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THE MICROSTRUCTURE OF FINANCIAL DERIVATIVES MARKETS:

Exchange-Traded versus Over-the-Counter

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ABSTRACT

In this report the author focusses on the microstructure of derivatives markets. While the primary objective is to examine derivatives markets in Canada, the author also discusses certain developments in global derivatives markets that are bound to influence the functioning and development of financial markets in a small, open economy such as Canada's. It is argued that most of the characteristics that have traditionally differentiated the two derivatives market structures, organized exchanges and over-the-counter markets, are no longer clearly defined. Moreover, if centralized multilateral netting schemes are implemented for over-the-counter derivatives trading and if automated trade execution systems become the norm for derivatives exchanges, the differences between these two market structures are likely to become even smaller.

RÉSUMÉ

La présente étude traite de la microstructure des marchés de produits dérivés. Si l'auteure s'intéresse principalement aux marchés canadiens de produits dérivés, elle examine également certains aspects de l'évolution des marchés mondiaux de ces produits qui influeront forcément sur le fonctionnement et le développement des marchés financiers dans une petite économie ouverte comme le Canada. L'auteure soutient que la plupart des particularités qui différenciaient habituellement les deux structures des marchés de produits dérivés, à savoir le marché organisé et le marché hors bourse, ne sont plus clairement définies. De plus, elle fait valoir que les distinctions entre les deux structures de marché sont susceptibles de s'estomper encore davantage si des systèmes centralisés de compensation multilatérale sont mis en place pour les opérations sur les produits dérivés offerts hors bourse et que l'automatisation du traitement des transactions se généralise sur les marchés organisés.

1 INTRODUCTION

One of the most notable recent developments in financial markets is the phenomenal growth of global financial derivatives markets during the last decade. One result of this has been the large body of literature on financial derivatives that has recently emerged, most of which focusses on theoretical pricing models, risk management and the investment strategies associated with a growing number of derivative products. Considerably less attention is given in the literature to analysing the implications of the microstructure of the trading mechanism by which market prices are formed.

Research into the literature on financial market microstructure suggests that the market structure matters a great deal in the analysis of agent behaviour and the properties of asset prices. Indeed, it has been suggested that different market structures can lead to different equilibrium outcomes. This literature stresses the importance of understanding the real world processes by which prices are set in actual markets and focusses on the trading process itself. In particular, it analyses the arrival and dissemination of information, the generation and arrival of orders, and how orders are transformed into trades.[1] The literature also focusses on the specific trading mechanism by which the latent demands of investors are transformed into realized transactions. This is the process of finding market-clearing prices – or "price discovery."

Advocates of the microstructure view argue that, because of market frictions (such as transaction and information costs), prices in securities markets are not set by a process that resembles the classic Walrasian

1. See Cohen, Maier, Schwartz and Whitcomb (1986) for a review of the key issues addressed by the literature on financial market microstructure.

auction parable.[2] Hence, actual market prices may differ from their theoretically desired values, even when markets are competitive.

It is argued that no two trading mechanisms are equal in the way they lead to price discovery. This results from the fact that each trading mechanism has a specific technology of order submission, times at which trading can occur, amount of information conveyed to investors at the time of order submission, and reliance upon intermediaries to balance supply and demand.[3] The microstructure analysis represents an attempt to study, and to incorporate in formal analysis, the specific institutional arrangements that make actual markets work. However, most of the current literature on financial microstructure deals with equity markets, giving relatively scarce attention to the microstructure of derivatives markets.

This report focusses on the microstructure of derivative securities markets. Its primary objective is to examine derivatives markets in Canada. However, in so doing, it also examines certain developments in global derivatives markets. In an environment where international financial markets are becoming increasingly interconnected, global trends (including technological innovations) are bound to influence the functioning and development of financial markets in a small, open economy such as Canada's.

The structure of the report is as follows. Section 2 provides a brief overview of the basic derivative securities and their economic interrelationship.

2. Economic theory, in particular, has made use of the "Walrasian auctioneer" parable to explain how prices are set through trade. In broad terms, in this scheme all buyers and sellers are treated as if they gathered in a central location where there is an auctioneer calling out prices. As prices are called, supplies and demands are revealed. If the market does not clear, all contracts are voided and a new set of prices is announced. This process continues until the market clears at the equilibrium price. The Walrasian trading scheme assumes that there are no transaction costs, that the auctioneer acts solely as an agent, that price information is centralized and that all trades occur at the same time and place.

3. Madhavan (1990) and Domowitz (1993), for example, argue that the institutional design of any transaction system affects market performance.

Section 3 briefly reviews the general characteristics that have traditionally differentiated the two market structures, organized exchanges and over-the-counter markets. To provide some notion of the size and growth of these markets and their instruments, this section also provides an overview of recent global and Canadian market activity.

Section 4 examines in considerable detail the key microstructure characteristics of exchange-traded derivatives markets. The implications of electronic trading systems, recently adopted by a number of exchanges worldwide, are also discussed.

Section 5 focusses on the microstructure of over-the-counter derivatives markets.

In Section 6 the overall risks present in derivative securities and markets are discussed.

Finally, Section 7 provides some concluding remarks based on the comparison of the microstructure of exchange-traded and over-the-counter derivatives markets. In particular, it points out that although some significant differences still remain, most of the characteristics that are assumed to differentiate the two market structures are no longer clearly defined. Moreover, if centralized multilateral netting schemes are implemented for over-the-counter derivatives trading and if automated trade execution systems become the norm for exchanges, the differences between the two market structures are likely to become even smaller.

2 DERIVATIVE SECURITIES

A financial derivative is an asset whose payoffs are contractually linked to the prices or payoffs of other underlying instruments. Underlying assets include equity, currencies and interest rates. Traded instruments typically fall into one of the following categories: futures or forwards on equity, interest rate and currency contracts; interest rate and currency swaps; options on equity, currency, interest rates, futures and swaps; and interest rate caps, floors and collars (which, as discussed below, constitute a series of options on interest rate contracts). As well, commodity-linked and equity-linked derivatives have recently emerged in over-the-counter markets as a natural outgrowth of other more traditional derivative securities.[4] The general characteristics of these instruments, and their economic interrelationships, are examined below.

A forward or futures contract obligates the holder to take delivery, and the writer to make delivery, of the underlying asset at a specified price on a future date. A forward contract is identical to a futures contract in that both constitute an obligation to take or to make delivery at a future date. The major difference between forward and futures contracts relates to the fact that futures contracts are exchange-traded instruments and are subject, therefore, to certain institutional requirements (discussed in Section 4). Technically, however, a futures contract is equivalent to a forward contract that is settled daily – or "marked-to-market" – and written simultaneously as a new forward contract.

An option contract gives the purchaser the right, but not the obligation, to purchase or sell an asset. A call option gives the owner the right to purchase an asset, while a put option gives the purchaser the right to sell the asset, at a specific future date (a "European" option) or by a certain date in the future (an "American" option), at a predetermined price.

4. The rate of return on commodity-linked (or equity-linked) derivatives transactions can be related to the price of a particular commodity index (or equity index) through the use of swaps, options, forward agreements, or some combination of these instruments. Since commodity-linked derivatives are settled for cash (rather than physical delivery in commodity exchange markets), they can be used to construct synthetic money market investments.

Interest rate caps, floors and collars represent the purchase or sale of options on interest rates over extended time frames. An interest rate cap, which places an upper limit on the interest cost to the purchaser of the contract, can be viewed as a portfolio of (European) call options on the relevant interest rate index or, equivalently, a portfolio of put options on discount bonds. An interest rate floor places a lower limit on the interest rate to be charged. Collars specify both the upper and lower limits for the rate that will be charged. Similar to an interest rate cap, an interest rate floor is a portfolio of put options on interest rates or, expressed differently, a portfolio of call options on discount bonds. A collar is a combination of a long position in a cap and a short position in a floor.

In a swap, which represents a series of forward transactions, the counterparties agree to buy and sell a stream of cash flows on a notional principal amount over a predetermined length of time. The cash flows exchanged in a swap can be based on fixed or floating interest rates and on the same or different currencies. In the case of a "plain vanilla" interest rate swap, a fixed interest rate (plus a spread) is paid in return for receiving a floating rate. Interest rate swaps involve only the exchange of interest payments, while currency swaps also entail the exchange of principal amounts.[5]

2.1 Economic interrelationships between instruments

All financial derivative instruments have certain economic interrelationships and can be decomposed into two basic instruments: forward-based and options-based contracts. Forward-based transactions include forwards, futures and swap contracts. Options-based contracts include

5. Although a number of variations exist for more sophisticated instruments, all swaps rely on the basic structure of cash flow exchange. For example, in an equity-index-linked swap, the investor pays a floating interest rate to the provider of the swap in exchange for the total return of an equity index plus or minus a spread. Similarly, in a commodity-linked swap, the counterparties agree to exchange cash flows based on the fixed price of a given commodity for the value of its floating index. As well, 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).

options, as well as caps, floors, collars and options on swaps. Diverse types of derivatives are created by combining the building blocks in different ways and by applying these structures to a wide range of underlying assets, rates or indexes.

Decomposition of derivative securities into their basic elements and analysis of their interrelationships is essential in understanding the structural and economic aspects of such transactions. Indeed, different derivative securities can be viewed not as separate instruments, but as a highly integrated set of financial transactions. Therefore, decomposition has important implications for pricing and hedging. It implies certain pricing relationships and related arbitrage opportunities among the different instruments. Understanding the substitutability and, in some cases, the complementarity among different derivative instruments traded in each of the market structures can also be useful in explaining the co-existence of the over-the-counter and the exchange market structures. Moreover, as discussed in Section 6.1, the market risks of a derivatives portfolio can be analysed in terms of the fundamental risks associated with the basic types of derivatives it may contain.

The interrelationships between (same currency) swaps, forwards or futures, and options markets are depicted in Figure 1.[6] The first element to note is that, because of portfolio arbitrage, the pricing of any derivative security will be a function of market interest rates. Consequently, a forward contract on any financial asset would essentially operate as a forward contract on interest rates.

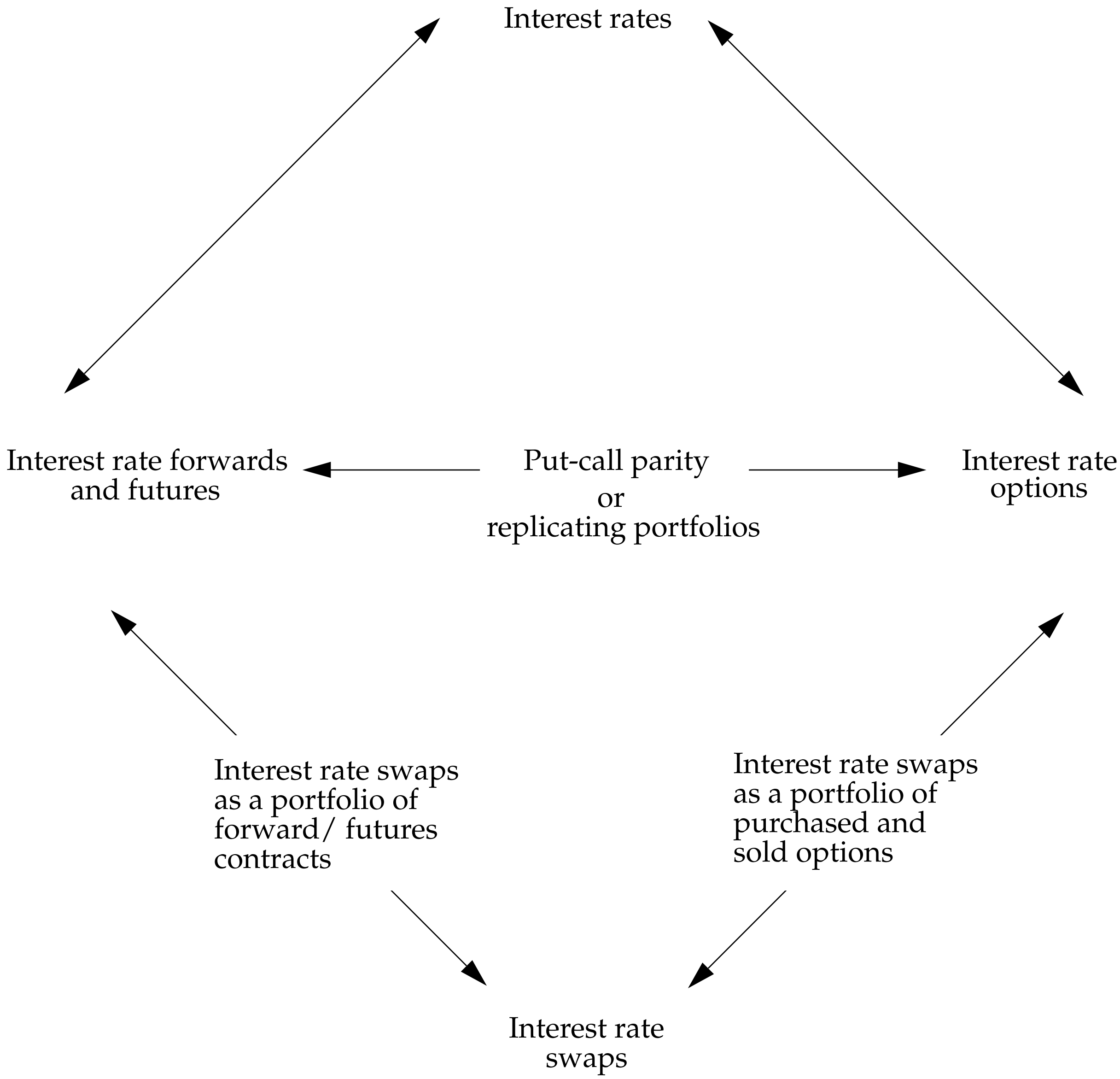
2.1.1 Interest rate swaps vis-à-vis forward interest rate contracts

