

# Recent developments in sterling inflation-linked markets

By Grellan McGrath and Robin Windle of the Bank's Sterling Markets Division.

Sterling inflation-linked markets have developed rapidly over recent years, both in size and complexity. These changes have been driven by increased demand, especially from institutional investors such as pension funds, which has stimulated new supply as well as the rapid development of the market for inflation swaps. This article surveys these developments and considers their implications, in particular for the way risk is transferred between market participants and the interpretation of observed market rates. Market contacts suggest the increases in activity and the number of participants have enhanced efficiency in these markets, although the timing of demand and supply flows can still influence observed market prices. Looking ahead, there are considerable uncertainties as to the size of future demand and supply in the market.

## Introduction

In recent years, the market for sterling inflation-linked instruments has developed substantially. Demand for inflation-linked cash flows has increased from institutional investors, such as pension funds. And the rapid development of the market for inflation swaps has resulted in additional ways in which inflation-linked products are structured. At the same time, there has been a significant increase in the supply of inflation-linked assets. Supply comes from both the UK government, which issues index-linked gilts, and non-government sources. The latter are primarily companies which issue corporate inflation-linked bonds and/or pay the inflation-linked legs of swaps.<sup>(1)</sup>

The development of new structures to accommodate supply and demand in the inflation-linked market means that inflation risk is being transferred more frequently. From a financial stability standpoint it is useful to gauge the sustainability of these new developments. And given the large role played by UK financial intermediaries in the market, it is also important to understand where the exposure to risk, inflation or otherwise, ultimately lies.

The Monetary Policy Committee (MPC) regularly examines market-based measures of inflation expectations and real interest rates derived from sterling inflation-linked instruments.<sup>(2)</sup> However, at times changes in market structure and market frictions may mean that these measures need to be interpreted with care. An understanding of current and potential future developments is therefore important for monetary policy makers.

**Diagram 1** summarises the structure of the sterling inflation-linked market as it currently stands. The next section of the article examines developments in demand from those who wish to receive inflation-linked cash flows. The article then examines the supply of inflation-linked cash flows, focusing in particular on the growth in new sources of supply. Finally, the article considers the microstructure of the sterling inflation-linked market, especially how financial intermediaries match demand and supply flows, how inflation risk is transferred, and also considers examples where market frictions may have affected pricing in the market.

## Demand for inflation-linked cash flows

Increased demand for inflation-linked cash flows from institutional investors, especially pension funds, has been regularly cited by market participants as an important catalyst for rapid growth in the sterling inflation-linked market over recent years.

Institutional investors dominate the index-linked gilt (IG) market, with pension funds and insurers directly holding around three quarters of IGs (**Chart 1**). The primary purpose of the majority of these holdings is for pension providers to hedge their liabilities which are typically linked to inflation. In

(1) An inflation-linked bond is typically one in which the coupon and principal payments are adjusted for inflation over the period since issuance. As the adjustment is based on changes in a price index, such as the retail prices index (RPI), they are also referred to as index-linked bonds. An inflation swap is an agreement to exchange fixed-interest payments (on a notional amount) for payments which vary according to inflation. For a more in-depth description see Deacon *et al* (2004).

(2) In bond markets, the difference between yields on nominal and inflation-linked bonds are referred to as (implied) breakeven inflation rates. In swap markets, breakeven inflation rates refer to the rates on the fixed leg of the swap. See Scholtens (2002) and Hurd and Relleen (2006) for more detailed explanations of these measures.

Diagram 1 The structure of the market for inflation-linked products in the United Kingdom

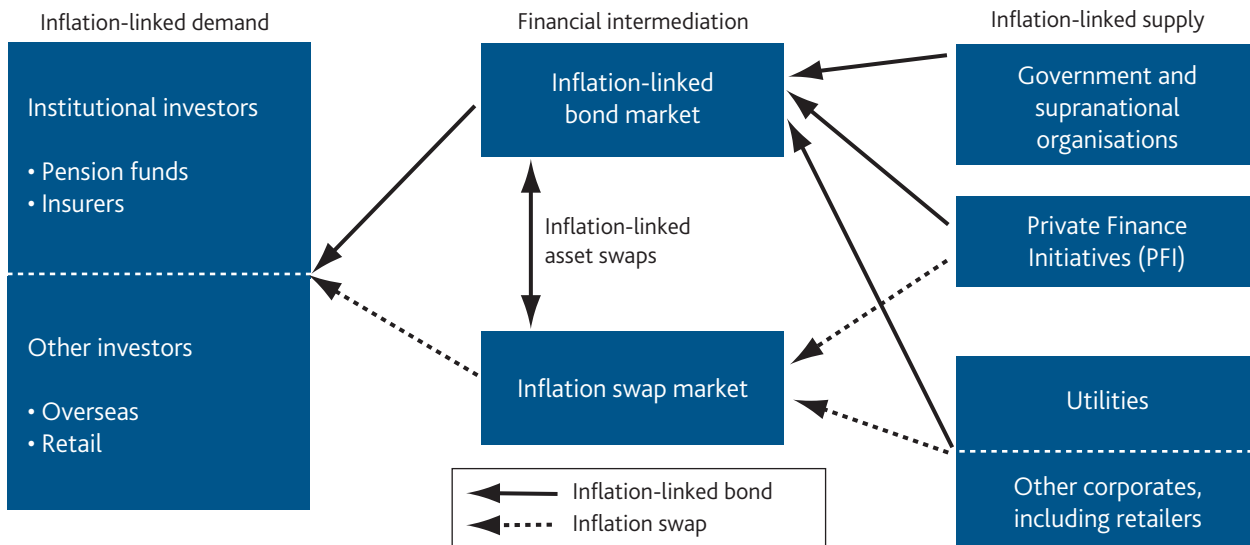
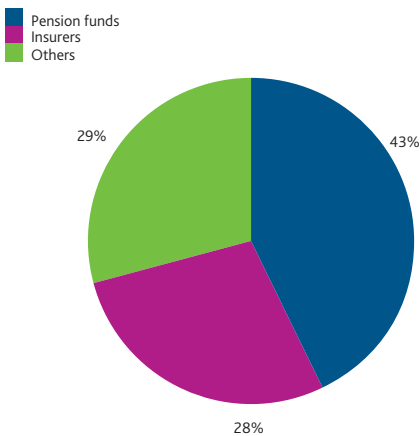


