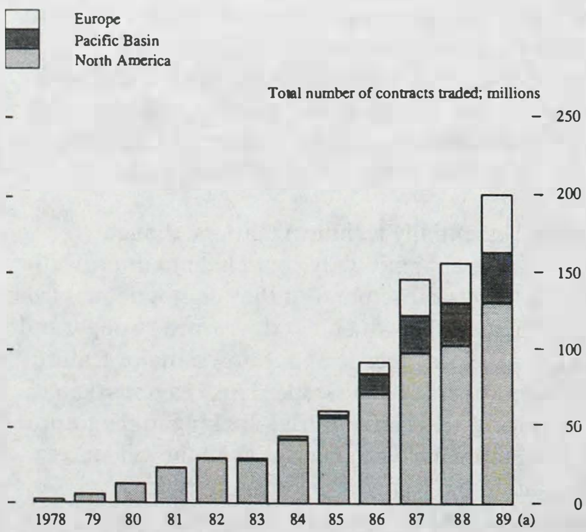
A survey of interest rate futures

This article[1] is one of a series of background articles for the general reader explaining how different financial markets and other parts of the financial system work. It surveys the development of interest rate futures within the context of the internationalisation of world financial markets. It provides a basic description of the various types of interest rate futures and their traditional uses and users as well as statistics of trading by exchanges, geographical areas and instruments. The article notes some of the economic factors underlying the growth of interest rate futures and seeks to provide some explanations for the successes and failures of individual futures contracts. Recent innovations with respect to the instruments themselves, and recent technological advances in trading mechanisms are also discussed.[2]

Introduction

Since the first contract on mortgage-backed securities of the US Government National Mortgage Association (GNMA) was introduced on the Chicago Board of Trade (CBOT) in October 1975, the trading of futures contracts on debt instruments (also called interest rate futures) has grown rapidly. The volume of global trading has risen from a little over 20,000 contracts in 1975 to over 156 million contracts in 1988 (see Table A). In the United States, the country which has the longest history of trading in financial futures, the futures markets for fixed-income securities have experienced the strongest sustained growth of any sector in the futures industry, and their share of the total futures volume has risen from 4% in 1978 to 42% by 1988, while the share accounted for by traditional contracts based on agricultural commodities has declined fairly steadily (see Chart 2).

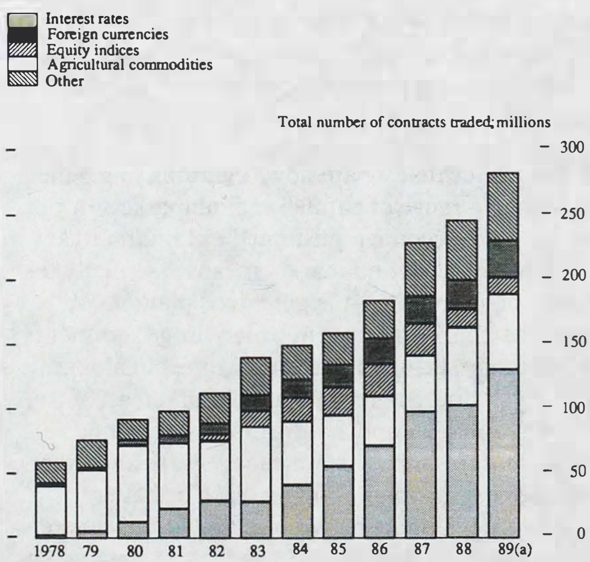
Chart 1
World interest rate futures contracts; turnover by geographical area



Source: US Futures Industry Association and individual exchanges.

(a) First six months at annual rate.

Chart 2
Futures contracts traded in the United States; by commodity group



Source: Futures Industry Association.

(a) First six months at annual rate.

During the 1970s a combination of high inflation, growing stocks of private and public debt and changes in the framework of monetary policies contributed to high levels of nominal interest rates and considerable interest rate volatility. These, and other factors—including the deregulation of domestic capital markets, the elimination of controls on international movements of capital, and the development of new information and trading technologies—affected the behaviour of both issuers and investors in the fixed income markets. Investors have shown greater interest in trading than was the case in the 1950s and 1960s, when interest rates fluctuated narrowly, and have sought new ways to protect or enhance their returns. Issuers of debt have found it increasingly difficult to forecast interest rates, and have therefore made greater use of hedging techniques. At the same time, participants in other derivative markets, such as interest rate options,

(1) Written by Serge Jeanneau in the Bank's International Division. The author wishes to thank the London International Financial Futures Exchange (LIFFE) for comments on technical aspects of the article.

(2) For more comprehensive reviews of financial futures see M D Fitzgerald, *Financial Futures*, Euromoney Publications, 1983 and R Dale, J Leslie and G Wyatt, *Futures and Options, Winners and Losers*, Financial Times Business Information Ltd, 1988.

Table A
Annual turnover of interest rate futures contracts by major exchanges[a]
Thousands

Exchange	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989 H1
North America															
ACE				17	64	13	—	—	—	—	—	—	—	—	—
CBOT	20	129	458	1,534	3,561	8,845	16,363	19,822	22,058	32,525	43,728	57,964	73,727	77,309	41,796
CME		110	322	775	1,953	3,340	6,070	8,479	5,761	8,414	11,398	12,643	22,343	23,079	22,486
COMEX					29	101	31	—	—	—	—	—	11	—	—
ME														10	13
MIDAM							110	520	305	282	334	502	1,041	1,441	639
NYCE/FINEX													384	790	345
NYFE						172	291	5	—	—	—	—	—	—	—
TFE						5	33	56	33	43	18	12	—	—	
Sub-total	20	239	780	2,326	5,607	12,476	22,898	28,882	28,157	41,264	55,478	71,121	97,506	102,629	65,279
Europe															
EOE/FTA													67	92	53
CSE														53	122
IFOX															2
LIFFE								191	1,187	2,307	3,130	6,291	11,890	13,305	9,662
MATIF												1,714	12,018	12,826	9,022
OM														5	—
OMF															26
Sub-total	—	—	—	—	—	—	—	191	1,187	2,307	3,130	8,005	23,975	26,281	18,887
Pacific area															
NZFE											20	121	214	384	151
SIMEX										34	295	495	1,534	1,881	2,078
SFE					2	17	28	159	161	185	837	2,512	4,162	6,201	5,013
TIFFE															216
TSE											453	9,395	18,284	18,732	8,612
Sub-total	—	—	—	—	2	17	28	159	161	219	1,604	12,523	24,194	27,198	16,070
Total	**20**	**239**	**780**	**2,326**	**5,609**	**12,493**	**22,926**	**29,232**	**29,505**	**43,790**	**60,213**	**91,649**	**145,675**	**156,108**	**100,236**

(a) Based on a detailed survey by the author of contracts traded on futures exchanges since 1975. The figures are rounded to the nearest thousand.

have used interest rate futures extensively to hedge their options positions.