The relationship between interest rate swaps and forward interest rate contracts, in the same currency, derives from the fact that a swap contract is a series of forward contracts combined. Since an interest rate swap entails the exchange of specified cash flows determined by reference to two interest rates (that is, a series of cash inflows in return for a series of cash out

6. Same-currency linkages among the various instruments can be similarly extended to a multicurrency situation. The discussion on the economic interrelationships between different derivative securities draws heavily from Das (1989).

FIGURE 1

Swap, forward and option market interrelationships (in the same currency) through arbitrage



flows), this contractual arrangement can be decomposed into a portfolio of simpler single-payment contracts, which in turn can be decomposed into a series of forward contracts. With this approach, it is possible to restate an interest rate swap as a series of implicit forward contracts on interest rates.

Indeed, an interest rate swap entered into can be parcelled into known rates of interest for various periods within the term of the overall interest rate swap and sold into the market as forward interest rate agreements (FRAs).[7] This allows interest rate swaps and FRAs to co-exist and complement each other.

2.1.2 Interest rate swaps vis-à-vis interest rate options

An interest rate swap is equivalent to the simultaneous purchase and sale of a portfolio of interest rate options. In particular, it is possible to characterize an interest rate swap, where one of the parties is the payer of the fixed rate, as the simultaneous purchase of a put option at the fixed interest rate with the writing of a call option at the same fixed rate – effectively constituting a collar with no difference between the floor and the cap rates. Similarly, where the party in question is a receiver of the fixed rate, the interest rate swap is equivalent to the simultaneous writing of a put option with the purchase of a call option. Because of this interrelationship, users of the swap market tend to view the interest rate cap-floor-collar markets as potential substitutes for interest rate swaps.

2.1.3 Options vis-à-vis forward contracts

There can be two linkages between options and forward contracts. First, an option can be replicated by continuously adjusting a portfolio of securities (or forward contracts on the underlying asset) and riskless securities or cash. Second, option contracts can be used to replicate forward contracts through a relationship known as the "put-call parity."[8] As a result of this

7. A forward rate agreement (FRA) is a contract that becomes effective at a specified future date for a specified interval over which a particular rate of interest, fixed at the initiation of the agreement, is charged on some notional underlying principal amount. If the reference interest rate, typically 3-month bankers' acceptances (BAs) in Canada, rises (or falls) relative to the contract rate, the seller (or buyer) of the FRA pays the buyer (or seller) the difference on the notional principal.

8. The put-call parity theorem shows that the value of a European call option with a certain exercise price and exercise date can be deduced from the value of a European put option with the same exercise price and exercise date, and vice versa. Although the put-call parity does not hold for American options, it is possible to use arbitrage arguments to obtain upper and lower bounds for the difference between the price of an American call and the price of an American put (Hull 1993).

relationship, the simultaneous purchase of a call option and the sale of a put option is equivalent to a forward purchase, while the sale of a call option simultaneously combined with the purchase of a put option is equivalent to a forward sale (which also constitutes an interest rate collar, as previously noted).

3 DERIVATIVE MARKETS

Derivative securities can be traded on organized exchanges or through over-the-counter arrangements. There are a number of characteristics that are traditionally used to describe the broad differences between exchange-traded (EXT) and over-the-counter (OTC) derivative markets. These are based on a number of considerations, including the standardization of instruments, the existence of a clearing house to deal with counterparty credit risk, the regulatory framework and the types of instruments traded in the different markets.

3.1 Traditional market structure characteristics

3.1.1 Standardization

Exchange-traded contracts are generally thought of as having been standardized (with regard to maturity date, contract size and delivery terms), whereas OTC contracts are custom-tailored to the client's needs.

Some exchanges, however, have recently introduced derivative instruments that can provide a significant degree of customization.[9] Also,

9. A notable example is the "Flex" option, which was introduced by the Chicago Board of Options Exchange (CBOE) in February 1993. Flex options allow investors to choose strike prices, expiration date and style (that is, European or American). Currently, the CBOE has Flex options listed on S&P100, S&P500 and the Russell Index (a basket of 2000 small-capitalization stocks). The CBOE is also planning to introduce Flex options on foreign equity indexes (such as the U.S.-dollar-denominated British FT-SE index). The increasing popularity of Flex options has prompted interest from other exchanges (including the Toronto Stock Exchange, the Chicago Board of Trade, the Philadelphia Stock Exchange, the American Stock Exchange, the London International Financial Futures Exchange and the Marché à Terme International de France MATIF) to introduce similar instruments. In April 1993, Sweden's Optionsmarknad (OM) introduced the "TailorMadeClearing" option, which allows investors to choose the underlying security, type of option, exercise period and exercise price (*International Financing Review*, 21 August 1993). As well, the Chicago Board of Trade (CBOT) recently announced the introduction of the "Flexible Treasury Option" written on U.S. Treasury bonds and bills which allows for investors' choice of exercise price, expiration date and style.

in practice, OTC markets may follow certain simplifying market conventions that provide a certain degree of standardization.[10]

3.1.2 The clearing corporation

Another distinction between EXT and OTC contracts that is typically assumed to be critical is the existence of a clearing organization at the exchange. As noted by Edwards (1983), clearing organizations in derivative markets perform two main functions. First, they attempt to assure the financial integrity of the transactions by directly guaranteeing contracts and by establishing an elaborate self-regulatory mechanism to maintain its financial integrity and that of all clearing members. Second, because clearing associations ultimately assume the obligations of a counterparty in all futures and options contracts, they provide a simple and convenient mechanism for settling contracts. The contractual role of the clearing association allows it to cancel one party's obligation if that party enters into an offsetting transaction – providing for a multilateral netting arrangement.

With the clearing organization guaranteeing contract performance – by assuming the counterparty obligations of the buyer and seller in each transaction – price, maturity and market risks are generally assumed to be the main factors determining trade in EXT derivatives. Counterparty (or credit) risk is generally perceived to be of second-order importance.

On the other hand, credit worthiness constitutes an important parameter in OTC markets, based on which market participants select their counterparties. Although transactions may include some schemes designed to reduce the likelihood of the contract's non-performance, OTC markets lack a uniform mechanism able to eliminate all counterparty risk. If an OTC party defaults, counterparties bear the financial losses associated with the transaction's obligations.

10. For example, most interest rate swaps in Canada are fairly standardized, typically involving the exchange of cash flows on a contract's notional value based on 1-month or 3-month bankers' acceptances (floating interest rate) for 2- to 5-year Government of Canada bonds (fixed rate). The adoption of master agreements (discussed in Section 5) also imply a degree of standardization in OTC contracts.

However, despite the mechanisms that clearing houses adopt to secure their financial soundness in case of default by members (discussed in Section 4), a clearing house may still carry a degree of default risk.[11] In addition, the importance of the clearing-house's role as a guarantor lessens when the level of credit quality of the participants is high. OTC markets are typically favoured by high credit quality participants who may not require the clearing-house financial guarantee.[12]

3.1.3 Regulation

EXT markets are highly regulated.[13] Although many participants in OTC markets are also regulated, OTC derivative markets themselves are not. Indeed, different agents which deal in OTC derivative markets, and perform similar activities in those markets, are often regulated quite differently (e.g., banks, securities firms, insurance companies and non-financial institutions).

3.1.4 Instruments

Financial derivatives traded in EXT markets are primarily futures and option contracts on equity, equity indexes and interest rates.[14] OTC financial derivatives include: forwards on interest rates and currencies, interest rate and currency swaps, options on stocks and interest rate instruments (including caps, floors and collars), options on swaps (or swaptions), equity-linked and commodity-linked derivatives, and a variety of other synthetic instruments.

11. For example, the Bourse de Commerce de Paris -- the clearing organization for futures markets in Paris -- did default in 1974 (Edwards (1983)).

12. According to a survey by the International Swaps and Derivatives Association (formerly known as the International Swap Dealers Association), 91% of swaps in the portfolios of its members were investment grade (triple B or above) at end-December 1991.

13. In Canada, EXT derivative markets are regulated by provincial securities authorities and by the exchanges' own by-laws (as self-regulatory institutions).

14. However, some exchanges appear to have plans to introduce exchange-traded swaps. For example, the Montreal Exchange has specific trading regulations applicable to exchange-traded interest rate swaps (see Art. 7226, Montreal Exchange By-Laws (1993)).

3.2 Market activity

3.2.1 Global Markets

The growth of turnover and of volumes outstanding in markets for derivative instruments has outpaced the growth of most other financial activities. In organized exchanges, worldwide open interest in financial derivatives rose an average of 36 per cent a year from 1986 to reach $3.5 trillion at the end of 1991. Even so remarkable an expansion appears to have been surpassed by the growth of financial derivatives in over-the-counter markets where the total notional principal grew an estimated 40 per cent a year during the period to more than $6 trillion by end-1991.[15]

In global organized exchanges, as well as OTC markets, the growth in derivatives has been dominated by contracts based on interest rates. In EXT markets, turnover in interest rate contracts grew 21 per cent a year from 1986 to 1992 and accounted for 90 per cent of the absolute increase in total EXT market turnover. The bulk of this growth came from interest rate futures contracts. As in the EXT markets, most derivatives' growth in the OTC markets consisted of interest rate contracts. Interest rate swaps, the dominant OTC derivative, grew an average of 41 per cent 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. FRA's are estimated to have grown as fast as interest rate swaps and may have accounted for another quarter of the total market increase. Options on interest rates (including caps, floors, collars and swaptions) grew the fastest of all OTC contracts, with notional principal rising 81 per cent a year during the period to account for 10 per cent of the total increase in the OTC market.

Next to interest rate contracts, currency contracts contributed the most to the global growth of derivatives, albeit in a comparatively smaller way. In EXT markets, trading in currency contracts rose about 8 per cent a

15. Global data are drawn from Remolona (1992). The Bank for International Settlements (1992b) also provides detailed information on global activity. It is worth noting that it is difficult to compare the size of the two markets, in part because the unwinding of positions by means of an opposite trade adds to notional principal in OTC markets while it adds to turnover in exchange markets.

year and accounted for less than 7 per cent of the absolute increase in total exchange market turnover from 1986 to 1992. In the OTC market, currency swaps kept pace with interest rate swaps by growing 42 per cent a year from 1986 to 1991, while currency options expanded at a significantly slower pace. Currency swaps may have shown much stronger growth than other currency contracts because they are in part interest rate contracts, involving the exchange of fixed/floating rate payments in one currency for fixed/floating rate payments in another.

