. This ought to lead to those with large inflation swap positions wanting to avoid overexposure to a single number, seeking to create a much smoother risk profile across a number of months.

A quoted seasonal basis is not necessarily indicative of underlying expectations of inflation seasonality; it may reflect positioning within the market. It is not just expiry months where such sensitivities can be important. In particular, there can also be an issue with exposure to resets depending on mark-to-market procedures, especially for Y/Y inflation swaps which effectively trade as consecutive forward trades. Banks, thus, may attempt to reduce risks from seasonality by having exposure spread as evenly as possible across the year.

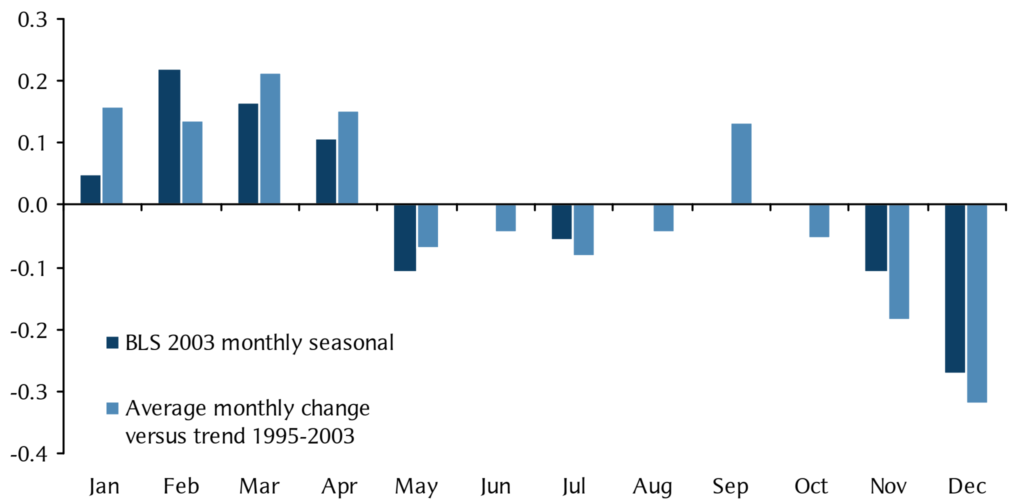
Unsurprisingly, months where there is a relatively heavy inflation swap exposure can trade out of line with fundamental inflation expectations. This is liable to happen, in particular where there are relatively heavy asset swap positions. Asset swapping creates inflation paying flows which help to balance up a market skewed by demand for structured product, but the maturity and reset dates of such structured notes typically are not versus the same inflation month, leaving a relatively high degree of basis risk in the market. So, Euro HICPx breakevens are likely to trade richer for June and July basis than other times of the year relative to the inflation seasonality, due to the exposure of the street to the asset swaps of BTP€is (which with 15 September maturities fix between June and July basis). The June and July 2008 breakevens ought to be particularly rich due to the very heavy percentage of the BTP€i08 that is asset swapped.

In an ideal world, inflation futures could be used to spread out both specific date and general seasonal inflation exposure. This would require a liquid future with a minimum of 12 monthly contracts. The relative size of the euro HICPx market and the fact that it trades mainly on a monthly basis makes it the market where the clamour for a monthly future to offset seasonality and reset risk is loudest. The existing framework for the US CPI future on the CME is of limited use as it only trades quarterly contracts. For the contracts it does trade, though, the existing CPI future provides an interesting comparison with the seasonality that is seen in the historical price index.

US seasonality

The US Bureau of Labor Statistics produces extensive details of its modelling of seasonal adjustment, but the US TIPS market consistently reacts with more surprise to seasonal factors than other countries. This may be due to the fact that most economists attempt to forecast the seasonally adjusted series and spend little time on the nsa number, in contrast to other markets, where non-seasonally-adjusted series receive almost all the attention of forecasters. The BLS uses the X12 seasonal adjustment model developed by the US Bureau of the Census. This model attempts to adjust for monthly distortions with the addition of an ARIMA time series process that BLS considers and attempts to adjust when there has been a one-off structural level shift in an individual component time series via so called intervention analysis. Seasonal factors are re-estimated and published at the start of each year, coinciding with the January data release and causing a change in the historical seasonally adjusted series. The seasonal adjustment is carried out on subcomponents of the index and then aggregated, which tends to produce a slightly more conservative estimate of seasonal factors than a top-down estimation even before a damping impact of the intervention analysis is considered.

Figure 12: US CPI-U estimated seasonal M/M changes



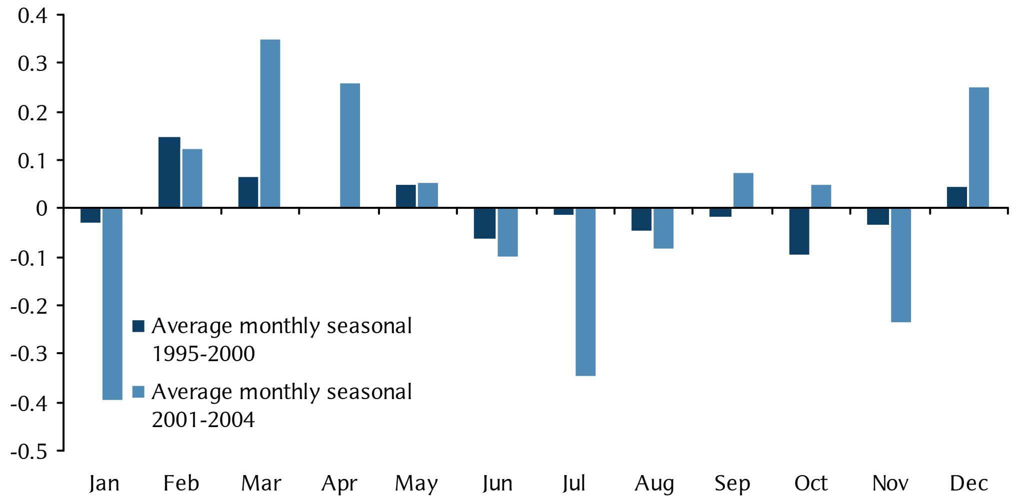
Source: Barclays Capital, Bureau of Labour Statistics.

In practice, CPI futures prices often imply seasonality greater than the last reported official seasonal factor. Seasonal modelling is likely to be seen most clearly in a forward spread between months not close to dates where there are bonds and hence outstanding asset swap exposure. Shorter dated contracts will be driven by more specific forecasts of short-term factors. On average, since the start of the contract the spread between the June 2006 and September 2006 contracts has been 1.05 points, ie, an annualised inflation differential of 1.05% between February and May 2006 and the May to August inflation periods. The BLS seasonal factor that has been available throughout this period implies that the spread should be 0.88, as the average seasonal difference between the two periods is 0.22%. On the other hand, Sep contracts have also implied less inflation than Dec contracts on average, even though the seasonal is slightly the other way. This suggests the richness of the Sep contract is more to do with relative supply and demand, but this is slightly surprising given that it implies that the street is short asset swaps since June and Dec contracts most closely match TIPS cash flow dates.

European seasonality

Seasonality is a particularly tricky issue in euro area HICPx due to the developing nature of the series. While a historical index for pre-1999 was constructed using individual country data, in some countries this is not consistent with data being collected now. There have been a number of changes in the measurement of seasonal items; in particular, in 2001 several countries, most notably Italy, started to include clothing sales prices in their HICP numbers, whereas previously, short-term price changes had not been included. While there is a very limited sample with which to compare, as the chart below shows, euro HICPx seasonality in recent years has been much greater in recent years than previously. Germany still does not include sales prices, if these are added it would mean a further significant increase to the seasonal component.

Figure 13: Average HICPx seasonality 1995-2000 and 2001-04



Source: Barclays Capital.

French CPI seasonality has been much more stable than that in the euro area. There has not been a significant change in recent years and seasonal volatility is now relatively lower than for euro HICPx. While Italian HICP seasonality increased sharply in 2001 with the introduction of sales prices, the seasonality of the FOI (ex tobacco) inflation measure that is traded in inflation swaps was not changed. This leaves Italian FOI seasonality notably less significant than euro HICPx. By contrast, the seasonality of Spanish CPI changed totally in 2001. It is now notably more volatile than the euro HICP but with similar monthly trends. Smaller countries within the euro area unsurprisingly have more volatility in their domestic inflation measures, but they also tend to exhibit much greater seasonal trends, which need to be considered when trading peripheral inflation swap markets as spreads to euro HICPx, as they are usually quoted.

The UK RPI exhibits considerably more seasonality than euro or US inflation but the impact on the bond market is generally smaller. For swaps, it is a relatively important pricing issue, albeit less so at the long end of the curve, where most trades occur. April consistently has the most positive inflation, on average more than 0.5% above the trend, due mainly to taxation effects from the start of the fiscal year. As elsewhere in Europe, in January and July price levels fall mainly due to discounting of clothes and furniture.

Forward inflation

Mike Oman, Robert Tzucker

Although many Fed speakers had hinted at it on several occasions it was not until 1 December 2004 that San Francisco Fed President Yellen confirmed the Fed's focus on market implied forward inflation when saying that, although inflation compensation over five years implied by TIPS breakevens had been increased by the rise in oil prices in 2004, "there has been almost no change in the compensation for inflation from five to ten years into the future". Clearly forward inflation has always been an important concept for the inflation market, but these comments bring it more sharply into focus.

There are various approaches to trading forward inflation. The conclusions of Yellen are drawn directly from the TIPS market. A view can be expressed using TIPS breakevens, perhaps by entering a long position in 10 yr breakevens combined with a short position in 5 yr breakevens should one believe that the measure that the Fed appears to watch as its gauge of inflation expectations, the 5 yr inflation rate 5 yrs in the future, is lower than policy makers will be comfortable with.

However the weights used for the trade are crucial to achieving the desired exposure. If executed using simple DV01 weights, a forward inflation position is not achieved. It is true that if 10 yr inflation expectations rise *relative* to 5 yr breakevens the position makes money, but this could happen while breakevens in general, and the implied forward rate, have fallen. It is exclusively a curve trade. Furthermore the DV01 weighted position described has an exposure to near-term inflation accretion, or in other words carry, as the cash size of the short position in 5 yr TIPS is necessarily larger than the cash size of the long position in 10 yr TIPS, making the mark-to-market of the position negatively correlated to current inflation accretion. If trying to isolate forward inflation expectations, current realised inflation conditions should not be a factor.

Far better is a cash-for-cash breakeven trade. To clarify, the trade involves selling an amount of 5 yr TIPS and investing that amount of cash in 10 yr TIPS, and then hedging the duration exposure of each of the TIPS positions using the nominal comparators. The investor has bought inflation from 0 yrs to 10 yrs and sold the first 5 yrs of the position leaving a position that is only influenced by changes to expectations from 5 yrs to 10 yrs. An example trade is summarised in Figure 14. Given a $100mn cash position on each leg with modified durations of 4.5 yrs and 8.6 yrs, if breakevens across the curve rise in parallel by 10 bp the long position in 10 yrs will rise in value by $860,000, and the short position in 5 yrs will lose $450,000. There is no exposure to inflation accretion as the cash amounts of the long and short TIPS positions offset each other. An alternative way for the forward inflation rate to rise by 10 bp is for the 5 yr to weaken relative to the 10 yr. The table shows that the result for the trade is no different if the same rise in the forward is brought about by a fall in 5 yr breakevens only.

Figure 14: Cash for cash weights give fwd inflation exposure only

	$100mn short TII Jan 10 position (MDur 4.50)		$100mn long TII Jul 14 position (MDur 8.59)			Overall P/L
	BEI rate	P/L ($mn)	BEI rate	P/L ($mn)	Fwd BEI rate	($mn)
At entry	2.664%		2.581%		2.489%	
+10bp parallel BEI shift	2.764%	-0.450	2.681%	0.859	2.589%	0.409
5yr BEI falls, 10yr unchanged	2.573%	0.409	2.581%	0.000	2.589%	0.409

Source: Barclays Capital.