Chart 1 Holdings of index-linked gilts (June 2006)



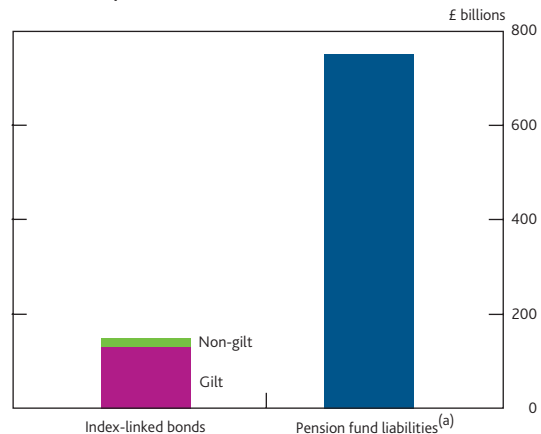
Sources: Barclays Capital, ONS and Bank calculations.

In addition to direct holdings by pension funds, this is also true of holdings by insurers, as they sell pensions products themselves.

Holdings of IGs by banks, dealers and hedge funds may also represent hedging of inflation-linked cash flows to pension funds, since institutional investors increasingly receive such cash flows via inflation swaps. As explained later, much of the inflation-linked cash flows from an IG may be transferred to a UK pension fund even if the registered holder is a bank, dealer or hedge fund. And if the latter is registered overseas, that may perhaps give a misleading impression in ONS data of the scale of overseas exposure to IGs.

The size of potential demand from institutional investors means that even proportionally small changes in demand could have a major impact on the sterling inflation-linked market (Chart 2). The IG market in total has a market capitalisation of around £120 billion,<sup>(1)</sup> and the

Chart 2 Inflation-linked bonds outstanding relative to estimated pension fund liabilities



Sources: Barclays, Dealogic, the Pensions Regulator and Bank calculations.

(a) Midpoint of £725 billion–£775 billion range.

non-government inflation-linked bond market has a value of around £18 billion. In July 2006 the existing liabilities of UK pension schemes were estimated to be £725 billion–£775 billion,<sup>(2)</sup> and additional liabilities will continue to accrue for many years.<sup>(3)</sup> So even asset hedging flows that represent a relatively small proportion of these liabilities have the potential to have a major impact on the inflation-linked market.

The move by pension funds to invest in assets more closely matching the characteristics of their liabilities seems to be due to the increased aversion of trustees and corporate sponsors to volatile pension fund valuations. This may be the result of a combination of factors:

(1) According to the Barclays Capital Gilt Inflation-Linked Bond Index.  
 (2) As estimated on an FRS17 basis in the Pensions Regulator's *Annual Report and Accounts, 2005–06*.  
 (3) In addition, closed schemes may seek to sell liabilities to insurers in the bulk annuity market. These insurers are required to match such products closely, suggesting that they will also have to pursue liability-matching strategies.

- Declines in equity values during 2001–03, falls in long-term interest rates, and upward revisions to longevity assumptions have resulted in many pension funds facing accounting deficits as the market value of their assets fell while the discounted present value of their liabilities increased.
- Changes to pension fund regulation and accounting standards have introduced more market-based valuation methods and required pension fund deficits to be explicitly recognised on the sponsoring companies' balance sheets.<sup>(1)</sup> Pension fund regulation can be particularly important in mergers and acquisitions, or leveraged buyouts as a large or volatile deficit may deter potential buyers.

