The Recent Growth of Financial Derivative Markets

by Eli M. Remolona

Recent years have seen phenomenal growth in financial derivative markets. Financial derivatives are instruments that derive their prices from the performance of underlying cash markets, specifically money and bond markets, the foreign exchange market, and stock markets. This article examines the patterns of growth exhibited by the various types of derivative markets and contracts and seeks to deduce from these patterns the fundamental forces driving growth.

Financial derivatives have grown strongly in both organized exchanges and over-the-counter (OTC) markets. Interest rate contracts, notably futures in exchange markets and swaps in OTC markets, dominated the growth of derivatives in the last six years. During the same period, growth in exchange-traded currency futures and options slowed, while in the last four years growth in new equity index options surged in both exchange and OTC markets. The most successful exchange-traded derivatives appear to be those that added liquidity to the underlying markets, while the most successful OTC derivatives were probably those that offered new configurations of risk and return.[1]

Financial derivative markets as a whole seem to have grown much the way any financial innovation might be expected to grow as it finds increasing acceptance among users. But the direction and speed of the derivatives' spread have been governed critically by particular demands for liquidity-enhancing and risk-transferring tools. This article identifies four developments giving rise to such demands: sustained shifts and temporary surges in market volatility, the emergence of important but relatively illiquid cash markets for government bonds, new inducements for financial institutions and nonfinancial firms to deal with interest rate risks, and the international diversification of institutional equity portfolios.

Patterns of growth in derivative markets

Growth by type of market

The stock of financial derivatives outstanding worldwide, as measured by open interest and notional principal,[2] multiplied fivefold in five years to approach $10 trillion by the end of 1991 (Chart 1). In organized exchanges, open interest in financial derivatives rose an average of 36 percent a year from 1986 to reach $3.5 trillion at the end of 1991. Even so remarkable an expansion was apparently surpassed by the growth of financial derivatives in OTC markets; here total notional principal grew an estimated 40 percent a year during the period to soar above $6 trillion by the end of 1991.[3] As explained below, however, it is hard to compare the

[1]This article emphasizes the functions of derivatives as liquidity-enhancing and risk-transferring innovations: see Bank for International Settlements, *Recent Innovations in International Banking*, Study Group Report, Central Banks of the Group of Ten Countries, April 1986.

[2]Most OTC derivatives involve no actual exchange of principal, but payments are computed on the basis of the "notional principal" amounts specified in the contracts.

[3]Forward rate agreements (FRAs) make up the largest estimated component. These are agreements on future interest rates that involve no exchange of principal amounts. Surveys by the Bank for International Settlements suggest that forward rate agreements represent a third of interest rate swaps outstanding in the United States and two-thirds of interest rate swaps outstanding in Europe. We exclude from our estimates the very large traditional market for foreign exchange forward contracts, which appears to be very much a part of the foreign exchange cash market.

size of the two markets, in part because the unwinding of positions adds to notional principal in OTC markets while it adds to turnover in exchange markets.

Exchange markets

Organized exchanges such as the Chicago Board of Trade (CBOT) and the London International Financial Futures and Options Exchange (LIFFE) trade standardized financial futures and options contracts. An important feature of these trades is the interposition of a clearinghouse as a counterparty to reduce the credit risk in each transaction. The arrangement has the virtue of providing for clearinghouse offset, a mechanism that allows a participant to close out a position simply by undertaking an opposite trade.[4] Closing out a position reduces open interest in the market. More important, the standardization of contracts together with clearinghouse offset serves to limit transactions costs and thus fosters high degrees of liquidity in exchange markets.[5]

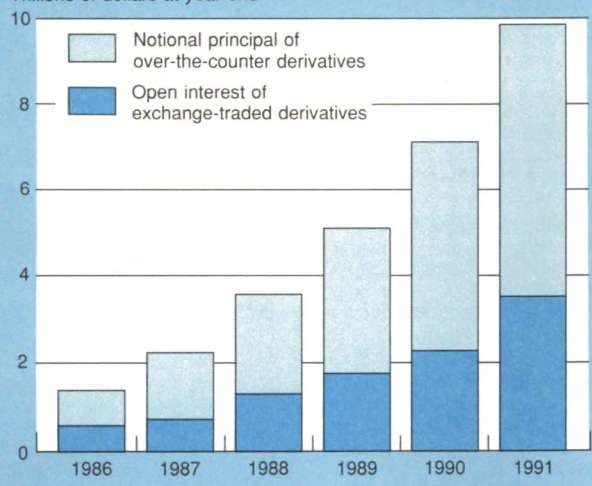
[4]First introduced at the Minneapolis Grain Exchange in 1891, the mechanism for clearinghouse offset has become a standard feature of organized exchanges in derivatives.

[5]It has been said of futures contracts, for example, that they "are designed and introduced by exchanges with basically one

Chart 1

Exchange-traded and Over-the-Counter Derivatives

Trillions of dollars at year-end



Sources: For exchange-traded derivatives, Bank for International Settlements (BIS); for over-the-counter derivatives, International Swap Dealers Association, Federal Reserve Bank of New York staff estimates, and BIS estimates.

Indeed, as argued below, the primary economic function of exchange-traded derivatives appears to be the provision of liquidity in excess of the liquidity in the cash markets.[6] If these derivatives succeed primarily by serving as a source of liquidity, then trading volumes rather than open interest would be the more relevant measure of market size.

The trading volumes of financial derivatives in exchange markets have always dwarfed changes in open interest, a pattern that reflects the markets' liquidity and the fact that most positions are closed out before maturity. In 1992, more than 600 million contracts were traded in organized exchanges around the world. This figure represents an increase in turnover exceeding 11 percent a year since 1986 (Chart 2). The total value of such trading volumes exceeds $35 trillion per quarter, roughly a hundred times the change in open interest over the quarter.

OTC markets

OTC markets trade customized swaps, options, and forward contracts in bilateral deals without the interposition of a clearinghouse. The customized contracts and lack of clearinghouse offset both inhibit liquidity in OTC markets. Indeed, unlike the derivative exchange markets, the OTC derivative markets tend to be less liquid than the underlying cash markets. It appears that OTC derivatives are designed primarily to reconfigure market risk rather than to provide liquidity.

When an OTC participant unwinds an initial position by means of an opposite trade, the original contract typically remains in place and the new transaction adds to total notional principal in the market.[7] Thus the portion of notional principal growth in the OTC markets that consisted of trades to unwind positions would be more akin to the growth in trading volumes in exchange markets than to the growth in open interest.

Footnote 5 continued

consideration in mind: low-cost trading." See Merton Miller, "Financial Innovations and Market Volatility," a talk given in London, England, at a seminar sponsored by Dimensional Asset Management, Ltd., March 24, 1987.

[6]Derivatives, of course, vary in the degree to which they serve the functions of liquidity and risk transformation. The liquidity of the underlying cash market helps determine the use of a derivative. The spot market for foreign exchange, for example, is itself so liquid that risk transformation is probably a more important function of exchange-traded currency derivatives than of other exchange-traded derivatives.

[7]Netting rules currently under development for the OTC markets would allow the offsetting of contracts between two counterparties but only in the event of default. Some OTC contracts provide for early termination, but the difficulty of pricing contracts after origination seems to make it easier to unwind a position by taking on another contract.

Growth by type of contract

Interest rate contracts

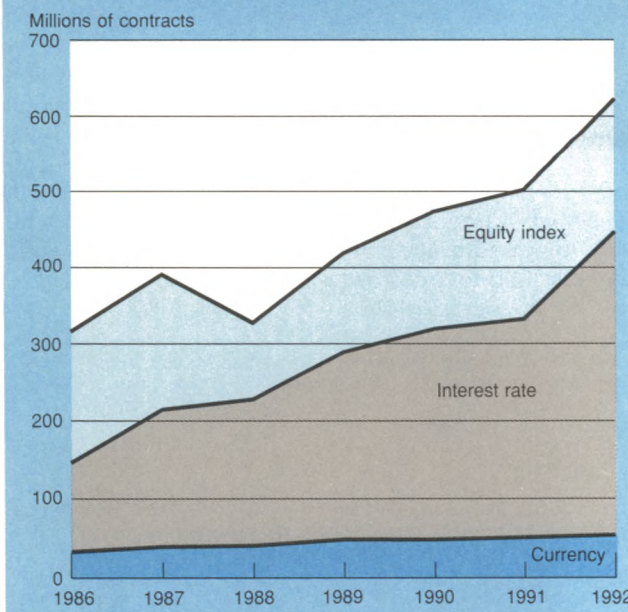
In both organized exchanges and OTC markets, the growth in derivatives has been dominated by contracts based on interest rates. The contracts on short-term interest rates have as their underlying cash markets the various money markets around the globe, most notably the Eurocurrency markets and the short-term sterling market. The underlying markets for derivatives on long-term interest rates are the world's major bond markets, most notably the U.S. Treasury bond market, the French government bond market, the Japanese government bond market, the German bund and Treuhand market, and the U.K. long gilt market.