The problem with doing the forward trade via bond breakevens is the cost of execution and some small potential mis-matches. Although it is increasingly normal for a breakeven trade to cost the same in bid-offer terms as a single real yield trade, the need to trade four securities to establish the forward position makes it a potentially costly execution. While it is a cash-for-cash position on the linker side there is likely to be a small net cash position from the nominal Treasury side, the size of which will depend on the relative coupons of the nominal comparators used. There may also be a running repo cost to the position which may be susceptible to specialness.

Figure 15: USD 5 yr 5 yr forward inflation in swaps and cash

Source: Barclays Capital.

As is usually the case, a cleaner way to trade in forward space is via derivatives. The problems such as repo specialness, high coupon comparators and, as the market develops, transaction costs, can be avoided in swaps. A further simplification is that swaps are quoted at par, and therefore do not have accreted principals like those of inflation bonds. As an example, we will look at a five-year forward starting 5 yr zero-coupon inflation swap paying inflation. The swap is constructed from the combination of a 10-year inflation swap paying inflation and a 5 yr inflation swap receiving inflation. This combination is used to eliminate exposure to inflation over the first five years of the swap. To achieve the offset the notionals in the two swaps in the combination of swaps used to create the forward should be equal. This ensures that the cash flows of the two swaps will accrete at the same rate.

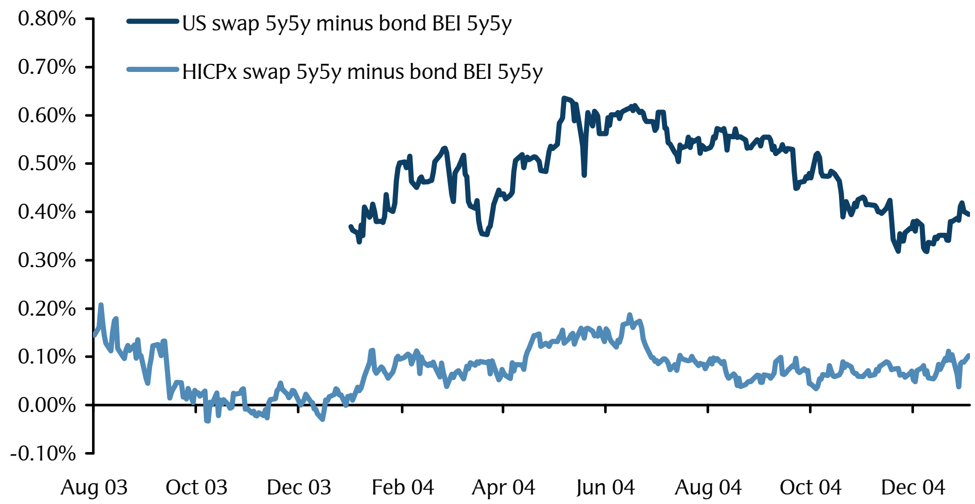
Although simpler than cash, forward inflation trading using inflation swaps still presents challenges that need to be considered. The problem for the hedger of a forward position lies in the fact that the notional size of the position at the forward settle date is dependent on the inflation experienced up to the forward settle date as both swaps used to create the forward exposure accrete in nominal terms with inflation. This is not something that is a problem for a forward interest rate swap, the notional size of which is deterministic.

For example, if the agreed notional of a 5 yr 5 yr trade is $100mn the initial notional amount used to hedge the trade should be an amount equal to $100mn discounted using the 5 yr inflation swap rate, the most appropriate estimate of what inflation will be over the coming 5 years. As long as inflation is positive, this number should be something less than the original $100mn. As the swaps age towards the forward start date, the legs may need to be rebalanced if inflation is higher or lower than anticipated to keep the notional on a path towards $100mn at the forward start date. If, just after entering this trade, the five-year zero coupon inflation swap rate climbed by 50 bp from say 2.50% to 3.00%, then the notional required in each leg will fall from roughly $88.4mn to $86.3mn. Without rebalancing, the position is left with too much or too little exposure to the forward rate.

For the above example the inflation convexity of the position is relevant. If the hedge is not rebalanced until the forward start date and inflation has surprised significantly to the upside since the hedge was put in place, it is likely that inflation breakevens are also higher. If a forward sale of floating inflation is being hedged, the hedger will be receiving fixed on the longer dated swap and paying fixed on the shorter dated swap. To rebalance the hedge the hedger is likely to be unwinding part of the position at better levels from his/her point of view, ie, receiving fixed on the forward at a higher breakeven level. It is also beneficial if inflation has undershot original expectations, as to rebalance the hedger needs to pay fixed on an additional amount at probably lower levels to regain the correct exposure. Hence we can say there is a positive convexity-style benefit to being long the forward as a hedge. This benefit relies on there being a positive correlation between changes to inflation experienced in the near term and the level of breakevens, which would appear to be a reasonable assumption. The frequency at which the hedge is restored is likely to increase the reliability of the correlation, but usually at the expense of the magnitude of the gain, as with any convexity issue.

The importance of the convexity issue to forward inflation in valuation terms is generally somewhat limited, although may have a non-negligible impact on forwards of particularly long tenor starting many years ahead such as a 15 yr 15 yr fwd position. Although a Y/Y swap structure is effectively a series of forward rates, the pricing is unlikely to be affected by this effect as the tenors of each are small.

Figure 16: Swap and bond forwards more closely connected in Europe



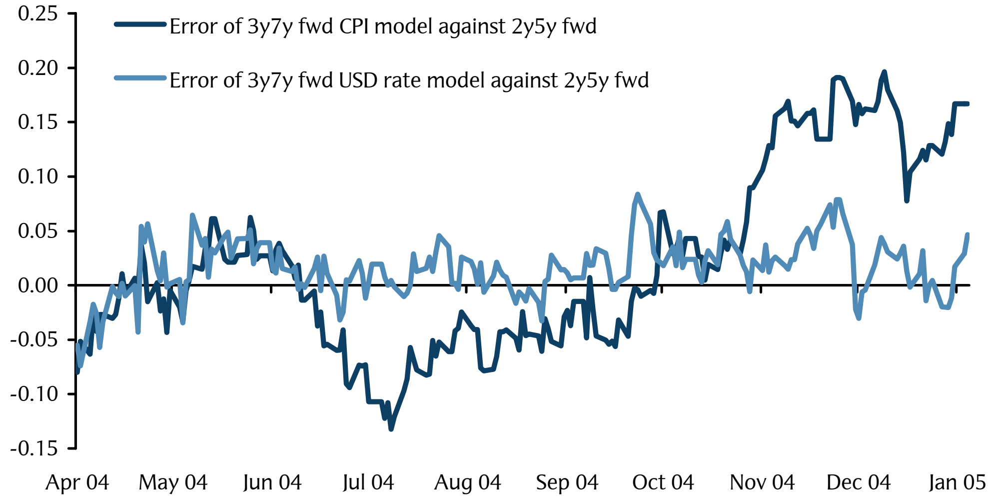
Source: Barclays Capital.

Valuation issues aside it is clear from Figure 16 above that there remains a fairly significant difference in the behaviour of forward inflation as implied by the swap curve and forward inflation as implied by bond breakevens in the US. It is still not uncommon for the spread between 5 yr 5 yr in each market place to move 10 bp in a matter of days. Although the bond breakevens used are coupon breakevens rather than zeros, the maturity is short enough for this fact to be insufficient to explain the differences and the pattern of the spread is not correlated with the direction of the forwards, so it is not a directional effect either. The disconnect in Europe has declined significantly since mid-2004, with the spread holding a tighter range of just 5 bp or so in the example shown since June 2004. We see this as an indication of the increasing maturity and liquidity of the European market, and partly related to the greater significance of asset swapping seen in Europe, a force that acts to tie swap and bond breakevens more closely. A similar reduction in the volatility of the spread in the US is likely if liquidity continues to develop at a strong pace, and particularly if TIPS asset swap volumes increase across the curve.

In addition to cash bonds and swaps, US forward inflation can also be traded using CPI futures contracts. US CPI futures exist as 12 quarterly contracts covering three years. CPI futures present the most straightforward method to trade forward inflation since each contract covers a 3-month period in the future. Positions covering longer periods can be created by combining futures contracts to get the desired length of exposure. Because they are exchange-traded futures, they are settled daily and have no convexity, so have an advantage to swaps for receiving inflation in the short end. Where they are disadvantaged, though, is the lack of flexibility in trading them. Whereas swaps can easily be modified to meet the specific needs of the investor, CPI futures have pre-set contract details that cannot be changed. Also, interpolation between futures is difficult due to monthly seasonality in inflation.

Forward rates may be more volatile than spot rates and this is particularly so in markets for which liquidity effects and positioning effects can play a significant role. For example, 10yr inflation may be cheapened in inflation markets by supply factors whilst 5yr inflation may be well bid due to pressures relating to hedging of specific retail deals. The consequence of the coincidence of these types of events can be volatility in 5 yr 5 yr inflation while spot levels are relatively stable. This characteristic makes inflation markets potentially very good hunting grounds for relative value opportunities in forward space. Just as an example, a simple regression model of the 3 yr 7 yr fwd against the 2 yr 5 yr fwd in both inflation swaps and nominal USD rate swaps demonstrates that the inflation curve has more often been prone to mis-pricing of sufficient magnitude to be attractive as a relative value opportunity even when considering bid-offer spreads as high as 4 bp.

Figure 17: There may be more attractive RV opportunities in inflation fwds



Source: Barclays Capital.

Such opportunities may be less regularly available in the future, however, as volumes and liquidity climb and we are already seeing a better disciplined inflation swap curve in Europe than previously.

Forward rates help to determine whether or not the inflation market's reaction to a one-off price shock is appropriate or not. Take for example the case of a one-off hike to indirect taxes on consumer goods which should only affect inflation prints within a certain period with no pass-through effects thereafter. It may be that the inflation market is well bid as a result of an announced tax rise, raising all spot breakevens to some extent. If by consequence forward rates for periods beyond that for which the one-off tax rise is relevant are significantly raised, a forward trade to fade the move is likely to be most appropriate, particularly if at that time carry to a breakeven curve flattening trade using bonds is negative.

As mentioned, the Fed's Yellen alluded to how useful the forward inflation market can be to judge the market's opinion of the likely impact of current inflation developments. In her interpretation, the market saw the inflation spike from a large rise in oil prices as fairly transitory. Others may disagree and take the market reaction as a cue to buy forward inflation. Indeed the comments themselves and comments made by other Fed members pointing to a very roughly delineated comfort zone for core inflation between 2% and 2.5% influence the market expectation for forward inflation rates, prompting forward trades should forward inflation rates move significantly beyond those boundaries. If an investor believes that inflation expectations have grown above the Fed's comfort level, they can pay floating inflation on a forward starting swap, betting that the Fed will take action to quell those expectations. In Europe the existence of an explicit ECB inflation ceiling of 2% makes the application clearer still.

Real yield derivatives and iSTRIPS

Gemma Wright, Mike Oman

The most obvious usages for inflation derivatives focus on inflation exposures, whether that is spot inflation, forward inflation or non-linear inflation. However, it is clear that combinations of inflation derivatives and nominal rate products can produce real yield exposures. In the same way that inflation positions can be more cleanly achieved by the use of derivatives in some circumstances it may be advantageous to use combinations of inflation derivatives and rates derivatives rather than use inflation-linked bonds to achieve real rate exposures.

