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RISK MANAGEMENT OF FINANCIAL DERIVATIVES

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Financial derivatives come in many shapes and forms, including futures, forwards, swaps, options, structured debt obligations and deposits, and various combinations thereof. Some are traded on organized exchanges, whereas others are privately negotiated transactions. Derivatives have become an integral part of the financial markets because they can serve several economic functions. Derivatives can be used to reduce business risks, expand product offerings to customers, trade for profit, manage capital and funding costs, and alter the risk-reward profile of a particular item or an entire balance sheet.

Although derivatives are legitimate and valuable tools for banks and corporations, like all financial instruments they contain risks that must be managed. Managing these risks should not be considered unique or singular. Risks associated with derivatives are not new or exotic. They are basically the same as those faced in traditional activities (e.g., price, interest rate, liquidity, credit risk). Fundamentally, the risk of derivatives (as of all financial instruments) is a function of the timing and variability of cash flows. It is very important to understand the various risk factors associated with business activities and to establish appropriate risk management systems to identify, measure, monitor, and control exposure and risk associated with derivatives.

Key words: financial derivatives, risk, market risk, credit risk, operational risk.

INTRODUCTION

Market deregulation, growth in global trade, and continuing technological developments have revolutionized the financial marketplace during the past two decades. A by-product of this revolution is increased market volatility, which has led to a corresponding increase in demand for risk management products. This demand is reflected in the growth of financial derivatives from the standardized futures and options products of the 1970s to the wide spectrum of over-the-counter (OTC) products offered and sold in the 1990s.

The term "derivative" encompasses any financial instrument, the value of which is derived from the price of some underlying asset, index or rate.¹ Originally based on commodities, the range and usage of these instruments have increased

¹ Cf., Ivanovic, Z., *Financial Management*, University of Rijeka, Rijeka, 1997.

dramatically to the extent that they now cover a wide range of financial products (e.g. equities and bonds), money rates (e.g. interest and exchange rates), indices (e.g. equity and commodity indices) as well as “soft” commodities (e.g. coffee, sugar, cocoa, wheat, barley), precious and base metals, electricity, gas, oil, weather and other energy products. Whether transacted on a regulated exchange or on any other form of multilateral trading platform or bilaterally over-the-counter (that is, off-exchange), derivatives today are increasingly being used – and used successfully – by growing numbers of corporates, financial institutions, building societies, insurance companies, commodity groups, fund managers and other organisations. Whether the purpose of trading is to hedge against future adverse price movements in respect of underlying assets and/or portfolios, manage interest rate or exchange rate risks, or take positions with a view to improving profits, derivatives are and will continue to play an important and internationally recognised role in the world’s trading and financial systems.

1. THE DERIVATIVES TRADING ENVIRONMENT

1.1. Trading on an Exchange

Exchanges have to operate with a high level of integrity, efficiency and transparency in order to deliver confidence in their markets and provide for the fair treatment of all market users. They usually have to be licensed in their own home state and be able to demonstrate continuing compliance with the requirements of that home state. While these requirements and the degree of accompanying oversight and enforcement may vary from country to country (and from exchange to exchange), their purpose is generally to ensure that an exchange:

- maintains high standards of integrity and fair dealing;
- facilitates a “proper market” in their instruments;
- ensures that its prices are transparent and the price formation process is reliable;
- has a mechanism to monitor compliance with its rules;
- has effective arrangements for the investigation of complaints;
- has financial resources sufficient to sustain proper performance;
- has a high degree of security and operational reliability and appropriate contingency arrangements.

These requirements are supplemented by regular liaison between exchanges and their licensing authorities over matters such as market supervision, the development of new products and strategies, enforcement and market safety and integrity. Each exchange will usually have a broad range of regulatory rules, practices and procedures designed to meet its recognition or licensing requirements and attain its commercial objectives, including membership rules, market regulation, contract rules and arbitration procedures.

1.2. Trading Over-the-Counter

A large and increasing amount of trading in derivatives is done privately or “over-the-counter” (OTC) i.e. on a bilateral basis between financial institutions, organisations and companies. Dealings may take place on an electronic platform that may provide similar functionality as a regulated exchange. Such a platform may be the proprietary platform of a single institution (e.g. a bank or an energy trading company) or it may be owned or used by a consortium of financial institutions.