In exchange markets, turnover in interest rate contracts grew 21 percent a year from 1986 to 1992 and accounted for 90 percent of the absolute increase in total exchange market turnover (Chart 2). The great bulk of this growth came from futures contracts, most notably futures on three-month Eurodollars at the International Money Market (IMM) of the Chicago Mercantile Exchange (CME), futures on the notional French government bond at the Marché à Terme International de France (MATIF), and German bund futures at LIFFE and the Deutsche Terminbörse (DTB).[8]

Chart 2

Exchange-traded Derivatives

Annual Trading Volume of Futures and Options Contracts



Sources: Bank for International Settlements; Futures Industry Association; Options Clearing Corporation; Philadelphia Stock Exchange.

Note: Values represent combined global volume of exchange-traded futures and options.

As in the exchange markets, most of the derivatives growth in the OTC markets consisted of interest rate contracts (Chart 3). Interest rate swaps, the dominant OTC derivative from the outset, grew an average of 41 percent a year in notional principal from 1986 to 1991 and alone accounted for possibly half of the absolute increase in total notional principal of all OTC derivatives during the period (Chart 4).[9] We estimate that forward rate agreements (FRAs) grew roughly as fast as interest rate swaps and accounted for perhaps another quarter of the total market increase. Option-like interest rate contracts, including caps, floors, collars, and swaptions, probably grew the fastest of all OTC contracts, with notional principal rising 81 percent a year during the period to account for 10 percent of the total increase in the OTC market.[10]

Currency contracts

Next to interest rate contracts, currency contracts contributed the most to the growth in derivatives, albeit in a comparatively small way. The underlying cash market for these contracts is the global foreign exchange market. In organized exchanges, trading in currency contracts rose about 8 percent a year and accounted for less than 7 percent of the absolute increase in total exchange market turnover from 1986 to 1992 (Chart 2).

In the OTC market, currency swaps more than kept pace with interest rate swaps by growing 42 percent a year from 1986 to 1991, but traditional currency options probably expanded at only a fraction of that rate (Chart 3). Currency swaps may have shown much stronger

[8]Three-month Eurodollar contracts are also traded at LIFFE, the Singapore Mercantile Exchange (SIMEX), the Sydney Futures Exchange (SFE), and the Tokyo International Financial Futures Exchange (TIFFE).

[9]A popular new type of interest rate swap is the "diff" or "quanto" swap, which exchanges payments based on interest rates in two currencies but makes both payments in a common currency. For example, firm A pays the Eurodollar rate while firm B pays the Eurolira rate less a spread, but all payments are made in U.S. dollars.

[10]Options on less developed country (LDC) debt are one of the fastest growing segments of this market. The International Monetary Fund estimates that annual turnover in the secondary market for this debt exceeds $200 billion, and market participants estimate that turnover in the options may be a tenth of this amount. See Richard Waters, "Derivatives Rush to Catch Up with Emerging Markets," *Financial Times*, December 29, 1992; and International Monetary Fund, *Private Market Financing for Developing Countries*, December 1992. Note that LDC debt options may be more like equity options than bond options because LDC debt is commonly used for equity investments in the debtor country through debt-equity swaps.

growth than other currency contracts because they are in part interest rate contracts, involving the exchange of fixed rate payments in one currency for floating rate payments in another.

Equity index contracts

Equity index contracts remain a small part of the whole derivatives market, but their recent growth has been so explosive that they promise to become a major part of the market in the near future. These index contracts have as their underlying markets the major stock markets around the world, most notably the New York, Tokyo, and Frankfurt stock markets.

Exchange trading in equity index contracts showed no expansion over the period 1986 to 1992 as a whole because the turnover in U.S. exchanges declined sharply after the October 1987 stock market break (Chart 2). Since 1988, however, equity index contracts have recovered so strongly that turnover in these contracts has grown faster than turnover in interest rate contracts. From 1988 to 1992, trading volumes in equity index contracts increased 14 percent a year. Even with growth coming from a small base, index contracts still accounted for a quarter of the absolute increase in total exchange market turnover in the four-year period. The recovery was led by new index contracts, notably Nikkei Index futures and options at the Osaka Securities Exchange (OSE) in Japan, options on the Deutsche Aktienindex (DAX) at DTB in Germany, Swiss Market Index options at the Swiss Options and Financial Futures Exchange (SOFFEX) in Switzerland, and Bovespa Stock Index futures at the Bolsa de Mercadorias e Futuros (BM&F) in Brazil.

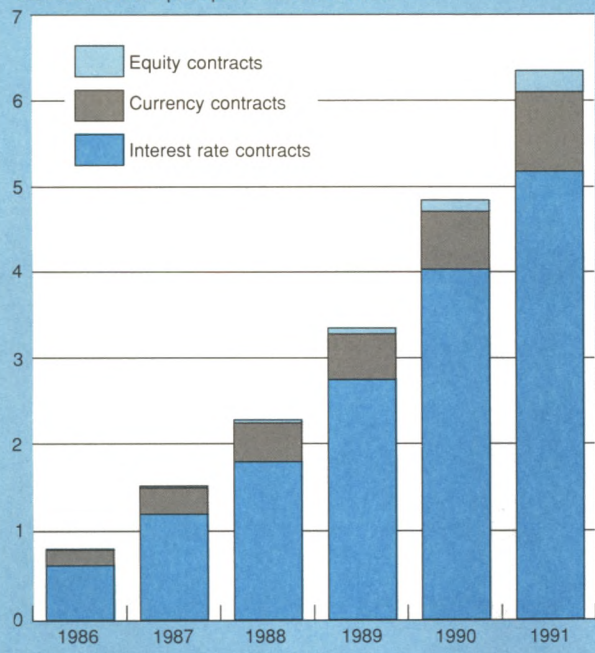
In the OTC market, equity index options and equity swaps made up a small fraction of the market, but the last few years witnessed such tremendous growth in these contracts that they accounted for perhaps 5 percent of the absolute expansion of notional principal in the OTC market from 1986 to 1991 (Chart 3). The OTC equity derivative market has two segments, the "off-the-peg" and the "bespoke" segments. In the off-the-peg segment, the older market, investment houses write covered equity warrants not specifically requested by investors.[11] In the bespoke segment, the newer and

[11]The Swiss Bank Corporation, for example, offers guaranteed return

Chart 3

Over-the-Counter Derivatives

Year-end notional principal in trillions of dollars

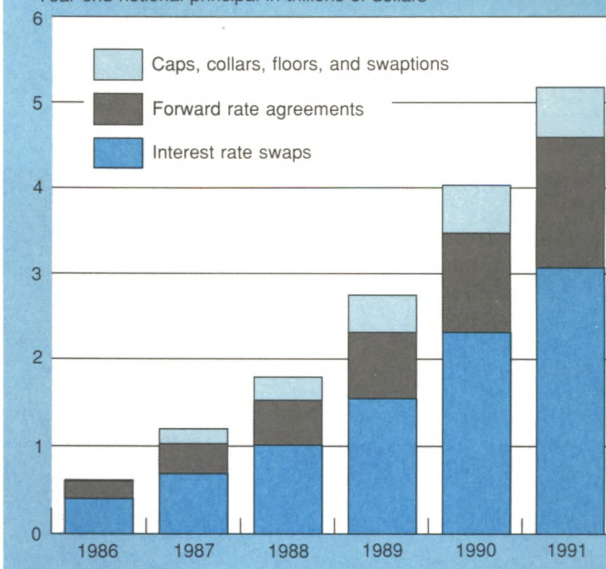


Sources: International Swap Dealers Association; Bank for International Settlements; Federal Reserve Bank of New York staff estimates.

Chart 4

Over-the-Counter Interest Rate Derivatives

Year-end notional principal in trillions of dollars



Sources: International Swap Dealers Association; Bank for International Settlements; Federal Reserve Bank of New York staff estimates.

apparently faster growing market, some dealers offer equity swaps but most concentrate on highly customized equity index options, predominantly Nikkei Index options.

Geographical growth

The geographical growth of financial derivatives manifested itself largely in the opening of new derivatives exchanges and the widening share of nondollar currencies in OTC derivatives.