Equity index contracts, although still constituting a small fraction of the whole derivatives market, have shown rapid growth recently. Although global exchange trading in equity index contracts showed no expansion over the period 1986 to 1992, largely as a result of a decline in turnover following the October 1987 stock market crash, equity index contracts have recovered strongly since 1988. Indeed, turnover in equity index contracts has grown even faster than turnover in interest rate contracts. In OTC markets, equity index options and swaps made up a small fraction of the market, but the last few years witnessed very fast growth resulting in these contracts accounting for about 5 per cent of the absolute expansion of notional principal in the OTC market from 1986 to 1991.

3.2.2 Canadian Markets

In Canada, derivatives financial markets (especially EXT markets) have had a comparatively slower start than in other countries. Nonetheless, the expansion of trading in derivative instruments has had a significant impact on Canadian financial markets.[16]

There are three organized exchanges where financial derivatives trade in Canada. Although all three exchanges trade a number of individual equity options, the two biggest exchanges, Toronto and Montreal, have effectively divided the market for other financial derivative products among themselves. In particular, the Toronto Stock Exchange (TSE) and the Toronto Futures Exchange (TFE) have occupied the territory for stock index products,[17] while the Montreal Exchange (ME) has expanded the

16. O'Connor (1993) provides a comprehensive analysis of the development of derivative markets in Canada.

fixed-interest side. The Vancouver Stock Exchange (VSE) has focused instead on commodity-related derivatives, including options on equity of commodity-related companies and gold (although the TSE also lists options on silver).[18]

Table 1 summarizes recent trading activity on financial derivatives in the two largest Canadian exchanges -- the Montreal Exchange and the Toronto Stock/Futures Exchange. In the Montreal Exchange, interest rate futures contracts constitute the bulk of the contracts traded. The volume of traded futures contracts on bankers' acceptances has roughly doubled each year since April 1988, when the 3-month contract was introduced (the 1-month contract was launched in April 1992). Turnover on the 10-year Government of Canada bond futures contract has also increased significantly since its introduction in September 1989, especially in recent years. Although turnover on Government of Canada bond options has stabilized since 1991, recent levels of trading activity remain significantly lower than in previous years. Turnover on Canadian Government bond futures options has been moderate since the introduction of this contract in March 1991; after declining sharply in 1992, the volume of contracts traded doubled during 1993. With regard to activity on equity options at the ME, the volume of contracts traded has remained roughly constant in the last few years after registering a sharp drop in 1990.

In the Toronto Stock/Futures Exchange, while turnover of futures contracts on the TSE-35 index has shown moderate growth in recent years, trading activity of options on the TSE-35 index has declined significantly since 1991. With regard to equity options, the volume of contracts traded

17. The Toronto Futures Exchange (TFE) is associated with the TSE but has its own board of governors.

18. Exchange-traded derivative securities currently traded in Canada include: *futures* on the TSE-35 stock index (TFE), on 3-month and 1-month Canadian bankers' acceptances (ME) and on 10-year government of Canada bonds (ME); *options* on the TSE-35 stock index (TSE), on silver (TSE), on gold (VSE), on Government of Canada bonds and on 10-year Government of Canada bonds futures (ME), as well as on equity (TSE, ME, and VSE). The TSE also trades Toronto 35 Index Participation Units ("TIPs") and options on TIPs, as well as index warrants.

at the TSE has remained roughly constant in the last few years, after experiencing a significant drop during 1990-91.

In terms of OTC derivative trading activity in Canada, only incomplete statistical information exists. Nonetheless, there are some indicators which suggest that activity in this market has grown dramatically in recent years. In 1992, Canada's six largest banks, which are the primary suppliers of OTC derivatives in the domestic market, had a notional principal outstanding of almost C$2.2 trillion in derivatives -- nearly five times the amount reported in 1986. About 46 per cent of this amount constitutes forward contracts on foreign exchange, while interest rate swaps represent 24 per cent, interest rate forwards and futures account for a further 20 per cent, and options constitute about 10 per cent of the total notional amount reported. All these OTC instruments have shown dramatic growth in recent years -- for example, the notional amount of options expanded by an average annual rate of 95 per cent between 1986 and 1992, while swaps and interest rate forwards/futures grew at an average annual rate of more than 40 per cent, and foreign exchange forwards expanded by nearly 20 per cent per year during that period.[19]

19. O'Connor (1993).

Table 1: F inancial Derivative Exchanges (ME and TSE/TSE)

	Face Value of Contract	Volume of Contracts Traded					
		1988	1989	1990	1991	1992	1993
Montreal Exchange		(In thousands of contracts)					
Interest rate contracts							
Futures							
Canadian Bankers' Acceptances [a]	C$1,000,000	10	28	88	194	443	752
Canadian Government bonds (ten-year)	C$100,000	n.t.	87	454	421	516	894
Options							
Canadian Government bonds	C$25,000	335	323	139	47	51	62
Canadian Government bond futures (ten-year)	C$100,000	n.t.	n.t.	n.t.	15	5	10
Equity contracts							
Options							
Stoc k options		809	893	431	582	665	507
Toronto Stock/Futures Exchange							
Equity contracts							
Futures							
TSE-35 index	C$500 x index	27	35	53	61	59	69
Options							
TSE-35 index	C$100 x index	429	487	698	465	302	221
Stoc k options		2,341	2,432	1,511	976	899	1,155

a. Include one- and three-month futures. Face value of contract for the one-month futures is C$3,000,000 and for the three-month futures is C$1,000,000.

n.t. not traded

Source: *Statistics*, Montreal Exchange; *Official Trading Statistics* and *Review,* Toronto Stock Exchange.

4 MARKET MICROSTRUCTURE: EXCHANGE-TRADED DERIVATIVES

An exchange market is a highly organized market, with specific rules of listing and trading, contractual terms, a market mode of operation, and conditions of membership.

4.1 The clearing corporation

The existence of a clearing corporation in EXT derivative markets is one of the main characteristics of this market structure.[19] Clearing corporations, or clearing houses, are usually owned by their members and provide an extensive guarantee system.

It is important to make a distinction between the clearing and execution of transactions. Execution is the transacting of an order on an exchange floor, while clearing involves the subsequent confirmation of the transaction by the clearing corporation and the actual cash settlement of the transaction.

Following the trade between two counterparties, the clearing corporation intervenes to assume the opposite position for both original transactions, thus becoming, in effect, the counterparty for both transactions. It then assumes the obligations of the buyer and the seller of the derivatives contract, agreeing to satisfy the terms set forth in the contract.[20] As a result, the investor does not need to worry about the financial strength and integrity of the original party to the transaction since, after initial execution of an order, the relationship between the two contractual parties ends. Investors are thus free to liquidate their positions without involving the other party in the original contract. This guarantee system relies fundamentally on the financial integrity of the clearing house. As discussed

19. However, Napoli (1992) notes that the clearing corporations of some derivative exchanges (for example MATIF and Sweden's OM) clear and settle certain OTC derivative transactions, albeit on a very small scale.

20. Clearing corporations for securities other than derivatives typically do not act as counterparties or guarantors of trade performance.

below, the clearing corporation uses a number of mechanisms to protect the soundness of the guarantee system.

4.1.1 Trans Canada Options Inc.

Trans Canada Options Inc. (TCO) -- owned one-third each by the ME, the TSE and the VSE -- is the clearing corporation for all financial options and futures traded on the Canadian exchanges. (In the United States, there are several clearing corporations.)[21] The Canadian exchanges report to TCO every trade transacted by their members. While trades are recorded and effective at the actual time of trading, settlement occurs on the morning of the next business day.

The main role of TCO, as a guarantor, is to ensure the integrity and financial stability of the Canadian options and futures markets. To manage risk on behalf of the market, TCO utilizes four primary mechanisms: i) minimum net capital requirements; ii) margin requirements; iii) clearing fund deposits; and iv) financial and market surveillance.

4.1.1.1 Minimum net capital requirements

Firms using the floor for the purpose of trading derivatives must be members of TCO (or have an arrangement with a TCO member). To qualify for membership in TCO, an applicant must be either a Schedule I bank, a full member of the ME, the TSE-TFE or the VSE. In addition, the applicant must maintain a minimum level of net capital determined by the exchanges and the Investment Dealers Association of Canada.

4.1.1.2 Margin requirements

TCO relies fundamentally on a margin system designed to cover its risks as issuer and guarantor of all financial derivatives traded in Canadian exchanges. Because TCO stands ready to assume a defaulting member's positions, in its role as guarantor, margin collections must be sufficient to cover all potential losses in case of default. As explained in more detail below, the margin system used by TCO basically calculates the daily

21. While the Options Clearing Corporation (OCC) clears all exchange-traded options in the United States, some American exchanges have their own clearing corporation for futures trading (for a discussion on those exchanges, see Edwards 1983).

market value of the positions within each account held by a member firm. TCO then estimates the "worst case" value of these positions for the next trading day, collecting sufficient margin to cover its costs should TCO need to liquidate the positions.

More specifically, TCO's margin system operates as follows. Daily margins are required for every class group or product group within any account held by a clearing member.[22] TCO maintains one or more accounts (for example, client, firm and on-floor professional trader accounts) for each of its clearing members.[23] Each account requires a separate margin, as if it were the only account held by the member. However, the daily margin collected from a clearing member reflects the sum of margin calculations across all its accounts.

The daily margin requirement for a class or product group within an account held by a member comprises three components: premium margin (calculated for option and futures option positions), additional margin (for options and futures) and spread margin (for futures positions only).

The premium margin is designed to cover the cost of liquidating all option and futures option contracts at market prices. Depending on the positions held and current market prices, this margin component can be either positive (constituting a margin requirement) or negative (a margin credit). A positive (or negative) premium margin would increase (or decrease) an account's overall margin requirement.

The second overall margin component, the additional margin, represents the difference between a position's current market value and a projected "worst case" market value. The projections are based on various

22. A class group is a collection of derivative securities that are based on the same underlying security. A product group is a collection of one or more class groups whose underlying securities exhibit a significant price correlation (for example, the 1-month and the 3-month banker's acceptance futures contracts fall within the same product group).

23. A Client account is one where the clearing member has no direct or indirect interest, other than the commission charged, in the customer's account. An account established by a member on its own behalf constitutes a Firm account. On-Floor Professional Trader accounts include those where traders transact for their own trading accounts.

price changes in the underlying securities. The additional margin constitutes the projected incremental cost (positive or negative) of liquidating a position.

The calculation of the additional margin for a class group involves several steps. In broad terms, the first step is the determination of the margin interval for the class group – this represents the maximum projected underlying price movement against which the margin system is to provide protection. Currently, margin intervals are designed to protect TCO against a situation where the underlying security experiences large price movements on two consecutive days.[24] The second step is to project the worst-case theoretical value of the class group, assuming several different price movements in the underlying securities. Theoretical values are projected separately for each series of options and futures held within an account. However, the margin requirement for that account is based on the projected theoretical values of each class group held within an account. In other words, TCO considers the worst case theoretical value of an entire class group (not the sum of each worst case for each series within that class group) for margin purposes. This allows TCO to provide margin relief for offsetting positions in different series. The final step is the comparison of the worst case theoretical value with the net premium margin for the class group. The difference, if negative, is the additional margin for the group.