It should always be borne in mind that, while there is often a close interface between cash and commodity markets and between over-the-counter trades and exchange trades, OTC transactions:

- are not subject to exchange rules (although some may be incorporated in their terms) and should not be confused with out-of-hours trading in exchange contracts (which will be covered by the exchange’s rules);
- unless otherwise specified, are not subject to clearing house rules, which means that, unless the parties otherwise agree, they are not subject to margin arrangements;
- have a different risk profile to exchange-traded contracts;
- have the advantages of being able to be traded in quantities or over trading periods or at points of delivery or in currencies other than those quoted on an exchange, thereby more accurately reflecting the real risk of the underlying transaction (rather than using the nearest available exchange-traded transaction);
- may, particularly where they are unusual or complex, be more difficult to value and be subject to lower levels of price transparency than exchange-traded contracts.

1.3. The Role of Clearing House

The role of a clearing house, which may be an independently established organisation or a division of an exchange, is to act as a central counterparty for trades executed on the regulated market(s) with which it is associated. Its principal objective is to help “guarantee” the financial performance of trades in order to reduce counterparty risk, increase market liquidity and use efficient “straight-through processing” to maintain low settlement costs. The provision of a secure, effective and cost-efficient clearing service into the market place helps to protect the overall integrity of the market(s).

A clearing house performs its role:

- by assessing and managing member counterparty risk, delivery risk, banking and collateral lodgement risk and contract risk;
- by operating a centralised, automated treasury operation for the purpose of administering payments and receipts for the lodgement and withdrawal of

collateral as well as the management of a multi-currency portfolio of significant proportions;

- by revaluing on a daily basis the novated contracts which it has entered into with its members and, reflecting the various price movements, collecting additional or “variation” margin from members whose positions have fallen in value and paying such margin to those whose positions have risen in value;
- by monitoring positions and reviewing financial reports, credit rating assessments and the internal controls of its member firms;
- through the settlement and delivery of netted transactions for futures and options markets, and the issue of netted settlement instructions to a Clearing and Settlement Depository (CSD) or International Clearing and Settlement Depository (ICSD) for equity and OTC markets.

2. RISK MANAGEMENT OF FINANCIAL DERIVATIVES

In general terms, risk can be defined as anything that can impede an organisation from achieving its strategic objectives. It encompasses not only some of the more predictable threats or hazards that an organisation may face, but also the failure to maximise opportunity or address the uncertainty of results not being as expected – and is endemic in all forms of commercial or trading activity.

In order to address risk in an efficient and effective manner, the organisation should:

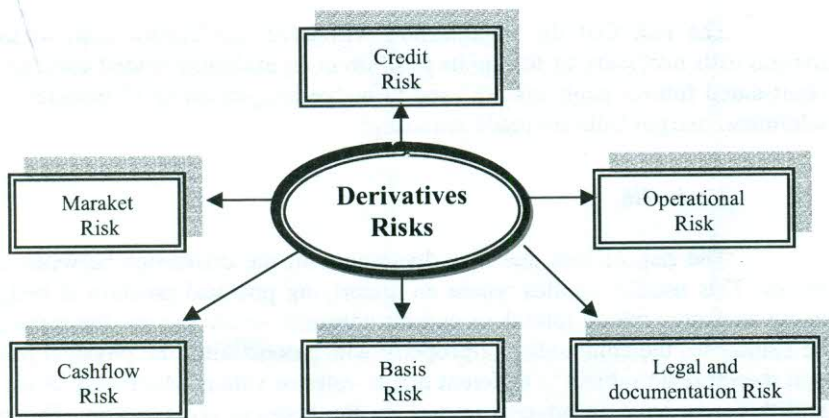
- identify, on a continuing basis, all the risks relating to its activities, including derivatives trading activities;
- determine its appetite for risk based on the above identification of risks, i.e. which risks it is prepared to accept and which risks it is not prepared to accept;
- develop effective and well-understood policies for defining the context, scope and objectives for managing risk;
- develop specific responsibilities for implementing those policies;
- establish procedures for measuring, managing, mitigating and reporting on risk across the organisation on an ongoing basis, particularly market risk, credit risk, operational risk and legal risk.