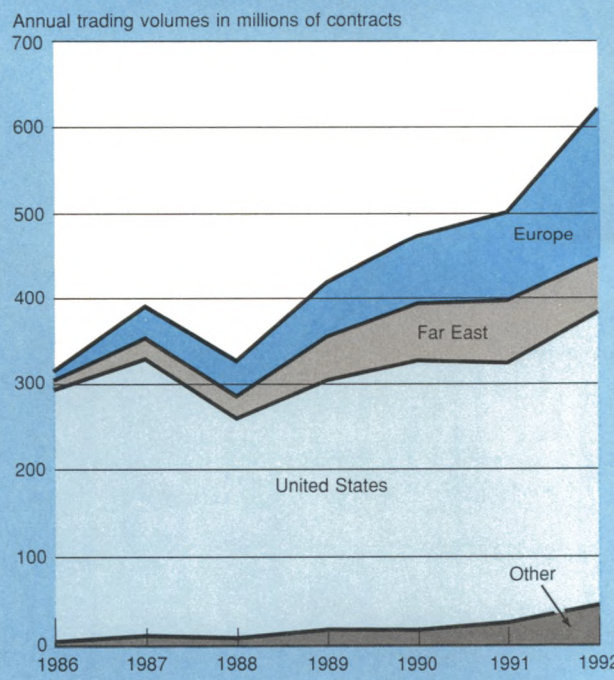
New derivatives exchanges

The growth in the turnover of exchange-traded derivatives was concentrated in exchanges outside the United States, most of them new ones (Chart 5). Between 1986 and 1992, a period when turnover on U.S. derivatives exchanges was barely growing, turnover in European exchanges rose 47 percent a year and contributed the largest share of the growth in turnover worldwide. Turnover in exchanges in the Far East grew 29 percent a year during the period and contributed the next largest share of global turnover growth. The turnover increase was spurred by the opening of new exchanges and the launching of interest rate and equity index derivatives (Chart 6). Since 1985, at least eighteen new derivatives exchanges have been organized around the world, including already established stock exchanges that only recently began trading derivatives (Table 1). Trading volumes at the MATIF, established in 1986, have catapulted it to the ranks of the world's five largest derivative exchanges. Other major new exchanges are the Tokyo International Financial Futures Exchange (TIFFE) in

Footnote 11 continued
on investment contracts (GROIs), which have the structure of portfolio insurance or put options on a stock market index. Eli Remolona and Stephen King analyze such contracts in "The Pricing and Hedging of Market Index Deposits," this *Quarterly Review*, Summer 1987.

Chart 5

Exchange-traded Derivatives by Region

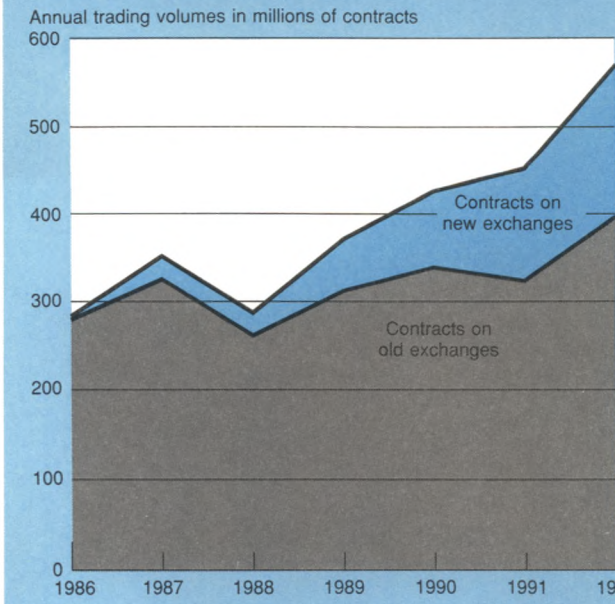


Sources: Bank for International Settlements; Options Clearing Corporation; Futures Industry Association; Philadelphia Stock Exchange.

Notes: The Far East comprises Japan, Hong Kong, and Singapore. "Other" comprises Australia, Brazil, Canada, and New Zealand.

Chart 6

Interest Rate and Equity Index Contracts by New and Old Exchanges



Sources: Bank for International Settlements; Options Clearing Corporation; Futures Industry Association; Philadelphia Stock Exchange.

Note: New exchanges are exchanges founded after 1985 or exchanges that opened trading in financial derivatives after 1985.

Japan, DTB in Germany, and SOFFEX in Switzerland.[12]

OTC derivatives in nondollar currencies

The OTC markets operate internationally over telephone lines without the benefit of a central clearinghouse to fix geographical locations. Transactions made in London may well be booked in Frankfurt. Nonetheless, the increasing importance of nondollar currencies in OTC contracts indicates the geographical diffusion of these derivatives.[13] The share of the nondollar sector in interest rate swaps widened from 20 percent in 1986 to 51 percent in 1991. The Japanese yen has been the most important nondollar currency; its share of interest rate swaps has doubled since 1987 to 16 percent in 1991. The pound sterling and German mark have been the next two most important currencies.

Forces driving derivatives growth

The growth and geographical diffusion of financial derivatives seemed to follow the pattern set by earlier innovations that found increasing acceptance among users. But the derivatives' spread was rooted in specific demand forces that largely determined the direction and speed that the spread took.[14] The analysis below suggests that the growth in exchange-traded derivatives arose primarily from the demand for liquidity-enhancing innovations and the growth in OTC derivatives from the demand for market-risk-transferring innovations.[15]

At least four broad developments gave rise to these demands. First, sustained shifts and temporary surges in market volatility differentially affected the demands for the various derivatives. Second, the emergence of important cash markets for government bonds and the

[12]The trading systems used by the new exchanges appear to indicate a trend away from trading pits toward floorless electronic systems. The largest exchanges, however, have continued to open new trading pits, convinced that the open outcry is still the most effective system for active trading. London's LIFFE did develop its own electronic system for futures trading, called Automated Pit Trading (APT), but uses it only to supplement pit trading activity. The CME, CBOT, and Reuters use their electronic system, GLOBEX, in a similarly supplemental fashion.

[13]The Bank for International Settlements provides a careful discussion of the share of nondollar currencies in "Derivative Financial Instruments and Banks' Involvement in Selected Off-Balance-Sheet Business," *International Banking and Financial Market Developments*, May 1992, pp. 22-26.

[14]Supply factors, of course, contributed to the spread of derivatives. Such factors include advances in communication and information-processing technologies and the development of option pricing and simulation models. The fact that currency option models were developed before fixed-income option models, for example, may help explain why currency options seem to have found acceptance sooner than bond options. Nonetheless, demand factors appear to have been more significant in the recent growth of derivatives.

[15]These are two of five types of financial innovation discussed in Bank for International Settlements, *Recent Innovations*. The other types are credit-risk-transferring, credit-generating, and equity-generating innovations. In their early stages, interest rate and currency swaps may be viewed largely as credit-generating innovations.

Table 1

Derivatives Exchanges Established after 1985

Exchange	Country	Date	Trading System
Bolsa de Mercadorias & Futuros (BM&F)	Brazil	1986	open outcry
European Options Exchange (EOE)†	Netherlands	1986	open outcry‡
Marché à Terme International de France (MATIF)	France	1986	open outcry
Stockholm Options Exchange (OM)	Sweden	1986	electronic
Swiss Options & Financial Futures Exchange (SOFFEX)	Switzerland	1986	electronic
Financial Futures Market Amsterdam (FTA)	Netherlands	1987	open outcry‡
Finnish Options Market (FOM)	Finland	1988	electronic
Guarantee Fund for Danish Options (FUTOP)	Denmark	1988	electronic
Irish Futures & Options Exchange (IFOX)	Ireland	1988	electronic
Osaka Securities Exchange (OSE)†	Japan	1988	electronic
Tokyo Stock Exchange (TSE)†	Japan	1988	electronic
Marché des Options Négociables de Paris (MONEP)†	France	1989	open outcry
Tokyo International Financial Futures Exchange (TIFFE)	Japan	1989	electronic
Deutsche Terminbörse (DTB)	Germany	1990	electronic
Mercado Español de Futuros Financiers (MEFF)	Spain	1990	electronic
Belgian Futures & Options Exchange (BELFOX)	Belgium	1991	electronic
Austrian Futures & Options Exchange (OTOB)	Austria	1992	electronic
Mercato Italiano dei Futures (MIF)	Italy	1992	electronic

†EOE, OSE, TSE, and MONEP existed before 1985, but TSE began trading bond futures in 1988, while EOE, OSE, and MONEP began trading equity index contracts in the indicated years.
‡EOE and FTA have announced plans for an electronic system.

growth of OTC derivatives fostered a demand for the liquidity provided by exchange-traded interest rate futures. Third, interest rate risks faced by financial institutions and nonfinancial corporations created a demand for risk-transferring OTC interest rate contracts. Finally, the global diversification of institutional equity portfolios led to a demand for risk-transferring OTC stock index options.