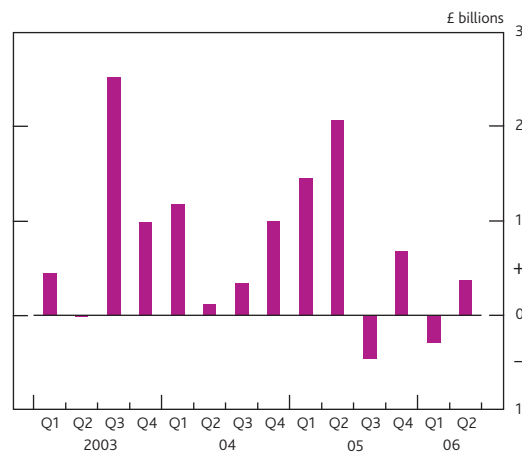
For defined-benefit (DB) pension funds (which currently form the majority of funds), liabilities usually have a long duration (ie have a valuation sensitive to changes in long-term interest rates). They are also inflation linked both directly, because retirement pensions are often linked (at least partially) to inflation, and indirectly, because a final salary scheme's liabilities rise with wages, and wage growth is correlated with inflation.<sup>(2)</sup>

The simplest strategy for hedging against inflation and interest rate risk involves direct portfolio switching into (long-duration) index-linked bonds, either through the purchase of IGs or sterling corporate index-linked bonds. These securities have the advantage that they provide both a duration and an inflation hedge. This approach of buying securities to match the duration and characteristics (eg inflation risk) of liabilities has been termed asset liability matching (ALM).

ONS data do show that over the past few years institutional investors have made substantial net purchases of index-linked gilts (Chart 3). They are also the main purchasers of corporate index-linked bonds, of which there has been significant issuance recently (discussed later). And while long-maturity bonds better suit the duration of these investors' liabilities, market contacts report that they are willing to buy IGs at all maturities in order to improve inflation matching. Some of these purchases have been funded by higher contribution rates to pension schemes, others by reducing allocations to other assets (eg equities).

Full matching of interest rate and inflation risk using bonds can leave a fund relatively neutral to changes in discount rates or inflation. However, the ALM approach has the disadvantage that the low-risk assets purchased have a relatively low expected real return. This can make full matching relatively costly for a fund with a deficit as it could 'lock in' the need for higher pension contributions on the part of the sponsoring company. And the purchase of corporate index-linked bonds can expose the fund to unwanted long-maturity credit risk.

Chart 3 Institutional investors' net purchases of index-linked gilts

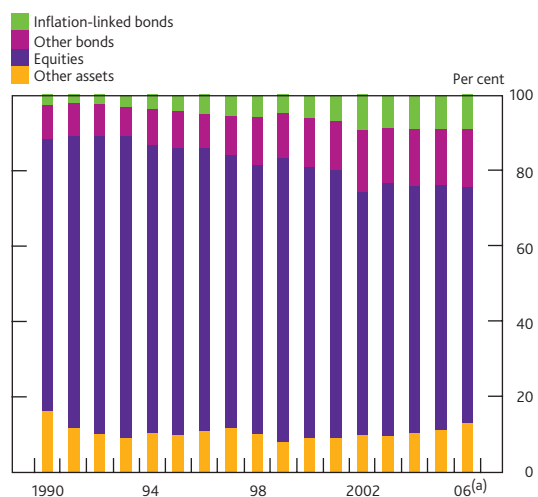


Sources: ONS and Bank calculations.

This may explain why few funds have pursued a full matching approach.

Indeed, although there have been some high profile examples of large pension funds moving into index-linked bonds, at an aggregate level the move has been more incremental (Chart 4).

Chart 4 Pension fund asset allocations



Source: WM Performance Services.

(a) End of Q3.

Another reason for this may be that the development of the inflation swaps market has facilitated an alternative approach to matching inflation liabilities. By using inflation swaps in combination with interest rate swaps,<sup>(3)</sup> a pension fund's

- (1) The box 'Recent developments in UK pension fund regulation' on page 10 of the Spring 2006 *Quarterly Bulletin* examines these changes in more detail.
- (2) The box 'Pension fund valuation and liability driven investment strategies' on page 8 of the Spring 2006 *Quarterly Bulletin* outlines in more detail the factors affecting the asset and liability valuation of DB pension funds.
- (3) An interest rate swap is an agreement to exchange fixed-interest payments (on a notional amount) for floating payments which vary with an agreed interest rate, eg Libor.

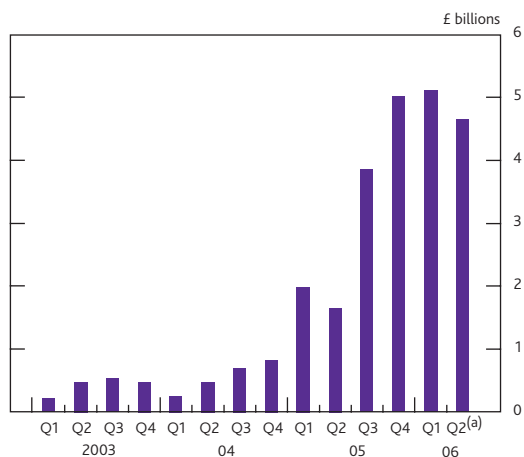
cash flows can be more closely tailored to match characteristics of their liabilities than may be possible with bonds: whereas the payment schedules on bonds are set at issuance, the payments on swaps can be negotiated at the time the swap is entered into. As there is no initial outlay when a swap is agreed, this approach offers the possibility that more of the fund can be invested in risky assets for higher expected returns. This use of derivatives, known as a 'swap overlay', effectively adds some leverage to the fund.