Trading forward real yield is an example of how real rate exposures can be better achieved using derivatives. Forward pricing in IL bond markets is difficult beyond the known inflation accretion period of between two and six weeks (depending on the trade date in the month) limiting the usefulness of cash products for forward exposures. As alluded to in the CPI futures section, a combination of a TIPS and a strip of CPI futures can lock in forward real rates, but only to the extent that the dates of the 12 contracts, and the liquidity of the back month contracts allow. There may also be small mismatches that arise from having to trade whole numbers of contracts. Clearly, this is also limited to the US, as at the time of writing no other CPI futures markets are in existence.

A far cleaner way to trade forward real rates would be to use a combination of inflation swaps and nominal swaps, ie, receiving in a nominal swap and paying in an inflation swap at one maturity and doing the reverse at another maturity in the same notional size. This is most easily done in zero coupon format.

Spot zero real rate exposures, which can be constructed in the same way, may be useful for the creation of retail products such as real capital protected products which are attracting increasing interest or for pension funds in order to match real yield exposures more accurately. More frequent quoting of synthetic real zeros for this purpose would have the knock-on effect of providing the market with a clearer idea of the fair value of Stripped Treasury Inflation-Indexed Securities, or iSTRIPS, which offer the same exposure but, given that each iSTRIP security is a component of a TIPS security, with US government credit quality. The iSTRIPS market has been little used up to now having been unable to overcome the hurdle of establishing a self-sustaining level of liquidity. A source of activity may be arbitrage plays as opportunities arise between the synthetic and the iSTRIPS zero real yield markets. But given that the two are truly interdependent, we would expect arbitrage opportunities to diminish quickly once activity picks up. In the meantime, the existence of more liquid inflation swap markets through time should not only encourage more dealers to quote iSTRIPS prices, but to do so with an increasing degree of competitiveness.

In the absence of zero coupon linker bonds, the development of the iSTRIPS market should offer access to zero real yields for those without a mandate to use inflation or nominal derivatives. The benefits of a readily available real zero coupon security are four-fold. The instruments: 1) provide the longest duration and most convex inflation indexed instrument for a given maturity; 2) provide discounted instruments with inflation protection; 3) give more flexibility and therefore accuracy to liability matching for pension funds without reinvestment risk and 4) carry the AAA (ie, default free) rating of the underlying instrument. Below we look at the features of US TIPS iSTRIPS, detailing the calculation methodologies involved.

iSTRIPS

The US Treasury over the years has developed the inflation-indexed security market in a similar fashion to the nominal Treasury market. Hence, the development of a full yield curve has led to increased issuance, increased investor demand and development of a deep and liquid market. Allowing TIPS notes and bonds to be stripped into zero coupon instruments is another step in this development process. STRIPS is an acronym for Separate Trading of Registered Interest and Principal Securities. A TIPS security can be divided into its two components – coupon and principal. Each coupon cash flow, along with the principal payment is made into a real zero coupon instrument, or iSTRIP. All TIPS issues are now eligible for stripping and Barclays Capital has been an innovator in this area, first stripping TIPS in November 2000.

The US Federal Register sets forth basic conventions for the stripping and future settlement prices of zero coupon inflation instruments. The complete formulas may be found at the following link for CFR 356.36 Appendix B. The link for this register is as follows: **http://www.access.gpo.gov/nara/cfr/waisidx_02/31cfr356_02.html**.

Principal component

There is only one principal component (corpus) per TIPS issue. The par amount is the original face value of the bond to be stripped in $1,000 increments. The principal component retains one of the key attractions to TIPS. Holders of the principal at maturity receive the inflation-adjusted principal value or the par amount, whichever is greater.

Figure 18: Example of principal inflation strip (SIIP)

TIPS 3.875% 1/15/09
P = $1,000,000 par amount
CPI – U = base CPI on issue date = 164.0

Source: Barclays Capital.

If on 15 January 2009, the CPI-U is equal to 210.8, then an owner of the principal component will receive:

(CPI-U at maturity/base CPI-U) * par value

(210.8/164.0) * 1,000,000 = $1,285,365.90

If, however, the 2009 CPI-U is less than the base CPI-U, resulting in an Index ratio of less than 1.0, the inflation-adjusted principal will be less than par and the investor will, accordingly, receive the $1,000,000 face value.

The principal component trades at a discount to par and for trade settlement purposes will settle in the intervening period using the same methodology as above, substituting the Current Reference CPI-U into the equation. So for example, the January 2009 TIIP is priced at 97 5/32nds. The settlement date of 20 December 2004 has a Reference CPI-U of 190.5129.

(190.5129/164) * 1,000,000 * 0.96984 = $1,126,628.24

Interest component

The US Treasury faced a hurdle in the initial formation of the strips programme, as each TIPS issue having its own base CPI index would have a different inflation accrual index. To make issues fungible to each other, Treasury had to create a two-step process: first, removing the inflation indexation to allow for stripping and then readjusting the zero coupons for their inflation accrual. The embedded deflation floor in the TIPS security stays with the principal component making the coupon component a true real rate security, the development of the inflation derivative market allows buyers of coupon iSTRIPS to purchase inflation floors cheaply. Hence, a buyer of coupon iSTRIPS can effectively create “P” if necessary.

The interest component (coupon) from a particular TIPS issue is transferred at an adjusted value initially, which is established using the CPI reference value for its original issue (dated) date. The adjusted value represents the reset of the inflation accrual to 100 with an inflation adjustment made to an investor at maturity. In this way, coupons with the same maturity from different TIPS are now fungible and the coupon strip would be inflation adjusted at the same rate. All such components with the same maturity date have the same CUSIP number, regardless of the underlying security from which the interest payments were stripped.

The US Treasury, in the Federal Register, sets the stripped interest component and its adjusted payment valuation. The Treasury established that the adjusted valuation (AV) calculation would be as follows:

Figure 19: Example of coupon inflation strip (SII) adjusted valuation

TIPS 3.875% 1/15/09
C = quoted coupon
P = $1,000,000 par amount
CPI = 164.00 base CPI on issue (dated) date
AV = adjusted value
AV = ((C/2) *P) *(100/CPI))
or ((0.03875/2) * 1000000) * (100/164) = $11,814.02

Source: Barclays Capital.

In this example, with a $1,000,000 notional stripped, 11.8 of $1,000 bonds are created. Bundled with other issues, there is sufficient liquidity created to generate round lots of bonds. Prior to maturity, a buyer/seller of a coupon would settle a trade as follows:

Par x (Reference CPI U/100).

Using the example, assume that the January 2009 note is purchased with a settlement date of 20 December 2004 and a reference CPI U of 190.5129. The coupon would settle at:

Par x (Reference CPI U/100) x market price or

$1,000,000 x (190.5129/100) x (0.96984375) = $1,847,677.45

At maturity, the amount payable on a coupon strip is made via the following formula:

Figure 20: Amount payable on coupon inflation strip

AP = amount payable at maturity
RVCPI = reference value for CPI at maturity date
AP = AV *(RVCPI/100)

Source: Barclays Capital.

Following on our example for the principal strip, assume that in January 2009, the CPI U (at maturity) is 210.8 and thus, final payment would be

$1,000, 000 * (210.8/100) = $2,108,000.00

Thus, for either principal or coupon zero coupon instrument the rate of growth between purchase and maturity is identical (14%).

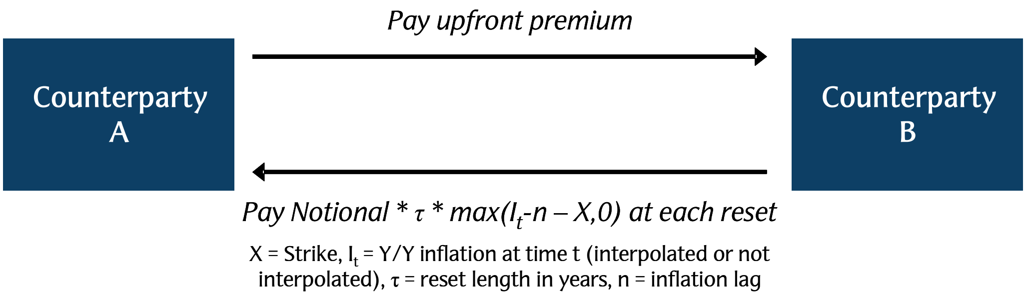
Inflation caps and floors

Robert Tzucker, Alan James

Features

Caps and floors in the inflation market operate in the same way as their counterparts in the interest rate market. A cap is a string of consecutive and uniform caplets, and a floor is a string of consecutive and uniform floorlets. In the inflation market, a caplet can be regarded as a call option on a future Y/Y inflation rate, with a pay-off in arrears, and the floorlet can be regarded as a put option. Caplets and floorlets are usually either annual or monthly on a Y/Y inflation rate. For example, a 5 yr cap with annual caplets has five caplets (in interest rates, it would have just four, as the first year's annual rate is known at the start), and a 5 yr cap with monthly caplets has 60 consecutive one-month caplets. If in-the-money, the pay-off of an individual annual caplet or floorlet will be the percentage difference between the realised inflation rate and the strike multiplied by the notional. Alternatively, if monthly, the pay-off will be, in simple terms, one-twelfth of the annual amount. Figure 21 shows the typical flows of an inflation caplet.

Figure 21: Typical inflation caplet structure



Source: Barclays Capital.

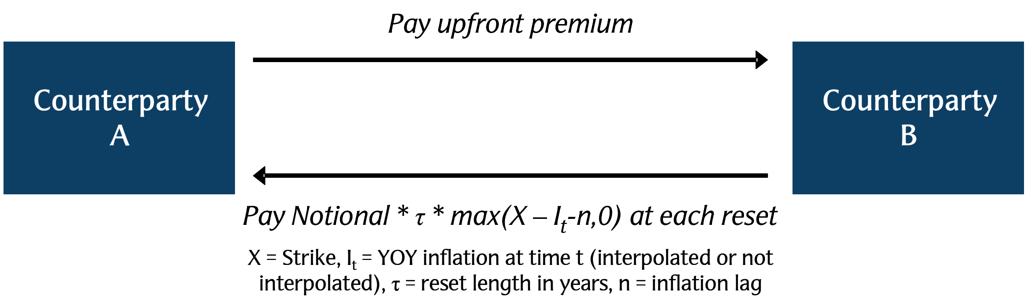
The purpose of a cap is to protect the buyer from inflation erosion above a certain rate on a given notional exposure. A floor can be used to give downside protection to investments in inflation-linked products. Caps and floors are used in structured products and are also often a feature of Canadian model inflation-linked government bonds.

When quoting inflation caps and floors, the inflation lag must also be specified. Typically, structured notes use a three-month lag when determining the payout of the note and, therefore, so do the caps and floors. Inflation may be interpolated at the three-month lag (like the TIPS and European linkers) or taken from release date to release date. The difference between the two is purely a preference of the parties involved in the transaction, though most commonly the same lag convention is quoted as in the underlying inflation swap market.

Inflation caps and floors trade very much like their interest rate counterparts, but face some issues not present when dealing with interest rates. As is the case for interest rate caps and floors, it is the premium on the trade rather than the volatility number that is quoted. This quoting convention allows the counterparty to easily adjust the implied volatility in their model to match the premium, and it may be the most efficient way of quoting the market, especially given the different views about forward inflation rates. In the US, traders most commonly quote caps/floors for monthly resets of Y/Y CPI form, as this is the format for most structured note coupons, but they frequently quote in yearly resets of Y/Y CPI as well. In Europe, most structured notes pay annual coupons and hence yearly resets are the norm. Quoting in Y/Y form removes a lot of the problems created by seasonality in inflation. Month-on-month CPI series display seasonal patterns usually driven by energy consumption patterns or seasonal retail discounting periods. Seasonality is lost when inflation is measured in Y/Y format. Longer yearly resets are not unknown, in particular 5 yr. A 5 yr floor is relatively trivial to hedge using new 5 yr bonds in the US and Europe, while in the UK there is some supply from 5 yr resets on property rental agreements. UK LPI swaps accrete in size, but otherwise the caps and floors on them behave just like other yearly fixing structures.