The life cycle of innovations

The acceptance and spread of new products can be said to follow a life cycle composed of different stages. Trading volumes in Treasury bond futures at the CBOT—the world's most actively traded contract—illustrate what may be the typical shape of an innovation's life cycle (Chart 7). The growth in the bond contract's turnover since its introduction in 1977 appears to follow the S shape of a logistic growth curve.[16] In general, growth in the use of a contract begins slowly, then surges as the contract becomes popular, and finally slows down as the contract matures and saturates its market.

Thus a derivative's growth rate may depend simply on the date of its introduction and consequently on the stage it has reached in its life cycle. The growth rates in the turnover of U.S. exchange-traded derivatives do seem to fit a rough life cycle explanation. The CME launched its currency futures and options in 1972; having been introduced early, these contracts may now be growing slowly because they have reached the stage of market saturation. The CBOT started trading its Treasury bond contracts in 1977 and the CME its Eurodollar contracts in 1981; these interest rate contracts may now be surging because they are still at the stage of gaining popularity and capturing new users. Finally, the Chicago Board Options Exchange (CBOE) launched its S&P 100 options and the CME its S&P 500 contracts in 1983; growth of these equity index contracts may now be accelerating because they are so new.

The life cycles of derivatives, however, have not been uniform. Demand factors have shaped and stretched the various S curves to cause some contracts to grow much faster and others much slower than might be indicated by a simple life cycle explanation.

Shifts and surges in market volatility

The volatilities of underlying markets in the last six years have not shown a sufficiently steep rising trend to explain the recent growth of financial derivatives. But major shifts in volatility that occurred in certain markets years ago do help to explain the differential performance of currency contracts and interest rate contracts. In addition, more recent temporary surges in volatility have clearly boosted the growth of exchange-traded interest rate and equity index derivatives.

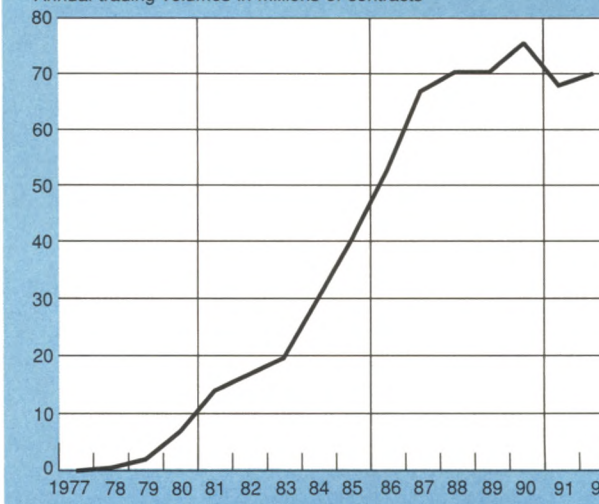
Sustained shifts in volatility

The timing of volatility-inducing shifts in policy regimes helps explain why currency contracts reached the slow-growth stage so much earlier than interest rate contracts. These policy shifts brought volatility first to the foreign exchange market, then to the money and bond markets. In the foreign exchange market, the advent of floating exchange rates in 1973 ushered in a new era of volatility (Chart 8). In the money and bond markets, the Federal Reserve's shift to targeting monetary aggregates rather than interest rates in October 1979 was the watershed event that lifted interest rate volatility to unprecedented levels (Chart 9). Market volatility, as measured by the standard deviation of Treasury bond returns, rose from an average of 8 percent a year in the 1970s to 15 percent in the 1980s. Thus the currency contracts gained popularity first and now appear to have reached the slow-growth stage of maturity, while

Chart 7

Growth of U.S. Treasury Bond Futures

Annual trading volumes in millions of contracts



Sources: Chicago Board of Trade; Futures Industry Association.

Note: Only contracts traded on the Chicago Board of Trade are included.

[16] Zvi Griliches finds that this S-shaped pattern applies to the use of hybrid corn, new farm equipment, new drugs, and new ideas; see "Hybrid Corn: An Exploration in the Economics of Technological Change," *Econometrica*, October 1957; also Nathan Rosenberg, ed., *The Economics of Technological Change* (Middlesex, England: Penguin Books, 1971), pp. 211-28.

the interest rate contracts are still gaining popularity and continuing to grow strongly in trading volumes.

Temporary surges in volatility

Temporary surges in volatility often induce temporary surges in turnover. It is also conceptually possible that a temporary volatility surge can increase demand permanently by bringing new converts to the market. Dramatic political events in 1991 sharply increased turnover in equity index options at the European Options Exchange, SOFFEX, the MATIF, and the Stockholm Options Exchange (Chart 10). Global turnover in equity index contracts grew 10 percent in 1991, but the 4 percent growth in 1992 belies the possibility of a permanent increase in demand. Similarly, the currency turmoil of September 1992 produced record turnover in interest rate contracts at LIFFE, the MATIF, and DTB (Chart 11).[17] Having grown 4 percent from 1990 to 1991, interest rate contracts grew 41 percent from 1991 to 1992. It remains to be seen whether such increases in turnover will be sustained in 1993.

In one case, an extreme surge in volatility seems to have actually reduced turnover permanently. Specifically, the October 1987 stock market break was followed by a sharp decline in the turnover of equity index contracts in U.S. exchanges. The demand for such transactions was driven in large part by portfolio insurance programs that relied on index futures and options for dynamic hedging. When the stock market crashed, the abrupt loss of liquidity in the cash and derivative markets made the large trades required by the programs hard if not impossible to execute. Since then, concerns about execution risk have dampened trading in index contracts in U.S. exchanges.

The demand for liquidity

Demands for liquidity help explain the strong growth of futures on both long-term and short-term interest rates

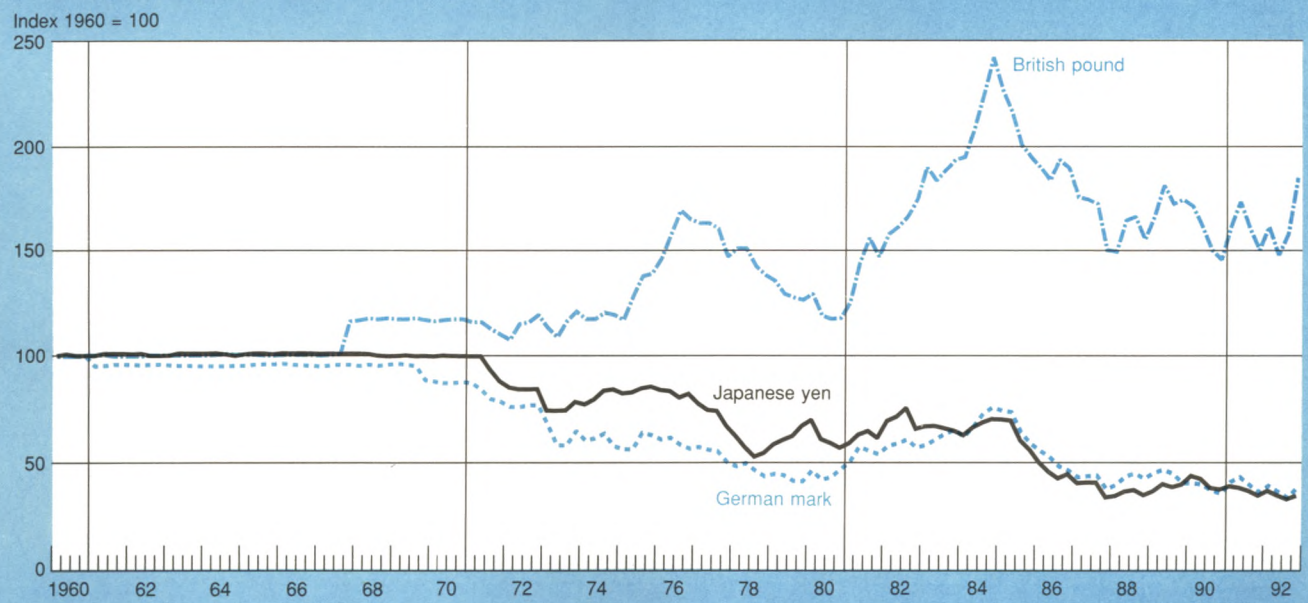
[17]Somewhat surprisingly, activity in exchange-traded currency contracts seemed little affected by the event. Accounts of the actions of major players suggest that they took most of their positions in the spot foreign exchange market and in fixed-income and equity markets. See, for example, Thomas Jaffe and Dyan

Footnote 17 continued
Machan, "How the Market Overwhelmed the Central Banks," *Forbes*, November 9, 1992, p. 40.