The broad approach of these swap overlay strategies — in combination with investing the majority of the fund in a diversified portfolio to generate returns — has been termed 'liability driven investment' (LDI). Typically, the pension fund will be left with future outlays linked to a market interest rate such as Libor, which must be funded by the returns on its risky assets. As an aside, some asset managers have reported that pension funds are looking for returns on risky assets of 100 to 150 basis points higher than their investment benchmark, compared to 50 basis points in previous years, seemingly to try to narrow their deficits.

Not all pension funds have a mandate and/or the expertise to invest in derivatives. However, financial intermediaries have recently begun to offer 'pooled' products which can provide inflation protection (often using inflation derivatives) in a form that small and medium-sized pension funds can invest in. The provider manages the cash flows from the derivatives, and the documentation that goes with it. This provides a means for smaller pension funds to pool their assets and engage in LDI.

Available data suggest that there has been a rapid growth in turnover in the inflation swap market (Chart 5), with high demand sustained over recent quarters. Market contacts suggest that a significant part of this demand may be related to the implementation of inflation swap overlay strategies.

Chart 5 Notional value of UK RPI swaps traded



Sources: ICAP estimates and Bank calculations.

(a) Quarterly estimate using data for April and May.

Survey data suggest that by mid-July 2006, only a small proportion (around 4%) of corporate pension funds had begun to use inflation derivatives.<sup>(1)</sup> However, even this level of demand could represent tens of billions of pounds worth of notional demand for inflation swaps.

A key question for the sterling inflation-linked market is the potential size of inflation-hedging demand from institutional investors going forward (and the ability of the market to meet any increased demand). The likely size of such demand will depend on a number of factors:

- the degree to which defined-benefit pension liabilities will rise in the future and to what extent pension funds will seek to match their existing and future liabilities;<sup>(2)</sup>
- the relative importance pension funds place on matching duration relative to matching inflation-linked liabilities;
- for those seeking to hedge inflation liabilities, whether they will use inflation-linked bonds or swaps to achieve this matching; and
- the emphasis placed on closing pension fund deficits in the context of mergers and acquisitions or leveraged buyout activity.

In summary, although to date only a minority of pension funds have pursued full matching strategies involving large-scale switching into sterling inflation-linked products, limited reallocation still represents a significant increase in demand relative to the size of the market. The potential size of future demand remains very significant, but there is uncertainty as to how much of this will be realised, and the timing of any flows.

## Supply of inflation-linked cash flows

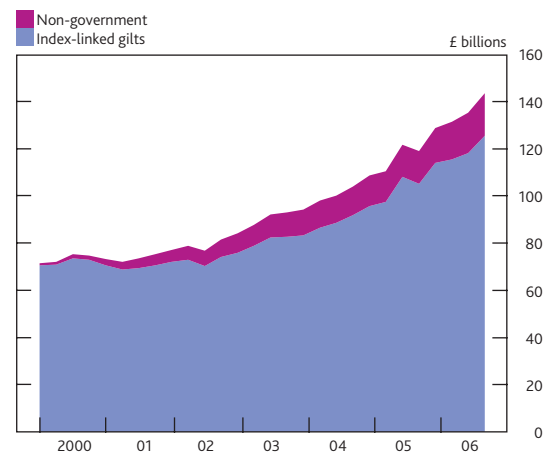
This section examines the sources of supply of sterling inflation-linked cash flows in both the bond and swap markets.

In terms of the outstanding value of sterling inflation-linked debt, the market is dominated by IGs (Chart 6). The large proportion of IGs in total inflation-linked assets outstanding reflects the fact that the UK government has been the primary issuer of sterling inflation-linked products since IGs were first issued in 1981. And IG issuance has recently been at record levels, particularly at longer maturities (fifteen years and above) where institutional demand has been strongest as the duration of UK pension fund liabilities is typically about 20 years (Chart 7).

(1) According to *Pension financial risk — survey of FTSE 350 companies* published by Mercer in July 2006.

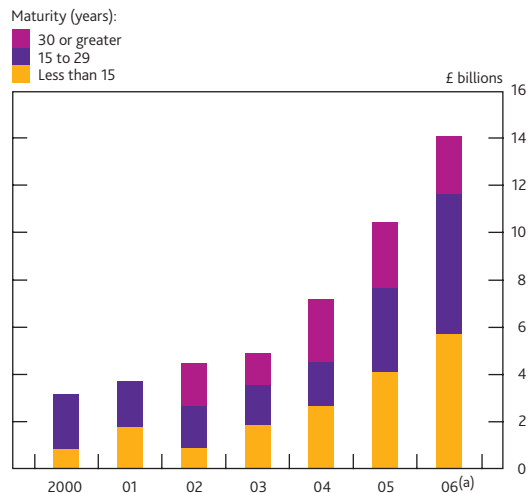
(2) The number of defined-benefit pension schemes is falling as schemes are either closed completely or closed to new members. Nevertheless, existing defined-benefit schemes will continue to accrue additional liabilities for many years to come.

**Chart 6** Market capitalisation of sterling inflation-linked bonds



Sources: Barclays Capital, Dealogic and Bank calculations.

