Over-the-counter interest rate options

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The Bank of England's Monetary Policy Committee uses market expectations of future interest rates to inform its policy decisions. Interest rate expectations can be inferred from a range of financial instruments, including interest rate options. This article surveys the structure and use of the over-the-counter (OTC) interest rate option market.(1) *It discusses what information OTC interest rate options may contain about market interest rate expectations, additional to that available from products traded on exchanges. It also considers the linkages between OTC interest rate option markets and the markets in the underlying assets.*

Options are financial instruments that are linked to an underlying asset, and whose payoffs depend on movements in the price of that underlying asset. Because of the asymmetric nature of their payoff profile, options provide information about the probability distribution of market participants' expectations of the price of the underlying asset. The Bank of England uses options to derive indicators of uncertainty about future interest rates, exchange rates and equity markets, in order to inform monetary policy and to identify potential financial stability risks.(2) For example, the *Inflation Report* uses exchange-traded option prices to derive the probability distribution of market expectations of UK short-term interest rates.

The Bank has made relatively little use, however, of the information available from interest rate options that are traded in the OTC market. The OTC market contains a range of financial products not traded on exchanges. However, less information is publicly available about OTC markets than about exchange-traded markets. So discussions with market participants are particularly important in gaining an understanding of the market structure and the use of OTC interest rate options, the information content of their prices, and their interrelationships with other financial markets.

This article discusses the information that OTC interest rate options may contain, additional to that available from exchange-traded products, given the wider range of products traded in the OTC market. The article begins with an introduction to derivatives and interest rate options. The differences in the sizes and other features of OTC and exchange-traded derivative markets are discussed. Later sections, which are based partly on information from market participants, consider the main applications of interest rate options, the usefulness of OTC interest rate options for inferring sterling interest rate expectations, and the relationship of the interest rate option markets with the markets of the underlying assets, such as government bonds and swaps. A glossary of terms is provided on page 181.

Introduction to derivatives and basic concepts

A 'derivative' is a financial contract whose value depends on the future value of one or more underlying asset. Originally, the underlying assets were commodities, such as cotton and rice, but many different financial instruments are now used, including interest rates, exchange rates, equities and commodities. Derivatives allow the contract holders to expose themselves to price changes in the underlying asset without having to purchase the asset. There are two main types of derivative instrument:

- *Outright contracts:* These are instruments with a linear payoff profile, ie they provide symmetric payoffs to upward and downward movements in the price of the underlying contract. Examples of such derivatives include interest rate futures,

(1) This article is based partly on interviews with staff from Barclays Capital, the Chase Manhattan Bank, Credit Suisse First Boston, Goldman Sachs, JP Morgan, the Royal Bank of Scotland, Tullett & Spuetz Capital Markets AG, UBS Warburg, and Westdeutsche Landesbank. Full details of this study are given in Moessner (2001), available at www.bankofengland.co.uk/ccbs/publication/otcoptions.htm

(2) See Clews, Panigirtzoglou and Proudman (2000), and Bank of England (2000).

forward-rate agreements (FRAs), and interest rate swaps (see the glossary on page 181).

- *Options:* These are instruments with a non-linear payoff profile. They provide payoffs that depend asymmetrically on changes in the price of the underlying contract.

Many derivatives are either pure outright contracts or pure options contracts, but there are also a large number of more complex derivatives that are a combination.

Interest rate options are option contracts that settle against interest-bearing securities such as money market interest rate futures, interest rate swaps and government bonds. A 'call option' gives the buyer the right, but not the obligation, to buy an underlying interest rate contract at a point in the future at a pre-determined price (the 'strike price'). 'Put options' give the right to sell the underlying contract. Options can be traded at a variety of strike prices, which may be at-the-money (ATM), out-of-the-money (OTM), and in-the-money (ITM).

Interest rate options can be divided roughly into the following categories: plain vanilla options, exotic options, and structured products. Plain vanilla options use standardised contracts and market conventions, and are traded in generally liquid markets. The main kinds of 'plain vanilla' OTC interest rate options are interest rate caps, floors and swaptions (see the box on pages 176–77). Exotic options are more complex contracts; and structured products are made up of several components, including outright derivative contracts, options, and the underlying contracts, such as bonds.