Chart 8

Exchange Rates

Value of the U.S. Dollar in Terms of Foreign Currency



Source: Board of Governors of the Federal Reserve System.

and the weak growth of currency futures, although these contracts are, of course, also used for transforming market risk.

The function of exchange-traded derivatives

The primary economic function of exchange-traded derivatives seems to be to provide liquidity.[18] Liquidity is the ability to alter exposure to market movements cheaply and quickly. This ability would depend on transactions costs, including commissions and bid-ask spreads, and the market's capacity to absorb large trades with small price movements. Derivatives exchanges use technology, clearinghouse and margin arrangements, and dealer competition to minimize transactions costs.[19] The market's capacity to absorb large trades would depend on the market-making capability of dealers, the depth of both the cash and derivatives market, and the effectiveness of arbitrage between cash and derivatives. In general, exchange-traded derivatives allow only a less than perfect replication of positions in the underlying market, but they are useful precisely because their liquidity makes it easier to change those positions.[20]

The most dramatic advantage in transactions costs seems to be provided by exchange-traded equity index derivatives, which have found enormous success in spite of an underlying cash market that is itself largely an exchange market and apparently rather liquid. Equity index contracts sharply reduce the cost of transactions motivated by market events rather than by company-specific events. The savings in transactions costs are delivered in part by trading a standard basket of stocks as defined by the index. One study, for example, has estimated that the commission and spread costs of a transaction in the stocks making up the S&P 500 Index were thirty times the comparable cost for the

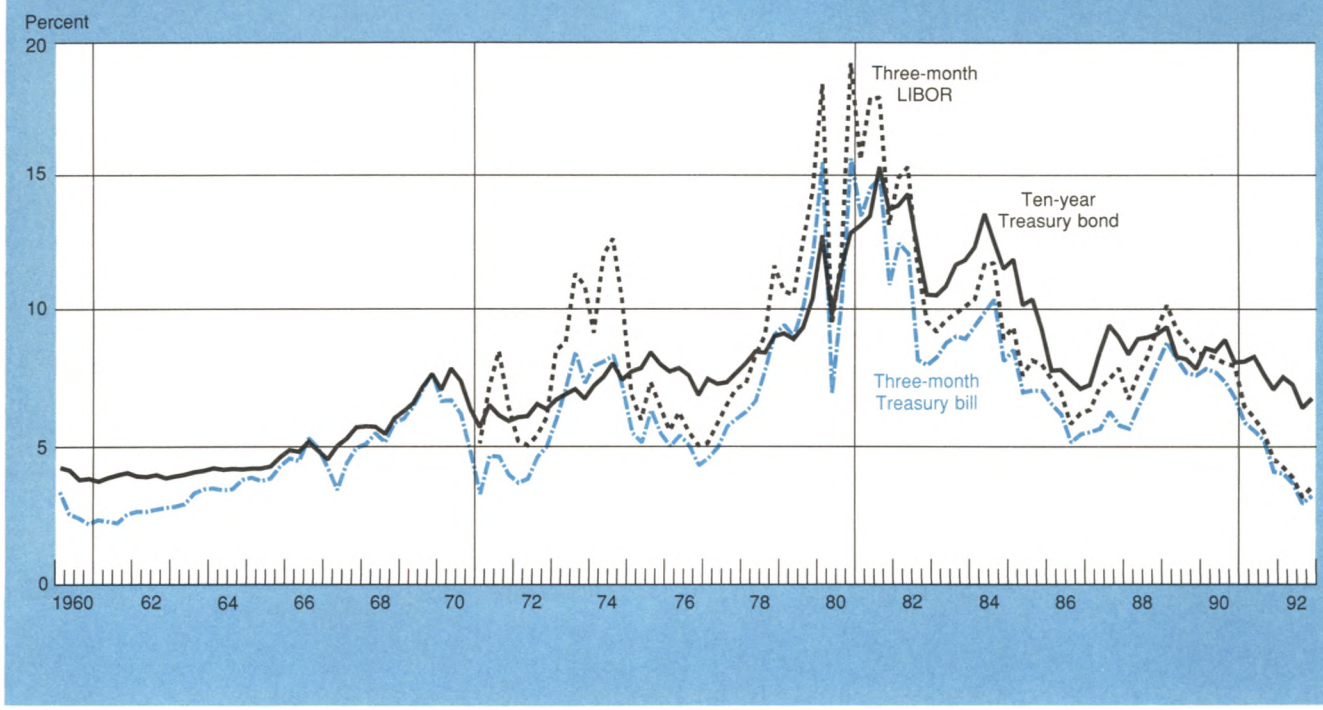
[18]These derivatives also offer investors the opportunity to take leveraged positions. A futures contract, for example, is structured to have zero value at origination, while call options are equivalent to positions in the underlying securities financed partly by borrowing. These contracts do not merely save on the transactions costs of borrowing but also reduce the credit risks entailed by an equivalent leveraged position in the cash markets.

[19]William Silber, for example, emphasizes that transactions costs are much lower in exchange-traded derivatives than in the cash markets. See "The Economic Role of Financial Futures," in Anne E. Peck, ed., *Futures Markets: Their Economic Role* (Washington, D.C.: American Enterprise Institute, 1985), pp. 83-114.

[20]The less-than-perfect replication of cash positions is reflected in the "basis," the difference between the derivative's actual price and the theoretical price implied by cash market prices.

Chart 9

U.S. Interest Rates



equivalent position in index futures at the CME.[21]

Liquidity in government bond markets

The liquidity provided by exchange-traded derivatives has recently found a place in two newly important cash markets. Trading in the cash markets for French and German government bonds was relatively inactive when interest rate futures for these bonds were introduced, suggesting that these markets lacked liquidity at that time. Table 2 reports a rough measure of liquidity, the ratios of secondary market transactions to amounts of government bonds outstanding in several of the major markets.[22] The ratios indicate that liquidity in the French and German government bond markets has been lower than in the U.K. market, and liquidity in the U.S. and Japanese markets higher than in the European markets.

The strong demand for bond futures

Thus a pent-up demand for liquidity in the new government bond markets helps explain the strong growth of exchange-traded futures on long-term interest rates. The growth of such contracts has been strongest where the underlying cash market seems most deficient in liquidity. In absolute terms, the fastest growing such contracts in terms of turnover have been the futures on

[21]Interest rate futures are estimated to save 40 percent of the transactions costs of the equivalent positions in the cash markets. See Arnold Kling, "Futures Markets and Transactions Costs," *Financial Futures and Options in the U.S. Economy*, Federal Reserve System staff study, December 1986, pp. 41-53.

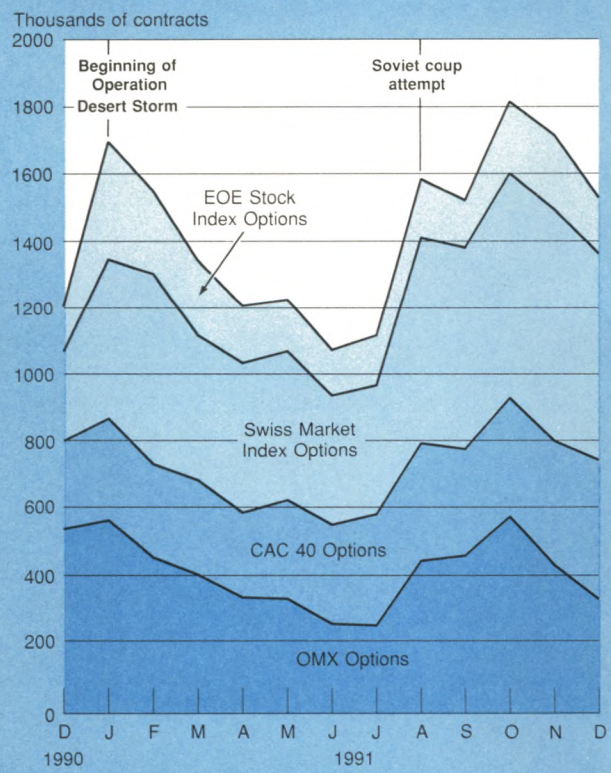
[22]Data are available only for secondary market transactions in the

Footnote 22 continued
home country. French and German bonds are actively traded also in London. Nonetheless, even doubling the amounts reported for France and Germany to account for foreign activity would not change the general pattern across countries.