From their inception in 1975 until the mid-1980s, the development of interest rate futures was most rapid and widespread in the United States. US futures exchanges located in Chicago and elsewhere responded to the volatility of interest rates by introducing a variety of interest rate futures contracts, and by the early 1980s these included contracts on a wide range of instruments. The success of financial futures trading in the United States stimulated the introduction of interest rate futures in other countries. Interest rate contracts were introduced on the Sydney Futures Exchange (SFE) in 1979 and the Toronto Stock Exchange in 1980. The movement accelerated after the opening of the London International Financial Futures Exchange (LIFFE) in 1982 and with the opening of new exchanges in the Pacific Basin area and in continental Europe. Whereas in 1980 US exchanges accounted for virtually all of world trading in interest rate futures, this proportion had declined to 66% by 1988 as trading developed rapidly in the United Kingdom, France and Japan (see Chart 1).

In the 1980s the introduction of new interest rate contracts has also reflected the growing internationalisation of debt markets as issuers and investors have increasingly required the ability to hedge their foreign currency assets and liabilities in the futures markets. As a result, in addition to contracts on domestic debt securities, several exchanges have introduced offshore contracts which are very similar to US contracts on Treasury securities or eurodollar time deposits. For instance, the Singapore International Monetary Exchange (SIMEX) is unique in that it concentrates exclusively on foreign products, reflecting the small size of its domestic financial market. Some contracts such as LIFFE's contracts on deutschemark-denominated debt instruments have also been introduced outside the 'home' country in response to offshore demand and domestic limitations on futures trading.

The nature of interest rate futures

Interest rate futures are a subset of financial futures; the latter can be broadly defined as futures contracts where the underlying assets are not physical commodities but financial instruments such as currencies, equities or fixed income securities. As with all futures contracts, interest rate futures enable participants in financial markets to fix in advance the price that will apply to their transactions at specified times in the future. This allows them to avoid the risks of adverse rate movements in the spot market or, alternatively, to speculate on such movements. In the specific case of interest rate futures, the price that is fixed implies either a yield on particular fixed-income securities or the level of some type of representative interest rate index. The contract is a legally binding standard agreement between a buyer and a seller for the delivery of a specified amount of a particular type of financial instrument or, in some cases, its cash equivalent on a given future date, and at a pre-agreed price.[1]

Interest rate futures markets operate in the same way as other futures markets. Contracts specify delivery for given

(1) Several options contracts also exist which specify delivery in terms of specific cash instruments or futures contracts. Such options have allowed a widening of the hedging and trading opportunities available with interest rate futures. This article, however, is confined to futures contracts.

months for the relevant securities. All exchanges determine a given sequence of calendar months as delivery months; the most common being a quarterly cycle of March, June, September and December, usually extending for up to two years in the future. In some cases the cycle can go as far as four years. Interest rate futures are generally traded by 'open outcry'[1] on centralised and regulated exchanges. Exchanges make public the transaction volumes, open interest[2] and prices.

One aspect of futures exchanges is that after the execution of a trade, the clearing house of the exchange places itself between the two clearing members of the two trading parties, acting as the seller to the buyer and as the buyer to the seller, at the terms agreed by the original parties. Thus, it is both long and short at the same price and assumes no net position in the market but functions as a conduit of transaction flows. The clearing house also usually assures the financial integrity of the contracts traded on the exchange by operating a system of daily revaluation ('marking-to-market') accompanied by the calling of margin to reflect changes in the net obligations of the members of the clearing house, and supported by an initial margin reflecting the intrinsic volatility in the prices of the underlying instruments. This substantially reduces bilateral credit risk, and is reflected in the exemption of interest rate futures from capital weighting for credit risk under the Basle convergence agreement. In addition, the standardisation of contracts and the role of the clearing house as counterparty to all clearing members make possible the netting of their buying and selling positions in a simple fashion rather than resulting in further counterparty relationships.

Since all contracts of a given maturity in the same market are identical, obligations under futures contracts can in effect be easily transferred from one party to another. A trader who holds a contract to either buy or sell can cancel this obligation by taking a new contract to either sell or buy in that maturity—a process known as 'offsetting' or 'closing out' of contracts. In practice delivery of the underlying financial instruments is unusual (although the possibility that a contract could be delivered is important as it ensures that the price of the futures contract and the underlying instrument will eventually converge).

Futures contracts are not the only way by which borrowers can reduce uncertainty over interest rate movements. Similar results can be obtained by the short-selling of securities in the cash market (where such a practice is permitted) or in forward markets. Forward contracts differ from futures contracts in that they are tailor-made rather than standardised, thus allowing participants to choose the exact date, size and type of instrument desired. However, since trading is not conducted on a centralised exchange, each counterparty must assess the creditworthiness of the other.[3]

Types of interest rate futures

Interest rate futures include a wide variety of contracts on government interest-bearing or discount securities, government-guaranteed securities, corporate securities, and bank securities or deposits. They range from contracts in money-market securities (with maturities of up to one year), such as Treasury bills, bankers acceptances, US federal funds, US commercial paper, US bank certificates of deposit and time deposits, to contracts on government and corporate securities with maturities of up to about 20 years. Some contracts are not based on delivery of particular securities, but are 'cash settled' with reference either to cash market interest rates (eg eurodollar contracts) or to a price index of eligible securities (eg the municipal bond contract traded on the CBOT). The nominal value of US dollar contracts ranges between $50,000 and $200,000 for US Treasury bonds and notes, and is $1 million for three-month eurodollar time deposits and $5 million for US federal funds, while contract denominations in sterling are £50,000–£100,000 for gilts and £500,000 for three-month time deposits. The nominal value of most contracts in other currencies generally falls within these ranges. In common with other aspects of contract specification, the nominal value of a contract is designed by exchanges to create as large a market as possible. The decision of an exchange to specify a given nominal size reflects its judgement about market participants' willingness for exposure to risk, and the cost of transacting a given amount. Because the impact of a given change in interest rates is smaller for shorter-maturity instruments, the less volatile short-term contracts are generally designed to have larger nominal amounts, reflecting their value-adjusted volatility. For this reason, it would be somewhat misleading to say that a eurodollar contract is equivalent to ten US Treasury bond contracts because the face value of the eurodollar contract is $1 million compared with $100,000 for the US Treasury bond contract. Examples of the main types of contracts traded are shown in Table B and the growth in trading is shown in Chart 3.

There are certain common basic principles involved in the pricing of various interest rate futures contracts. Short-term interest rate contracts are priced on an index basis where the contract price is always given as 100 minus the implied interest rate. This pricing method preserves the normal inverse relationship between financial asset prices and interest rates. In the case of longer-term instruments such as bonds, which carry widely differing coupons and maturities, the contract design and pricing is slightly more complex.