**Chart 7** Index-linked gilt issuance



Source: Debt Management Office.

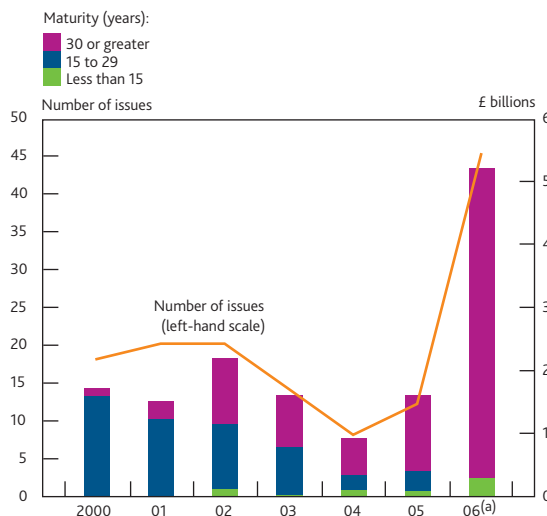
(a) Year to 17 November 2006.

However, there has recently also been rapid growth in non-government supply of inflation-linked instruments, with the majority of issues at maturities greater than 30 years (Chart 8). Non-gilt inflation-linked cash flows come from a variety of sources, examined in the box on page 391.

A number of factors have driven this recent supply of inflation-linked cash flows from non-gilt sources:

- The low level of real rates (especially at long maturities) has encouraged companies to use funding with inflation-linked repayments in order to lock in low financing costs.
- As a result of the apparent increase in demand, intermediaries are increasingly seeking to bring new sources of inflation-linked supply into the sterling market (eg property companies with rental payments linked to inflation).

**Chart 8** Non-government sterling inflation-linked bond issuance



Source: Dealogic.

(a) Year to 17 November 2006.

- Additionally, a number of large PFI projects have been approved during 2006 and a significant amount of the anticipated revenues have been hedged in the sterling inflation-linked market.
- The growth of the credit market and willingness of insurance companies to insure against default in corporate bonds (known as 'credit wrapping') have improved the ability of companies to issue highly rated debt, which is more appealing to UK institutional investors.

In the past, a corporate issuer seeking inflation-linked financing might have done so directly by issuing an inflation-linked bond. But the rates on offer for payments linked to inflation have at times been more attractive in the swap than the bond market (see the box on page 392 for an explanation of this). In response to this, financial intermediaries are increasingly able to arrange complex funding solutions that make use of the inflation swap market.

For example, a company can issue a nominal bond and simultaneously agree with the buyer of the bond to swap the nominal cash flows on it for inflation-linked cash flows. Alternatively, they can issue an inflation-linked bond to a special purpose vehicle (ie a company specially created for financing purposes), that in turn pays the inflation-linked cash flows to the swap market. By allowing corporates to achieve inflation-linked funding at more attractive rates, these complex strategies have probably helped increase the supply of inflation-linked cash flows, and the efficiency of the market as a whole.

Looking forward, maintaining the relatively high non-government inflation-linked issuance seen during the first half of 2006 will require a continued increase in

## Supply of non-gilt sterling inflation-linked assets

As noted in the main text, the supply of non-gilt inflation-linked cash flows has grown rapidly in importance in the sterling market. This supply can be in the form of inflation-linked bonds, or, increasingly, inflation-linked swaps facilitated by an intermediary. These underlying inflation-linked cash flows come from a variety of sources:

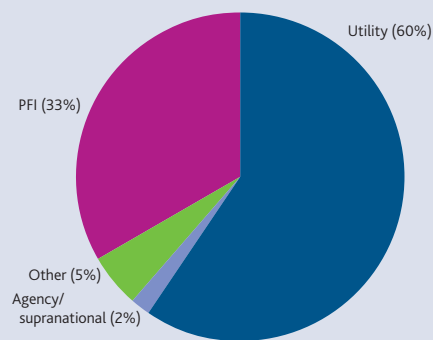
- **Regulated utilities** — these are companies with cash flows that are partly subject to government regulation, including privatised utilities such as water, electricity and gas firms. Typically their pricing structure will be set by the regulator, with some prices allowed to rise each year by inflation (plus or minus a certain percentage). That gives rise to a flow of revenues linked to some degree to inflation.
- **Private Finance Initiatives (PFIs)** — under these public finance schemes, a private company pays for and runs a public infrastructure project (for example, building and maintaining a school or hospital) for a number of years. In return, the government pays the company an income stream, often inflation-linked.
- **Other corporates** — some private sector contracts are directly linked to an inflation index (eg some property leases and outsourcing contracts). However, they are relatively few in number. Corporates that have an indirect inflation exposure might also be tempted to issue an index-linked bond or make inflation-linked payments in the swap market. A key factor here is the correlation of the company's revenues with inflation. For example, in recent years Tesco has issued £600 million worth of RPI-linked debt: as a retailer selling a large number of products in the RPI basket, it is argued that the correlation will be high. But these types of corporate issuers only account for around 12% of total non-government inflation-linked bonds outstanding, suggesting that few corporates with an indirect exposure to

inflation-linked funding. But a number of issuers have reportedly already brought forward issuance plans to take advantage of low rates, which perhaps raises questions about the sustainability of current issuance levels. One key source will be PFI contracts, with about £1.5 billion of NHS projects expected over coming years,<sup>(1)</sup> some of which may be funded in inflation-linked markets. There may also be a growth in 'new' sources of supply, including commercial property agreements, which have the potential to provide substantial supply to the market as leaseback agreements are often linked to RPI.

inflation have considered the correlation to be high enough to use inflation-linked funding.