Chart 10

Impact of 1991 Events on Exchange-traded Derivatives

Monthly Volumes of the Most Affected Major Contracts

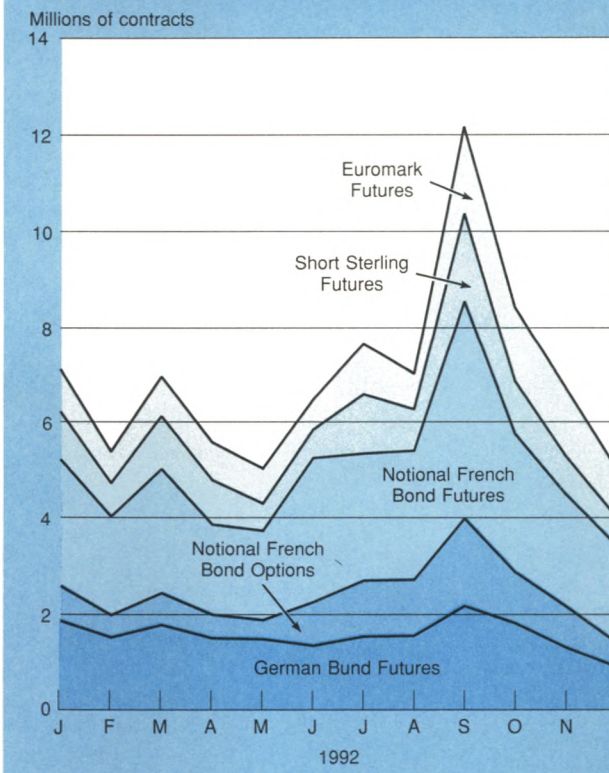


Source: Futures Industry Association.

Chart 11

Impact of September 1992 Currency Turmoil on Exchange-traded Derivatives

Monthly Volumes of the Five Most Affected Major Contracts



Source: Futures Industry Association.

Note: Figures on bund futures combine trading at LIFFE and DTB.

the notional French government bond and those on the German bund. In relative terms, the ratio of futures turnover to cash market turnover has been highest for the French and German markets and lowest for the U.S. market (Chart 12). Note that growth in the use of bond futures was accompanied by a decline in cash market transactions relative to bonds outstanding in Japan, France, and the United Kingdom from 1987 to 1991 (Table 2).

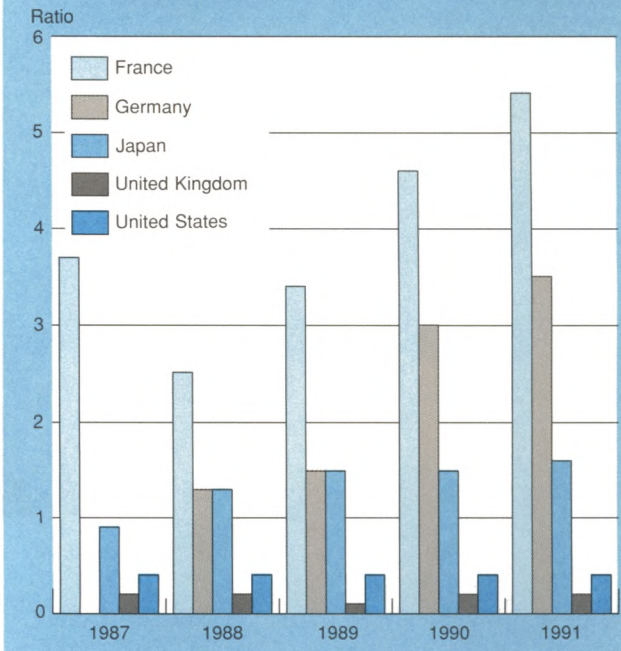
The strong demand for short-term interest rate futures
The growth of OTC derivatives has also helped boost turnover in certain exchange-traded derivatives. The liquidity of exchange-traded derivatives generally makes them convenient hedging tools for OTC derivatives dealers. In particular, the strong growth of Eurodollar futures and other interest rate futures may be traced to their use by swap dealers for hedging temporary positions in interest rate swaps. Turnover in Eurodollar futures has come to overshadow turnover in U.S. Treasury bill futures, not least because most dollar floating rate payments in swaps are based on LIBOR instead of Treasury bill rates.

The weak demand for currency futures
Liquidity also seems to be a factor in the poor growth of currency futures relative to interest rate futures. The spot market for foreign exchange is apparently already so liquid that it has created little need for the liquidity enhancement of exchange-traded derivatives. It is a telling fact that for the most part OTC dealers hedge their currency option positions in the spot market instead of the futures market.[23]

[23]Certain hedging strategies may still call for the use of exchange-traded options. In general, options can be hedged in either the cash or futures market by a technique called dynamic hedging or "delta" hedging. The technique requires frequent changes in positions to respond to changes in the sensitivity of the option price to the underlying asset price. These position changes can become costly during periods of high volatility, but exchange-traded options can be used to further hedge against the adjustment costs with a technique called "gamma" hedging.

The demand for new ways to transfer interest rate risk
It appears that demands by both financial and nonfinancial firms for new ways of dealing with interest rate movements help explain the huge expansion in interest rate swaps, just as demands for liquidity help explain the growth of certain exchange-traded derivatives.

Chart 12
Ratio of Futures to Cash Transactions in Government Securities



Source: Bank for International Settlements calculations.

Table 2
Ratio of Transactions to Amounts of Government Debt Outstanding

	1987	1991	Securities Included
United States	14.4	13.5	Treasury notes and bonds
Japan	22.1	8.9	Long-term interest-bearing government bonds
Germany	3.3	3.3	Bunds, railways, and post office bonds
United Kingdom	10.4	7.6	Long-term government and government-guaranteed securities
France	1.9	1.4	Central government marketable debt

Sources: Board of Governors of the Federal Reserve System, Bank of Japan, Deutsche Bundesbank, U.K. Central Statistical Office, London Stock Exchange, Bank for International Settlements, Banque de France, and Federal Reserve Bank of New York estimates.

The function of OTC derivatives

OTC derivatives have served to transform market risk, or equivalently, to provide new ways of transferring that risk.[24] Interest rate swaps, for example, were innovative because they functionally allowed the exchange of two notes paying two different types of interest streams—most commonly a floating-rate note and a fixed-rate note—without an exchange of principal amounts. The swap was designed essentially to allow a transfer of interest rate risk that entailed no credit risks associated with the principal.[25]

The rapid growth in OTC interest rate contracts, particularly swap contracts, may be attributed to financial institutions' and nonfinancial corporations' desire to deal with interest rate risks in new ways. Financial institutions turned to these derivatives to replace traditional hedging operations executed in the cash market, while nonfinancial corporations, some facing increased leverage, turned to the derivatives for general hedging and positioning purposes rather than just for saving on borrowing costs.

Development of the swap market

A movement towards greater market integration promoted the rapid rise of interest rate swaps. Throughout most of the 1980s, the swap market seems to have divided itself between a short-term segment (of maturities up to three years) catering largely to financial institution end-users and a long-term segment (of maturities longer than three years) catering to mainly nonfinancial end-users. In recent years, however, the division has blurred as nonfinancial end-users have increased their share of the market (Table 3) by migrating to the short-term segment, which has thus grown faster than the long-term segment (Chart 13).

The broadening of the market has been supported by stronger market-making activity, a trend evident in a wider share of interdealer swaps relative to end-user swaps and in narrower bid-ask spreads. Swap intermediation evolved from a business of simply bringing end-users together to one in which dealers acted as the counterparty to each side of a swap transaction. Assuming the role of counterparty allowed dealers to take swaps before matching positions could be found and to sell parts of the transaction to other dealers who could reach matching customers. As the market grew, the customers themselves began to see the importance of a dealer's credit rating, so that the business became increasingly concentrated in the highest rated intermediaries.[26]

[24] In the terminology of finance theory, the function of derivatives is to help "complete" financial markets. Stephen Ross, for example, demonstrates that in a world of uncertainty, options may often be the most effective way to widen investors' range of choices. See "Options and Efficiency," *Quarterly Journal of Economics*, vol. 90 (February 1976), pp. 75-89.