The three-month sterling interest rate (short sterling) contract introduced on LIFFE in October 1982 may be taken as an example of a short-term instrument. The contract is based on a notional £500,000 three-month

(1) Open outcry is a method of dealing on futures markets involving oral bids and offers which are audible to all other market participants on the trading floor. Some exchanges, however, such as the New Zealand Futures Exchange and the Tokyo Stock Exchange, have developed screen-based electronic trading systems.

(2) Open interest is the cumulative number of futures contracts which have been purchased and not yet offset by opposite futures transactions, nor fulfilled by delivery.

(3) Trades in interest rate hedging instruments carried out off organised exchanges, ie 'over-the-counter' (OTC), are not covered in this survey.

Table B
The ten interest rate futures contracts most actively traded in 1988(a)

Contract	Exchange	Introduction date	Size	Minimum price fluctuation	Settlement	Volume (Thousands)
20-year US Treasury bond	CBOT	Aug. 77	$100,000 with 8% coupon	$\frac{1}{32}$ point = $31.25	Physical	70,308
3-month eurodollar time deposit	CME	Dec. 81	$1 million	0.01 point = $25	Cash	21,705
10-year Japanese government bond	TSE	Oct. 85	¥100 million with 6% coupon	0.01 point = ¥10,000	Physical	18,720
10-year French Treasury bond	MATIF	Feb. 86	Fr.Fc.500,000 with 10% coupon	0.05 point =Fr.Fc.250	Physical	12,357
20-year gilt	LIFFE	Nov. 82	£50,000 with 9% coupon	$\frac{1}{32}$ point = £15.625	Physical	5,587
10-year US Treasury note	CBOT	May 82	$100,000 with 8% coupon	$\frac{1}{32}$ point = $31.25	Physical	5,201
3-month sterling time deposit	LIFFE	Oct. 82	£500,000	0.01 point = £12.50	Cash	3,538
90-day bank accepted bills	SFE	Oct.79	A$500,000	0.01% = variable tick value(b)	Physical	2,989
10-year Commonwealth Treasury bond	SFE	Dec. 84	A$100,000 with 12% coupon	0.005% = variable tick value	Cash	2,712
20-year US Treasury bond	LIFFE	June 84	$100,000 with 8% coupon	$\frac{1}{32}$ point = $31.25	Physical	2,042

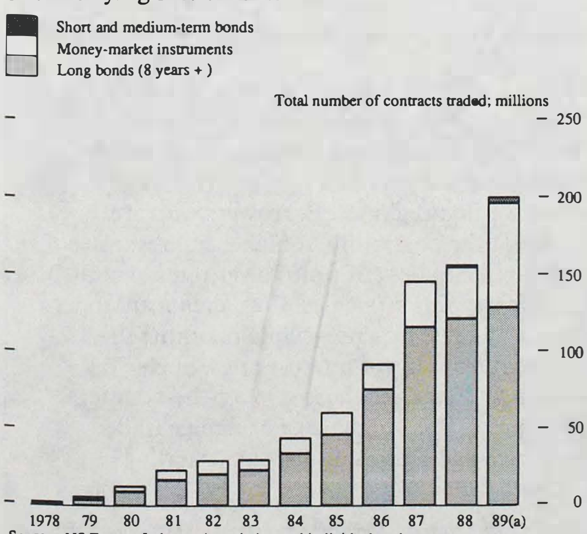
(a) This table is based on current published information. It should be noted that contract specifications are often changed by the exchanges.

(b) On the SFE, all interest rate futures are quoted on an index basis whereby the annual percentage yield is deducted from 100. This means that the dollar value of minimum fluctuations changes with interest rate levels.

deposit and is settled at maturity at a price determined by the interest rate at which three-month deposits are being offered to prime banking names in London (ie three-month Libor). Currently contracts mature once a quarter in March, June, September and December. At any time there are eight contract months available for trading: as one comes to delivery a new contract for 24 months hence is introduced. The minimum price fluctuation of a short sterling contract (the 'tick' in market terminology) is one basis point (or $\frac{1}{100}$ of a percentage point). Since each contract is for interest on a notional three-month deposit, the value of each basis point change is £12.50 (ie 0.01% × £500,000 × $\frac{1}{4}$ of one year).

Whereas money-market instruments have no coupons, coupon securities such as US Treasury bonds are much more heterogeneous, having differing coupons as well as varying current maturities. Accordingly, in order to create an acceptably liquid contract in bond futures, some way has had to be found to make a wide and changing array of bonds more or less equivalent for delivery against the futures contract. The US Treasury bond contract introduced by the CBOT in August 1977 may be used as an example. The contract is for $100,000 face value of notional 8% US Treasury bonds. It specifies that deliverable bonds include any bond, whatever its coupon, that does not mature, nor is callable, for at least 15 years from the date of delivery. The value of each bond eligible for delivery against the contract is calculated through the use of conversion factors which reflect the difference between the actual coupon and the 8% standard. Conversion factors are obtained by determining the prices at which the bonds to be delivered would display a yield to maturity of 8%. The minimum price fluctuation is $\frac{1}{32}$ of a percentage point, which is equivalent to $31.25. Most other contracts on long-term securities are structured along similar lines.

Chart 3
World interest rate futures contracts; turnover by type of underlying instruments



Source: US Futures Industry Association and individual exchanges.

(a) First six months at annual rate.

Uses of interest rate futures

The three basic motives for trading in interest rate futures have traditionally been described as hedging, trading and arbitrage, although in practice it is increasingly difficult to make such a clear-cut distinction, given the greater use made of them by financial institutions for purposes of asset/liability management. Hedging involves using futures contracts to reduce risk and to protect the value or the cost of existing or anticipated assets and liabilities. Speculation implies the assumption of a greater degree of risk in the hope of greater reward. Arbitrage exploits actual or perceived anomalies between the prices of a futures contract and the underlying security or other instruments to earn small but riskless profits.

Hedgers make use of futures contracts to reduce the risk of losses resulting from movements in interest rates. For example, a corporate treasurer expecting to receive and invest a sum of money in three months' time and concerned that interest rates may fall over this period could purchase a futures contract. Since the price of futures contracts moves inversely with changes in interest

An example of hedging with three-month sterling futures[1]

Hedging in the interest rate futures market is used to reduce the risk of loss through adverse movements in interest rates by temporarily offsetting a current or expected position in the cash market with a matching, but opposite, position in the futures market. The following example using the three-month sterling interest rate contract traded on LIFFE shows how such a contract can be used to hedge interest rate risk.