The third overall margin component, the spread margin, is only calculated in the case of futures positions. Within any one class group, TCO's margin system automatically offsets net long futures positions in one contract month against net short futures positions in another month. The spread margin is the fixed dollar amount that is charged per spread and is

24. TCO computes the margin intervals by multiplying the maximum standard deviation of an underlying security's daily returns, based on closing prices over a rolling 20-, 90- and 260-day trading period, times (1.4 x 3). The rationale is that, assuming that daily returns are normally distributed, three standard deviations would yield a confidence interval of about 99 per cent probability of occurrence. Also, since the standard deviation of returns over a period of n days is equal to $\sqrt{n}$ times the standard deviation over one day, for n=2 days; $\sqrt{2}$ is roughly equal to 1.4.

based on the expected relative price movements between contract months.[25]

The sum of the premium margin, the additional margin and the spread margin (for futures contracts only) represents the total daily margin requirement for a class group. The calculation of the margin requirements is performed once a day, after the markets close. The amount of margin that is subsequently collected is expected to be sufficient to cover projected worst-case movements in the underlying securities.[26]

Under extreme volatility conditions during a trading session, an intraday margin could be also required by the clearing corporation. The intra-day margin is calculated by projecting price movements which are larger than those assumed in the calculation of margin intervals. If such price movements actually occur during a trading session, TCO may collect intraday margins from its members. There is rapid collection of additional intraday margins.

The daily margin settlement figure represents the netting of each member's debits and credits into a single amount. Each day, this net position is added or substracted from the clearing member's accounts with TCO. The collection of the margin deposits is the responsibility of TCO. Clearing member's margins must be in the form of cash, bills or bonds (maturing in less than one year) of the government of Canada or a provincial government or hydro company guaranteed by a provincial govern-

25. A futures spread order involves the simultaneous buy and sell of an equal number of contracts on the same underlying interest, but with different maturities. In the case of options, a spread order involves the simultaneous buy and sell of an equal number of puts (or, alternatively, calls) on the same underlying security, but the expiration date or the striking price may be different.

26. Of course, the actual outcome could turn out to be worse than anticipated in the worst-case scenario. In the case of options, for example, the theoretical values are primarily obtained from inputting the implied volatility of the contract and by assuming a range of other likely volatility parameters. The volatility assumptions could underestimate realized values.

ment, or U.S. Treasury bills. In addition, letters of credit from approved depository institutions are accepted from clearing members.[27]

In turn, the exchanges also require clearing members to collect minimum margins from the clients for whom the trade is performed. The minimum margin that a client must maintain with a member varies depending on the type of contract. The TSE-35 index futures contract, for example, requires a minimum margin ranging from 1 per cent to 15 per cent of the contract's underlying value. The ME requires a minimum margin of Can.$300 for spreads, Can.$1,000 for hedges and Can.$1,500 for speculators per Canadian government bond futures contract. The same minimum margins per contract are required for Canadian bankers' acceptances futures contracts, except that spreads require a deposit of Can.$625.

4.1.1.3 Clearing fund deposits

Each clearing member must maintain a deposit with a clearing fund that is to be used solely to cover any losses incurred by TCO as a result of the failure of any clearing member to perform its obligations under a contract. The deposit of each clearing member to the clearing fund consists of a base deposit (Can.$75,000 for futures clearing members, Can.$25,000 for options clearing members, or Can.$100,000 if clearing members trade in both markets) and a variable deposit that is proportional to the positions held by the clearing member in all accounts during the preceding three months.

4.1.1.4 Financial and market surveillance

In conjunction with the three participating exchanges, TCO monitors the financial conditions of its clearing members through regular reporting of financial information.

4.1.1.5 Default by a clearing member

Minimum net capital requirements, margin deposits and the clearing fund maintained by the clearing corporation serve as part of a guarantee backup system in the event of a member's default.

27. Approved TCO depository institutions include a number of Canadian banks and trust companies.

To see how the system would work in the case of default by a clearing member, consider, for example, the case of an option presented to a client for exercise. The clearing house would randomly select a writing clearing member to deliver the shares (in the case of a call) or deliver the payment based on a striking price (in the case of a put). The clearing member would then assign the exercise notice to one of its customers.

If the clearing member cannot deliver on the terms of the contract (or fails to meet the deadline for margin payments), the clearing organization would normally first contact the member, as the default may possibly be caused by a technical deficiency. After that, the exchange and the supervisory body may be contacted. If the member's default is confirmed, the clearing corporation would close the member's accounts and no further transactions by the member would be accepted for clearing. The clearing corporation would then attempt to transfer non-involved customer positions and customer deposits to another clearing member. The next step would be to liquidate the open positions of the suspended clearing member. To this end, the clearing house would close the member's positions and the member's margins would be used for this purpose.

If this does not suffice, the clearing member must use its own net capital. If this proves inadequate, then the member's clearing fund deposit is used and, following this, the entire clearing fund of all members on a *pro rata* basis. Each clearing member would be then required to provide an additional amount up to 100 per cent of the amount of its clearing fund deposit. If the default remains unsatisfied, the clearing corporation would then look to the participating exchanges and their members for remedy.

4.2 Placement, execution and settlement of orders

4.2.1 Trading systems

Following Cohen, Maier, Schwartz and Whitcomb (1986), trading systems can be classified primarily as batch or continuous. In batch trading systems, orders coming in over an interval of time are not transacted immediately, but rather are stored and transacted together in a multilateral transaction. In continuous market systems, transactions occur only when the orders of two traders match (that is the price of the best offer to buy is equal to, or greater than, that of the best offer to sell).

Continuous trading systems can be further classified by whether they are dealer systems or matching systems. In a dealer system, an intermediary "makes the market" by satisfying the ultimate customer's order from the intermediary's own account. Most OTC markets follow this structure. Alternatively, in matching systems, traders act as agents for the ultimate customers.

Matching systems can be classified by their technology of order entry as order book, board trading and crowd systems. An order book matching system is broadly characterized by assigning to an agent (or central computer) the responsibility of gathering standing orders for execution when prices match, based on price and time priority. Board trading is done by brokers themselves entering offers on a trading board, with no personnel from the exchange being involved in order entry or price setting. In a continuous crowd (or open-outcry) auction system, trade occurs whenever two traders agree on the price and no better offer is made by another trader.

However, these classifications are indicative only of the broad characteristics of different trading systems, as most continuous markets worldwide are not pure matching systems nor pure dealer systems. Moreover, continuous markets with matching systems and order books often open through batch trading.

4.2.1.1 Global derivatives markets

Traditionally, EXT futures trading has been performed by means of an open-outcry auction system. Indeed, the world's largest exchanges continue to use trading pits, and have introduced electronic order book matching systems only to supplement pit trading activity (for small trades or after hours, for example).[28]

28. The LIFFE automated pit trading system was introduced only to supplement pit activity. The Chicago Mercantile Exchange (CME), the CBOT and MATIF are also currently using the electronic system Globex (discussed in Section 4.3.1), in a similar supplementary fashion.

However, there has been a noticeable trend towards floorless electronic systems over the past few years. Since 1986, when the Marché à terme international de France (MATIF) opened and retained the traditional open-outcry system, every new European derivatives exchange has been founded on an automated trading system.[29] Particularly noteworthy is Frankfurt's Deutsche Terminbörse (DTB), which has a fully automated trade execution system.

4.2.1.2 Canadian derivatives markets

In Canada, EXT derivatives are traded through trading pits in the exchanges – automated trade execution systems have not yet been introduced. Currently, an order-book matching system is used for options trading, while an open-outcry auction system is used for trading futures.

In an order-book system, limit orders are kept by a specialist until a matched order is found. Specialists are responsible for maintaining an order book for certain option classes and for providing market depth, liquidity and an orderly market. Specialists, who can be either employees of a member of the exchange or independent professional traders, are also responsible for quoting the best ask-bid price (the highest bid and the lowest ask) for a given contract on the exchange's monitors. Specialists may also initiate a transaction by quoting a price for contracts for which no bid-ask prices are being submitted by traders during a trading day. Quoted prices are usually good only for a given number of contracts, so that these prices are, effectively, only indicative quotes for different sized orders.[30]

In an open-outcry auction system, traders call out bid-ask prices for a particular number of contracts, which may be matched by another trader. A bid or offer is only valid for the time necessary for its immediate acceptance. Thus, bids or offers made by an open-outcry are automatically withdrawn unless immediately accepted. Matched trades are then recorded by

29. Courtney (1992), Remolona (1992) and Domowitz (1992b) examine the new derivatives exchanges that have introduced automated trade execution systems.

30. In the TSE, for example, quotes are assumed to be for at least 10 contracts, but the bidding trader is only liable for filling up to l0 contracts on the declared bid or offer – which is apparently a relatively small number of contracts for a normal trade.

the exchange's officials, posted on the screens and incorporated in the clearing-house books. The bid-ask prices displayed on the screens are thus only indicative of the last trade recorded for a particular contract, and new transactions may take place at a different price than that shown on the board.

4.2.2 Types of orders

Before examining the placing and execution of orders in EXT markets, the types of orders that may be placed should be noted. An order is, simply stated, the client's instruction to the broker to buy or sell a contract. An order constitutes one of four possible transactions: opening purchase transaction; opening sale transaction; closing purchase transaction; and closing sale transaction. In an opening purchase (sale) transaction of an option, a customer buys (sells) an option he does not already hold as a writer (buyer) in his portfolio -- therefore increasing the number of options outstanding or the open interest. In contrast, a closing purchase (sale) transaction cancels his position as a writer (buyer) of an option and reduces the open interest.

Orders fall into two general categories: market and limit orders. A market order is an order to buy or sell a stated number of contracts at the best possible price. A price is not specified on the order. A limit order is an order to buy or sell a stated number of contracts at a specified price or better. A market or limit order can be "good-for-a-day" or "good-till-cancelled" and can also be contingent upon additional conditions being satisfied. Contingent orders can take several forms. For example, a stop order is a contingent order to buy or sell when the market for a particular contract reaches a specified price (the "stop-price"). The order becomes a market order when triggered.

4.2.3 Execution and settlement of orders

Derivatives exchanges worldwide tend to use somewhat different rules and procedures for order execution.[31] In addition, similar functions can be

31. Cox and Rubinstein (1985) examine some of the different institutional practices among U.S. exchanges.

performed by agents with different titles (e.g., an "Options Attorney" in Canada is equivalent to a "Floor Broker" in the United States, while an independent trader at the TSE is called a "Local" if he/she trades futures and a "Competitive Options Trader" if trading options). Furthermore, even for a given exchange, procedures applicable to options and futures trading may be different.

In spite of the differences among the various exchanges, a general description of the mechanics of trading and the process of price discovery in exchange derivative markets can be illustrative. Accordingly, the mechanics associated with the execution and settlement of orders for options and futures at the TSE/TFE are examined below.[32]

4.2.3.1 Options trading sequence

At the TSE, a trade involving option contracts typically proceeds as follows:

1. The client, either a buyer or a seller of a contract, contacts his/her broker who obtains complete instructions regarding the order.

2. The broker has the wire room relay the option order to the member's booth on the Options Floor. The order may also be routed through a computerized system which will print the order on a printer located in the member's booth. All orders must be time-stamped in the offices of the member.

3. The order is passed to one of the member's Options Floor Traders (or "Options Attorneys") for execution. He/she takes the order to the trading square where that class of options is traded.

4. Before trading begins, the opening price posted on the overhead options monitors is that of closing at the previous session. Through the trading day, Specialists will post on the monitors only the best bid and offer in their assigned options classes. Quotes are assumed to be for at

32. The TSE/TFE apparently use a trading system which is similar to that employed on the ME, the NYSE and the PHLX.

least 10 contracts (the so-called "minimum guaranteed fill").[33] Thus, all bids and offers are assumed for at least 10 contracts, unless another number of contracts is specifically stated.

5. The posted markets on the overhead monitors may be improved by the Specialist. For example, smaller or larger orders than the minimum guaranteed fill may result in a renegotiation of the quoted prices. The Specialist would quote a bid and an ask price for the order, which may be improved by other traders in the trading square. Hence, the quoted price for a particular options contract may not be the actual trading price for orders of different size than the minimum guaranteed fill.

6. If the order cannot be filled immediately, the Options Floor Trader may leave the order with the Open Options Book (which, at the TSE, is a pigeon hole) for execution when tradeable. However, some orders are placed in the Closed Options Book. While the information on the outstanding bids/offers which is placed in the open book is available to traders, the Specialist is not required to reveal the contents of the closed book.[34] The ticket left in the order book is time-stamped and initialized by the Specialist. The Options Book only accepts limit orders (either valid for one day or good-until-cancelled orders) and contingent orders.