Information contained in option prices

A call option is valuable only if there is a chance that the price of the underlying contract will exceed the strike price when the option is exercised. By comparing the prices of traded options with different strike prices, it is therefore possible to infer the probabilities that market participants attach to various levels of the price of the underlying contract.(1) Interest rate option prices can be used to infer so-called 'implied volatilities' (see the glossary on page 181), which provide a measure of market participants' uncertainty about future interest rate movements.

The price of an option is sensitive to the dispersion of expected future prices of the underlying contract, since options have an asymmetric payoff profile. Call options are more expensive the greater the dispersion of future prices expected by the market, ie the greater the uncertainty. This is because greater uncertainty increases the probability that the price of the underlying contract will move further above or below the strike price at the expiry of the option, leading to a greater payoff to the holder, while the loss to the holder is still limited to the option premium. Similarly, options are cheaper when the market is more sure about future outcomes. Interest rate options therefore provide valuable information about the distribution of future interest rates expected by market participants.

OTC and exchange-traded derivatives

Derivatives contracts can be traded on organised exchanges or in over-the-counter markets. OTC interest rate options can be tailored to a user's specific requirements, since they are direct contracts between counterparties without an exchange acting as an intermediary. The main advantage of OTC contracts is therefore their greater variety and flexibility (see the table overleaf). The greater variety is also a disadvantage, however, since as a consequence individual OTC interest rate options contracts tend to be less liquid than the more standardised exchange-traded contracts. The main disadvantage of OTC contracts is that they involve greater counterparty credit risk than exchange-traded contracts.

The main kinds of outright OTC interest rate derivatives are interest rate swaps and FRAs. Interest rate options traded in the OTC market comprise a wider range of products than those traded on exchanges, and include options with much longer times to expiry, options on swaps, many kinds of exotic options, and structured products (see the box on pages 176–77).

The OTC derivatives market is almost exclusively a wholesale market. End-users of OTC derivatives are for the most part institutional investors, corporate treasurers (especially of large or multinational companies), governments, and other professionals. Providers of OTC products are mainly banks and securities houses. Brokers also play an important role in OTC derivative markets, acting as agents between the potential counterparties.

(1) See Clews, Panigirtzoglou and Proudman (2000).

Exchange-traded and OTC derivatives

	Exchange-traded	OTC
Trading practices	Central market place. Trading under defined rules and regulations. Access is only via exchange members.	Direct contracts between counterparties, often via brokers.
Transparency	Exchanges provide continually updated information about prices and volumes of contracts traded.	Very little publicly available information about the prices of recently agreed contracts. Indicative prices are often posted on brokers' screens.
Credit risk	Minimal credit risk since the exchange clearing house acts as the counterparty to all trades. Most exchanges insist on initial margin deposits and daily marking to market. Netting different positions is easy.	Counterparty credit risk is an important consideration. Margins, regular revaluation and posting of collateral can be agreed, but are not obligatory. Similarly, there is no netting of positions with different counterparties, but netting of positions with the same counterparty can be agreed.
Contract types	Standardisation of contracts and expiry dates. There are a small number of contract types, and individual contracts are of small and fixed size. Maturities, and times to expiry of options, are shorter on average than for OTC markets.	Products are flexible and can be tailored to users' specifications. There is a proliferation of contract types, but there are also 'plain vanilla' contracts, which are more standardised.
Liquidity	Liquidity created by standardisation of contracts, a wide range of market participants, and a concentration of contracts at short maturities.	OTC contracts are more often held to maturity than exchange-traded contracts.
Market participants	Wide range of market participants.	Almost exclusively a wholesale market.