While organisations around the world are focussing continually on how to manage risk effectively and being encouraged by regulatory agencies to implement robust systems and processes, the impact of globalisation and technology and the growing interface between products and services are not only impacting significantly on the management of existing risks, but are also generating new and different kinds of risks, making the overall quantification and management of risk that much more complicated.

2.1. Types of Risk

Identifying and evaluating each of the different risks to which an organisation is subject is the foundation for developing and maintaining an effective control system.

Figure 1. Risks associated with derivatives



Market risk

The risk of losses due to adverse movements in, as relevant, equity, bond, commodity, currency and other market prices, indices or rates or changes in the volatility of these movements.

Credit risk

Credit risk is defined as “the risk of loss if a counterparty fails to perform its financial obligations to the firm”. It “is found in all activities where success depends on counterparty, issuer or borrower performance. It arises any time that funds are extended, committed, invested or otherwise exposed through actual or implied contractual agreements, whether reflected on or off balance sheet.”²

Operational risk

Operational risk is defined as “the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events”.³

² Guide to Risk Based Supervision, Bank of England, June, 1998.

³ Basel Committee on Banking Supervision, *The New Basel Capital Accord*, Bank for International Settlement, 2001.

Legal and documentation risk

Legal risk is the risk that an organisation, in the event of default or dispute, may be unable to enforce or rely on rights or obligations arising under contractual arrangements with its broker or counterparty. It includes specific unusual types of legal risk such as criminal liability and regulatory risk.

Cashflow risk

The risk that the organisation will have insufficient cash to meet regular margin calls necessary to sustain its position in an exchange-traded contract (e.g. where short-dated futures contracts are used to hedge long-dated OTC transactions or where additional margin calls are made intra-day).

Basis risk

The risk of loss due to a divergence in the difference between two rates or prices. This usually applies where an underlying physical position is hedged through using exchange traded futures or options contracts which are not the same as (but may be similar to) the commodity or property which constitutes the physical position. They will therefore be subject to different prices, rates or values which may change over time and this may have an adverse impact on the hedging arrangement. The same is true where short-dated contracts are used to hedge long-dated positions.

3. MANAGING MARKET RISK

Senior management should ensure that there are procedures and controls for derivatives in place sufficient to identify, measure, manage, mitigate and report on all forms of market risk that may be generated by adverse movements in equity, bond, commodity, currency or other market prices, indices or rates or changes in the volatility of such movements.

Senior management should ensure that all trading activities, including those in derivatives, are properly organised and executed in accordance with board policy and the organisation's trading procedures.

Any new form of (or significant variation in) trading activity, particularly where new instruments or products are involved, should be subject to rigorous prior assessment and approval to determine appropriate parameters, controls and limits and ensure that any consequential risks are properly understood and within the organisation's accepted level of tolerance to risk. Such assessment should cover accounting and control procedures, IT and systems implications, relevant legal or regulatory approvals, tax implications and appropriate sign-offs in all relevant areas by senior line management.

3.1. Measurement of Market Risk

A consistent and readily verifiable method of measuring market risk which is appropriate to the scale of trading activity is essential. It should include monitoring transactional activity where derivatives are used so that the impact on the organisation's market risk is known, understood and measured appropriately.

Before any measurement methodology is adopted, its advantages and shortcomings should be fully considered by the risk management function, measured against the nature and type of the organisation's trading activities and assessed against possible alternative methodologies.

When measuring the exposures of positions, consideration should be given to making provisions/fair value adjustments arising from, for example, large-size positions which may prove difficult to unwind at other than below-market prices.