Assume that on 1 February a corporate borrower has a £500,000 three-month loan from the money market which costs him 10% per annum, and which will be rolled over on 1 May. The borrower expects a rise in interest rates and wants to protect himself against such an eventuality by using LIFFE's short sterling contract. The contract is for a three-month deposit of £500,000 beginning in March, June, September and December. As the March contract will have matured before the 1 May rollover, the borrower establishes his hedge by selecting the contract for June delivery.

Since the borrower is concerned that interest rates will rise, he arranges to sell a June futures contract. The contract is priced by subtracting the implied deposit interest rate from 100. Assuming, for purposes of illustration, that market expectations are such that the implied interest rate on the futures contract which the borrower sells on 1 February is equal to the present spot rate of 10%, the price of the contract will therefore be 90. If it is assumed that by 1 May, when the loan is rolled over, interest rates have risen to 12%, and that implied rates in the futures market have moved similarly, the price of the futures contract will have fallen, enabling the borrower to buy an offsetting contract at a lower price—88.

It may be shown that the 2% increase in interest rates results in a hedging gain of £2,500. The minimum price fluctuation of a short-term sterling futures contract (a tick) is one basis point (1/100 of one percentage point). Prices can move by this minimum discrete amount of .01—from 95.05 to 95.06, for example. Since each contract has a £500,000 face value, the value of each tick is £12.50 (.01% × £500,000 × ¼ of the year). The 2% increase in interest rates results in a gain on the contract of 200 × £12.50 = £2,500, which exactly offsets the loss incurred because of the higher rate in the cash market.

Cash market	Futures market
1 February	
Fears of rise in rates by date of rollover of loan	Sells one June contract at 90.00 (rate = 10%)
1 May	
Rolls over loan at 12%	Buys back futures at 88.00 (rate = 12%)
Extra cost 2% of £0.5 million for one quarter = £2,500	Gain on hedge 200 ticks at £12.50 = £2,500

The result of the hedge is shown in the table. In this example the gain on the futures contract equals the extra interest cost, allowing the borrower to achieve a net borrowing cost of 10% per annum. If interest rates had fallen, the hedger's loss on his futures position would have been matched by lower interest payments so that his net borrowing costs would still have been 10%. The borrower has achieved protection against a rise in rates, but has also foregone the possibility of benefiting from a fall in rates.

In practice a perfect hedge as illustrated above is rare. Futures prices may not move exactly in line with cash market rates on the underlying instrument. Futures contracts are only traded on a limited number of underlying instruments, and therefore not every financial transaction has an exact hedge in the futures markets. When the underlying liability is different from the futures contract used to hedge (such as a loan priced off commercial paper rates compared with a loan priced in relation to LIBOR), or does not exactly match the maturity date of the futures contract, the user exposes himself to the risk of an imperfect correlation between the liability and the futures contract ('basis risk'). These cross hedges give less protection than the exact hedge provided by the unique matching of a single liability and corresponding futures contract. However, as long as the rates on the liability to be hedged show a sufficiently high degree of correlation with the underlying security for which there exists a futures contract, hedges will provide a substantial degree of protection. But if rates move in opposite directions hedgers could face losses. Therefore such cross hedges involve an element of risk. Another reason why perfect protection is difficult to achieve is that the amount to be hedged may not be exactly equal to the nominal value of the futures contract (or the nominal value of several contracts if the amount were to be larger than £500,000). This means that the position may be only partially hedged, or over-hedged.

Borrowers can also hedge against short-term interest rate risk by entering into forward rate agreements (FRAs), by arranging long-term loans or by arranging interest rate swaps whereby they agree to pay fixed rates and receive floating rates. Borrowers who are concerned about the possibility of higher interest rates, but who would like to benefit from lower rates, could use a variety of capping strategies. Caps create an upper limit on future interest expenses while retaining the ability to benefit from lower interest rates. Such instruments include the purchase of over-the-counter interest rate caps or the purchase of exchange traded put options, such as LIFFE's on the short sterling contract.

(1) For other examples of hedging and trading using financial futures and options see *LIFFE, an introduction*, 1988.

rates, the contract would increase in value as interest rates fell, enabling him to sell the contract at a profit, offsetting some or all of the adverse movement in rates in the spot market. Conversely, an investor concerned to maintain the value of fixed-interest investments in the face of the possibility of higher rates could sell a futures contract, which, if rates were to rise in the meantime, could then be bought back at a lower price, yielding a profit to offset the effect of the increase in rates in the spot market (see the note on page 392 for a worked example).

The main users of interest rate futures markets for hedging include corporate treasurers who may want to fix a rate on a forecast cash surplus or to lock in a borrowing rate on a planned issue of fixed-income securities; pension funds and insurance companies who want to protect the yield on a planned investment in debt securities; investment banks who underwrite large bond issues in volatile conditions and who want to protect their bond positions during primary distribution; commercial banks who want to modify the average maturity of their financial assets or liabilities without wanting to carry their transactions in the cash markets; market makers in cash markets whose ability to quote in size is dependent on the ability to control the risk of the positions they hold; and mortgage originators who want to protect themselves against interest rate swings between mortgage origination and the sale of loans in the secondary mortgage market. The ability to acquire protection against unforeseen changes in interest rates allows these users to reduce some of the uncertainty inherent in the financial planning process.

In contrast to hedgers, with pre-existing risk positions, speculators and arbitrageurs enter the market purely to profit from absolute or relative price movements. Three aspects of futures markets make them attractive to speculators. First, lower transaction costs can make futures contracts attractive trading alternatives to cash transactions. Second, fractional margin requirements may at times allow some speculators to attain higher levels of leverage than would be available on cash transactions. Third, they may allow speculators to short the market—a type of trade which is restricted in many cash markets. Speculators play an essential role because their willingness to take risks provides hedgers with counterparties and therefore increases the liquidity of futures markets. Liquidity is also supported by the activity of arbitrageurs.

Because they allow risk to be spread out across a large number of investors and transferred away from those hedging spot positions to professional speculators or arbitrageurs, there may be less need for investors to require a risk premium in cash transactions to compensate for the possibility of adverse price fluctuations on their investments. By reducing search costs for financial transactions and permitting the effective hedging of cash positions, futures trading can narrow bid/offer spreads in the cash markets, so helping to increase their liquidity.