- **Agencies/supranational** — these are AAA-rated organisations with direct government guarantees. They issue in the inflation-linked market if they can achieve a lower cost of funding, but often swap the inflation-linked cash flows immediately back into nominal cash flows, resulting in no net supply to the inflation-linked market. The European Investment Bank (EIB) has been the most active in the sterling market.

**Chart A** Issuers of sterling non-government inflation-linked bonds in 2006



Source: Dealogic.

Although non-government supply has increased, a disincentive to using inflation swaps remains in the form of derivatives accounting regulations. In particular, IAS 39 requires that, for an inflation swap to qualify as a hedge for accounting purposes (and thus remove changes in the value of the swap position from a company's profit and loss statement), a company's cashflows must be explicitly linked to inflation for the length of the swap. For most corporates and utilities (whose revenues are typically only explicitly linked to inflation for the next five years) this means that long-dated inflation swaps could be a potential source of profit volatility, decreasing their attractiveness as part of a funding package. This is less of a problem for PFI projects, the cash flows of which are typically inflation-linked for long periods.

## Microstructure of the sterling inflation market

Although both supply and demand in the sterling inflation-linked market have increased in recent years, they are sometimes not perfectly matched. Specifically, institutional demand sometimes does not match the duration or timing of supply from government IG issuance and other suppliers. For example, a utility may issue a 40-year inflation-linked bond,

(1) As outlined in a Department of Health press release, 18 August 2006.

## Inflation-linked asset swaps: connecting bond and swap markets

Theory would suggest that breakeven inflation rates derived from the difference between the yields on nominal and conventional bonds and those implied by the fixed-rate leg of an inflation swap should be equal, as they both effectively represent the price of securing payments linked to RPI.<sup>(1)</sup> However, at times these rates have diverged by up to 40 basis points (**Chart A**). Market contacts suggest these divergences may have been due to differences in demand and supply between the markets. While institutional demand for inflation-linked swaps is heightened because swap payments can be more closely tailored to pension fund liabilities, the repayment profiles of bonds tend to be a better match for the funding targets of issuers of inflation-linked cash flows.

**Chart A** Twenty-year forward breakeven inflation rates derived from bonds and inflation swaps<sup>(a)</sup>



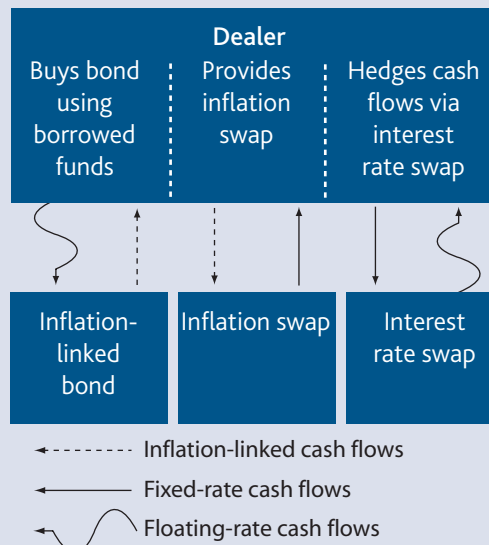
(a) Instantaneous inflation forward rates derived from the Bank's government liability curve and inflation swap rates.

Inflation-linked asset swaps provide a means of balancing supply so that prices come into line across swap and bond markets; a possible asset swap structure is summarised in **Diagram A**. In this example the dealer borrows funds (at a floating rate of interest) to purchase an inflation-linked bond, and simultaneously agrees to pay inflation-linked cash flows (usually to a pension fund) in an inflation swap. Then, to match the cash flows on the first two transactions, the dealer swaps the fixed cash flows from the inflation swap for floating payments, which are used to fund the original purchase of the bond.

but a pension fund may prefer to receive a series of inflation-linked cash flows with a maturity of 20–30 years. This section considers the role of financial intermediaries that try to balance supply and demand, and how temporary mismatches can affect market rates.

Financial intermediaries have improved the efficiency of inflation-linked markets by being able to shape the characteristics

**Diagram A** Inflation-linked asset swap



The simplified net result is that the dealer will receive inflation-linked cashflows from the bond market, and supply inflation-linked cashflows to the inflation swap market. As the breakeven inflation rate in the bond market represents the premium paid by the dealer to receive inflation-linked cashflows from a bond, and the breakeven inflation rate in the swap market represents the price paid by the pension fund to receive inflation-linked cashflows from the dealer, the dealer makes a net gain if swap breakeven inflation rates are higher than bond breakeven inflation rates.

Asset swaps can also be used by issuers who wish to take advantage of the higher breakeven inflation rate available in swap markets, but would prefer the repayment profile associated with a bond. In this case a financial intermediary arranges an asset swap at the same time that the bond is issued.