Value-at-Risk⁴ (VaR) is one of key measures for the assessment and monitoring of market risk. Since VaR is limited by some of its underlying assumptions (e.g. that the future risk can be predicted from the historical distribution of returns), the organisation should integrate VaR measures with all other risk indicators (e.g. scenario analysis and stress testing) in order to achieve a better picture of risk.⁵

Whether evaluating a new model or assessing the accuracy of an existing model, a VaR backtesting policy should be adopted to compare realised trading results with model generated risk measures. The most straightforward way to backtest is to plot the daily P&L against the predicted VaR and to monitor the number of excessions or departures from the agreed confidence band. Steps should be taken to identify the source of error if excessions are outside of the confidence band expectations.

3.2. Limit Setting

Overall organisation-wide risk limits should be developed to control exposure and monitor transactions and positions in accordance with the strategic appetite of the organisation and the nature and extent of its trading activity, the expertise of its individuals and the availability of netting⁶ or collateralisation⁷ techniques. For example, in more complex situations, specific consideration should be given to:

⁴ A measure of quantifying market risk based on an estimated probable (generally within a 95%-99% confidence level) loss over a given period of time in the value of an asset or portfolio of assets. Cf., Jorion, P., *Value-at-Risk*, 2nd ed., McGraw-Hill, New York, 2001.

⁵ Cf., Alexander, Carol, *Risk Management and Control: New Markets and Products*, John Wiley & Sons, San Francisco, 1999.

⁶ The process by which a single payment obligation is derived from a number of sums owing between the parties.

⁷ Assets provided by one party (or a third party acting as a credit support provider) to the other party to secure payment of the first party's obligations in relation to derivative or other transactions in the event of default. Collateral may also take other forms such as the provision of a guarantee by a parent organisation.

- notional, maturity and (VaR) limits;
- organisation-wide stress-based limits to supplement VaR limits;
- sensitivity-based limits to manage risks within specific market parameters;
- trading limits by trader/desk/country/ industry sector and currency.

3.3. Reporting and Monitoring

There should be an independent monitoring of market risk exposures versus limits to identify limit violations. Regular, intelligible and timely reports on trading activities should be prepared or checked by competent staff, independent of the organisation's dealing activities, covering:⁸

- a reasoned description of the profit/loss and trading activity in a given period; of the positions at the end of that period (including relevant portfolio VaR analysis; and, where relevant, of the underlying transactions being hedged by type of product;
- details of the level of operational exceptions (for example, errors on timely trade capture and generally for middle/back-office operations statistics on confirmed/affirmed/ unconfirmed/unaffirmed transactions;
- reconciliations of all items in the trade life cycle, including cash, stock, unmatched and failed trades;
- utilisation against limits, giving details of any regulatory or internal limits breached in the period and action taken;
- where appropriate, stress test/scenario results;
- details of likely future activity, including hedging against any anticipated transactions.

Such reports should be circulated regularly and on a timely basis (to the board and senior management and any relevant responsible sub-group of directors).

A formal process should be established to ensure that market risk issues and VaR limit violations are escalated to the appropriate level in the organisation on a timely basis. The trigger levels for escalation will be based on the materiality and duration of the limit breach.

3.4. Independent Price Verification

In order to produce reliable market risk reports on which management decisions can be based, market parameters (instrument prices, data sets, interest rates and foreign exchange rates) fed into the approved market risk measurement and assessment models must be checked for integrity and reasonableness.

⁸ Cf., Comptroller of the Currency, *Risk Management of Financial Derivatives*, Comptroller's Handbook, Januray, 1997.

Market parameters may be input into approved market risk measurement and assessment models manually or by automated feeds which may give rise to manual input error, linkage error, systems error (when links fail) or third party input error.

Policies and procedures should be developed to identify and correct these errors by comparing previous sets of market parameters (i.e. closing prices and rates) to current end-of-day market parameters, investigating the reasons behind large variations, and taking the appropriate action. Responsibility should be allocated to appropriate and skilled staff who are independent of those responsible for trade execution. If this is not possible, the variations should be checked or audited on a regular basis by an independent area such as Internal Audit.

If transactions do not have readily available market prices or are complex (e.g. structured OTC products), some form of independent pricing will have to be sourced either from within the organisation (where there is a sufficient degree of expertise to do so), or possibly externally from an institution other than the product provider. In the case of a particularly complex product, or where there is an illiquid market in a product, the only source of valuation may be the product provider itself. In this event, the valuation and the methodology used should be assessed particularly carefully by the organisation.