With respect to volatility, as we discuss in the inflation swaptions section of this document, inflation volatility follows a more normal pattern (inflation can be negative), so using a Black model will not price them correctly. The options should, therefore, be priced using a model based on a normal distribution. One other important factor in pricing is the effect of skew. Since caps and floors are typically quoted out-of-the-money, it makes sense that the supply/demand imbalance could have major implications for skew. Despite having similar out-of-the-moneyness a cap and floor may be priced with very different volatilities. This can be seen most clearly in the UK market where for long periods 0-5% LPI swaps traded flat to RPI – ie, the 0% floor and 5% cap where equally valued, even though the underlying breakeven of around 3% was significantly above the 2.5% mid-point of the range.

Figure 22: Typical inflation floorlet structure



Source: Barclays Capital.

Uses

Other than the UK, the market for inflation caps and floors is driven by retail structured product, though there is increasing direct interest from investors. A high percentage of retail notes continue to have floors in cash flows, mainly at 0%. That is, the strike on the floor is set equal and opposite to the fixed coupon. For example, a note paying Y/Y inflation of +140 bp would have a floor at -140 bp. Typically, an issuer hedges the inflation-related cash flows using inflation swaps carrying the same floor, creating demand for floors from dealers. In late-2004, issuer hedging left the street short of floors, which in the US created a supply/demand imbalance that caused floors to trade relatively rich. In Europe, the continued increase in dealers in the market meant that the imbalance was less noticeable, even though the structured market and hence demand for floors was larger.

Issuers and investors can hedge their inflation exposures through the use of caps and floors. An issuer of an inflation-linked note can buy inflation caps to eliminate their susceptibility to spikes in inflation. This is especially useful if the issuer has cash-generating operations that are linked in some way to inflation, but cannot predict in what manner their cash flows would be affected by a spike. On the other hand, investors who do not own inflation bonds as they see them as too expensive but need protection versus spikes in inflation, should be interested in buying inflation caps. As the market develops, we would expect industrial corporates in particular to have interest in cap-based products. Despite the opportunities for the caps market to grow in the US, we expect the market for floors to develop liquidity much more quickly. As long as structured issuance continues, there will be a growing need for floors. Issuers are not likely to issue non-floored Y/Y-style coupons because the possibility of the investor having to pay the issuer if there is deflation could make the instruments difficult to sell.

Investors looking for yield-enhancement or relative-value opportunities may help to ease the imbalance in supply and demand in inflation caps and floors. Holders of structured notes with embedded caps can sell inflation caps to enhance the yield. In return for the extra yield, they give up gains related to inflation spikes. Issuers of structured notes may also imbed inflation caps in their products. An issuer can hedge inflation by buying caps (the investor sells caps embedded in the structure), while financing that purchase by selling floors (embedded in the coupon structure). The imbalance in supply and demand also creates opportunity for relative value traders. If the street short in floors persists and floors become very rich, put/call parity may drive cap prices higher at certain strikes. What this suggests is that implied volatility may grow to artificially high levels, drawing relative value investors into the market to sell caps and floors.

Another opportunity to use floors resides in the iSTRIPS market, a market which currently only exists in US TIPS. Floors can be combined with coupon iSTRIPS to create synthetic principal iSTRIPS. The difference in pricing between principals and coupons should reflect the value of the floor, so if floors price away from that value, arbitrage opportunities could surface.

Market dynamics and development

The only structural supply of floors comes from issuance of accreting bonds by governments or quasi-governmental agencies. Bond floors from these issues only apply to the principal, and so do not generate an abundance of supply. As of late-2004, the relative newness of euro bonds and hence their limited inflation accrual means that issuance had been a more significant factor in Europe than in the US. The principal floors built into bonds (coupons carry no floor) that have been accreting positive inflation for many years have negligible value, so provide little relief when the street is short. As issuance in the inflation-linked market grows, we would expect the supply/demand imbalance to be less of a factor in market dynamics. In the US, the addition of the 5 yr issue combined with two new 10 yr issues and a new 20 yr issue every year provides a much-needed boost to supply. However, at the same time, the attention that the new issues garner may increase demand for floored retail notes, has limited the impact.

The market for inflation caps and floors in the US and Europe is still rather small, but is growing. In the US, there was approximately $6.6bn of outstanding corporate inflation-linked notes as of December 2004. The inflation swaps market has been in existence for several years longer in the euro area than in the US, with more than four times the value of structured notes outstanding and, as a result, the caps and floors market is more mature with more transparent pricing and better liquidity. As corporate inflation-linked issuance becomes more popular in the US, we believe that the inflation swaps market will grow, driving growth in the inflation caps and floors market.

A change in the structure of the CPI futures contract may further assist the development of the inflation caps and floors market in the US. If the frequency of the contracts were to be changed to monthly and priced on the basis of Y/Y inflation as has been suggested, hedging of caps, floors and short-term inflation obligations would become much more feasible. The introduction of a Y/Y inflation future for euro inflation would help the euro caps and floors markets in the same way.

The UK caps and floors market is much older than the euro or US markets as it is based on the pension liabilities format, which follows so-called Limited Price Indexation (LPI). From 1997 to 2004, defined benefit indexation was based on an annual RPI inflation, but with a floor of 0% and a cap of 5%. Prior to this, there were often caps and floors in individual schemes but with levels that varied, such as 0-3% and 3-5%. For new pension obligations from April 2005, the LPI range is 0-2.5%, which with actual breakevens well above this should mean that pension fund inflation liabilities in the UK stop growing. The UK Debt Management Office considered requests to issue LPI bonds, but announced in their December 2004 consultation document on ultra-long issuance that they would not do so due to concerns that liquidity in the UK linker market could become impaired due to the bifurcation. With less than £1bn in LPI corporate bonds, the market is largely confined to LPI swaps.

Given the immense scale of LPI liabilities (over £200bn), it is somewhat surprising how limited the activity in LPI swaps has been, even though LPI payers are always likely to be in short supply. Activity in RPI swaps surged in Q4 04, but there was not a corresponding pick-up in LPI turnover. This may be due to a general acceptance that a more cost-effective approach is to balance between nominal and real exposure rather than use a direct liability hedge. Such an argument could become self-reinforcing if the perception of LPI liquidity relative to RPI liquidity falls due to the increased RPI turnover. This would be a misperception though, because the increased focus in other markets on inflation caps and floors has helped add to the depth of the UK market too. The strongest demand has been at the 25 yr maturity, but there is consistent interest at all long dates.

Non-linear inflation-linked derivatives

Robert Tzucker

Following the launch of inflation futures and the continued strong growth in inflation swaps, new areas of development in non-linear products beyond the relatively well-established caps and floors markets are emerging. Much of the innovation is centred in the US market, which is rapidly developing the widest range of traded inflation products. Options on linkers, known as TIPStions in the US TIPS market, and options on breakevens have begun to trade. Other non-linear inflation products such as inflation swaptions, callable inflation swaps, and even options on inflation indices have been developed as well, complementing the options on cash products. Each of these products encompasses unique features while at the same time being held together through their common relationship with real and nominal rates. Non-linear inflation derivatives present unique challenges in pricing, hedging and relative value, while offering investors new and exciting opportunities to enhance real returns.

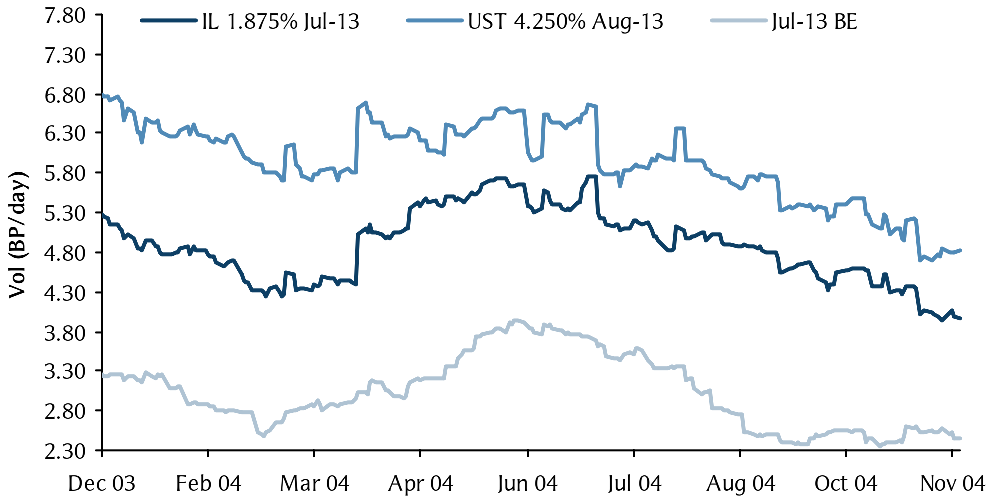
TIPStions

One of the first developments in non-linear inflation products was options on TIPS. TIPStions are a useful addition to the armoury of TIPS portfolio managers and other real money investors as they offer an easy way of managing portfolio risk without having to make outright purchases or sales of TIPS holdings. Several portfolio strategies can be used to attain greater portfolio returns or protect against losses using TIPStions. Among the uses are enhancing portfolio returns by writing covered calls. If an investor is long TIPS and has the view that TIPS yields may rise modestly in the near term, instead of selling their TIPS position, they can write call options to help offset the expected losses. The opposite approach can be taken when an investor or fund needs to invest in TIPS structurally but feels they are rich and does not want to buy them at current levels. By selling puts at a strike that represents an acceptable price to the investor, if the price falls below the strike, they are obligated to buy the TIPS and the income from selling the options effectively reduces the purchase price. Likewise, buying puts on a portfolio can help protect value in the case that real yields climb. Otherwise, an investor can use TIPStions to make a bet on forward real yields by buying calls or bet on real yield volatility through the purchase or sale of TIPStions straddles.

A call TIPStion gives the buyer the right to purchase TIPS at a preset price on the expiration date of the option. The market convention for quoting the options is typically in terms of at-the-money-spot rather than at-the-money-forward. Quoting in this manner reduces the complications involved with calculating forward prices in TIPS. TIPStions pay off just like standard options, with the expected payoff for a call being the maximum of the price at expiry minus the strike and zero, whereas a put TIPStion pays the maximum of the strike minus the price at expiry and zero.

Although TIPStions appear to be simple conceptually, there are some subtleties that make pricing difficult. First, calculating the forward price for TIPS with option expiries beyond the known inflation index values depends upon a forecast of inflation to two months prior to the expiry date. In order to price the option in a standard option pricing model, the forward price is used as an input. Pricing of TIPS forwards becomes somewhat of an art form when the forward date depends upon on unknown inflation rates and on term repo rates that do not exist beyond the known inflation timescale. CPI futures or swaps can be used to imply an inflation rate, but neither is traded on monthly contracts and would require some seasonally adjusted interpolation.

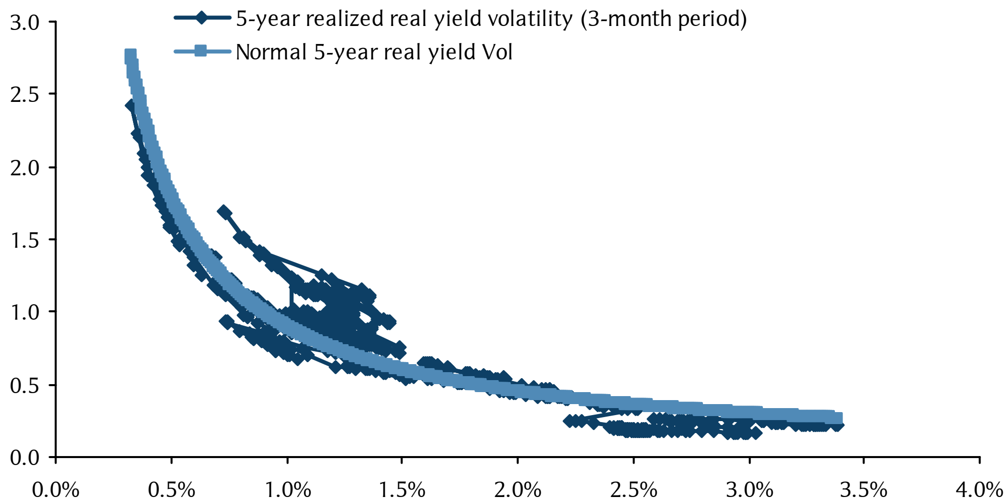
Figure 23: Historical realized volatility (bp/day) of July13 TIPS and Aug13 nominal treasuries



Source: Barclays Capital.