In addition to hedging, trading and arbitrage, interest rate futures contracts can allow users to adjust the average maturity of portfolios of debt securities through the shortening or lengthening of particular securities' maturities. The maturity of a security can be shortened synthetically by the sale of a futures contract against which the security is deliverable. The new maturity of the security is the delivery date of the contract while the new redemption value is the price implied by the futures quote. This would allow, for instance, a 20-year bond to be shortened to a two-month investment. Conversely, the maturity of a portfolio of short-term securities could be synthetically lengthened by the purchase of a strip of short-term contracts which would set rates on rollover dates of the securities. Financial institutions such as banks make extensive use of interest rate futures contracts to adjust the maturity structure of their financial assets and liabilities. This allows them either to hedge away the net interest rate risk resulting from a mismatch of financial assets and liabilities or to increase interest rate exposure in order to take advantage of an expected favourable change in interest rates.[1]

Economic factors responsible for the growth of debt futures

The growth in the trading of interest rate futures has been rapid. This has been the result of both continued strength in trading on the US exchanges, especially the CBOT and the Chicago Mercantile Exchange (CME), and the establishment of many more exchanges outside the United States during the 1980s. Between 1980 and 1986 the CBOT's US Treasury bond contract regularly accounted for over half of the total world volume of trading of interest rate futures; by 1988 this contract and the CME's eurodollar contract accounted for about 60% of global annual turnover. The ten most heavily traded contracts by volume, listed in Table B, represented some 93% of annual global turnover in 1988. It should be noted, however, that the ranking of contracts differs if they are calculated on the basis of nominal values, reflecting the variations in the size of individual contracts. On this

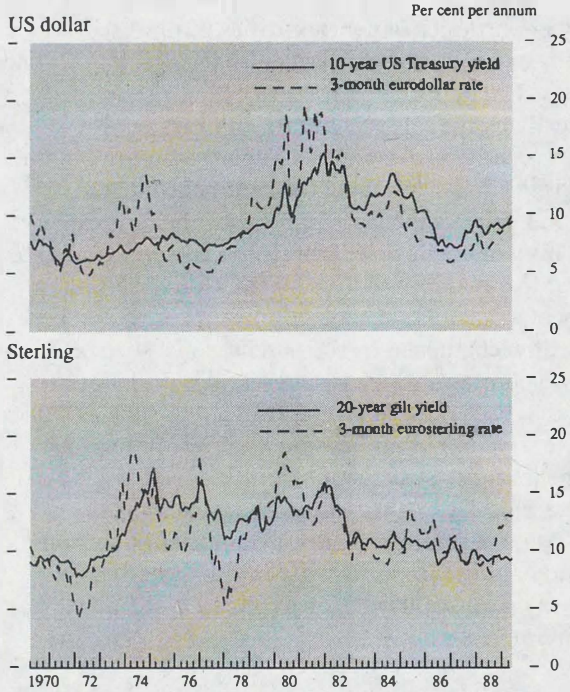
Table C
Average daily trading value of the five largest contracts: 1989 H1

	Daily contract turnover (Thousands)	Contract value(a) in US$	Value ($ billion)
3-month eurodollar time deposit $1 million; (CME)	172.5	1,000,000	172.5
10-year JGB ¥100 million; (TSE)	69.9	750,188	52.4
20-year US Treasury bonds $100,000; (CBOT)	295.5	100,000	29.6
3-month sterling interest rate £500,000; (LIFFE)	26.7	845,000	22.6
3-month eurodollar time deposit $1 million; (SIMEX)	16.7	1,000,000	16.7

Source: Individual exchanges.
(a) Average dollar exchange rates for the first half of 1989: ¥133.3, £1.69.

(1) See R W Kopprasch, *Introduction to interest rate hedging*, Salomon Brothers Inc, November 1982.

Chart 4
Interest rates



Source: BIS Databank.

basis, the CME's eurodollar contract was the largest contract in 1988 and in the first half of 1989 (see Table C).

A number of factors are responsible for the growth of trading in interest rate futures. These include the increase in interest rate volatility that occurred during the late 1970s (see Chart 4), a period of rising inflation (and higher nominal interest rates), and changes in monetary policy in a number of centres which placed greater emphasis on monetary targeting.[1] The higher stock of government and corporate debt (resulting from public sector deficits and the trend towards private sector securitised financing) also stimulated trading in interest rate futures. Growth in primary market issuance has supported a higher volume of secondary market transactions, which, combined with the greater volatility of asset prices, has created demand for hedging instruments. Institutional investors have grown in importance, and it is possible that the narrowing of the investment horizon over which portfolio managers have been assessed may have led them to put greater emphasis on the use of debt derivatives as a quicker way of adjusting their interest rate exposure.

New information and trading technology has contributed to lower costs, thereby raising both volumes and liquidity, which has in turn encouraged more users to regard financial futures as an effective risk management tool.

New computer-based technologies have not only reduced the absolute cost of executing transactions but have also allowed the development of new types of trading strategies. They have also enabled trading firms to develop sophisticated risk management systems allowing them to monitor their risk exposure more closely.

Other factors contributing to the growth of interest rate futures have been the progressive deregulation of domestic financial markets, which has made financial asset prices more responsive to market forces. In addition, the widespread liberalisation of exchange controls has enabled borrowers to have greater recourse to international capital markets to finance both their domestic and their foreign operations. For instance, overall usage of interest rate futures has been fuelled by intermediaries in the euromarkets such as eurobond underwriters who use such contracts to hedge their underwriting exposures or swap books.

The growth of trading on the main exchanges

The US exchanges account for the bulk of trading in interest rate futures. However, a combination of the importance of trading in domestic instruments and time zone differences has enabled other exchanges around the world to grow and gain a rising share of turnover in interest rate futures. Some exchanges have tended to trade mostly in local products, the size of the futures markets being partly determined by the size of the local cash markets as well as by the domestic regulatory environment. Others, such as LIFFE, SIMEX and the SFE, have attempted to acquire additional market niches by covering the European and Far Eastern time zones in US dollar instruments with contracts which are close substitutes for US contracts. Some exchanges have created trading links where trading positions can be transferred from one exchange to another. For example, SIMEX and the CME, and LIFFE and the SFE,[2] established mutual offset arrangements for the contracts which they have in common, allowing positions opened on one exchange to be closed on the other, so that trading costs in terms of margin requirements, etc, are equivalent to dealing on a single exchange rather than on two different exchanges.

The United States and Canada

Interest rate futures were first developed by the two large Chicago commodity futures exchanges—the CBOT and the CME; together they dominate the US interest rate futures industry. Since 1975 the CBOT has been the industry's leader in volume terms. Although turnover on its first contract, the GNMA, has fallen continuously since

(1) Longer-term studies have shown that interest rate volatility was higher in the 1970s than in the three previous decades. However, the coefficient of variation of interest rates was small in comparison with the coefficient of variation for some other commodities traded in other futures markets. But interest rates affect all long-lived transactions. Hence the value of transactions and the number of individuals directly or indirectly affected by fluctuations in interest rates are very large when compared with similar measures for commodities in other futures markets. In 1979, a shift by the US Federal Reserve which de-emphasised direct federal funds rate pegging in favour of targeting certain reserve aggregates led to unprecedented volatility in US financial markets. A move away from this policy in 1983 led to a moderation of volatility. However, interest rate futures had by then gained wide acceptance by financial market participants. See D W Carlton: 'Futures Markets: Their Purpose, Their History, Their Growth, Their Successes and Failures', *The Journal of Futures Markets*, vol. 4, no 3, pages 237–71, 1984 and F R Edwards, 'Futures Trading and Cash Market Volatility: Stock Index and Interest Rate Futures, *The Journal of Futures Markets*', vol. 8, no 4, pages 421–39, 1988.