7. Alternatively, if the Options Floor Trader wishes to trade, this is indicated by accepting a bid or offer from another floor trader with the word "sold."

8. A ticket is completed to confirm the details of the trade. This information is entered into a computer by an operator and sent to TCO where buy and sell orders are confirmed.

Orders are allocated under certain priority rules. In particular, a bid at the highest price and an offer at the lowest price will have priority regardless of time of entry. If two or more bids are made at the highest

33. Each options contract at the TSE represents 100 shares.

34. It would appear that the purpose of the closed book is to provide the Specialist with some "inside" information to compensate him/her for costly market-making services.

price, or two or more offers are made at the lowest price, transactions will be made by giving priority to client accounts (versus firm accounts) and time of entry.

While trades are effective at the actual time of trading, the option contract is issued by TCO on the next day following the trade when settlement occurs. Separate opening and closing positions are maintained by TCO for each member's client account.

4.2.3.2 Futures trading sequence

The first three steps described above are identical in the case of futures trading, except that the order in the floor is passed to a member's Futures Floor Trader. Subsequently,

4. The member's Futures Floor Trader takes the order to the futures pit on the floor.

5. The market is established by open-outcry of bids and offers. All bids and offers at the TFE are for at least one contract unless a different number of contracts is specified.

6. If the Futures Floor Trader wishes to trade, he/she indicates this by accepting a bid or offer from another Futures Floor Trader.

7. A trade ticket is completed to confirm the details of the trade. The information is entered into a computer by an operator, displayed on the monitors and sent to TCO. The bid/ask prices displayed on the screens for future contracts are, therefore, only indicative of the last trade recorded for a particular contract and new transactions may take place at a different price than that shown on the monitors.

4.2.4 Exchange limits on trading activity

Exchanges typically have certain guidelines established to maintain an orderly market, provide financial protection and prevent manipulative practices. These measures include price limits, exercise limits, position limits and circuit breakers.

4.2.4.1 Price limits

Exchanges typically place limits on how much futures prices may move on a given trading day. "Daily price limits", which are intended to reduce "excess" volatility in the market, are measured in both directions from the previous day's settlement price. Recognizing that daily price limits can constrain the price discovery process in the market place, exchanges usually also have "expanded price limits" which allow for further price movements under certain circumstances.

In the case of the TSE-35 futures index contract, for example, its daily price limit variation is 13.5 points. The expanded price limit allows for a further price variation equivalent to 150% of the normal daily price limit. The expanded price limit would be triggered if the daily price limit ends a trading day at the upper (or lower) limit for two successive trading days. The expanded daily price limit would remain in effect until the contract closes within the range of the daily price limit in the same direction for a further two day interval. At the ME, the Government of Canada bond futures contract also has a daily price limit variation of 300 basis points or C$3,000 per contract. The expanded (or "variable") limit for this contract may raise the ceiling to 150% of the original level, for successive periods of three business days, if the contract closes on the daily limit bid for one business day. However, not all contracts have a price limit. For example, the 1-month and 3-month Bankers' Acceptance futures contracts at the ME have no daily price limit variations.

4.2.4.2 Exercise limits

The exchanges may limit the number of options of the same class which may be exercised by one holder (or a group of investors acting in concert) within any five consecutive business days. Further, the exchanges and the clearing corporation reserve the right to restrict exercise of specific options to maintain an orderly market in such class of options or underlying interest. No exercise restriction may apply, however, during the ten business days immediately before an option's expiry.

4.2.4.3 Position limits

The exchanges have certain position limit regulations which restrict the number of futures or options contracts which may be bought or sold by an individual trader on the same underlying security. The objective of these limits is to prevent an investor, or group of investors acting in concert, from causing a disruptive effect in a particular futures or options contract or the underlying asset. Position limits apply regardless of whether the contracts are bought or sold through one or more accounts, or through one or more brokers. In the case of options, position limits take into account the number of contracts held on the same underlying interest on the same side of the market (i.e., on the same underlying interest, long calls are totalled with short puts and long puts are totalled with short calls). Position limits may vary depending on whether the investor is acting as a speculator or a hedger. For example, position limits for the TSE-35 index futures is 1,000 contracts for speculators and 2,200 contracts for hedgers.

4.2.4.4 Circuit breakers

Circuit breakers are mechanisms designed to stop prices from falling in times of panic-selling by providing a short cooling-down period for investors to re-evaluate market conditions. The presumption is that, without this type of mechanism, large and rapid price declines might cause investors to panic and sell their assets before any further price declines may occur -- thus, adding to the downward pressure on prices. The objective of circuit breakers is to provide participants with certain time-out to review whether the price declines are due to economic fundamentals. Coordinated circuit breakers, imposing the same trading restrictions across certain stock and futures/options markets, have been adopted by a number of exchanges.[35] The activation level of the breaker reflects an *ex ante* policy decision by the exchanges.

In Canada, the TSE/TFE, the ME and the VSE have coordinated circuit breakers for equity, and equity futures and options markets. Canada's circuit breakers are also coordinated with those implemented in some U.S.

35. See Morris (1990) for a review of the issues associated with coordination of circuit breaker mechanisms. In particular, it is argued that uncoordinated circuit breakers may actually exacerbate the fall in prices.

exchanges (including the New York Stock Exchange). In particular, circuit breakers in the Canadian exchanges are triggered if the Dow Jones Industrial Average (DJIA) declines by 250 points on a given day-- at which time, trading is suspended for one hour. During that period, trading on all equities, options and futures is suspended. The equity and futures markets will re-open one hour after the halt, while options trading will commence 15 minutes after trading of the underlying begins. If the DJIA continues to drop during the day and falls by a further 400 points after re-opening, then circuit breakers are re-invoked and all markets will be halted for a further two hours until the end of the trading session, whichever comes first.

4.3 Automated trade execution systems

Automated trade execution constitutes a new and seemingly growing form of financial market microstructure in EXT derivatives trading. As noted earlier, most of the new derivatives exchanges, especially in Europe, have adopted electronic trading systems. Furthermore, there have been efforts on the part of some exchanges to make their automated trading systems compatible.[36]

Domowitz (1992a) notes that it is important to distinguish between automated trade execution and "automated trading". Automated trading is the practice of automatically transmitting orders to an exchange for execution of trades mandated by computerized contingent order strategies (such as program trading). Computerized trading was made feasible by advances in information dissemination and order routing, and existed much before the recent emergence of automated trade execution systems.

36. The current degree of automatization at MATIF is relatively limited, especially compared with Frankfurt's DTB which has a fully automated trade execution system. However, an example of increasing co-ordination among exchanges is the plans of these two institutions -- Europe's second and third largest derivatives exchanges -- to link certain operations. The first phase of this Franco-German agreement is planned to come into force by mid-1994, when MATIF members are expected to start to trade interest rate products listed on the DTB electronic system. In the second phase, scheduled to be completed in 1995, MATIF plans to list two of its contracts on the DTB system and cease to trade them on its open-outcry system. The third and fourth stages involve the development of new joint products and trading software. The prospect of a joint clearing and settlement mechanism is expected to be reviewed by the end of 1995 (*International Financing Review,* July 30, 1993).

Automated trade execution systems are computerized mathematical algorithms that enable trade matching, quantity allocation and price discovery. Any trade execution system is basically a communications technology for passing information between traders, combined with a set of rules for trade execution that have an impact on trading strategy and pricing outcomes.

Different automated trade execution systems can vary in the way that they determine: i) the rules applicable to priority of trade execution (e.g., the priority assigned to bids and offers governs the place of the order in the queue awaiting execution); ii) the degree of automation of the price discovery process (e.g., some systems do not determine transaction prices endogenously); and iii) the transparency of information to market participants.[37]

4.3.1 Globex

An automated trade execution system which has recently captured significant attention because of its promising potential is Globex. This system was developed jointly by Reuters and the CME, with the CBOT later joining as co-owner. Globex was implemented for trading futures and options outside regular floor trading hours in Chicago.[38] In business since June 1992, Globex currently has terminals in Chicago, New York and Paris. Plans for expansion include extended trading through a network of "partner exchanges", each of which will retain control, ownership, clearing and financial responsibility for their own products. MATIF is currently a Globex partner exchange, while a number of other derivatives exchanges worldwide are looking into joining Globex.[39]

37. Domowitz (1992a) provides a survey how automated execution trading systems for equity and derivatives in a number of exchanges compare according to these criteria.

38. Globex was apparently conceived in the mid-1980s partly to discourage foreign exchanges from setting up their own versions of Chicago's most successful derivatives contracts. Since derivative products cannot be patented, longer trading hours through electronic trading was seen as a strategy to protect market share (*The Economist*, October 24, 1992).

The Globex order matching algorithm generates trades by matching bids and offers based on criteria of price, quantity and time. The rules by which trades are processed as the users interact with the order book through their bid and offer submissions form the substantive difference between an automated execution system and other auction market systems on the trading floor.

Globex is a strict price and time order matching priority system. Through this matching system, trades take place at the price of orders standing on the electronic order book of bids and offers. This guarantees that all new orders are filled at the best available price at the time of order entry. Only good-until-cancelled limit orders are accepted. Because of current technological limitations, neither market orders nor contingent orders can yet be accepted by the system. Regarding transparency of information, it is worth noting that the Globex system discloses the *ten* best bids and offers, with associated quantities at each price.[40] In contrast, the information which is formally available in the pit for derivatives trading is typically limited to the best bid and offer, with size, per contract.[41]

39. Negotiations with other exchanges (e.g., London, Tokyo, Hong Kong and Geneva) to join Globex have been under way for some time. However, negotiations with LIFFE have been slow due to disagreement between LIFFE and CBOT over which exchange may be able to list German bond (Bund) futures contracts. The proprietary conflict between LIFFE and CBOT results from a 1992 agreement under which the partners of Globex agreed to secure "exclusive rights to trade their own existing contracts on the Globex system". However, 'existing' contracts include those which the exchanges had either listed or applied to the U.S. Commodity Futures Trading Commission (CFTC) to trade by April 7, 1992. Although no Bund contracts are currently traded at the CBOT, the exchange had applied to the CFTC to list a Bund futures contract by that date. Bund future contracts are currently traded in LIFFE (as well as in Frankfurt's DTB). (*International Financing Review*, August 8, 1993 and August 21, 1993.)

40. Other automated systems also disclose all or most of the order book. In particular, Frankfurt's DTB fully automated system displays total contracts bid and offered several ticks (or minimum quoted price changes) above and below the market for derivatives contracts (Courtney (1992)). As well, the automated systems for derivatives trading in Japan's Tokyo Stock Exchange and the Osaka Securities Exchange also disclose the order book (Domowitz (1992a)).

41. Some argue, however, that pit trading provides an informal informational advantage in that the incoming flow of orders can be observed and traders typically talk to each other as these orders are being generated.

The rules governing the Globex automatic trade execution are as follows (Domowitz 1990, 1993)

1. *Order eligibility.* A new order is eligible to be matched with a standing order, and a trade will result, whenever the following conditions occur:

   1.1) one order is a buy order and the other is a sell order;
   1.2) the two orders are for the same contract;
   1.3) the price of the buy order is greater than or equal to the price of the sell order.

2. *Trade price*. If an order match is possible according to the criteria in Rule 1, then the trade will take place at the price of the standing order.

3. *Trade quantity*. If an order match is possible according to Rule 1, then the trade will take place for a quantity equal to the smaller of:

   3.1) the remaining quantity of the new order;
   3.2) the remaining quantity of the standing order.

4. *Maximization of total trade size.* If there are multiple standing orders eligible for matching against a new order, then matching will be considered in priority sequence until one of the following conditions is attained:

   4.1) the new order is completely filled;
   4.2) all eligible standing orders have been considered.

5. *Standing order priority*.