The lack of a liquidity and transparency, and the lack of historical data on TIPStions implied volatility presents an initial stumbling block to pricing. Alternative methods for devising reasonable volatility estimates must be used. One such approach would be to use historical volatilities on TIPS to estimate the implied volatility. Figure 23 shows the historical volatility for the July13 TIPS, the Aug13 nominal Treasury, and the breakeven rate. The problem with using historical volatilities is that they are often shown to have been unstable through time and may not provide a useful guide to volatility looking forward, making valuation very tricky.

Figure 24: Realized 5-year real yield Black-Scholes volatility behaves normally (x-axis shows level of rates, y-axis % rate vol)

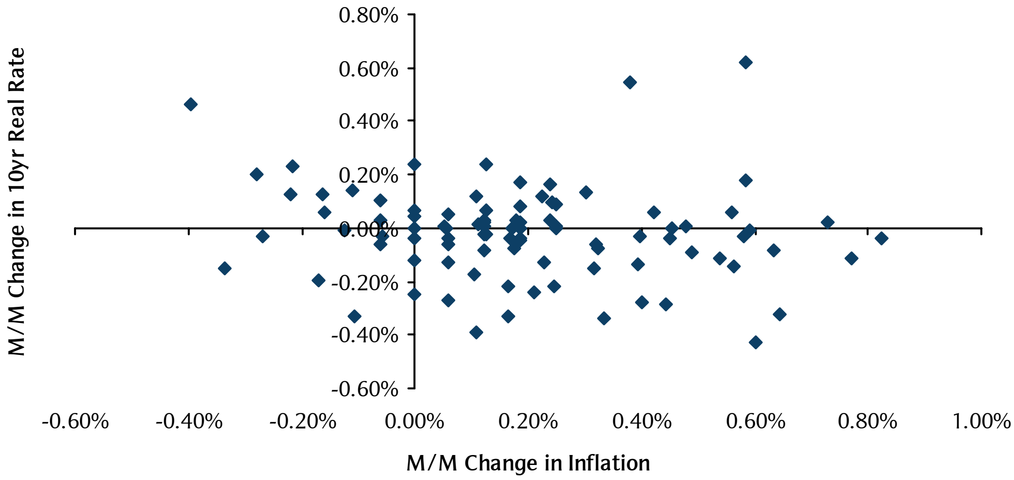


Source: Barclays Capital.

In choosing a pricing model it must be determined whether volatility exhibits normal or lognormal behaviour. What we find when looking at real rate volatility is that it behaves normally, meaning the basis point volatility does not change dependent on the level of rates, so as rates fall the volatility as a percentage of the level rises. Figure 24 shows the three-month realized volatility (annualized as a percentage of real yield) of the 5-year rolling benchmark series in real yields graphed against the level of rates. The graph also shows the long-run average realized volatility as a percentage of rates at each and every level of rates (annualized as a percentage of real yield since mid 2001) to illustrate how a perfectly normal volatility compares to the actual volatility. Obviously, the three-month realized volatility diverts from its long run average at times but still appears very stable. This result is somewhat intuitive because real rates are not prevented from dipping below zero like nominal rates, so have no lower bounds. Therefore, choosing a normal model to price TIPStions may be the most suitable choice.

Hedging TIPStions can be equally as difficult as pricing them. Because forward prices are determined by both the level of interest rates and the future inflation index, the forward price can change independently of the spot price if there is a change in inflation. This means that the value of the option can change independently of the value of the underlying, making hedging more challenging. Historically, interest rates and inflation rates show little or no correlation over short-term moves (see Figure 25), leaving the option holder susceptible to inflation risk. There are several mechanisms available for hedging this risk, but none is perfect. For example, an investor could use a position in inflation futures to hedge the inflation risk, but the risk remains that if the expiry date of the option falls between futures dates that the hedge may not offset intermediate inflation prints perfectly.

Figure 25: Inflation and real rate changes are not well correlated over short periods



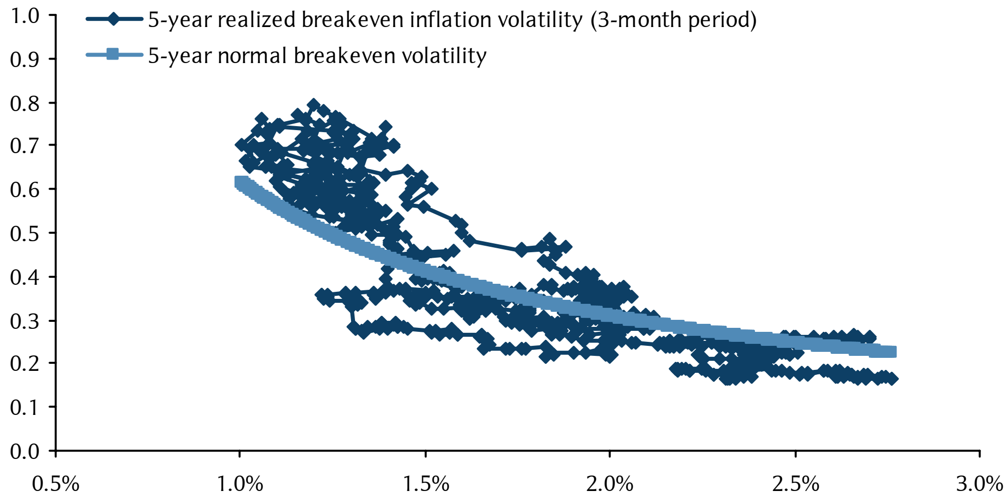
Source: Barclays Capital.

Breakeven options

Another product which is the obvious next step in trading TIPStions is breakeven options. A breakeven call option gives the buyer the right to buy TIPS and sell a DV01 weighted nominal at a pre-specified breakeven rate. Although this product is a little bit more complicated to price than TIPStions due to the addition of a nominal component, the idea may be somewhat more appealing to investors. Many of the same strategies that can be applied to TIPStions can also be applied to breakeven options, in addition to several other uses. Breakeven options give an investor the opportunity to protect a portfolio from swings in inflation. For example, placing breakeven calls in a portfolio will allow the manager to protect against adverse moves in inflation at a much lower cost of capital than buying outright breakevens, while still maintaining the positive attributes of nominal bonds when inflation falls. Additionally, breakeven options can be used as a tool to express a view on inflation without having to directly purchase the bonds.

Much like real yields, breakeven inflation volatility follows a normal pattern of behavior. Figure 26 shows a graph of realized three-month Black-Scholes volatility of the 5-year breakeven inflation benchmark series. The graph shows that the volatility of breakeven inflation varies as a percentage of the level of breakevens, exhibiting normality. Like real yields, inflation can also be negative, which is an assumption of normality. Therefore, pricing breakeven inflation options may be best suited for a normal option pricing model.

Figure 26: Realized 5-year breakeven inflation volatility exhibits normal behavior



Source: Barclays Capital.

One interesting point to note is the level of inflation volatility compared to real and nominal volatility. Looking back at Figure 23 shows that it is much lower. Although this is based on a relatively limited history of breakevens, it is intuitive from the relationship of nominal yields with real yields and inflation described by the Fisher equation. The Fisher equation states that nominal yields are the combination of real yields, inflation, and some inflation risk premium. This implies that the volatility of nominal yields is also a function of the volatility of real yields and inflation. The function is:

σ^2nominal = σ^2real + σ^2inflation + 2*Covariance (real, inflation)

As long as the covariance of real yields and inflation is not sharply negative, nominal rates will have a higher volatility than inflation. What we cannot say is whether real rates will continue to have a higher volatility than inflation.

Inflation swaptions

As the market for inflation-indexed derivatives grows, investor uses for more varied instruments grow, and the obvious next step in this evolution is the inflation swaption. An inflation payer swaption gives the owner the right to pay fixed in an inflation swap at a preset level at a specified forward date, whereas an inflation receiver swaption gives the owner the right to receive fixed in an inflation swap at a preset level at a specified forward date. This product gives more opportunity for the different types of investors to hedge inflation exposure in a more efficient manner.

Inflation swaptions can be used in a variety of manners and will likely develop more uses as the market grows. One use for these instruments is as a hedge for insurance companies that issue guaranteed investment contracts (GICs). Many insurance companies have begun to offer inflation-linked GICs. In the process of selling the contracts, the insurance companies quote the rate the investors can lock in during a specified period until the offer is over (typically two weeks). During this two-week period, the insurance company is exposed to a large move in inflation. Inflation swaps can be used to hedge the downside exposure, but swaps hedge the upside exposure as well. A better solution may be to use a short inflation swaption, allowing the insurance company to limit downside risk and keep the upside potential. Many different entities having payments that are influenced by inflation could take advantage of inflation swaptions to hedge their exposure. These institutions include, but are not limited to, pension funds, insurance companies, general contractors and any business that engages in long-term projects that use a variety of commoditized resources.

In addition to the previously mentioned uses, speculation on inflation by hedge funds or alpha plays for real money investors could help grow the market. For example, a hedge fund may take the view that one year forward inflation as measured by inflation swaps is rich. Rather than use inflation swaps to take a position and risk losing if swaps become richer, an inflation swaption receiver may offer a better risk return profile. If inflation swap rates climb, the option expires worthless, but if inflation falls as suspected, the option expires in the money. Inflation swaptions can also be used to create callable swaptions. Paying inflation in a swap (receiving fixed) and selling a receiver inflation swaption allows an investor with the view that inflation will remain steady to gain return enhancement from the option premium. Callable inflation swaps can also be used to match liability streams that are linked to inflation.

Because of the limited history of inflation swaps, we estimate the behaviour of inflation by using breakeven inflation from cash securities as a proxy. We can use the approximation because inflation swap rates are merely the breakeven rate between a nominal swap and a real swap, and so will be highly correlated with a cash breakeven rate. This suggests that inflation swap rates behave normally and can also be priced using a normal option pricing model. The normality of breakeven inflation can be seen in Figure 26.

Options on NSA CPI can hedge short-term inflation risk

Another interesting development in the non-linear inflation market is options on NSA CPI. This option simply pays off based on the level of the NSA CPI and can be used to hedge short-term inflation risk linked to the release of a particular CPI date. Among other things, a CPI option could be used to hedge a CPI futures contract, a short TIPS position, a structured note payment, etc.

Accounting for inflation derivatives

Mike Oman

Inflation derivatives and IAS39

Most local GAAP accounting standards that have been applied in recent years in the UK and Europe have accommodated corporate debt issuers' use of inflation swaps by allowing an inflation-swapped debt issue to be treated for accounting purposes as a "synthetic instrument". The package of a nominal bond and an inflation swap were treated like a regular linker and accounted for on an accruals basis. A linker issue swapped into floating was treated in a similar way, with the swap mark-to-market off balance sheet. However, from financial years beginning in 2005, UK and European corporates will be required to adopt International Financial Reporting Standards (IFRS) for their consolidated financial statements. The IFRS standard that covers derivatives, IAS39, has significantly different implications. The US FASB equivalent to IAS39, FAS133, introduced several years ago has for all intents and purposes similar implications for the usage of inflation derivatives by US institutions.