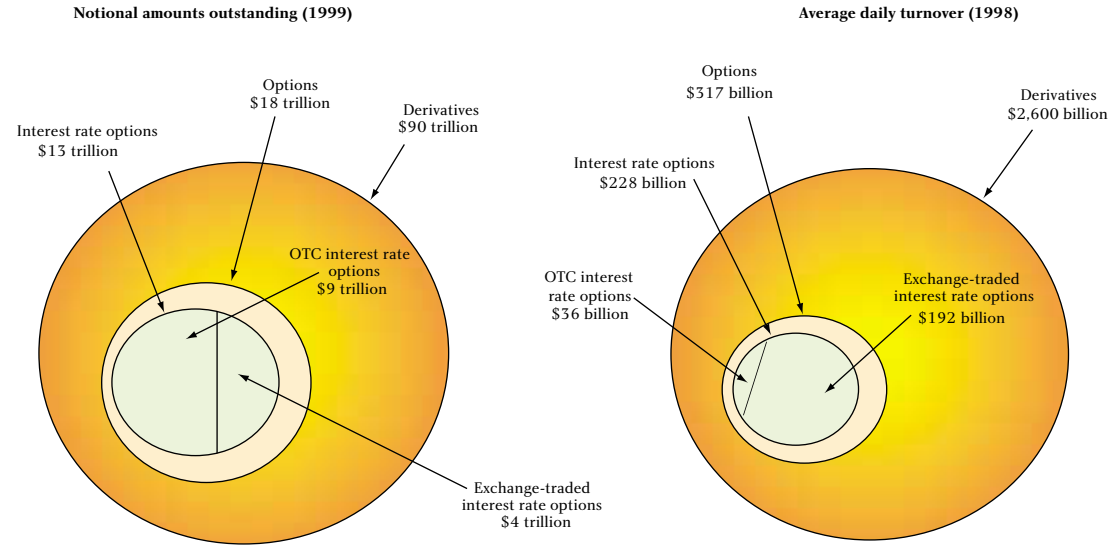
Sources: Ward (1993), Reuters Ltd (1998), and discussions with market participants.

Sizes of the derivative and interest rate option markets

OTC interest rate options accounted for approximately 15% of the notional amount outstanding of the global OTC interest rate derivative markets at end-1999; options also accounted for approximately 15% of market turnover in April 1998 (see Bank for International Settlements (1999a and 2000a)).(1)

Chart 1 illustrates the size of the global OTC interest rate option markets in relation to other derivative markets.(2) As the chart shows, the notional amounts of OTC interest rate options outstanding worldwide significantly exceed the size of the exchange-traded interest rate option market. At $9.4 trillion, the former accounted for about a half of the global option market and one tenth of the total derivative market at the end of 1999. The importance of OTC interest rate options is smaller when measured by turnover, however. In April 1998, average daily turnover in OTC interest rate options was only $36 billion, about 1.4% of the total daily turnover in derivatives contracts. The combination of relatively low turnover and relatively high notional

Chart 1
Global OTC and exchange-traded derivatives markets



Sources: FOW TRADEdata; Futures Industry Association; various futures and options exchanges; Bank for International Settlements (1999a and b, 2000a and b).

(1) Notional amounts outstanding are the absolute gross nominal or notional principal value of all deals concluded and not yet settled at a certain point in time. Turnover is the absolute gross notional value of all deals concluded during a certain period, measured in terms of nominal or notional principal value of the contracts.

(2) Included in total notional amounts outstanding of derivatives are forward, swap and option contracts for OTC interest rate, foreign exchange, and equity-linked contracts; and exchange-traded interest rate, currency and equity-index futures and options contracts. However, the figures exclude commodity and credit derivatives. Turnover data include the same contracts, except for equity derivatives. Data on the global options market include the options elements of the contracts mentioned above. For exchange-traded derivatives, turnover for 1998 Q2 was converted to average daily turnover assuming 61 trading days in the quarter. Results from the next central bank survey of derivative market turnover will be available in autumn 2001.

amounts outstanding of OTC interest rate options is partly explained by OTC interest rate options displaying, on average, longer times to expiry than exchange-traded interest rate options, and partly by OTC interest rate options contracts being more commonly held to maturity than exchange-traded contracts.

Uses of interest rate options

To interpret developments in interest rate option markets, it is important to know the purposes for which these options are traded. This and the following sections are based partly on information from market-makers.