The increased use of asset swaps involving both existing and newly issued bonds has probably contributed to the narrowing of the gap between breakeven inflation rates derived from government bonds and those implied by inflation swaps (**Chart A**).

(1) See Hurd and Relleen (2006) for more detail on the determinants of breakeven inflation rates.

of underlying issuance to improve the match with institutional demand. This includes offering the means to improve the credit quality of bonds, and transforming repayments on bond issuance into inflation-linked swap payments, which can be more closely tailored to the profile of pension fund demand. Some banks are also said to have used inflation-linked cash flows in corporate loanbooks and commercial property leases to hedge inflation-linked swap liabilities.

But the timing mismatch between inflation-linked supply and demand raises questions about whether large flows leave financial intermediaries holding significant risk for any length of time. For example, if an intermediary enters into an agreement to receive inflation-linked cash flows from a company, there may be a delay before it agrees to pay out those cash flows to a pension fund. This could either be because it is waiting for sufficient institutional demand, or because it thinks market rates will move in a favourable way. Market contacts have reported that such 'warehousing' of inflation risk does happen to some degree, at times leaving intermediaries with large unhedged positions and hence market risk.

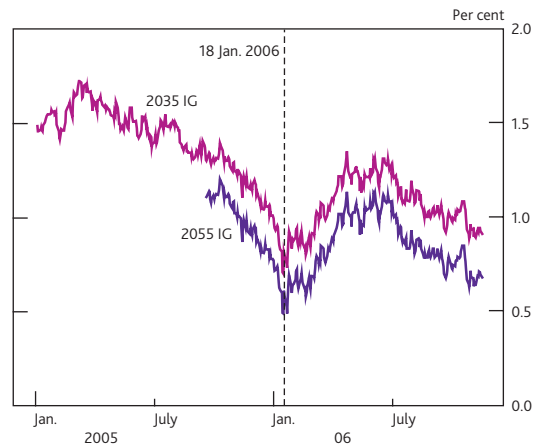
This market risk could be exacerbated by the relative illiquidity and smaller size of inflation-linked markets compared with equivalent sterling nominal markets. The frequency with which IGs are traded is around 20% of that of conventional gilts,<sup>(1)</sup> reflecting the fact that institutional investors often buy IGs in order to hold them to maturity. Corporate index-linked bond turnover is reported to be even lower.

IGs and inflation swaps also tend to involve higher trading costs than their conventional counterparts, in the form of spreads between prices bid and offered by dealers. However, the increased size of the inflation-linked market has been accompanied by increased competition, and market contacts have reported a narrowing of bid-offer spreads and an increase in liquidity in recent years. The seasonality of inflation is a further consideration market participants must take into account when entering the inflation-linked market (see the box on page 394).

The relatively unpredictable nature of both demand and non-government supply can have an impact on the price of inflation-linked assets (and hence real interest rates and breakeven inflation rates). An example of this occurred in January 2006. Contacts suggest that in mid-January some investors speculated that long-term real rates had fallen too low and would return to more usual levels: some speculators had taken short positions in very long-dated IGs (for example those maturing in 2035 and 2055), and some index-fund managers held less of these bonds than their benchmark allocation. But institutional demand (and temporary uncertainty about future PFI issuance) continued to push rates lower, resulting in a 'short squeeze' whereby those speculative players and fund managers were forced to buy the IGs in order to prevent further losses. As a result, ultra-long real rates fell to record lows on 17 and 18 January (Chart 9).<sup>(2)</sup>

Rates subsequently rose in the first part of 2006, apparently reflecting quiet institutional demand, according to market contacts, and greater inflation-linked supply. However,

Chart 9 Yields on long-maturity index-linked gilts



Source: Bloomberg.

renewed strength of institutional demand in recent months has seemingly caused real rates to fall once again.

Supply and demand imbalances can also affect the inflation swap market. As discussed in the box on page 392, strong institutional demand to receive inflation-linked cash flows from swaps has at times driven a wedge between breakeven inflation rates implied by swaps and those derived from bonds. Furthermore, the less transparent nature of the timing and size of non-government supply can add volatility to rates in the swap market. Whereas the timetable for IG issuance is published well in advance by the Debt Management Office, the timing of payments by corporate issuers into the inflation-linked swap markets is generally not known beforehand.

Hedge funds and other participants that try to profit by taking speculative positions can play an important role in sterling inflation-linked markets by improving pricing in the market — including by entering into asset swaps. But the tendency for market rates to move for non-fundamental reasons (as in January) can lead to a high level of volatility in the value of such positions, which may deter some of these participants.

For policymakers, it is important to be aware that the supply and demand flows and market characteristics such as trading costs and illiquidity can affect observed market rates, at least temporarily. This is particularly significant at longer maturities, where rates are particularly sensitive to fluctuations in non-government supply and institutional demand.

(1) Monthly gilt turnover as a percentage of market capitalisation. Source: DMO.

(2) These developments were discussed in detail in the 'Markets and operations' section of the Spring 2006 *Quarterly Bulletin*. For a description of the theoretical determinants of long-maturity rates see the box 'Interpreting long-term forward rates' on page 418 of the Winter 2005 *Quarterly Bulletin*.