So far, the most significant usage by corporates of inflation-linked derivatives has been in the UK. Although the accounting profession in the UK is still finding its way on the issue, it is clear that IAS39 treatment of inflation derivatives will be quite different and will pose some challenges to the use of inflation swaps on the liability and the asset side of the balance sheet.

Under IAS39, all derivatives (including inflation derivatives) will be valued at market value rather than any other measure such as amortised cost. Unless the user can convincingly demonstrate that the swap qualifies for "hedge accounting", fluctuations in the mark-to-market of the swap will impact the profit and loss account, potentially adding volatility to a firm's earnings figures. Availability of hedge accounting is restricted to derivatives that can be shown to be an "effective hedge" against a "highly probable" inflation-driven cash flow, or as a fair value hedge against an asset or liability. Furthermore, it will be necessary to show that an inflation swap is an effective hedge: the user has to demonstrate that the impact of the cash flow directly attributable to inflation variation is offset by the swap to within an 80-125% range. The administrative burden of the effectiveness test, both initial and ongoing, could be significant.

There is even a question mark over the accounting treatment of inflation swap usage for the regulated utilities with contractual exposure to inflation. Regulatory periods within which the inflation linkage is set in stone are typically just five years long. A swap with a maturity significantly in excess of five years may not qualify as a hedging instrument in accounting terms because the inflation-linked revenue stream out to the maturity of the swap may not be "highly probable" enough. So far, most paying by regulated utilities in the UK has been at the long-end, as this is where demand to receive inflation – and therefore the pricing advantage for payers – is most intense.

An important point to note with regards to effectiveness testing when hedging non-financial cash flows is that the user cannot separate out the inflation-linked element of the cash flow as the designated exposure set against the derivative. The hedge must stand up as an effective hedge against the whole cash flow. For example, a water utility may wish to use an inflation swap to hedge a regulated contractual exposure to inflation; however, the price of water sold would also be influenced by factors other than just the contractual inflation linkage such as demand conditions and costs. There is, therefore, a potential mismatch between the hedge and the cash flow, which in some cases may be significant enough, with the result that the hedge is insufficient for hedge accounting purposes.

The UK RPI market has seen the most regular inflation paying on the part of corporates, ranging from utility companies with inflation-linked revenue contracts to supermarkets that have judged their revenue streams to be sufficiently influenced by inflation for some degree of inflation exposure to be worthwhile in an economic sense. Hedge effectiveness of inflation derivatives for more tenuous linkages such as this may be difficult to prove.

In the past two years in the UK, there has been a clear trend away from corporate issuance towards paying inflation. This trend, however, may be reversed due to IAS39 accounting potentially being less stringent for an RPI bond than swaps. While there are uncertainties and challenges from an accounting perspective that is not to say that use of inflation derivatives will dry up as a result. To put things into perspective, if used for bona fide risk reduction purposes, the use of inflation derivatives should not be of concern to shareholders. Given that the analyst community should be able to distinguish between volatility imposed by a hedge and other less desirable sources of volatility (particularly if careful disclosures are made), we think that in this context their use is more likely to be viewed as positive, and credit ratings agencies have made noises to that effect.

Asset swaps and IAS39

When considering asset swaps as an investment, there are two accounting options for the underlying bond: fair value through the profit and loss account (FVTPL) or available for sale (AFS). The third typical classification for a financial asset is "Held to maturity". However, because an asset swap inherently involves an interest rate hedge, hedge accounting would not be permitted for this classification. The swap element of the asset swap must be carried at mark-to-market (though profit and loss).

FVTPL values both bond and swap at market value and the fluctuation in both impact the P&L. This would still expose the holder to differences in the change in value of the bond (effectively valued off the bond curve plus current market credit spread if there is one) and the swap (valued off swap curve). For a trading account, however, this is in any case the risk that the P&L should be reflecting making this option potentially attractive.

Under AFS, the bond is still valued at mark-to-market; however, changes in mark-to-market are taken to equity until the bond is sold or matures. To avoid P&L volatility, the swap will need to qualify as a fair value hedge of the bond. In this case, the change in value of the bond attributable to the hedged risk may be taken to the P&L statement (instead of directly to equity) to offset the change in the value of the derivative (leaving any hedge ineffectiveness on the swap to impact the P&L and any residual mark-to-market volatility on the bond to impact equity).

Inflation-linked bonds

Inflation-linked bonds themselves, even in a standalone context, may be treated as having an embedded derivative since they pay cash flows linked to inflation. Some accounting firms may require the embedded derivatives to be separated from the bond and accounted for through P&L. Under IAS 39, if it can be demonstrated that the embedded derivative has characteristics and risks that are "closely related" to the host contract, then separation is usually not required.

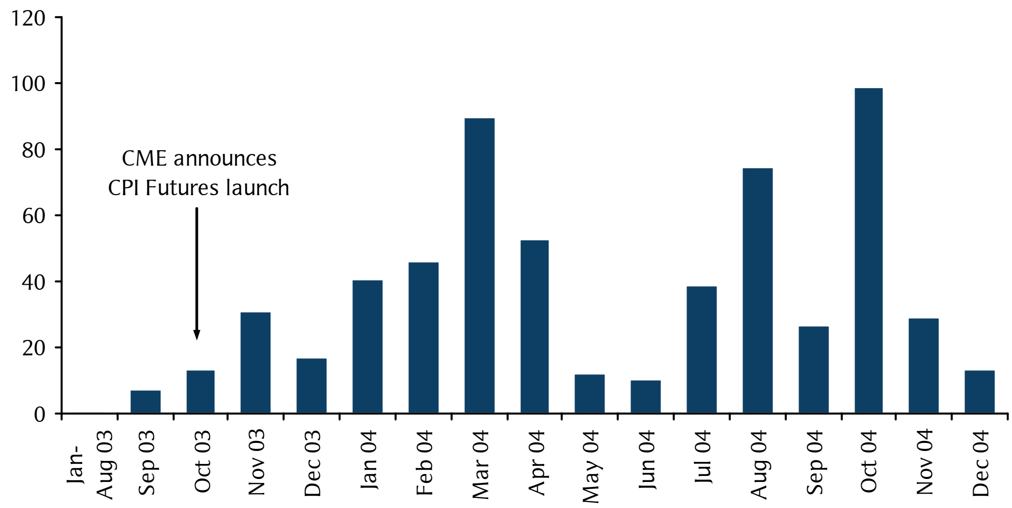
The markets

US

Mike Pond

The US inflation derivative market was virtually non-existent before September 2003 and only since the latter half of 2004 has activity picked up beyond CPI swaps. In all of 2003, there was roughly $1.5bn notional of CPI swaps traded. Since then, there has been a marked pick-up in inflation-linked swap volumes and product development. Figure 27 demonstrates that while the market still lacks consistency – volume was particularly low in July and September 2004 relative to higher levels in August and October, for example – activity is increasing. Trading volume in 2004 was estimated at over $12bn. Along with the pick-up in trading activity has come an increase in liquidity, as shown both by a compression of bid/offer spreads and a significant increase in the size that dealers are willing to quote for.

Figure 27: Inter-dealer broker average daily CPI swap volume (mn)



Source: Barclays Capital.

US zero coupon CPI swaps have adopted an interpolated base index format, in the same way as the French CPIx market. This more closely aligns the swaps market methodology with the bond market, which also features an interpolated daily reference index. This serves to smooth out the discontinuities in swap breakevens at month-end that occurred while the market found its feet using the HICPx style format. The index used is the CPI-U non-seasonally adjusted index with a three-month lag, the same as that for TIPS. The Bloomberg ticker for the index is CPURNSA <Index>. Barclays Capital has launched a live indicative CPI-U zero coupon swaps Bloomberg page, BCAP4.

While zero-coupon-style swaps are the most active structure traded on the inter-broker market, Y/Y structures are most commonly demanded by the US retail sector. The primary driver of US swap activity thus far has been hedging related to inflation-linked MTN deals. Typically, these corporate deals pay Y/Y inflation on a monthly basis plus a fixed spread (with a floor usually set at zero on the sum of inflation plus the fixed coupon). Paying the inflation uplift out rather than accreting the principal as with TIPS is done primarily to avoid the phantom income tax problem associated with TIPS.

The relatively low use of asset swaps thus far in the US means that CPI swaps breakevens and bond breakevens are more loosely connected than say in the euro area. As liquidity and activity develops in both CPI swaps and TIPS asset swaps, the relationship of the two breakevens should become closer. This may encourage more issuers to bring inflation-linked notes to market. In fact, increased volume has already led to an increase in both corporate and municipal inflation-linked bonds in 2004. In the US, there was approximately $6.6bn of outstanding corporate inflation-linked notes as at December 2004.

CPI futures were introduced in the US in February 2004. Despite the uninspiring activity levels, the CPI futures strip has been valuable in examining market inflation expectations. As increasing volumes of existing CPI swap agreements approach maturity and pose more pressing reset risks for dealers, and as more TIPS securities age sufficiently (so that all their remaining cash flows fall within the maturity range of the strip), we believe the US CPI futures contracts will become more useful for both risk management and relative value trading.

Product development has begun to expand beyond generic CPI swaps and futures. Options on CPI Swaps, TIPS and breakevens, along with other non-linear inflation products, such as caps and floors, have started to trade and are taking inflation trading to a higher level of sophistication. The total rate of return swaps provide an alternative way to gain long or short exposure to cash instruments. iSTRIPS is another existing, but little used, market that provides opportunities for investors.

We believe the outlook is positive for continued development in inflation derivatives in the US. Although the US inflation derivative market is comparatively young, the range of instruments available, along with the size and growth of the US cash market, means it could grow much faster, and even overtake other markets. Trading momentum should gather as more investors climb the learning curve on how to utilise inflation derivatives for both hedging and relative value. Increased TIPS issuance, inflation-linked spread product issuance and an increase in relative value trading should improve dealers' ability to hedge and thus improve market liquidity.

Euro area

Mike Oman

Although younger than the UK market and backed by a smaller inflation-linked bond market than the US, the Euro inflation swap market is now far more active, liquid and transparent than either. Broker volumes began to pick up substantially from late-2002 driven by a rise in the need to hedge retail product and structured MTNs. In 2003, it accelerated further, aided by the issuance of BTP€i08, the most suitable hedge for the exposures. Typical monthly broker volumes have moved from €500mn in mid-2002 to €5bn in mid-2004. Euro area HICP ex-tobacco (HICPx) and French CPI ex-tobacco (French CPIx) are the most commonly traded and account for at least 90% of activity, although as detailed in the “Other euro inflation derivatives markets” section, other euro inflation bases do trade. Hedging of Italian and French Government linker asset swaps accounts for a significant proportion of volumes in the euro area inflation swap markets. The relatively high level of activity in asset swaps has aligned swap and bond breakevens more closely than has been seen in other markets.