[25] In fact, credit risks are only associated with *net* interest payments. Katerina Simons simulates these risks in "Measuring Credit Risk in Interest Rate Swaps," *New England Economic Review*, November-December 1989.

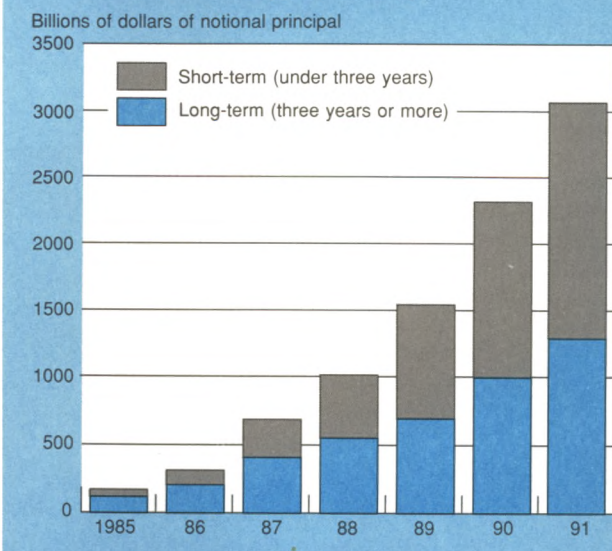
[26] The importance of credit ratings has led investment houses to form triple-A-rated subsidiaries to deal in OTC derivatives. Although

Table 3
End-Users of Interest Rate Swaps
(Percent Share of Total Notional Principal)

	1989	1991
Corporations	24	31
Financial institutions	62	57
Government	7	11
Other	7	1

Source: International Swaps Dealers Association

Chart 13
Interest Rate Swaps by Maturity



Source: International Swap Dealers Association.

Note: Values for 1985 and 1986 are estimates based on reports by fifteen dealers.

Credit market arbitrage

Some analysts have argued that borrowers most often turn to swaps to obtain the cost savings from arbitrage between credit markets.[27] Fixed rate debt markets are seen as demanding higher credit risk premiums relative to the floating rate debt markets. Thus interest rate swaps would lower borrowing costs through specialization by comparative advantage: a higher rated borrower would issue in the fixed rate market and a lower rated borrower in the floating rate market, each seeking the market where it was relatively favored. They would then switch interest payments net of a spread.

Such credit market arbitrage, however, fails to explain a surge in swaps issuance that goes well beyond the gross issuance of all Eurobonds and U.S. corporate bonds (Chart 14). The swap market has developed to the point where good opportunities for credit market arbitrage come only in occasional windows, so that swaps are now more often used for general hedging and positioning purposes than for saving on borrowing costs. Indeed the perceived savings in borrowing costs through swaps may now merely compensate for the added credit risk taken on by the swap counterparties.[28]

Swaps by financial institutions

End-user swap activity grew as financial institutions started using swaps for their own risk management and positioning purposes. The increased importance of funds management from the mid-1980s on and new regulatory capital standards later in the decade prompted many banks to turn to swaps as a way to deal with increased interest rate risks.

Footnote 26 continued
dealers themselves may need high credit ratings, they can still choose to serve customers with lower ratings or even unrated customers.

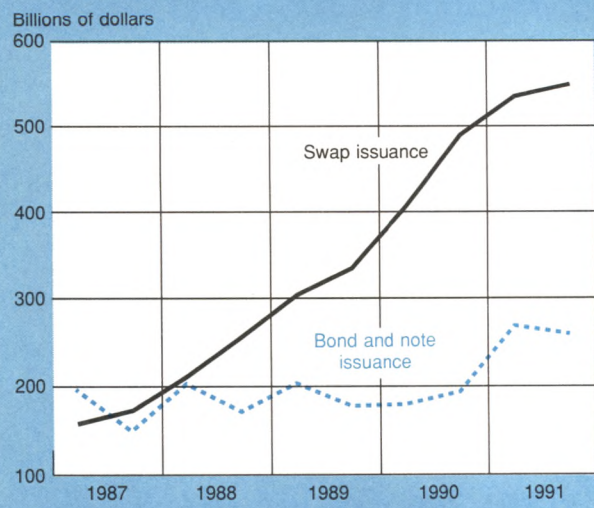
[27] D.K. Hargreaves, "Swaps: Versatility at Controlled Risk," *World Financial Markets*, Morgan Guaranty Trust Company, April 1991; J. Bicksler and A.H. Chen, "An Economic Analysis of Interest Rate Swaps," *Journal of Finance*, July 1986.

[28] A fixed rate borrower, for example, has two alternatives: (a) it may borrow directly in the fixed rate market, or (b) it may borrow in the floating rate market and swap into fixed rates. Alternative (b) may offer the lower all-in cost of funds, but unlike (a), it will also entail some credit risk from the swap counterparty.

Chart 14

Bond and Swap Issuance

Notional Value of Gross Interest Rate and Currency Swap Issuance and Gross Eurobond and U.S. Corporate Bond Issuance



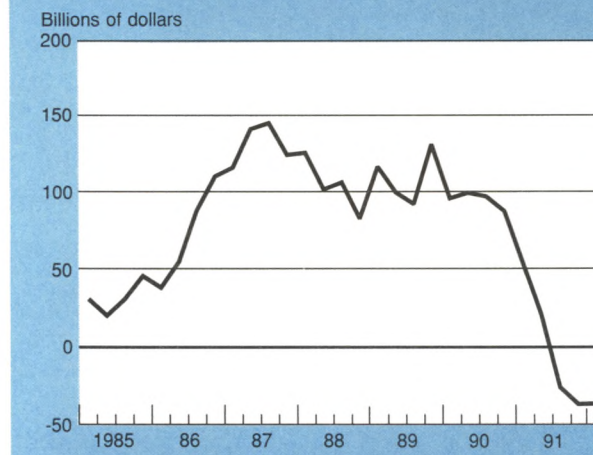
Sources: International Swap Dealers Association; Board of Governors of the Federal Reserve System; Organization for Economic Cooperation and Development.

Notes: Chart shows bond issuance by financial and nonfinancial companies. Swap issuance excludes interdealer transactions.

Chart 15

Total International Interbank Lending

Four-Quarter Moving Averages of Exchange-Rate-adjusted Changes in International Bank Assets



Source: Bank for International Settlements (BIS), *International Banking and Financial Market Developments.*

Notes: Chart shows both cross-border lending and local foreign currency lending. International lending refers only to lending among banks in countries reporting to the BIS.

During the 1980s, pension funds, insurance companies, mutual funds, and employer thrift plans joined the contest for household savings and forced banks to attract deposits by paying more competitive and variable interest rates.[29] At the same time, a loss of borrowers to the securities markets led banks to make the best of the situation by offering credit guarantees such as standby letters of credit and loan commitments. Funds management assured the availability of funds in case of need, but it also required the payment of interest rates sensitive to the money market. With the cost of funds so sensitive to the market, banks learned to separate funding risk from price risk by hedging their interest rate exposures, particularly by using interest rate swaps. In Europe, the need for funds management and hedging may have been more acute than in the United States. The deregulation of deposit rates in France and Switzerland and the efforts of the various monetary authorities to defend exchange rates under the European Monetary System added to the volatility of short-term interest rates and drew banks to swaps and forward rate agreements.

New regulatory capital standards also encouraged financial institutions to use derivatives rather than cash markets for the management of interest rate risks. The Basle accord of 1989 required banks to assign a 20 percent weight to interbank credit for calculating risk-based capital requirements but to apply the same weight only to "credit-equivalent" amounts of OTC derivatives.[30] Hence an interbank swap would require only a small fraction of the capital required by an equivalent interbank cash position on the balance sheet. In the early 1980s, the most important cash market used by banks for hedging was the international interbank credit market. In recent years, the interbank market has plunged, in part because banks now use the market narrowly for funding and use OTC derivatives for hedging (Chart 15).[31]

Swaps by nonfinancial corporations

The use of interest rate swaps by nonfinancial corporations expanded as credit market arbitrage ceased to be the primary motivation and as the corporations began to appreciate the derivative's general usefulness for hedging and speculating. An important factor in the growth of swaps was the rise in U.S. corporate leverage (Chart 16).[32] While the most leveraged corporations probably did not use swaps—for lack of the credit quality required by the market—more moderately leveraged firms evidently found swaps useful. A recent study by Anuradha Dayal of 356 publicly traded firms, for example, shows that the swap end-users were on average more leveraged than the nonusers (Table 4).[33] Most of the swap end-users in the sample were apparently hedging against interest rate risk by swapping into fixed rates.