(2) However, in May 1989 the SFE suspended trading in its two futures contracts (US Treasury bonds and eurodollars) that are linked to LIFFE. The decision, made in agreement with LIFFE, was the result of low trading volumes since the contracts were introduced, but the suspension did not terminate their formal linkage agreement.

its peak in 1980,[1] the CBOT's contract on US Treasury bonds is the most active contract to have been launched, accounting for some 45% of the world's total volume of trading in 1988. The success of the contract is explained by the large size and liquidity of the US Treasury debt market. The size of US public debt rose rapidly in the early 1980s as a result of large budget deficits. The contract received a further boost with the introduction of night trading in 1988. Shorter-maturity contracts, on 10-year and 5-year US Treasury notes, have also been developed. The first was introduced in response to the increase in five to ten year Treasury notes as a proportion of total US marketable Treasury debt. The latter was designed to compete with a similar contract introduced by the New York Cotton Exchange (NYCE). Various attempts in earlier years to introduce short-term contracts were less successful, although the CBOT has recently made another attempt to capture part of the short-term market by introducing a contract on US federal funds.

The CME introduced the first money-market contract ever listed in January 1976 with its US Treasury bills contract. Since then, the CME has established its niche in the short-term area and its contract on three-month eurodollar time deposits has not only eclipsed the Treasury bill contract, but became the second most actively traded contract in the world in 1988. In the first half of 1989, the volume of 21.7 million contracts was larger than the volume for 1988 as a whole. The contract's success reflects the fact that it has met the needs of international banks and securities firms located in the euromarkets, which have used it extensively to hedge their short-term dollar liabilities/assets and their sales/purchases of forward rate agreements (FRAs)[2] as well as their swap positions. By contrast, the volume of trading of Treasury bill contracts has declined continuously since 1983. This may have reflected a fall in the volatility of US Treasury bills after 1983, as well as increased corporate demand for Libor-based liabilities which has fuelled demand for the eurodollar contract. The exchange's CD contract, which witnessed considerable activity in 1982, is now dormant because of declining activity in the underlying market as a result of commercial and savings banks being permitted to offer market rates on small time deposits (which reduced the need to issue CDs). Trading in the CD contract was also adversely affected by the success of the eurodollar contract which benefited from simpler delivery and settlement procedures than the CD contract.

Several other futures exchanges in the United States, including the AMEX Commodity Exchange (ACE), the Mid America Commodity Exchange (MIDAM), and the New York Futures Exchange (NYFE), have attempted to enter the market. So far only the MIDAM has managed to trade an interest rate contract successfully for most of the 1980s. This may have reflected demand for its small-sized contracts as well as smaller tick sizes. A particular feature of US futures exchanges has been that all the contracts have so far been based on dollar-denominated debt instruments partly because of restrictions which existed on resident holdings of foreign exchange at US banks. Two general conclusions can be drawn from the US experience of trading in interest rate futures. The two Chicago exchanges established their predominant positions by being the first to create successful contracts and by specialising in particular market sectors, with the CBOT and CME dominating the long and short-term areas respectively. Once these contracts became established and liquid, it became very difficult for other US exchanges to gain market share. Second, trading is concentrated in a very small number of instruments—the three-month eurodollar futures contract and the US Treasury bond contract accounted for about 98% of the volume of trading in debt instruments in the United States in 1988. Medium-term contracts have failed to make any major inroads, perhaps because of the large size of the market for repurchase agreements of government securities (see Chart 3).

The Toronto Stock Exchange, which in 1984 sponsored the creation of the Toronto Futures Exchange (TFE), began trading Canadian Treasury bonds and bills in September 1980. However, after some growth in the early 1980s, trading suffered from a lack of market liquidity, and it became easier and cheaper for traders to deal in the liquid Chicago markets than on the TFE. There was no trading in these contracts in either 1987 or 1988. With the trend towards securitisation, there has been a growing use of bankers acceptances (BAs) in Canada, and trading in interest rate futures has recently resumed with a contract on three-month Canadian BAs launched by the Montreal Exchange (ME) in July 1988. Later this year, the ME plans to introduce a contract on long-term Canadian government bonds.

Pacific Basin area

The SFE was the first futures exchange outside the United States to trade interest rate contracts when trading began in 1979 with a contract on 90-day bank bills. Most of the volume on the exchange (over 90%) is accounted for by domestic interest rate business, especially bank bills and Commonwealth bonds. In October 1986 the SFE began trading 20-year US Treasury bonds and eurodollar time deposits in a link with LIFFE. However, the offshore contracts have been less successful and the exchange is now concentrating on domestic instruments. Several interest rate contracts have been traded on the New Zealand Futures Exchange (NZFE) since 1985.

SIMEX capitalised on its time zone advantage and the fact that it is one of the main centres of the Asian

(1) In June this year the CBOT launched new futures and options contracts on mortgage-backed securities. This represented the fifth attempt to introduce a successful contract on mortgage-backed securities. The previous contracts suffered from design problems which eventually led to their demise. These new contracts will represent a further attempt to secure part of the large volume of mortgage business, which has hitherto been hedged in the forward market.

(2) FRAs are OTC equivalents of exchange-traded short-dated interest rate futures. The two parties involved agree an interest rate for a specified period of time from a specified future settlement date, based on an agreed principal amount. No commitment is made by either party to lend or borrow the principal amount. The only exposure of either party is the interest difference between the initially agreed and actual rates at settlement.

eurodollar market to introduce an interest rate futures contract in September 1984 under a mutual offset link with the CME which allowed trading of the CME-designed eurodollar deposit contract. In 1986 it introduced a US Treasury bond contract. The Treasury bond contract was delisted in 1988, but the eurodollar contract has witnessed a steady increase in volume, and in the first half of 1989 it was the most active offshore contract, with a little over two million trades, followed closely by LIFFE's German government bond contract. Although SIMEX's eurodollar contract has become the most actively traded offshore contract in the Pacific area, the commencement of futures trading in eurodollar contracts in Tokyo in June of this year could eventually represent a challenge to SIMEX's international role.