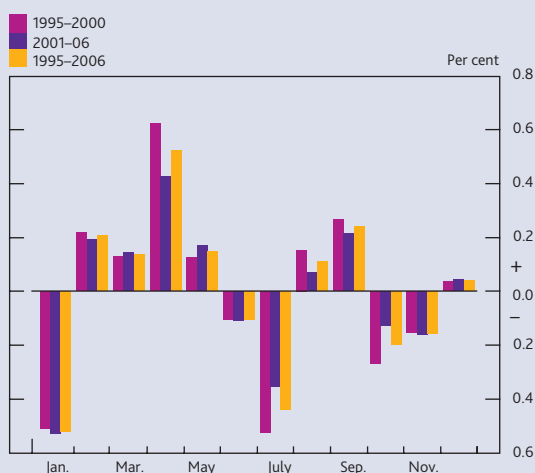


## Seasonality and inflation-linked markets

Unlike conventional instruments, inflation-linked market instruments provide payments that are typically based on the level of seasonally unadjusted price indices. Monthly inflation tends to vary depending on the time of year, and market contacts often mention these seasonal factors as being important for market pricing. This box looks at how inflation seasonality may affect observed market prices and rates.

**Chart A** shows the average seasonal pattern of the United Kingdom's RPI inflation measure, which is the main reference index for the sterling inflation-linked market. These trends arise because of pricing patterns in the components of the indices: for example, clothing prices typically fall during the January sales. Seasonal patterns may change over time; indeed, **Chart A** shows that RPI seasonality has changed slightly since 2001.

**Chart A** Seasonality of RPI<sup>(a)</sup>



(a) Average deviations from twelve-month averages.

Coupon and redemption payments on IGs are adjusted upwards according to the growth in the relevant index between the issuance date and a reference month. This reference month is typically three or eight months prior to the month that the payment is due,<sup>(1)</sup> in order to allow time for the index to be published and the payment calculated. Differing final reference months mean that some IGs will be expected to offer greater nominal returns than others due to the seasonal pattern of monthly inflation. For example, the IGs maturing in 2009 and 2011 have final reference months of September and December respectively. In the past, the growth in the index between October and December has been about 0.3 percentage points lower than at other times of the year. So, in proportion to its maturity, the 2009 IG might be expected to provide a higher nominal return than the 2011 IG (abstracting from factors other than seasonality). This should be reflected in a higher breakeven inflation rate for the

2009 IG than the 2011 IG. And the effect will become more pronounced as time to maturity decreases and the change in the index in the final months becomes relatively more important.

Seasonality could also lead to a general rise in the price of IGs at certain times of the year. Higher RPI outturns result in higher nominal payments on the bond, which come in the form of semi-annual coupons and the final payment of principal. Other things being equal, that would widen the gap between real and nominal yields, raising implied breakeven inflation rates.

Inflation swaps are generally entered into for whole years over which seasonal effects sum to zero. But seasonality is important when marking-to-market the value of existing swap positions. For example, if a swap has six months to maturity, the expected seasonality over this period will affect its valuation. Market participants typically use monthly forward rates based on their predictions of seasonality to value these swaps. Again, the shorter the time to maturity, the more important will be the role of seasonality.

Seasonality can also be important in understanding moves in inflation swap rates when the reference month changes. Payments on the inflation leg of an inflation swap are based on the growth of the index over the tenor (or period) of the swap, lagged two months. For example, a two-year inflation swap entered into in June 2007 will be based on the expected growth of the RPI index between April 2007 and April 2009. In July the reference month will change to May, and the swap rate will be based on the growth in the index between May 2007 and May 2009.

On the day the reference month changes there may be a jump in the quoted two-year inflation swap rate. The size of this jump will depend on the change in the index between April and May 2006, and market estimates of the change in the index between April and May 2008, probably based on forecast differences in RPI seasonality between April and May. Forward rates derived from swaps should be unaffected by this rolling of reference months.

(1) Payments on recently issued IGs tend to be referenced to the level of RPI with a three-month lag. IGs first issued prior to September 2005 have an eight-month lag.

## Summary and conclusions

This article has examined sterling inflation-linked markets. These markets have developed significantly in recent years, involving a larger number of participants, a wider range of instruments and greater market activity. Institutional investors appear to have increased their demand for sterling inflation-linked products, primarily to hedge pension fund liabilities, and this demand has drawn new sources of supply into the market.

The role of financial intermediaries has become more important as they reconcile mismatches in the timing and structure of inflation-linked supply and demand. In particular, this has facilitated increased supply of inflation-linked cash

flows from non-government sources, which intermediaries have helped tailor towards the profile of pension fund demand.

Overall, this has improved the efficiency with which inflation risks are transferred between agents. However, liquidity in the index-linked market remains lower than in the conventional market and rates can still be sensitive to supply and demand flows. These issues are important for policymakers to understand when interpreting rates observed in inflation-linked markets.

Looking forward, the key issues for the sterling inflation-linked market will be the strength of demand from institutional investors for inflation-linked assets, and the willingness and ability of suppliers of inflation-linked cash flows to meet it.

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