The uncoupling of swaps issuance from bond and note issuance suggests that many end-users were borrowers from banks rather than from securities mar-

[29]See Federal Reserve Bank of New York, *Funding and Liquidity: Recent Changes in Liquidity Management Practices at Commercial Banks and Securities Firms*, July 1990.

[30]The credit-equivalent amount for an interest rate derivative with remaining maturity of more than a year, for example, would be half a percent of notional principal plus the mark-to-market value (if positive), which would be on the order of perhaps another 1 percent of notional principal.

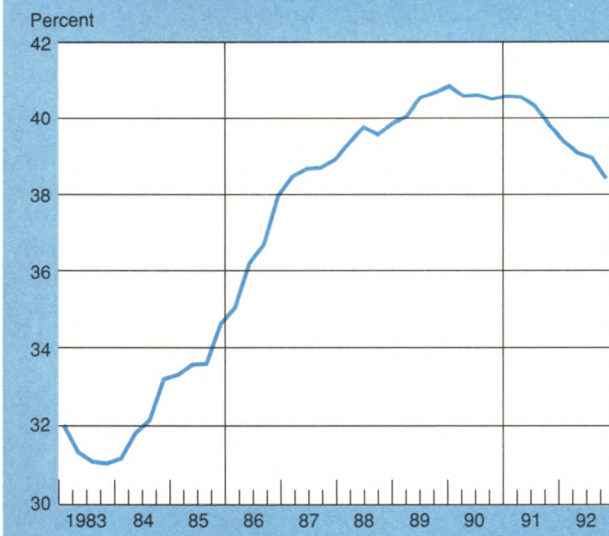
[31]Svein Andresen provides a good discussion of the development of the interbank market for OTC derivatives; see "The Growth of Interbank Markets for OTC Derivative Instruments," Bank for International Settlements, November 1992

[32]Another measure of leverage, the ratio of net interest payments to cash flows, declined sharply in the last two years. Most of this decline, however, resulted from the fall in short-term interest rates during the period; see Eli Remolona, Robert McCauley, Judy Ruud, and Frank Iacono, "Corporate Refinancing in the 1990s," in this issue of the *Quarterly Review*. Debt-asset ratios have remained high, and many firms still fear the risk of a rise in interest rates.

[33]Anuradha Dayal, "Firm Participation in the Interest Rate Swap Market: An Empirical Investigation," unpublished paper, Brown University, November 1992.

Chart 16

Ratio of U.S. Nonfinancial Corporate Debt to GNP



Source: Board of Governors of the Federal Reserve System, Flow of Funds data.

Table 4

Characteristics of U.S. Nonfinancial End-Users and Nonusers of Swaps

	Fixed Rate Payers	Floating Rate Payers	Nonusers
Number of firms	140	30	186
Leverage			
Ratio of debt to assets	0.42	0.34	0.28
Ratio of interest to cash flow	0.31	0.24	0.14
Type of debt hedged (percent)			
Bank loan	49		
Floating rate or commercial paper	22		
Fixed rate	—	47	
No information	29	53	

Source of basic data: Anuradha Dayal, "Firm Participation in the Interest Rate Swap Market," unpublished paper, Brown University, November 1992.

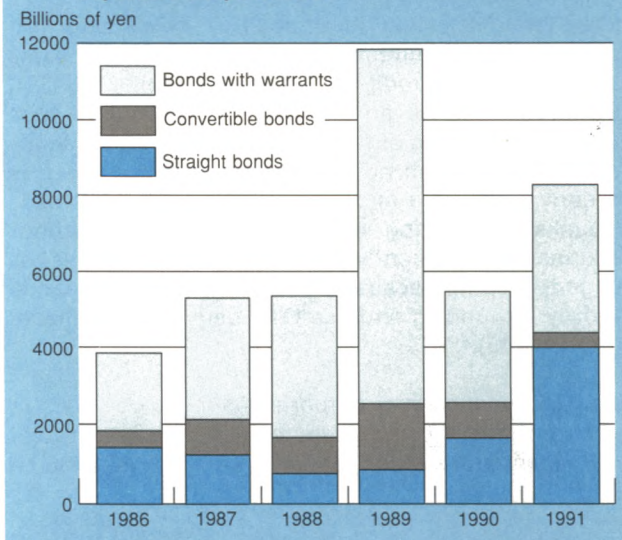
kets.[34] The Dayal study does find that most fixed rate swap payers reported hedging bank loans rather than floating rate notes (Table 4). Indeed, recent theory suggests that instead of issuing floating rate notes, a nonfinancial firm will roll over short-term loans to swap into fixed rates if the management expects the firm's credit rating to improve over time or if a bank creditor believes it can reduce credit risk by monitoring the firm.[35] At the same time, the recent disappearance of the once-ubiquitous call feature of U.S. corporate bonds may be explained in part by the availability of swap floors, collars, and interest rate options as alternative means of protecting fixed rate issuers from a fall in interest rates.

The global diversification of equity portfolios

In the 1980s, moves by institutional investors to diversify their equity portfolios contributed to the growth of the OTC equity index option market. Modern portfolio theory had persuaded these investors that diversification could reduce risk without sacrificing return.[36] They saw that in the absence of transfer risks, settlement risks, and substantial transaction costs, a global diversification of equity portfolios could provide considerable gains over purely domestic diversification, especially when correlations between stock markets remained

Chart 17

Bonds and Warrants Issued Overseas by Japanese Corporations



Source: Tokyo Stock Exchange.

[34] If bank borrowers tend to be poorer credit risks than bond and note issuers, the swaps market may now be subject to greater risks of default than before.

[35] See Robert H. Litzenberger, "Swaps: Plain and Fanciful," *Journal of Finance*, July 1992, pp. 831-50; Larry Wall, "Interest Rate Swaps in an Agency Theoretic Model with Uncertain Interest Rates," *Journal of Banking and Finance*, May 1989; and Marcelle Arak, Arturo Estrella, Laurie Goodman, and Andrew Silver, "Interest Rate Swaps: An Alternative Explanation," *Financial Management*, Summer 1988.

[36] Indeed, the capital asset pricing model (CAPM) suggests that in an efficient market, investors would hold the market portfolio consisting of all securities offered in the market; see William Sharpe, *Portfolio Theory and Capital Markets* (New York: McGraw Hill, 1970).

low.[37] In the 1980s, the Japanese stock market had become one of the world's major stock markets, and exposure to it was an important component of diversification.

During the period, burdensome rules for issuing equity directly in the Tokyo stock market drove capital-seeking Japanese firms to Europe, where they issued equity implicitly by attaching equity warrants to their Eurobonds. Issuance of these equity-linked bonds peaked in 1989 when Japanese firms issued over 9 trillion yen in face value (Chart 17). Investors found it convenient to detach the warrants from the bonds and to trade them separately as a way of trading the underlying Japanese equities. Japanese investors bought up most of the warrants, but enough found their way into the trading accounts of investment houses and the globally diversifying portfolios of institutional investors to form a viable market in Japanese equities outside Japan.

The development of the Japanese equity warrant market gave investment houses a convenient underlying market for OTC index derivatives, especially Nikkei Index options. Demand for these options surged when volatility began to beset the Tokyo stock market in 1990. Experience with trading the Nikkei contracts has apparently whet the appetite of investors and writers for OTC index options on the world's other major stock markets, notably the New York and Frankfurt markets.

[37]Bruno Solnik and B. Noetzlin estimate these gains in "Optimal International Asset Allocation," *Journal of Portfolio Management*, Fall 1982.

Conclusions

The growth and geographical diffusion of financial derivatives seem broadly consistent with the spread of other innovations. Nevertheless, powerful forces of demand played a decisive role in shaping the spread of derivatives in recent years. The growth in exchange-traded derivatives reflected primarily a demand for liquidity-enhancing innovations and the growth in OTC derivatives a demand for risk-transferring innovations.

Four broad developments contributed to the demand for these innovations in recent years. The volatility created by shifts in policy regimes led first to the growth of currency contracts, then to the growth of interest rate contracts, while recent temporary surges in volatility intensified activity in exchange-traded interest rate and equity index contracts in the last two years. The emergence of major new government bond markets and the growth of OTC derivatives created a demand for liquidity that exchange-traded interest rate futures were designed to provide. New inducements to financial institutions and nonfinancial corporations to deal with interest rate risks led to the growth of OTC interest rate contracts, most notably interest rate swaps and forward rate agreements. Finally, the global diversification of equity portfolios and the trading of Japanese equity warrants led to a demand for OTC Nikkei Index options and for OTC index options on other stock markets.