If an interest rate option contract is used primarily for speculation about the levels of future interest rates, and if it is traded in liquid markets, its price should normally be a good reflection of market participants' interest rate expectations. On the other hand, if an option contract is used primarily for risk management and traded in rather illiquid markets, its price is more likely to contain a risk premium (in addition to the credit risk premium) and so it is less likely to give an accurate reflection of the market's true interest rate expectations. This section outlines the main applications of interest rate options reported by market participants.

Speculation

Interest rate options can be used to speculate on both the direction and the volatility of future interest rate movements. Hedge funds and the proprietary desks of investment banks frequently engage in such activity. If speculators buy call options, they will profit if the price of the underlying contract rises sufficiently above the strike price. By buying and selling certain combinations of call and put options and outright contracts, trades can be arranged whose payoffs are sensitive (over a short period of time) to changes in the volatility of interest rate movements, but not to the direction of interest rate changes. Such trades are not possible without using options. An important example is a straddle trade, which consists of the purchase of a call option and the sale of a put option with the same strike price and expiry date. The buyer of the straddle profits if interest rate movements are large, no matter in which direction.

Market-makers report that interest rate options with a shorter time to expiry, especially three months, are used for speculation to a greater extent than longer-dated options. The exchange-traded short-term interest rate option market is generally deemed to be more liquid than the OTC market, and is consequently used more for speculation. Among OTC contracts, short-dated swaptions (see the box on pages 176–77) are used to the greatest extent for speculation. In particular, ATM swaption straddles with three months to expiry are used to speculate on changes in the volatility of interest rates. Speculation using OTC interest rate options is reported to have declined in relative importance in recent years. This partly reflects past losses and partly consolidation in the banking industry, which has left fewer globally active banks.

Risk management and yield enhancement

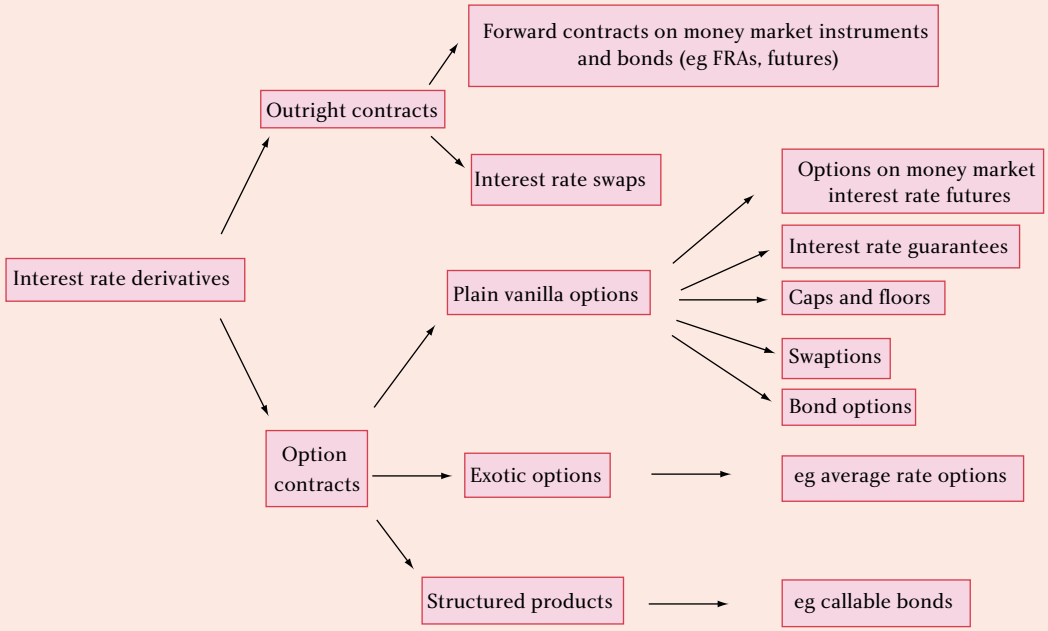
One of the attractions of interest rate options is that investors can use them in combination with outright contracts to alter the risk and return attributes of their investments. The purchase of an outright contract allows the holder to benefit fully from a price rise, but the holder is also fully exposed to downside risk if the price falls. In contrast, the downside risk from buying a call option is limited to the option premium. The option, in effect, provides insurance, as the worst possible outcome is known in advance. Thus derivatives, including interest rate options, allow companies and banks to manage the risk profile and cash flow structures of their assets and liabilities (see Cavalla (1993)). In particular, corporate treasurers can use interest rate options to match liabilities (for example their maturity profile) against their assets, and fund managers can use derivatives to match assets against their liabilities (eg pensions). Corporates, fund managers and banks use interest rate options for hedging existing or anticipated risk exposures. Such hedging involves buying protection against unfavourable interest rate movements. Interest rate options are ideally suited for hedging claims whose occurrence, timing, and size are uncertain, but have particular probabilities attached to them. If the claim materialises, the option used to hedge that claim can be exercised. Interest rate options are also used to manage existing risk exposure. In this process, some return from favourable interest rate movements is surrendered in order to limit the loss from unfavourable interest rate movements.