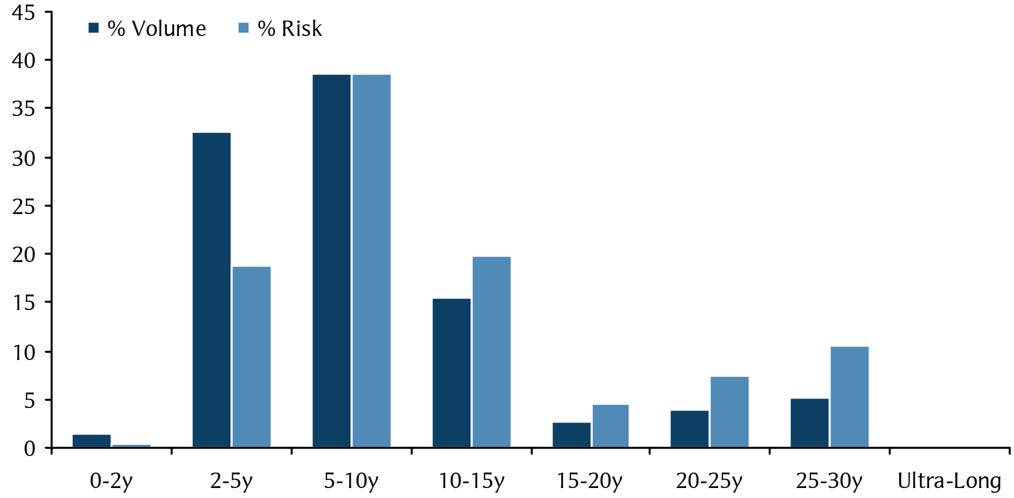
As yet, there is not a euro inflation futures market, although exchanges have expressed interest in launching a euro HICP futures contract of some description. Given the scale of inflation swap activity and the reset risks that this creates for dealers, it seems very probable that some form of instrument will emerge to allow better management of short-term euro inflation risk, and a future is a natural choice given the precedent has already been set in the US. Whether it is most likely to be based on the Eurodollar style US CPI futures contract specification or on a Y/Y inflation rate is not clear as yet. As in the US, a market in non-linear inflation products is tentatively emerging and we think that, in time, we will see a full suite of euro inflation-linked derivatives.

Euro HICPx

The benchmark format for Euro HICPx is the zero-coupon structure, as shown in the “Inflation swap structures” section of this report. Standard settlement is T+2 and the standard lag is three months meaning that the base inflation index for the swap is the index value of the month, three months before the month of settlement. Towards the end of the month, swaps on the next base month also begin to trade. There will be a discontinuity in the quoted “breakeven” at the time of the roll from one month to the next in reflection of the typical seasonality between months. Barclays Capital live executable prices for the currently trading base are shown on the Bloomberg page BISW1. The index is published by EuroStat to the OATEI01 Reuters page, or CPTFEMU <Index> on Bloomberg.

As the chart below shows, more than a third of inflation swap volume and risk in the euro-denominated market as a whole is in the 5 yr to 10 yr sector. The Euro HICPx swap market has been bolstered by the entry of Italy into the bond market in 2003. Italian bond supply not only provided the first government supply of Euro area inflation with which to hedge 5 yr liabilities, but also further encouraged the growth of the Italian inflation-linked retail product market. Initially, the demand for inflation swaps was mostly driven by structured MTN products which really took off in popularity taking market share away from out of favour equity-linked notes. More than €10bn of inflation-linked MTNs were sold in both 2003 and 2004. However, increasingly it is domestic bank retail notes and over-the-counter products in southern Europe that are generating the hedging demand.

Figure 28: Euro inflation swap flows skewed towards the 5-10 yr sector



Source: Barclays Capital.

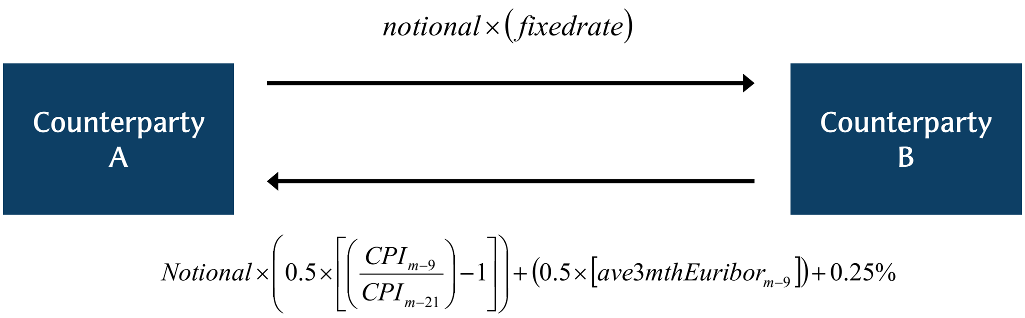
French CPIx

Zero-coupon is also the benchmark structure for French CPI swaps, although there are certain differences in conventions. French CPIx swaps trade off a base index that is interpolated daily using the monthly index values between two and three months prior to the month of the settlement date of the swap (also a T+2 standard settlement), in the same fashion as for OATis. This avoids the discontinuity of the HICPx method and aligns swap methodology more closely with bond methodology. Be that as it may, it could be said that it adds unwelcome complication and makes it more difficult to compare market movements within a given month, as it is likely to impose a drift to the level of breakevens. The daily interpolated index values are published by INSEE on the OATINFLATION01 Reuters page. The index is FRCPXTOB <Index> on Bloomberg.

The French CPIx market is the older of the two main euro area inflation markets first trading in 1998, ahead of the Euro market that began almost as soon as the euro currency was created in 1999. The French CPIx market can claim to pre-date the OATi market, albeit only just. Short-dated issuance by French agency CADES and the earlier development of the OATi bond market allowed the French CPI swaps to initially have better liquidity than HICPx. Some real money domestics started using swaps to match cash flows as the market developed, however it was not until trading of the basis against Euro HICPx began and that broker screens became readily visible, that the market gained any depth. The enlargement of the balance sheet of CADES and their willingness to pay inflation as well as issue leaves a less skewed market than the HICPx market.

The decision to link the *Livret A* French public sector savings rate to inflation from August 2004 heightened activity levels in French CPIx. The savings product offers a rate of half the three-month money rate, plus half of the Y/Y French CPIx plus 25 bp. With limits on how much a money manager can hold of each particular OATi inflation-linked bond, the fear was that potentially large exposures (thought to be of similar magnitude to the OAT€i market at the time) would need to be hedged via swaps. A by-product of the richening of swap breakevens to bond breakevens (although the latter richened considerably too) was to make linker asset swaps attractively cheap, kick-starting activity in that market. Below, is an example of a *Livret A* swap, a product tailored to *Livret A* hedging needs.

Figure 29: Livret A swap flow diagram



Source: Barclays Capital.

Other euro inflation markets

Alan James

Italy

By far the most active inflation swaps market that does not have an underlying government bond market to hedge against is the market for Italian FOI inflation (ex tobacco), Bloomberg code ITCPIUNR. This has been driven mainly by substantial retail note issuance in Italy on this basis, mainly in 5 yr and 10 yr notes. The FOIx market is quoted by brokers almost exclusively as zero coupon spread to euro HICPx, with the same conventions including lagged basis month. Almost all retail issuance pays year-on-year inflation and much of it is floored, usually at 0% inflation. As in euros, there are sufficient dealers pushing for hedging business that embedded floors are priced cheaply, but any floor quote outside of a deal is very rare.

The market for Italian linked retail notes started in 2002, at which time there were small issues in both FOIx and the alternative NIC basis (Bloomberg code ITCPNIC). The FOIx measure, which technically is the price index for workers as opposed to the universal NIC measure, has become the predominantly used measure because it is the basis of most Italian inflation-linked liabilities. While Italian retail notes are predominantly sold to individuals, there was some demand from corporates which have been required to save ~7% of total salary to pay as severance when an employee leaves. This so-called TFR payment is partly indexed to inflation, increasing at the rate of 1.5% plus 75% of FOI ex tobacco inflation every year. As real yields have fallen, the demand from the corporate sector has died down, as they have become unable to achieve this TFR indexation rate risk free. Recent reforms encourage a transfer of TFR positions into pension schemes, which is likely to produce significant demand for longer dated FOI inflation in the coming years.

There were several billion euros of Italian FOIx inflation-linked notes in both 2003 and 2004, with almost all of this hedged via inflation swaps. This left a natural imbalance of supply versus demand, leaving the spread to euro HICPx notably wider than expectations of the inflation differential. The only substantial outright issuance over this period was the €750mn 15 yr accreting bond issued by Italian agency Infrastrutture, a bond which initially met with a relatively muted response as its maturity was too long to be that useful as a direct hedging instrument but then steadily richened in asset swaps, particularly after the TFR pension reform was approved. Unless the Italian Government itself issues FOIx linked notes, it is likely to be agency and/or regional government issuers that will provide the main paying/unswapped issuance of FOIx in the coming years. Until significant supply or inflation paying is forthcoming, short end spreads to euro HICPx are likely to remain richer than justified by economic fundamentals.

Spain

The Spanish CPI market developed without bond issuance in 2004, and quotes are usually as spreads to euro HICPx. While demand is strongest at the traditional 5 yr and 10 yr retail maturities, there is receiving interest at maturities out to 30 yrs. Breakeven spreads to euro HICPx are notably higher than even the high historical spread suggests: the 5 yr spread has traded above 120 bp due to the clear imbalance of demand over inflation supply. While there are no large inflation payers, there are a growing number of small payers from the infrastructure and housing sectors given the richness of breakevens.

The Netherlands

Given the relative size of Dutch defined benefit pension schemes, demand for Netherlands CPI ought to be very large. In the absence of large natural inflation payers, most pension funds have accepted that they cannot hope to match their liabilities though. Some funds are willing to pay a significant premium to source specific inflation, inducing payers mainly from the infrastructure and property firms. This is a market of one-way flow, with all inflation receiving by pension funds locked to maturity. Absent the unlikely event of the Dutch state issuing domestic CPI linked notes, we believe not much is likely to change in the nature of the market, though IAS accounting may mean that inflation payers become more transparent. We estimate at least €2bn notional CPI had been transferred to the pension sector via OTC transactions by the end of 2004.

Small and nascent markets

Belgium has the potential to develop into a relatively significant inflation market. The relevant index, against which almost all inflation liabilities are based, is the health index measure, which excludes alcohol, tobacco and fuel oils; Bloomberg code BECPHLTH. This is the closest to a core inflation measure traded in Europe, and notably has a seasonality that has actually offset euro HICPx in recent years but with a very similar trend growth. These characteristics may make it particularly ripe for development. As with other smaller markets local government, infrastructure and property developments may bring the most likely payers of Belgian inflation.

Ireland has a longer history of inflation paying than anywhere else in the euro area, mainly by housing associations. Pension fund liability needs are more explicit than in most other euro countries, which coupled with the longer history of the market often results in relatively complex structures. The size of the market is such that it is unlikely to impact valuations elsewhere but it may encourage innovation in other markets, particularly if the trend for pension funds of multi-national companies to base themselves in Ireland accelerates.

As two countries that have experienced high inflation within recent memory, Portugal and Greece are countries with fairly high interest in domestic inflation. Contracts more commonly contain inflation linkages than northern European countries where price stability has been the norm. As of the end of 2004, Greece was the only euro country other than France to have outstanding government bonds linked to domestic inflation, albeit less than €40mn in nominal size and in the year-on-year coupon format. Portugal has seen a higher larger degree of potential payers than elsewhere as a result, producing a relatively balanced market. By contrast, in Finland, even though there is interest to receive domestic inflation from pension funds, the lack of Finnish CPI payers restricts the development of a market.