Futures trading in Japan began in 1985 with a contract on 10-year Japanese government bonds (JGBs) on the Tokyo Stock Exchange, and within three years it has become one of the most active interest rate futures exchanges in the world. As was the case in other countries, the introduction of the JGB futures contract was precipitated by the rapid growth in government debt and the deregulation of domestic financial markets. Another reason for such growth was the absence of other hedging mechanisms, particularly as participants in the cash market faced restrictions on the short-selling of bonds. Trading was adversely affected by the near collapse in September 1987 of Tateho Chemicals, a company which suffered heavy losses from speculation in the futures market. Moreover, once the latent demand for bond futures was satisfied, turnover reached a plateau: trading in the 10-year contract did not grow significantly in 1988 or the first half of 1989. This may also have been the result of lower volatility in the JGB market. A 20-year JGB contract was introduced earlier this year and it remains to be seen whether the depth and liquidity of that segment of the cash market will be sufficient to support trading in the futures market. Other recent developments include the establishment in June of this year of a new financial futures market, the Tokyo International Financial Futures Exchange (TIFFE), which is trading euroyen and eurodollar deposit contracts as well as a yen/dollar currency contract.

Europe
LIFFE became the first financial futures market in Europe when it opened in September 1982. Of all the exchanges around the world it has the widest range of interest rate contracts. In addition to domestic contracts on gilts and short-term sterling deposits, LIFFE's contracts include contracts on US, Japanese and German government bonds. It therefore covers four of the five largest central government debt markets in the world (the remaining one being Italy). LIFFE's main advantages in this respect are its key geographic position between the financial markets of North America and the Far East, and London's pre-eminent position in euromarket activity. Until 1985 the three-month eurodollar contract was the most successful, but by 1988 the long gilt contract and the three-month sterling interest rate contract had taken the lead. In 1988 LIFFE's domestic contracts accounted for almost 70% of total turnover of 13.3 million contracts, although the appeal of international contracts was emphasised by the fact that over 40% of contracts traded in the first half of 1989 were non-sterling based.

Trading activity in the long gilt contract increased markedly at the end of 1986 when 'Big Bang' allowed the entry of new market makers and led to an intensification of competition, speculation and arbitrage activity in the gilts market. The volatility of interest rates and the strength of sterling in 1987, associated with renewed foreign participation in gilts, were also factors which contributed to a doubling of turnover in that year to almost 7 million lots. In 1988, however, volume declined, reflecting lower volatility in the cash market and a strong fall in new gilt issues following the improvement in the budgetary position of the UK government. Short and medium-term gilt contracts have also been introduced, in 1986 and 1988 respectively. Trading in the short gilt contract has fallen since 1986, partly because the maturity range of deliverable gilts was relatively wide, making it difficult to hedge short gilt positions with the contract. LIFFE considered that, with the shortening of the maturity structure of the UK public debt, the development of the sterling swap and eurosterling bond markets, and the revival in the UK corporate bond market, there would be sufficient demand for a medium-term gilt contract. Introduced in 1988, the contract has, so far, failed to meet expectations, principally because of technical factors relating to the yield curve behaviour of the cheapest-to-deliver stocks.(1) In view of these cash market developments, earlier this year, LIFFE modified the specification of its long gilt contract to allow for delivery of long-term gilts with maturities shorter than the original 15-25 year standard.

Until 1988, the most successful offshore contract on LIFFE had been that on US Treasury bonds, which was introduced in June 1984. Its success reflected the large volume of trade in US Treasuries carried out in Europe as well as the hedging of eurodollar bonds. The eurodollar contract was introduced in September 1982 but, although LIFFE's time zone advantages meant that it had a good chance of capturing market share, trading volume has failed to match the volume of the CME's eurodollar contract. The latter may have benefited from the CME's decision in 1987 to extend the contract cycle from two to three years (compared with a two year cycle on LIFFE)(2), from the very strong growth in the US domestic swap market,(3) and from greater liquidity. In addition, LIFFE may have lost some business as a result of the introduction of the CME's arrangement with SIMEX. In July 1987, LIFFE became the first exchange outside Japan

(1) The cheapest-to-deliver stock (CTD) is the cash stock which generates the maximum profit or minimum loss in a cash-and-carry arbitrage, ie where there is a simultaneous purchase of a cash stock with borrowed funds and sale of a futures contract.
(2) The CME recently announced that it would extend the maturity cycle to five years.
(3) A substantial proportion of domestic floating-rate loans in the United States are priced off eurodollar rates, which are more representative of banks' marginal cost of funds than rates on US Treasury bills.

to offer, in co-operation with the Tokyo Stock Exchange, a JGB futures contract. It has, however, so far been the least successful of LIFFE's foreign contracts, handicapped by a number of technical and market problems, including the fact that there was already a well-established market in Japan which had a much larger cash base and which was preferred by Japanese traders. In addition, Japanese securities firms were initially prohibited from using overseas futures markets. By contrast, the contract on German government bonds (bunds), introduced in September 1988, has been very successful, reflecting the absence of debt derivative instruments in Germany and the difficulty of short selling cash bunds. In the first half of 1989, it became the most active offshore contract traded on LIFFE. In April 1989 LIFFE introduced a contract on three-month eurodeutschemark deposit rates which has witnessed brisk activity.

The development of trading in interest rate futures in France can be seen as part of the general liberalisation of French financial markets. It has been spurred by the increasing tendency for monetary policy to be implemented through changes in interest rates rather than quantitative credit controls, so that participants in the financial markets required a derivatives market to manage their interest risk exposure. These factors led to the establishment of the Marché à Terme d'Instruments Financiers (MATIF)[1] which began its operations in February 1986 with a 10-year bond contract (the 'notionel'), which has grown extremely rapidly. There are a number of reasons for the success of the contract, including the large volume of out of hours trading in the notionel (equivalent to perhaps 30% of on-exchange trading, according to some sources) with the trades being recorded on the MATIF the following day. The contract also reportedly benefited from intense speculative activity. In addition, until 1988 there was no futures contract on bunds and investors wishing to hedge positions in bunds often used the notionel as a surrogate bund contract. A contract on French Treasury bills was introduced in 1986, but the volume has been sluggish because Treasury bill rates are not used as a reference rate by corporate treasurers and banks, and because of the lack of liquidity of the secondary market in cash bills. To remedy this situation, the MATIF introduced in September 1988 a new contract based on the three-month Paris interbank offer rate (PIBOR) which found rapid acceptance by market users. Earlier this year the MATIF introduced a contract on eurodeutschemark deposit rates which competes directly with LIFFE's contract. A contract on short-term French government bonds was introduced in June of this year on the newly-established Organisation de Marché Financier (OMF) exchange.

In the rest of Europe, interest rate futures are also traded on a small scale in the Netherlands (European Options Exchange (EOE)) on guilder bonds, in Denmark (Copenhagen Stock Exchange (CSE)) on mortgage bonds and in Ireland (Irish Futures and Options Exchange (IFOX)) on Irish pound short-term deposits and long gilts. Futures contracts on government bonds have also been traded on the Stockholm OptionsMarknad (OM) but trading was interrupted by the government's introduction of a turnover tax on securities transactions.