   5.1) *Price*: for buy orders, higher price has a higher priority; for sell orders, lowest price has a higher priority.
   5.2) *Quantity:* a standing order for a "primary quantity" has a higher priority than that for "supplementary quantity" if they are both at the same price (discussed below). A standing order for a supplementary quantity has priority over a standing order for primary quantity if the former is at a better price. A supplementary quantity order may be executed only in conjunction with the associated primary quantity.

5.3) *Time*: within the same price and quantity type, older orders have higher priority.

The term "standing order" refers to a bid or offer entered previously into the system, which has been saved on the electronic order book. There are three priority rules that govern this execution algorithm. Best price (rule 5.1) is the chief priority. Following price is time: first in, first out. Whereas certain matching rules can prevail for bids and offers when time priority cannot be clearly established on the trading floor, the computer does not allow for ties in terms of time. The final priority is one of display. A trader may split a bid or offer at the same price into primary and secondary amounts. The primary quantity is shown to all system participants. The secondary quantity is not displayed. The displayed quantity has precedence over that which is not displayed. If a trader's secondary quantity cannot be executed at the same time as the primary, the system will cancel the secondary bid or offer, as undisplayed orders have zero priority if they stand alone without some displayed quantity. Such a feature favours traders who disclose their order information to the market, but a trader need not 'show his hand' completely at the time of entering a potentially large order.

A contract is traded when the outstanding bid or offer is accepted. Acceptance occurs when the orders match, with the price of the transaction being the price of the standing order. Prices are thus determined endogenously within the system, based on order flow and priority rules. Trades are confirmed at participants' screens, prices and quantities are reported through the system, trades are cleared, and buyers' and sellers' accounts are adjusted. A new auction starts with each new completed transaction and the priority of bids and offers carries over from auction to auction. Traders deal anonymously with one another. However, Globex, like other automated trade execution systems, does produce an electronic audit trail.

4.3.2 Performance of Automated Trade Execution Systems

The performance of automated trade execution systems, relative to pit trading, appears to be an area of concern at the regulatory level and of some controversy in the literature.

In the United States, for example, the U.S. General Accounting Office (GAO) has stressed the need for technical reviews on automated markets out of concerns that automated trade execution systems could diminish competitiveness and pricing efficiency of exchanges. Also, the U.S. Commodity Futures Trading Commission (CFTC) is required to evaluate new market mechanisms with respect to the openness and competitiveness of open-outcry auction on a trading floor (CFTC Regulation 1.38). Similar concerns have been expressed by the U.S. Securities and Exchange Commission (Domowitz 1992a). And, at the international level, the International Organization of Securities Commissions (IOSCO) has been investigating regulatory issues surrounding the growth of automated systems worldwide (International Organization of Securities Commissions 1990).

In the current literature, there are those who argue that automated trade execution systems result in a loss of efficiency vis-à-vis pit trading. Miller (1990), for example, argues that automated trade execution systems, especially order-matching systems with a limit order book like that of Globex, reduce the (informal) information advantage that traders draw from being present on the floor and able to observe the incoming order flow. Miller argues that by having to post quotes in advance on the screen, a trader offers, in effect, a free option to all other traders and, therefore, runs a greater risk of being picked off by someone with better or more up-to-date information.

On the other hand, experimental research suggests that automated trade execution systems may result in increased trading efficiency. The objective behind such experimental settings, typically involving computerized inputs to the auction mechanism, is to create a manageable microeconomic trading environment in which certain performance criteria can be measured. Domowitz (1993), for example, performs a battery of tests comparing the performance of the open-outcry auction system relative to Globex. Although, as noted earlier, a number of automated trade execution systems with different characteristics exist worldwide, Globex was selected as a benchmark because its price and time priority structure is common to most other automated trade execution systems. Moreover, Globex constitutes a ready-laboratory case which can be examined more realistically than academic descriptions of other "ideal" trade execution systems.

Using simulated computer trading experiments, Domowitz (1993) examines the competitiveness of automated trade execution (under the Globex rules) relative to the open-outcry auction system based on the efficiency of the price discovery process. Although there is no significant difference in how the two systems extract available profit from the market (measured by the ratio of total traders' surplus to total market surplus available), convergence in floor markets is very time consuming. That is, the percentage of bids and offers that result in trades is higher, and increases faster as there are more traders, in Globex than in the open-outcry auction system. Globex also performs considerably better than open-outcry auctions on a number of other tests. In particular, Globex provides lower volatility and more liquidity measured in terms of market tightness (defined as the cost of turning over a position in a short period of time) and depth (the market's ability to absorb order flow without an appreciable effect on prices), and exhibits smaller spreads and spread volatility. Domowitz argues that the superior performance of Globex is a result of its electronic order book supplying more information to the price discovery process at each point in time relative to the price information provided by the open-outcry auction mechanism.

5 MARKET MICROSTRUCTURE: OTC DERIVATIVES

5.1 Trading System

OTC derivative markets can be broadly characterized as continuous-market dealer systems, where intermediaries "make the market" by satisfying the ultimate customer's order from the intermediary's own account. Dealers may expose orders to the market by displaying quotes (through computer screens such as Reuters) or by giving quotes upon request (e.g., by telephone or fax). The terms on the OTC transactions are negotiated over the telephone and finalized in writing.

5.2 Market Participants

The participants in OTC derivatives activity can be broadly categorized in two groups: end-users and dealers.

The extent of activity by each of these groups in global OTC derivative markets is provided by a survey recently performed by the International Swap and Derivatives Association (ISDA). ISDA estimates that of the $1.95 trillion in interest rate and currency swaps written worldwide in 1991, about 45 per cent involved transactions between dealers, while 55 per cent of the activity were transactions with end-users (of which, financial institutions account for roughly 55 per cent of total end-users' transactions). The survey also shows that there has been a marked growth in dealers' activity relative to transactions by end-users. In 1988, for example, transactions between dealers accounted for about 32 per cent of all swaps written, while transactions with end-users represented roughly 68 per cent of the total.

5.2.1 End-Users

End-users include government entities, institutional investors, corporations and financial institutions. Derivatives are used by end-users to lower funding costs, enhance yields, diversify sources of funding, hedge risks (including foreign exchange and commodity price exposure, and debt or asset portfolios), and speculation. In Canada, most of the end-users of OTC derivatives are government agencies (including provincial governments and utility companies). Until recently, the participation of Canadian institutional investors in derivative markets had been limited by certain restrictions on the permitted investments of insurance companies, pension funds and mutual funds.[42]

Dealers

Dealers consist mainly of banks and securities firms.[43] In Canada, the structure of domestic financial markets, which is characterized by a relatively strong banking sector, has favoured the dominant presence of banks in the OTC derivatives market. In particular, the largest Canadian banks (and the securities firms associated with them), as well as some foreign banks (Schedule II banks such as BT Bank of Canada and Citibank Canada), are the main OTC derivatives dealers in Canada.

5.3 OTC Secondary Market

Das (1989) identifies two types of transactions involving derivative securities. First, a "primary market" transaction referring to a transaction between the original two counterparties. Second, a "secondary market" transaction referring to subsequent transactions involving the original contract between the counterparties.

42. Formerly, financial institutions in different Canadian jurisdictions (provincial and federal) were governed according to a strict "corporate powers" approach to regulation which defined 'eligible' investments. All new financial products that were not specifically defined as eligible investments (such as derivative securities) were largely not permitted. Consequently, few institutions other than securities firms and banks had unrestricted access to derivative securities. In the last two years, however, some regulatory changes have been introduced allowing for wider participation of Canadian institutional investors in derivative securities. In 1992, for example, the Canadian Securities Administrators (representing all provincial securities regulators) permitted mutual funds to use derivatives for hedging and, in certain circumstances, investment. Also, as part of the new federal financial legislation introduced in June 1992, federally incorporated trust and mortgage loan companies, insurance companies and credit unions, were allowed to adopt a "prudent portfolio" approach. That is, within certain broad quantitative limitations designed to minimize risk concentration and exposure, the prudent portfolio approach permits institutions to invest in any class of securities that may be deemed to constitute a prudent investment opportunity.

43. It is worth emphasizing that financial institutions often act as both dealers and end-users. As end-users, financial institutions may utilize derivative securities for portfolio risk management purposes.

What type of subsequent transactions could result, for example, from a swap arrangement entered into by two counterparties? The original swap arrangement could be unwound through any of the following transactions: (i) a swap reversal; (ii) a swap assignment (or sale) to a third party; and (iii) voluntary termination.

Reverse swaps are merely new swaps arranged as a perfect or near-perfect offset to existing swaps -- the party that wants out of the transaction will ideally look to arrange for a new swap in which the maturity of the new instrument is equal to the time remaining of the original swap, and the underlying security and notional principal amount are the same. Aside from the practical difficulty of finding an exact match to offset the original contract, particularly with a counterparty different than the one for the original contract, this approach could result in increased default risk exposure as the party would have two offsetting interest rate swaps on its books instead of one. Although netting would be more likely if the contract reversal is with the same counterparty, it may not be necessarily legally binding.

The swap assignment overcomes this drawback as the party that wishes to close out the original swap must find another party that is willing to accept, for a fee to be negotiated among the new counterparties, its obligation under the swap. Although a swap assignment would be otherwise similar to the secondary market for other types of securities, the rules in the ISDA Swap Master Agreement require both original counterparties in the swap to consent to the re-assignment to a third party.

A voluntary close-out sale or termination involves the sale of the swap to the original counterparty. As in the case of a swap assignment, one party might have to compensate the other, depending on how interest rates and spreads have changed since the inception of the swap.

Despite this apparent difficulty in unwinding positions taken in the OTC market, an OTC derivatives “market” has clearly emerged. To examine how was this market formed, it may be useful to review how OTC derivatives activity evolved from a purely broker-based activity to a fullfledged secondary market where agents are able to enter and unwind transactions with relative ease.

First, early in the evolution of OTC derivatives, financial institutions acted for the most part as brokers finding counterparties with offsetting requirements with regard to notional amount, currencies, types of interest rate to be paid, etc. They then negotiated on behalf of the two counterparties. Acting as agent or broker for a fee, the institution took no position in the transactions.

As this type of activity became more generalized in global markets, most financial institutions found their role evolving beyond brokering to acting as dealers; offering themselves as counterparties to intermediate customers and acting as market-makers (willing to make a market by being ready to buy or sell a security for a price). By quoting bid and offer prices, dealers (acting as market-makers) provided liquidity and continuous availability of derivatives transactions.

In this new role as dealers, financial institutions first sought to match or hedge their transactions almost immediately by entering into an opposing "matched" transaction. For example, the interest rate risk in a swap could be hedged by taking an opposite position in another swap. Each pair of transactions was dealt with separately. This new role, however, required a commitment of capital since dealers now faced counterparty and market risks (these risks are discussed in Section 6).

The next step in the evolution of the OTC derivatives was the "warehousing" of derivatives transactions. Dealers would temporarily hedge a particular derivative security -- typically with a spot security or futures position -- until a matched transaction could be found to replace the temporary hedge.

At present, as documented by the Group of Thirty's (1993) study, major dealers, especially in the United States, have moved from the "warehouse" approach to a "portfolio" approach. Under a "portfolio" approach, dealers simply take the customers' transactions into their portfolios or book of derivatives and manage the net or residual risk of their overall positions.[44] Each new transaction is decomposed into its component cash flows and risk factors, and aggregated with all previous transactions. The focus of position taking and risk management for dealers changed, therefore, from individual transactions to portfolio or book exposures. Thus, the economic inter-relationships that exist between different instruments and across markets, as discussed in Section 2.1, play an essential role in how the OTC secondary derivatives market functions. Indeed, by breaking down the market risk of a particular derivative into its fundamental elements, dealers are able to move beyond the risk of a particular product to portfolio risk.

The move by major dealers to focus on the net or residual risk of their portfolios might have added liquidity and depth to the OTC secondary market for derivatives. By dealing with the market risks of a derivatives portfolio in terms of the fundamental risks associated with the basic types of derivative instruments that it may contain, a customized contract which may appear to be illiquid could have component risks which are liquid, hence allowing for the effective hedging of the transaction.[45] Moreover, a dealer's portfolio generally will contain many offsetting positions, which can substantially reduce the risk of the overall portfolio. A smaller residual risk to be hedged, as a result of adopting a portfolio approach, is likely to improve the ability and readiness of dealers to act as market-makers in OTC derivative markets.