Two examples of the risk management applications of interest rate options are the following. First, banks and building societies that offer fixed-rate mortgages and variable deposit rates are faced with potential losses if the variable deposit rate that they pay rises above the fixed mortgage rate that they receive. By buying interest

Types of interest rate option

Chart A illustrates the different types of interest rate derivative.

Chart A
Interest rate derivatives



Plain vanilla options

Options on money market interest rate futures

Options on money market interest rate futures contracts are traded on exchanges. Examples include the options on short sterling futures traded on the London International Financial Futures and Options Exchange (LIFFE). They give the holder of the option the right to buy (or sell) an interest rate futures contract at a pre-determined price when the option expires. The most actively traded options on short sterling futures are those with times to expiry of up to one year.

Interest rate guarantees, caps and floors

Options on forward-rate agreements (FRAs) are only traded over-the-counter and are known as interest rate guarantees (IRGs) or interest rate caplets. A call option on an FRA, or 'borrower's IRG', gives a floating-rate borrower the right to lock in a known maximum future borrowing rate. A put option on an FRA, or 'lender's IRG', allows a lender to lock in a known minimum lending rate.

A strip of caplets, one maturing after the other, is called an interest rate cap. Such contracts allow the buyer to establish a maximum interest rate (the strike rate) for floating-rate borrowing over a certain period, for example at the three-month Libor rate over a period of three years. If at the rollover of the loan, three-month Libor is above the strike rate, the borrower is compensated for the difference between these two rates. A cap is not a single option, but rather a strip of individual call options on three-month forward Libor rates, with each option expiring three months after the previous one. Each caplet within the cap is exercised only if the floating interest rate rises above the strike rate in that period (see Kolb (2000)). An interest rate floor is similar to a cap, but it sets a minimum level to be paid on floating-rate borrowing.

Swaptions

Swaptions are options on interest rate swaps and are traded over-the-counter. A swaption gives the buyer the right, but not the obligation, to enter into an interest rate swap at a specific date in the future, at a particular fixed rate (the 'strike rate'), and for a specified term. A particular swaption contract is specified by the option's expiry date, at which point a swap is entered into or the option is cash settled, and by the maturity (or 'tenor') of the forward swap rate.

Bond options

Bond options give the holder of the option the right to buy (or sell) the underlying bond at a pre-determined price at the expiry of the option. They are traded both over-the-counter and on exchanges. Options in the OTC market exist on government and corporate bonds.

Exotic options

There is a wide variety of exotic interest rate options in existence, but only some of them are commonly used. One of the more commonly used types is an average-rate option on a variable interest-bearing security. These are options that relate to the average of the variable rate holding over the life of the option. They are cheaper than plain vanilla options on the underlying rate, since the volatility of the average of a rate is smaller than the volatility of the rate itself, and the price of an option increases with the expected volatility of the underlying contract.