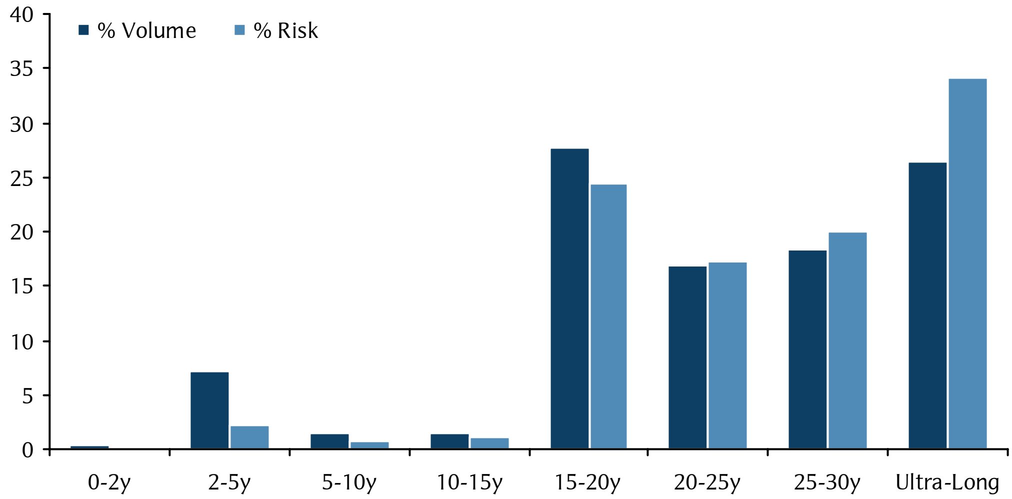
Austria was the first government within the euro area after France to issue inflation-linked bonds, albeit swapped. However, interest in domestic CPI products lagged most other euro countries as there are very few inflation-linked liabilities. The market has seen more activity than Germany, though, which has seen less interest than any country other than Luxembourg. Until 2003, it was illegal for German liabilities to be linked to inflation so despite the size of the domestic financial market, institutional demand for German CPI is distinctly limited, while potential retail demand is just as muted given perceptions of likely inflation trends. German Government issuance in euro HICPx may create some interest for domestic inflation but it would be a major surprise if significant demand were to emerge.

UK

Alan James

The UK is the longest established inflation derivatives market; Barclays Capital has traded RPI swaps since 1994. Despite this, until September 2004 the market in RPI swaps was significantly more opaque than in either euro inflation or US CPI swaps. However, there has since been a significant increase in transparency, which coincided with Barclays Capital displaying live RPI zero swap breakevens on the BISW3 Bloomberg page. This also coincided with an increased focus in the need for liability hedging ahead of the implementation of IAS accounting standards, producing a significant increase in turnovers. Previously, market participants perceived more advantage from concealing what were often lumpy long end flows. The market is underpinned by the demand for inflation-linked exposure from the pension sector. As the chart below shows, activity is consistently skewed towards long maturities – positions of 50 yr and beyond are not uncommon. 15-20 yr maturities no longer see the heaviest volume; in the past, much of this flow was on the part of life insurers who had large inflation-linked liabilities. Now, however, much of the existing exposures are hedged and there are few new real liabilities developing.

Figure 30: UK RPI swap flows skewed towards the long end



Source: Barclays Capital.

The trading month for UK RPI breakeven swaps has a lag of two months, eg, throughout December quotes will be for the October RPI. Unlike continental Europe and the US, there is no significant retail note flow driving the front end of the RPI derivatives market. This is due in large part to more attractive tax treatment for individuals holding index-linked gilts and RPI linked National Savings notes than government product elsewhere. The RPI swap market remains relatively smaller than the underlying index-linked gilt market but its relative importance has picked up significantly. While turnover remains a fraction of that in linkers, most of the flow remains one-way, so that the absolute size of long end swap receiving in 2004 was close to the £4.5bn in new long linker supply.

Back in 2000, when the MFR encouraged pension funds to favour gilts, asset swaps were sufficiently attractive for significant supranational swapped supply. This helped kick start what was until then a niche RPI swaps market. As equity markets declined in the following two years, the life insurance industry began to focus on the potentially more accurate liability matching benefits of using inflation derivatives rather than bonds but the pension sector remained intent on bond supply. Since the start of 2003, though, a rapidly increasing number of pension funds have realised the benefits of RPI swaps and enabled themselves to receive inflation. We estimate that as of the start of 2005, the majority of money managed for defined benefit pension schemes can now use RPI swaps, albeit still a minority of funds. This has led to much more corporate paying of inflation than inflation-linked issuance in these two years. The IAS 39 accounting regulation may lead to some shift back towards supply in the coming years, as accounting is less stringent for RPI bonds than swaps, but as the focus of pension funds is increasingly upon liability matching, the RPI swaps market is likely to continue its growth path nonetheless.

As discussed in the caps and floors section of this guide, most pension fund inflation-linked liabilities are limited price indexed (LPI, rather than RPI), but the vast majority of activity takes place in RPI rather than LPI swaps. Of this, most is capped at 5% and floored at 0%. The main reason for the lack of activity is that there are very few natural payers of LPI; there are less than £1bn of corporate LPI bonds and the DMO reiterated in its December 2004 ultra long consultation document that there were no plans for LPI gilt issuance at present due to the risk of reducing liquidity. Most pension funds appear to have accepted that the easiest way to achieve large size liability offsetting is via a combination of long nominal and RPI exposure. It is likely that LPI swaps will remain a significant one-way subset of the market, particularly as the hedging techniques of banks become more advanced to enable them to transform more effectively from RPI, with the flow growth in the market likely to be concentrated in generic RPI swaps.

Even with a large demand from the pension and life insurance sectors, the RPI swaps market could not have developed as it has without a significant number of payers of inflation, notably more than in the euro or US. A brief look at issuers in the Barclays Capital Sterling Inflation-Linked Bond Index highlights the type of institutions that are natural payers of RPI due to their revenues having inflation linkages. Water companies and other utilities have their price levels to consumers capped by an RPI based formula. The greater the natural monopoly in the industry the more likely this regulation will continue in the long run; usually RPI fixes are for five years but the demand is much longer. Rail infrastructure projects commonly have RPI linkages on the line charges, producing natural RPI payers. Other private finance initiative schemes similarly have inflation linkages embedded within their cash flows, most notably hospitals. Other inflation linkages are less explicit but may still encourage inflation paying or issuance. For instance, the core revenue of supermarket chains has a relatively close tie to the RPI as the products that they sell make up most of the RPI basket. Such companies may thus employ inflation-linked financing as part of a broad funding strategy, albeit with less relative importance than firms with explicitly linked cash flows. The property sector provides an additional source of natural paying; especially housing associations, some of which have LPI style cash flows. The housing market has always been a factor; both the first non-gilt RPI bond issuance and inflation swaps involved building societies.

With a broader range of inflation payers and without the structured retail demand of the US and euro markets, linker asset swaps have generally been in line with the nominal market and we would not expect the market to develop as fast or to the same extent as elsewhere. Asset swap levels are rarely traded directly, but are quoted on a proceeds basis rather than the par-par norm in other markets. In the second half of 2004, long end linker asset swaps moved significantly tighter than nominals as pressure to receive RPI rather than own bonds intensified. As the asset swap neared the LIBOR-GC spread, there was significant interest in fading this move, but trades were consistently of the format of buying the IL35 on breakeven and paying the zero coupon RPI rather than a true asset swap.

Japan

Alan James

The Japanese inflation swaps market has developed relatively slowly since the first JGBi was launched in March 2004. What has emerged is a market for total return swaps based on underlying JGBi issues that enables foreign investors and others restricted from owning JGBis until April 2005 to have exposure to real yields. Almost all total return swaps trading has been bond specific, allowing exposure to individual issues, but the launch of the third bond prompted some interest in total return swaps on a JGBi index. The emphasis on this kind of product has also tilted the nascent inflation swap market towards more of a relative focus on real yields, as opposed to other markets where the vast majority of derivatives are considered in breakeven inflation space. All trades are based on the national CPI ex perishables index, Bloomberg code JCPNGENF.

The potential for further development of the single bond based total return swaps is limited with the easing of holding restrictions in April 2005. The introduction of JGBis into global government indices at the same time may encourage use of index-based total return swaps though, for those not wanting to invest in relatively illiquid existing issues directly. While bond matched total return swaps are usually hedged directly by banks with holdings of the specific issues, it is likely that hedging strategies for total return index swaps are notably more dynamic than a simple balance sheet transfer. Holding an index neutral position in a rapidly growing market is a far from passive strategy in itself, so banks with this kind of exposure are likely to hedge such positioning tactically themselves, encouraging turnover in the underlying issues.

There is significant potential for a market in Japanese inflation swaps to develop in the coming years but the development is likely to continue to lag that of the JGBi bond market. While most pension funds have the majority of their liabilities inflation-linked, they are a long way from addressing this exposure. As is the case in other countries, liability matching is unlikely to be pursued while schemes are under funded. Pension funds are generally still reluctant to use nominal swaps to address the duration of their exposures let alone consider inflation derivative overlays. Direct real yield derivatives rather than overlay strategies may prove more palatable. It is thus possible that, unlike elsewhere, zero coupon breakevens do not develop as the basic building block of the market. While there are limited broker quotes, trading remains scarce, with the most standard format for zero coupon breakevens using the same interpolated inflation basis as JGBi bonds, ie, a three-month lagged inflation reference from the tenth of the month. Year-on-year and accreting swaps quotes have also been seen.

The choice of the Japanese Ministry of Finance not to include a deflation floor in the principal of JGBi bonds left a notable gap between supply and demand for deflation protection in the market. One of the main reasons that a floor was not included was to make the real yield a relatively representative value. Otherwise the value of the embedded floor would have been a significant part of the value of a new bond. The demand for almost all structured MTNs has been to include a floor, but how to hedge this exposure is far from clear. By far the largest structured note issued offered a par floor on the principle but coupled with a par cap at 10% on the 10 yr note, 96 bp annualised. As JGBi breakevens at the time were close to 80 bp, it highlights the premium with which some investors view owning the floor, though it also shows tendency for them to view inflation-linked notes as defensive instruments. This supranational note will have been swapped by the issuer who does not have yen inflation linked cash flows, but the fact it was maturity matched to a JGBi does not suggest swap activity elsewhere.

Other inflation derivatives markets

Alan James, Leon Myburgh

Sweden

The Swedish CPI swaps market is surprisingly underdeveloped given the breadth of the bond market and pension fund inflation liabilities. While there have been some corporate Swedish CPI issues that must have been swapped, particularly those from outside of Sweden, almost all corporate supply has been maturity-matched to government issues, suggesting relatively trivial hedging. The lack of liquidity in long nominal swaps is probably a major factor in preventing interest from pension funds in using Swedish derivatives, leaving little impetus to consider CPI swaps. What limited receiving interest there has been has stemmed from the corporate sector.

Denmark

Danish CPI linked bonds used to be a significant sub-sector of the callable mortgage bond market, but while there is almost $10bn notional outstanding, there has been no issuance this decade. The potential for development of a large derivatives market is limited by the fact that the vast majority Danish pension liabilities are nominal. Interest may start to pick-up if global long real yields fall further though, as this could produce a wave of mortgage bond calling – almost all the remaining real coupons are 2.5%. Other than the property sector, in which pension funds are more likely to invest directly, the only clear paying of Danish CPI comes from infrastructure projects. Accreting euro-denominated Danish CPI issuance of over €700mn has helped fund the transport link to Sweden. Iceland CPI swaps do not trade, despite the fact that most bonds in Iceland are CPI linked, and around $5bn in notional size.

South Africa

The South Africa inflation derivatives market really only came into being in 2002, two years after the bond market. It is driven by client interest, though there is a small interbank market. Swaps typically have an inflation annuity profile of up to 30 years. Typical bid/offer spreads are around 30 bp. In line with the bonds, the swaps are based on headline inflation with a four-month lag.

Demand to receive inflation is dominated by institutional investors' liability matching books and this probably comprises 90% of the market. Retail product demand is fairly limited. The typical pension fund actuarial assumption of 5% real growth will need to be reassessed for the inflation swaps market to really take off, as real returns are currently below 4%.

Payers of inflation have typically come from corporate project-related sources. Road construction has been dominant in this regard, and credit appetite for toll road paper is beginning to wane. Another, more limited, source of inflation paying has been banks with property leases. Aside from the National Roads Agency, public utilities have not been active, though they are natural payers, with revenues regulated to inflation-linked levels.

There is no linker asset swap activity. Swaps are typically priced off bond breakevens. Another product that has traded is five-year inflation strips. There have also been some moves to create inflation-protected products linked to a credit or equity exposure. Some banks have issued inflation-linked zero-coupon bonds, and there is some demand for inflation-linked zero coupon deposits.

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