44. Although this seems to be the global trend, it should be noted that not all dealers have yet adopted a "complete" portfolio approach (integrating derivatives positions with securities trading and other traditional positions). In Canada, some dealers manage the net risk in their derivatives book, while others still manage risk on a product-by-product basis.

45. For example, the interest rate risk of a complex interest rate swap can be hedged with other swaps, FRAs, interest rate futures contracts, treasury bills, or even bank loans and deposits.

6 RISKS IN DERIVATIVE SECURITIES AND MARKETS

The risks faced by end-users and dealers involved in derivatives can be broadly categorized as market, counterparty, settlement, legal and systemic risks.[46] Some of these risks can be, of course, inter-connected. Risks in EXT derivative markets are usually limited to market risk, but they could also include other risks (particularly systemic risk and, possibly, counterparty risk).

6.1 Market risk

The market risk associated with both OTC and EXT derivative securities depends upon their price behaviour when market conditions change. The assessment of market risk relies on a mark-to-market valuation of derivative securities and the underlying instruments. The fundamental market risks include:[47]

- *Absolute price or rate (or delta) risk.* This is the exposure to a change in the value of a transaction corresponding to a given change in the price of the underlying instrument.

- *Convexity (or gamma) risk.* This is the risk that arises when the relationship between the price of an underlying and the value of a transaction is not linear, as it is the case with options-based contracts. In effect, it is the sensitivity of delta risk to the price change of the underlying asset.

- *Volatility (or vega) risk.* Associated with option-based instruments, this is the exposure to a change in the value of a transaction resulting from a given change in the expected volatility of the price of the underlying instrument.

46. The Group of Thirty (1993) also identifies 'operational risk' as a further general classification of the risks facing participants in OTC derivative markets. Operational risk is the risk of losses occurring as a result of inadequate systems and control, or human error.

47. Market risks, and hedging strategies, are discussed in more detail in Group of Thirty (1993).

- *Time decay (or theta) risk.* This is typically associated with option-based instruments and is the exposure to a change in the value of a transaction arising from the passage of time.

- *Basis or correlation risk*. This is the exposure of a transaction to differences in the price performance of the derivatives used as hedges and the price performance of the underlying asset.

- *Discount rate (or rho) risk.* This is the exposure to a change in the value of a transaction corresponding to a change in the rate used for discounting future cash flows.

- *Market liquidity risk*. This is the risk that a large transaction in a particular instrument could result in a sharp move in the price and/or volatility of the instrument. The cost of hedging also increases as bid/ask spreads tend to be larger in illiquid markets.

- Where dealers have adopted a portfolio approach to managing market risk, particularly in OTC derivative markets, the net position of the portfolio must be determined in order to asses the market risk of the portfolio. This is done by looking beyond the particular contracts and focusing instead on identifying the fundamental risks they contain so the overall portfolio can be decomposed into underlying risk factors that can be quantified. Once a portfolio has been decomposed into its component parts, the various risks can be aggregated and hedged on a net basis.

6.1.1 Management of market risk

As noted earlier, the market risks involved in a single derivative transaction or in a portfolio are best analysed in terms of the fundamental risks associated with the two basic types of derivatives it may contain: forward-based and option-based derivatives.

In the case of forward-based derivatives, market risks are relatively straightforward since the dominant risk is absolute price or rate risk. Changes in the price of the underlying instrument result in proportional changes in the value of the derivative security. In this case, a hedge could be constructed using the underlying instrument or another forward-based derivative.

The market risks inherent in option-based derivatives are, however, more complex. In particular, the relationship between the price of an option and the price of the underlying asset is not constant, as is the case with forward-based derivatives. The price sensitivity of an option's value changes with changes in the price of the underlying instrument. Changes in the expected volatility of the underlying and the passage of time will also affect the value of the option.

Thus, since the price sensitivity of an option varies with changes in the price of the underlying instrument, a position that is initially delta-hedged must be adjusted as time passes, or prices change, if it is to remain hedged. The process of continuously hedging an option with a position in the underlying is known as 'dynamic hedging'. There are, however, two main risks associated with a dynamic hedge. The cost of hedging may turn out to be greater than expected because actual volatility is greater than anticipated and prices may move significantly before positions can be adjusted.

Hedging option-based derivatives is therefore a dynamic process, unlike the static nature of hedging forward-based derivatives. The alternative to dynamic hedging is to use options as hedges. The hedging of an option with another option is usually known as gamma or vega hedging. Here, the risks to changes in delta and changes in volatility are neutralized by offsetting changes in other options. Balanced portfolios can hedge options with options, while dynamically hedging the smaller residual risk arising from mismatches in the options portfolio.

It is worth noting that market participants typically use a variety of mechanisms to manage market risk. However, a strategy which seems to have become increasingly appealing is Monte Carlo simulations based on expected changes in market conditions. "Stress" tests, for example, measure market risk based on simulations of improbable, but potentially significant, market conditions.[48] Through this approach, expected and maximum potential exposures of complex transactions or portfolio effects can be measured.

6.2 Settlement risk

Settlement risk refers to the potential loss that a party could suffer if prices moved in his favour and against the counterparty, resulting in the latter refusing to make payments on the settlement date. Some of the largest settlement exposures may occur on the settlement day itself when the value of the security can be at risk if delivery of the security and delivery of the payment are not synchronized.

Although settlement risk can be considerable, a number of mechanisms are typically used to manage this type of risk. In particular, market participants often place a limit on the size of the allowable daily settlement with any one party. Bilateral netting arrangements (discussed in Section 6.3.1) could also reduce the settlement exposure of both counterparties. As well, there are arrangements under which parties deposit funds in a third party's escrow account until settlement is completed.

6.3 Counterparty risk

Counterparty (or credit) risk refers to the probability that a counterparty may default on a derivatives contract. While there can be credit risk considerations in EXT derivative markets when the financial soundness of the clearing corporation is questionable, counterparty risk is typically present, and can be very significant, in OTC derivatives trading. Credit risk is a dynamic concept that changes with the passage of time and movements in the underlying variables.

The loss due to counterparty default is the cost of replacing the contract with a new one. The replacement cost at the time of default is equal to the present value of the expected future cash flows. Thus, for a credit loss to occur, two conditions must co-exist: i) the counterparty defaults on a

48. The Group of Thirty (1993) reports that, according to the Survey of Industry Practice, most large dealers conduct some kind of stress tests on their portfolios, while other dealers plan to do so in the future.

contract; and ii) the replacement cost of the transaction is positive.[49] Whereas counterparty risk is two-sided in the case of forwards and swaps, counterparty risk in options is one-sided -- only the buyer of the option is exposed to the risk that the seller may default prior to fulfilling the commitment under the option.

The potential exposure for a portfolio of derivatives is significantly more difficult to calculate than that of individual transactions. Adding the potential exposure of each transaction in the portfolio may overstate the actual potential exposure of the overall portfolio as it does not take into account transactions in the portfolio with offsetting exposures, nor transactions that have peak maximum potential exposures that occur at different time periods.[50] Moreover, the overall credit risk of a derivatives portfolio also depends upon the extent of diversification across specific counterparties and types of counterparties. Concentration of the portfolio with one counterparty (or type of counterparty) would increase the credit risk of the portfolio.

6.3.1 Management of counterparty risk in OTC derivatives

Although the credit quality of the users of OTC derivatives is usually high, there are concerns about the soundness of the risk management programs of certain financial institutions (for example, some Savings and Loans institutions and regional banks in the United States, as well as some trust companies in Canada).

The Bank for International Settlements' (1992b) study notes that, for many participants in OTC derivative markets, credit risks are not fully incorporated in the pricing of the products. This is particularly the case for short-term derivative securities which are perceived to carry a low default probability. However, the study notes that even in the case of longer-term contracts, where the value of potential losses and probability of default can increase steeply, credit risk is not generally managed by pric-

49. This is in contrast to the one-sided credit exposure of a loan where a loss is incurred simply as a result of default by the borrower.

50. Group of Thirty (1993).

ing risk, but by some other methods. OTC derivative market participants have devised a variety of credit enhancement structures to reduce or limit the credit exposure of dealing with particular counterparties.

6.3.1 Credit assessment

Dealers usually have certain internal controls to ensure that credit risk is assessed both prior to entering into over-the-counter transactions with a given counterparty and over the life of the transaction. Typically, dealers assess the credit of their counterparties and incorporate "credit support" clauses in the ISDA Master Agreement. In effect, this "credit-check" vehicle opens a line of business between the counterparties. The provisions contained in the agreement are often reviewed periodically.

Mark-to-Market and Discretionary Cash Settlement

Mark-to-market settlement is often used by counterparties in OTC derivatives transactions to reduce bilateral credit exposure. In this case, two counterparties agree to periodically send cash to cover any negative mark-to-market position that exists. The counterparty with the positive mark-to-market position takes actual ownership of the cash and the terms of the transaction are reset at market rates to have a zero mark-to-market value. *This procedure is indeed very similar to the manner in which EXT markets require full and immediate payment to cover losses incurred.* However, because valuing complex contracts can be difficult, the counterparties involved in OTC trading may not agree on settlement values.

Whereas mark-to-market settlements require periodic payments on losses for existing contracts, discretionary cash settlement provisions permit early termination of existing contracts at a predetermined settlement date. For example, the ISDA Master Agreement addendum can incorporate provisions stating that a swap agreement involving a 5-year fixed interest rate may have an effective maturity of 2 years. In other words, while the fixed interest rate may correspond to a 5-year contract, the agreement is good only for 2 years -- usually with the option of renewal by the counterparties. *This effectively marks-to-market the value of the contract on renewal dates.*

Special Purpose Vehicles

A number of dealers have recently established so-called "special purpose vehicles" (SPV) as separately capitalized institutions with high credit ratings to trade OTC derivatives. SPVs' credit ratings (typically AAA) are significantly higher than that of the parent company (A or A+ for unsecured debt).[51] SPVs have been established as subsidiaries of the parent firm, with sufficient capital to withstand extreme stress scenarios involving severe market movements. The legal corporate separateness from the parent ensures that in the event of insolvency or bankruptcy of the latter, the SPV can avoid consolidation of its assets with those of the parent company. Moreover, SPVs are restricted from taking any open or unmatched positions. That is, positions must be continuously hedged. This often is accomplished by requiring that the subsidiary enters into a mirror transaction with its parent for every transaction it enters into with a third party.[52]

Institutions which have established SPVs include various U.S. securities firms (such as Goldman Sachs, Salomon Brothers and Merril Lynch) and a French bank holding company (Compagnie Financiere de Paribas, the holding company of Banque Paribas). Paribas is of special interest as it is the first financial institution regulated by a banking authority (France's Commission Bancaire) to establish an SPV.[53] Although SPVs are in their infancy, there are indications that these institutions have been fairly successful in booking businesses with corporate users and other OTC market participants.[54]

There are currently no SPVs in Canada. Because of the high credit ratings of Canadian banks and their affiliated securities firms, these vehicles are unlikely to be very popular in Canada -- though smaller non-bank-

51. See Behof (1993) for a detailed discussion on SPVs.

52. Group of Thirty (1993).

53. It appears that the U.S. Office of the Comptroller of the Currency (OCC) has put the brakes on U.S. banks' attempts to set up derivatives subsidiaries. At the end of 1992, Citibank and Continental Bank withdrew applications to establish SPVs, apparently because of concerns expressed by the OCC (*International Financing Review* (August 14, 1993)).

54. *International Financing Review* (August 14, 1993).

affiliated Canadian securities firms and some trust companies may find SPVs of interest.