Structured products

Structured products are made up of several components, including outright derivative contracts, options, and the underlying contracts, such as bonds. They frequently take the form of conventional debt instruments that contain embedded swaps and options (eg callable and puttable bonds). The payment flows can be linked to one or more underlying asset.

rate caps with a strike rate related to the fixed mortgage rate offered to customers, these institutions can cap the interest cost of their floating-rate liabilities at a maximum rate related to the fixed rate that they receive from their mortgage customers. Second, issuers of, and investors in, callable and puttable bonds (see glossary) can use swaptions to hedge against changes in cash flows arising from the early redemption of these bonds.

The income from writing options can enhance the yield of investments, or lower the cost of funding. For example, a fund manager with a portfolio of bonds can write a call option on a bond, at a strike price for the call option above which he or she thinks the price of the bond will be unlikely to move. If the bond price remains below the strike price, the option will not be exercised and the fund manager earns the option premium, thereby enhancing the yield of the bond portfolio. Investors can also enlarge the yield on their bond portfolios by buying callable bonds, which provide the bond issuer with an early redemption option. Similarly, bond issuers can reduce their funding costs by issuing puttable bonds, which provide investors with an early repayment option.

The long-dated OTC interest rate option market is said by market-makers to be used mainly for risk management and yield enhancement. Trades are often direct responses to customer demand. These customer flows are often linked to structured products, such as callable bond issues. Caps are said to be used mainly for hedging, especially by corporates, who use them to hedge their floating-rate liabilities, and by mortgage banks, who use them to hedge their capped-rate mortgages.

Market-makers report that their customers typically buy out-of-the-money (OTM) OTC interest rate options for risk management purposes. However, the liquidity of OTM options is generally poor, so that market-makers cannot easily sell on positions they have taken from customers. An integral part of the business of an active options dealer is therefore to manage the risk of at-the-money (ATM) versus OTM option positions.

What can OTC options tell us about interest rate expectations?

As noted above, interest rate option prices can be used to derive implied volatilities. These provide a measure of the market's uncertainty about future interest rate movements. This section reports market-makers' perceptions of the information that sterling OTC interest rate options may contain about market interest rate expectations, additional to that available from exchange-traded products.

Market-makers report that the demand for and supply of OTC interest rate options by their customers is driven mainly by factors other than pure expectations about future interest rates. In particular the demand for and supply of OTC interest rate options is often strongly related to customers' risk management and yield enhancement practices. These considerations can generate imbalances in the demand for and supply of interest rate options, so option prices may no longer accurately reflect market participants' true interest rate

expectations. However, interest rate expectations are thought to influence choices about risk management and yield enhancement to some extent. Such expectations are likely to affect customers' decisions on which particular risk exposures to hedge and which to leave unhedged, and which kinds of interest rate contracts, including options, to choose as hedges.

An example of this effect is that the interest rate option contracts that are used by customers mainly for hedging rather than speculation can have prices and implied volatilities that exceed their fair values based solely on future interest rate expectations. Customers are prepared to pay a premium for obtaining insurance by holding these options, and market-makers demand a premium for providing such insurance. In particular, prices of longer-dated OTC interest rate options are said to be affected significantly by customer flows related to hedging and yield enhancement.

Short-dated interest rate options, especially with up to one year to expiry, are thought to reflect the market's interest rate expectations better than long-dated options, since they are more liquid, and are used more for speculation. Short-dated options also match speculators' time horizons more closely. Among short-dated options, exchange-traded contracts are thought to reflect the market's interest rate expectations better than OTC contracts, partly since exchange-traded markets are more transparent than OTC markets, enabling better price discovery. This helps to explain why the exchange-traded contracts are more widely used to derive information about interest rate uncertainty.

However, in order to interpret the information content of the more liquid exchange-traded option contracts, it may still be useful to understand developments in the OTC interest rate option markets. Some market participants arbitrage the prices of OTC interest rate options against those of exchange-traded interest rate options, and use exchange-traded options to hedge OTC option positions. Due to these arbitrage and hedging linkages, for example between prices of interest rate caps and short sterling futures options, distortions in the prices of OTC interest rate options, due to their use for risk management and yield enhancement, may affect the exchange-traded markets.