Reasons for the success and failure of individual contracts

It is apparent from the review of individual contracts traded on the various exchanges that there have been a number of failures and successes. The main reasons for the success of particular contracts appear to be a combination of sufficient market depth and liquidity. Liquidity is ensured by a high volume of transactions, and therefore the number of contracts introduced on any particular class of underlying debt instruments must be limited if this liquidity is to be preserved (and the corresponding economies of scale to be attained). In general it appears that there is rarely room for more than one contract of a particular maturity type in each domestic market.[2] If competing contracts are introduced, they may lack the liquidity of the original instrument. It is also necessary to ensure a sufficient volume of deliverable securities, which minimises the risk of shortages or the possibility that some market participants may try to corner the market for the deliverable securities. However, the size of the underlying cash market is not entirely sufficient in itself to make a contract viable. There must also be sufficient volatility in the price of the underlying financial asset and a sufficient number of speculators who are willing to supply the market with the required liquidity. In addition, trading can only develop within an appropriate tax and regulatory framework. In Germany, for instance, the regulatory regime has hitherto prevented the development of futures trading while in Sweden the announcement of a turnover tax on securities transactions affected the development of the futures market in that country. On the other hand, a light regulatory regime may initially stimulate trading but could eventually have harmful effects should participants default.

When designing a new contract, an exchange has to ensure that the contract does not duplicate the characteristics of an existing contract, since, as noted above, it could deprive the initial contract of liquidity and damage its performance. The tactic adopted by many exchanges has been to try to move from their position of strength to intermediate areas of the yield curve, leaving too small a gap for other exchanges to exploit.[3] The CBOT and LIFFE, for example, only introduced medium-term contracts when their long-term contracts were well established. But even this strategy carries risks; for instance, the CBOT may have involuntarily affected the volume of trading on its GNMA contract by introducing a competing contract on US Treasury bonds. However, because of the greater size of the Treasury bond market and the inherently greater liquidity of government bonds compared with mortgage-backed securities, the CBOT has been able to retain its domination of the long-term market because of the success of that contract.

(1) In 1989 the MATIF changed its name to Marché à Terme International de France.
(2) In the United States for instance, the eurodollar contract and the Treasury bond contract dominate trading.
(3) See Dale, Leslie and Wyatt, *Futures and Options, Winners and Losers*.

Innovations were initially concentrated on the design of contracts on various types of government debt and bank liabilities, especially in the late 1970s when there was a flurry of new contracts. However, few of these contracts were successful. Subsequently innovation concentrated more on varying maturities than on developing entirely new products. Since then a number of contracts based on bond indices have been introduced to create futures in debt markets which would otherwise have lacked the necessary liquidity. For instance, the CBOT's municipal bond index was designed to improve the risk management opportunities of investors in the US municipal bond market. Until then, market users had been confined to hedging municipal bonds with surrogate futures contracts such as the Treasury bond contract. In the past there have also been discussions between LIFFE, the Association of International Bond Dealers and the CBOT about the construction of a eurodollar bond index which could be used as a basis for a eurobond futures contract. The main problem in designing a eurodollar contract is the development of an index of eurodollar bonds that can be constantly adjusted to include only those issues that have a sufficiently high turnover. In June of this year the CME introduced an innovative type of contract which is similar in some respects to the exchange's eurodollar contract, but which is based on the differential between eurodollar deposit rates and euromarket deposit rates in yen, deutschemark and sterling.

It is extremely difficult to predict which contracts will be successful. Experience has shown that the successful contracts are those designed on underlying debt instruments which have a high degree of homogeneity, high turnover and liquidity as well as low default risks, such as government securities and short-term liabilities of reputable international banks. Futures contracts based on corporate bonds have been slow to gain market acceptance because of the generally lower liquidity of such bonds compared with government obligations, and, possibly, greater credit risk. One additional feature explaining the success of particular contracts is the extent to which a given contract can be used by participants in other debt markets.

Technological advances

The competition between exchanges for world market share, especially following the success of futures markets in Europe and Japan, has led US exchanges to consider ways of defending their position. The major US exchanges have considered trading links with exchanges in other time zones to cover hours when the trading floor is closed, although to date only the CME/SIMEX link to trade the eurodollar contract has proved successful. A few, such as the CBOT, have extended floor trading hours, but the main development is the potential for automated trading, which could itself intensify the competition between exchanges.

The older established exchanges generally adopted the open outcry method of trading which was the established method for trading commodity futures. New information and trading technologies usually played a supportive role to activities conducted on the trading floor. In recent years, however, several new exchanges in Europe have adopted electronic trading systems. Such systems would appear to have several advantages, especially for smaller markets, since the infrastructure costs of physical trading floors can be avoided (although development of automated systems from scratch can be expensive). In addition, traders can be simultaneously in contact with both physical and derivative markets, thus potentially enhancing arbitrage opportunities and liquidity. Claims have also been made that automated trading could allow greater market transparency than open outcry.

Several of the major exchanges are currently developing automated transaction systems. In 1987, the CME and Reuters announced a long-term agreement to establish a screen-based transaction system (Globex), for the trading of futures and options on futures outside regular trading hours. It is expected that the new system will be operational for trading US contracts at the end of this year. The CBOT, which had initially expressed scepticism about the value of screen-based trading, is currently developing its own system—Aurora. In contrast to Globex, which is essentially an order-matching system, Aurora aims to replicate pit trading. The CME and the CBOT have recently entered into talks on a possible joint venture concerning their screen-based trading systems. However, LIFFE may be the first exchange to introduce an automated trading system with the fast response time required to support active trading. This will be linked to its order-routing system, which will allow both members and members' clients to put orders directly through financial quote vendors. These orders will then be routed automatically to members' offices or directly to the exchange floor.

Prospects

Trading in interest rate futures is likely to increase as financial market deregulation and the trend towards active asset/liability management continue. Turnover may be supported by the development of other derivative products, such as interest rate swaps and interest rate options, since these are often hedged in the futures markets, but if futures were not to remain competitive in terms of cost and flexibility they could also lose business to those other instruments. Even if the volatility of interest rates were to moderate substantially from the levels witnessed in recent years, greater awareness and understanding of interest rate futures by the corporate sector should sustain demand for such products. As an example, the recent trend towards leveraged financing has increased the demand for instruments which enable borrowers to reduce their exposure to fluctuations in interest rates. Competition between exchanges located within a single time zone or between those in different time zones will continue to be strong, and once markets become established in most financial centres, innovative contract design and improved market systems may become of greater importance in securing market share.