Netting

Netting arrangements can be a useful means of reducing credit risk in OTC derivatives trading. Bilateral netting of interest rate and foreign exchange derivative products has become increasingly common among large institutions worldwide. Although bilateral netting across products, currencies and settlement dates has been more difficult to implement, some efforts have been made to establish a framework for such netting.[55] Netting on a multilateral basis is an extension of bilateral netting. However, there are currently no major multilateral netting arrangements in operation for OTC derivatives transactions.[56]

i) Bilateral Netting

Bilateral netting is designed to reduce counterparty exposure by automatically offsetting the concurrent payment obligations that each party has to the other. Bilateral netting agreements can generally be classified into three general categories: netting by novation, close-out netting and cross product netting.[57]

Netting by novation refers to the process whereby matched pairs of trades between counterparties (i.e., same currency, same settlement date,

55. For example, there have been two attempts to establish a clearing-house system for foreign exchange trades, with the aim of including foreign exchange derivatives. In particular, the North American Clearing House (NACHO) -- which involves two U.S. and six Canadian banks -- began to use a centralized facility to match and bilaterally net foreign exchange trades. NACHO plans to introduce multilateral netting by novation of foreign exchange trading, net trades for settlement, mark-to-market, and include foreign exchange derivative products in the arrangement. Clearing-house members will be responsible for covering another member's default based on a loss sharing formula. A similar netting system under development for foreign exchange trades is the European Clearinghouse Organization (ECHO) which is owned by fourteen European banks and is expected to be operative in 1994 (Behof (1993)).

56. Group of Thirty (1993).

57. Payment netting is also another type of netting. However, payment netting involves no change in credit risk since it only refers to netting of payments between two counterparties whose bilateral payment obligations in the same currency are due on the same day.

same counterparty) are replaced by a single transaction requiring a payment equal to the difference of payments of the transactions. Netting by novation has been popular with foreign exchange contracts because large number of matched trades typically exist. In interest rate products and other OTC derivatives, netting by novation is less common since trades with matching terms are more unusual. Behof (1993) suggests that the desire to utilize netting by novation in a credit sensitive environment is likely to encourage more standardization in OTC derivative products.

Close-out netting becomes operative only in the event that one or both counterparties default on their obligations or a triggering event (such as a credit downgrade) takes place. The ISDA Master Agreement defines the methodology by which all contracts between two counterparties will be netted to a single amount in the event of default. In addition, the Master Agreement typically includes provisions stating that default of any single derivative obligation would trigger termination of all derivative contracts between the two counterparties, thus preventing "cherry picking" -- demanding payment for trades with positive mark-to-market and reneging on trades with negative mark-to-market -- by the counterparties. Once termination is triggered, all positions are marked-to-market and any payments owed to the defaulting party are netted against payments owed by the defaulting party before settlement is done.

Cross-product netting permits netting of payments in different currencies, and between derivatives and other types of securities. Cross-currency netting, where different currency payments are converted into a base currency at the prevailing spot rate, is a common type of cross-product netting in the case of close-outs.[58] Behof (1993) notes that netting across derivative product categories has been experimented with for the last several years, while netting derivatives with other (non-derivative) securities 'is just beginning'.

ii) Multilateral Netting

58. Group of Thirty (1993).

Netting on a multilateral basis is achieved by adding each participants' bilateral net positions with each of the other participants in the arrangement. This sum is called the "net-net" position of the participant with the system as a whole. Multilateral netting arrangements can be constructed on a "decentralized" or "centralized" fashion.[59]

In decentralized multilateral netting arrangements, participants retain responsibility for managing credit risk. In the event of a participant's default, credit losses would be allocated on a pro-rata basis among the rest of the participants (based on their bilateral exposures to the defaulter). The viability of this system would depend on the ability of the participants to manage their contingent liabilities with other participants under a loss-sharing formula. The Group of Thirty (1993) suggests the use of collateral as a means to manage those contingent liabilities.

When netting is conducted through a central entity which is substituted for the original counterparty to each derivatives transaction, the net-net position will constitute a bilateral net position between each participant and the central counterparty. The sum of the net-credit and net-debit positions with the central counterparty is always zero. *Centralized multilateral netting arrangements in OTC derivative markets would closely resemble, therefore, the role that clearing corporations play in exchange-traded derivative markets.*

Although no major multilateral netting arrangement is currently in operation for OTC derivatives transactions, some observers support the introduction of such arrangements.[60] It is generally recognized, however, that multilateral netting arrangements also have the potential of producing systemic risk. In particular, such arrangement would be vulnerable to the

59. Group of Thirty (1993).

60. Masera (1993), for example, argues in favour of introducing a multilateral netting scheme for swap trading in Europe. The Group of Thirty (1993) also argues that multilateral netting arrangements could provide three primary benefits: i) reduce credit risk by more than the reduction that would accrue through bilateral netting arrangements; ii) improve efficiency by releasing some of the capital currently used to support derivatives transactions and by generating savings in the settlement and risk management process; iii) broaden access to the derivatives market by weaker credits and smaller participants on a collateralized basis.

central counterparty's ability to manage risk and absorb losses. In addition, the existence of a multilateral netting arrangement could provide an incentive for participants to expand their derivatives activities with counterparties whose credit risk is poor.[61] According to Behof (1993), multilateral clearing-houses for OTC derivative transactions appear to be 'a year or two' away from establishment.

Collateralization

A number of derivatives dealers have established unilateral and bilateral collateral agreements, or margin agreements, among themselves and with end-users in order to reduce counterparty risk in OTC derivatives trading. Unilateral agreements require one counterparty to deliver collateral on trades in which it has a negative mark-to-market value. The other counterparty in the transaction is not required to post collateral. Unilateral collateral agreements are generally used when one of the counterparties is less creditworthy. Bilateral collateral arrangements require two-way movement of collateral, whereby the counterparty with the negative mark-to-market value collateralizes its exposure to the other party. The most common form of collateral used is cash and government securities.[62] *This framework is analogous to the mark-to-market system used in EXT derivative markets*.

Collateralization has become popular in global OTC derivative markets and, according to some observers, is likely to continue to grow as a means of dealing with credit concerns.[63] In Canada, however, the use of collateral as a means of reducing credit risk appears to be somewhat limited -- at least with regard to swap transactions. The reason for this is that if a Canadian bank, for example, requested the unilateral deposit of collat-

61. These risks are noted in the Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries (1990). The Group of Thirty (1993) also acknowledges these potential risks.

62. If netting applies and is enforceable, the collateral is generally applied to the net negative mark-to-market value. If netting does not apply, the collateral agreement is typically on a gross basis (Group of Thirty (1993)).

63. See, for example, Behof (1993).

eral from a counterparty in a swap deal, the latter would also likely require collateral from that bank -- after all, a swap constitutes an exchange of cash flows. However, the Bank Act explicitly prohibits chartered banks from pledging collateral on such types of transactions -- the rationale being that, in case of default, a bank should first pay out its depositors.

6.4 Legal Risk

Legal risk is the risk of a loss because a contract cannot be enforced. This risk is present in many OTC derivatives transactions and includes exposure arising from insufficient documentation or authority, and uncertain enforceability in bankruptcy or insolvency.

Although, as noted earlier, transactions documented under the ISDA Master Agreement offer provisions for netting of exposures, there is some uncertainty about the enforceability of close-out netting provisions in some jurisdictions.[64] However, according to legal opinions commissioned by the ISDA, netting provisions contained in bilateral master agreements are likely to be upheld in several industrial countries (including Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United States and the United Kingdom).[65]

6.5 Systemic Risk

Systemic risk refers to the risk that a disruption in a firm or market segment can cause widespread difficulties in other market segments or in the financial system as a whole.

There have been some concerns that both EXT and OTC derivatives trading could produce systemic risk.[66] However, there is apparently no general agreement as to which aspects of derivatives activity pose the

64. The most publicized case of legal risk is that where some of London's boroughs were declared, by the U.K. courts in 1991, to lack the necessary capacity to enter into the interest rate swaps that they contracted during the 1980s. The boroughs were therefore declared not liable to make payments on those contracts on which they would otherwise have suffered large losses.

65. Behof (1993).

66. The Bank for International Settlements (1992b) and Farrant (1992), for example, raise some concerns about potential systemic risk resulting from derivatives trading.

greatest systemic concerns. The Group of Thirty (1993) notes that some of the relevant issues to consider before determining the factors which may lead to systemic risk include: the size and complexity of derivatives activity; the concentration of activity among participants; the transparency of risk management activities; the liquidity of customized derivatives transactions; the credit exposure undertaken by dealers; the presence of dealers whose derivative trading activity is not regulated;[67] and the interconnection risk arising from the role played by derivatives in increasing links among capital markets.

67. Certain regulations apply to derivative dealers such as banks and securities firms -- though the regulations applicable to these two types of financial institutions are usually different. However, derivatives trading is typically not a regulated activity for insurance companies and certain non-financial firms, even though some of them have become active dealers in global OTC derivatives markets.

7 Concluding Remarks

One of the most significant developments in global financial markets is undoubtedly the recent dramatic growth in the use of derivatives in both EXT and OTC markets.

Some observers have argued that the OTC and EXT derivative market structures co-exist, and are likely to continue to do so, because they fulfil different needs for users. O'Connor (1993), for example, argues that OTC markets attract relatively uninformed agents in search for the best client service, as illustrated by the customized design of instruments, while informed users in search of the most efficient means of price discovery are drawn to EXT derivative markets. Alternatively, Remolona (1992) suggests that the growth in EXT derivatives reflects primarily a demand for liquidity-enhancing innovations (by adding liquidity to the spot market), while the growth of OTC derivatives reflects demand for risk-transferring innovations.

Implicit in these arguments, and indeed through most of the current literature, is the assumption that there are two competing market structures for derivatives trading -- each of which has certain unique characteristics. In particular, it is usually assumed that EXT derivative markets are unique in that they provide standardized instruments and are immune to counterparty risk concerns since transactions are backed by the guarantee system of the clearing corporation. In contrast, OTC derivative markets are characterized as markets where transactions are generally non-standardized and where credit risks are usually large. Some observers even assume that the instruments typically traded in these two markets have small linkages, if any.

However, after examining the microstructure of EXT and OTC market operations, it would appear that most of the "traditional" differences between these two market structures are no longer clearly defined. In particular, OTC instruments appear to have become fairly standardized while exchanges are exploring ways of providing more flexible instruments. As well, in an attempt to reduce counterparty credit risk, OTC markets have incorporated a number of features which are similar to those characteristic of exchanges. Furthermore, in the event that centralized multilateral netting schemes are implemented for OTC derivatives trading and the norm for exchanges becomes adopting automated trade execution systems, the differences between the two market structures are likely to become even smaller.

Notwithstanding the increasing "blurring" between the two market structures, EXT derivatives markets are still characterized by certain trading rules set by some combination of self-regulation and official regulation. The OTC derivatives market structure, in contrast, is a dealer market organized by the intermediaries themselves where orders constitute an off-balance sheet item. Based on this critical difference between the two market structures, EXT markets are often assumed to provide a higher degree of transparency and the most efficient means of price discovery.[73]

From a microstructure perspective, however, it is not clear that EXT markets provide greater transparency than OTC markets. Indeed, floor exchange trading typically involves disclosing *only* the best bid/ask price for a given contract. Even the best bid/ask price is typically guaranteed for a specific number of contracts and may be therefore only indicative -- different size orders could imply renegotiation of prices. Furthermore, EXT markets with order book matching systems can also have a closed book, in addition to an open book, which contains information that is not generally revealed to market participants -- although some automated trade execution systems disclose the entire order book to the market.

In OTC markets, quoted prices are also only indicative and may vary with order size and counterparty. However, because there is typically only a relatively small number of market-makers in the OTC derivatives market, it would appear that end-users and other dealers may be able to search with relative ease for the best price in the OTC market.[74]

The efficiency of price discovery between the two market structures is an empirical issue yet to be tested. However, some of the recent research

73. See, for example, Miller (1990) and Masera (1993).

suggests that traditional floor trading mechanisms in EXT markets could be greatly improved in terms of proving greater efficiency in the price discovery process.

74. Shirreff (1991) notes that trading in the Canadian OTC derivatives market is dominated by the five largest Canadian banks and a handful of foreign banks. In the United States, activity in OTC derivative markets is also highly concentrated at a few large institutions (Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation and Office of the Controller of the Currency (1993)).

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