Among OTC interest rate options with short periods to expiry, market participants believe that three-month options on two, five and ten-year swaps reflect the markets' future interest rate expectations better than other swaption contracts, caps, or OTC gilt options. Information about the uncertainty of expected future swap rates is available only from the OTC interest rate options market. However, OTC options involve greater counterparty credit risk than exchange-traded options, so their prices may contain larger credit risk premia.

Most of the exotic interest rate option trades carried out by market-makers are said to respond directly to customer demand; there is very little interbank trade in these products, and they are therefore not thought likely to reflect the market's interest rate expectations accurately.

Interrelationship with the underlying markets

Interest rate options markets may also affect the prices of the underlying contracts. Understanding these linkages may help in interpreting price movements in the underlying contracts.

The risk management of interest rate option positions establishes an interrelationship between the interest rate options markets and the markets for the underlying contracts such as government bonds and interest rate swaps. These interrelationships may make markets more efficient by establishing arbitrage links between different markets. In illiquid markets, however, the hedging of interest rate options positions may increase the price volatility of government bonds and swaps.

An interest rate option can be hedged initially against directional price movements of the underlying interest rate contract, by buying or selling an appropriate fraction, delta, of the underlying contracts. Delta is the rate at which the value of an option changes as the price of the underlying contract changes. This process is called delta-hedging. As the price of the underlying contract rises, a call option moves deeper into-the-money and becomes more likely to be exercised, and its delta increases. The sellers of the options therefore have to buy additional underlying contracts if they want to hedge this exposure. Similarly, if the price of the underlying contract decreases, the sellers may choose to sell some of them to re-establish the delta hedge. In rebalancing the delta hedge, sellers therefore 'buy high and sell low'. Consequently, rebalancing the delta hedge may increase the price volatility of the underlying interest rate contract, especially if the size of the option position is large in relation to the size of the underlying market, and assuming that the holders of the

options conduct no delta-hedging of their own, perhaps because the option itself has been bought as a hedge against pre-existing risk exposure.

If the liquidity of the underlying asset market is poor, any such rehedging is likely to be expensive. As the liquidity of the underlying contracts decreases, their bid-offer spreads (ie the difference between the prices at which one can buy and sell these contracts) tend to widen, and it becomes more costly to hedge an option position by buying and selling underlying contracts. When rehedging an option position whose size is large in relation to the size of the underlying market, the price of the underlying asset may move against the seller of the option.(1)

If the underlying asset is illiquid, the greater cost and difficulty of hedging an option position will make it more costly and more risky, and therefore provide a disincentive for entering into option contracts. In this way, lack of liquidity in the government bond or interest rate swaps market can, in turn, help to reduce the liquidity in the interest rate options market.

Market-makers confirm that the liquidity of the market for the underlying interest rate contracts has an important effect on the liquidity of the related interest rate options market. A frequently cited example of this link is the reduction in the past few years in the liquidity and size of both the exchange-traded and OTC gilt option markets. Market participants attribute this development largely to a reduction in the liquidity of the gilt market.

There is less agreement, however, about causal linkages from the interest rate option markets to the underlying asset markets. Some market participants argue that activity in the interest rate option markets has little, if any, impact on activity in the market of the underlying asset. Others, in contrast, believe that interest rate option markets also have an effect on the underlying market, both on activity and price volatility, partly due to the linkages generated by hedging. Depending on the circumstances, liquidity in the interest rate option market could either enhance or impair liquidity in the underlying market. Provided that the underlying market is already liquid, and price movements are not too large, option positions could add to that liquidity due to the use of the underlying market for rehedging. But if there are large price realignments, or if interest rate option positions are large in relation to the size of the underlying market, liquidity in the underlying market could be adversely affected, due to demand from rehedging, which could be very much one-way. For example, activity in the long-dated sterling swaption market was thought by some market-makers to have affected the long-dated sterling swap market and to have increased the price volatility of the gilt market in 1999, when swaptions were sold by investment banks to insurance companies, as a hedge for insurance companies' guaranteed annuity liabilities.(2) It was suggested, however, that the effect of options on the price volatility of the underlying market is generally larger for foreign exchange options than for interest rate options.

Conclusions

Given the wider range of products traded in the OTC interest rate options market, OTC interest rate options may be useful for investigating longer-term interest rate expectations. Among sterling OTC interest rate options, market-makers believe that three-month at-the-money options on two, five and ten-year interest rate swaps reflect the market's interest rate expectations to the greatest extent. Information about the uncertainty of expected future swap rates is available only from the OTC interest rate option market, since options on swaps are not traded on exchanges.

Market participants generally believe that in the sterling OTC interest rate options market, option contracts with more than one year to expiry do not accurately reflect the market's future interest rate expectations, since their prices are mainly affected by other considerations. In particular, OTC interest rate options in sterling with long periods to expiry are said to be used mainly for risk management and yield enhancement, rather than interest rate speculation. Moreover, OTC options involve greater counterparty credit risk than exchange-traded options, so their prices may contain larger credit risk premia.

Exchange-traded interest rate option contracts on short sterling interest rate futures with up to a year to expiry are thought by market participants to provide a better guide to near-term market interest rate expectations than

(1) A model that shows how delta-hedging can influence and move the market in the underlying contract is presented in Wilmott (2000).
(2) These products guarantee a minimum annuity rate at retirement. They are, in effect, options since they allow policyholders to choose the higher of the annuity rate available in the market and the guaranteed rate when they retire.

OTC interest rate options, since they are more liquid and used more for speculation. However, in order to interpret the information content of the more liquid exchange-traded option contracts, it may still be useful to understand developments in the OTC interest rate option markets, since price distortions in the OTC markets may affect exchange-traded interest rate option markets due to arbitrage and hedging linkages between them.

Market participants generally believe that the liquidity of the underlying market has a profound effect on the liquidity of the related option market. However, there is less agreement about the causal linkages from the OTC interest rate option markets to the underlying markets. Some suggest that the OTC interest rate option markets affect the price volatility and liquidity of interest rate swaps and government bonds, while others argue that there is little, if any, effect.

Glossary of terms

At-the-money (ATM)—Options contracts that give the right to buy or sell the underlying asset at a strike price equal to the current forward price of the underlying asset.

Callable bond—A bond that gives the issuer of the bond the right to redeem the bond before its maturity date. The issuer pays a higher yield to the investor for this right.

Call option—A call option gives the buyer the right, but not the obligation, to buy an asset at a predetermined strike price when the option expires. The buyer of a call option profits if the price of the underlying asset rises above the strike price.

Forward-rate agreement (FRA)—A contract for the exchange of fixed versus floating interest rate payments calculated from a notional principal amount. FRAs are only traded over-the-counter.

Implied volatility—This is the volatility of the underlying asset price of an option implied by the Black-Scholes option pricing model, expected over the lifetime of the option (see, for example, Kolb (2000)). It is a non-linear transformation of the option price.

In-the-money (ITM)—Call options with a strike price lower, and put options with a strike price higher, than the current forward price of the underlying contract.

Interest rate swap—An agreement between two parties to exchange fixed versus floating interest payments on a certain notional principal amount at the start of each of a number of successive periods. An interest rate swap is like a strip of FRAs, each one beginning once the previous one has matured. Interest rate swaps are only traded over-the-counter.

Out-of-the-money (OTM)—Call options with a strike price higher, and put options with a strike price lower, than the current forward price of the underlying contract.

Put option—A put option on an asset gives the buyer the right, but not the obligation, to sell the asset at the strike price at the time of expiry of the option. The buyer of a put option profits if the price of the underlying asset falls below the strike price.

Puttable bond—A bond that gives the investor the right to sell back the bond to the issuer before its maturity date. The investor accepts a lower yield in return for this optionality element.

Short sterling future—A sterling interest rate futures contract, which settles on the three-month Libor rate prevailing on the contract's delivery date. Contracts are standardised and traded between members of LIFFE. The most liquid and widely used contracts trade on a quarterly cycle with maturities in March, June, September and December. Similar interest rate futures contracts exist on dollar, euro and yen Libor rates.

Strike price—The pre-determined price at which an option can be exercised, ie at which the underlying contract can be bought or sold at expiry of the option.

Volatility—The standard deviation of daily percentage changes in the price of a financial instrument or an interest rate.

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