3.5. Stress Testing and Scenario Analysis

It is important that an organisation understands the effects on it of sudden market changes (e.g. in price, volatility, liquidity) that are outside the norm. It should therefore:

- analyse the organisation's situation in the event of sudden or unpredictable market changes;
- put in place policies and procedures for reacting to such situations, including trigger points at which risk must be actively reduced and/or senior management should become more closely involved.

To be meaningful, stress testing and scenario analysis should be performed at multiple levels and tie back into the decision-making process. It should be discussed in regular forum by risk monitors, senior management and risk takers. At senior management level, the results should guide the organisation's appetite for aggregate risk taking and influence the internal capital allocation process. At the book level, such tests may trigger discussions on how best to unwind or hedge a position.⁹

Senior management should ensure that stress testing and scenario analysis is carried out with such regularity that is appropriate to the overall exposure of the organisation, the volume and size of its trading activities and the impact upon it of meeting any additional margin calls or utilising available credit lines.

⁹ Cf., Schwartz, J. Robert and Clifford W. Smith, Jr., *Derivatives Handbook: Risk Management and Control*, John Wiley / Sons, New York, 1997.

4. MANAGING CREDIT RISK

Senior management should ensure that there are procedures and controls for derivatives in place to identify, measure, manage, monitor and report on all forms of credit risk to which the organisation will be exposed and secure its mitigation through the use of netting and collateral arrangements or other credit enhancement techniques.

Credit risk exists in some form in most types of financial transactions. Transaction credit risk should not, however, be considered in isolation, but aggregated with credit risks arising elsewhere in the organisation so as to give a total picture. The organisation should therefore have in place procedures and competent staff to identify, analyse, measure and manage all credit risks associated with its trading activities to reduce, so far as possible, loss due to counterparty default and to ensure that they are within the organisation's credit risk tolerance.

Credit risk should be controlled by:

- reviewing regularly the brokers and counterparties with whom an organisation has credit exposure or with which it places, for example, margin monies;
- setting limits on exposures to counterparties and brokers, as appropriate (taking into account the financial strength, credit worthiness and experience of brokers/counterparties (as well as such issues as conflicts of interest)), and monitoring and dealing with credit limit excesses or sudden margin calls caused by the effect of price movements or by the impact of new transactions;
- an analysis of credit exposures by counterparty taking into account, where appropriate, marked to market values;
- where appropriate and practicable, using enforceable netting agreements, collateral offsets and other credit advancement techniques, as appropriate and where practicable.

So far as derivatives are concerned, credit risk will vary according to, for example, whether the transactions are traded OTC (and where and with whom they are traded) or executed on or under the rules of an exchange or on any alternative market and whether they are cleared.

4.1. Defining and Measuring Pre-settlement and Settlement Risk

Credit risk from derivatives activity arises in two distinct ways depending on the phase the contract is in when one of the parties fails. It arises either before settlement is due (i.e. pre-settlement risk) or when settlement is due (i.e. settlement risk).

Pre-settlement credit risk is the risk due to the cost of replacing a derivatives transaction if the counterparty/customer fails during the life of the transaction, but before final settlement is due. It arises where trades have a positive mark to market (mtm) value when the counterparty fails. The marked to market value represents the

cost of replicating the contract with another party, or, put another way, the unrealised profit which has to be written off.

Because trades change in value in line with market forces, the cost of replacing a failed transaction can also vary and for this reason pre-settlement risk is also sometimes called market-driven credit risk. This risk is one-sided for options, with only the option buyer assuming any risk, since the seller has already received value, in the form of the premium payment. For swaps, the risk is two-sided, since each side exchanges value at various points in time. The size of the pre-settlement risk is a reflection of the counterparty's creditworthiness, market volatility and the length of the pre-settlement period (or "tenor").

The latter is the most significant factor in over-the-counter derivatives, since the tenor of the trade can often be one year or longer.

Pre-settlement risk exposure should be measured by summing the current value of the contract (the current exposure (CE)) as well an estimate of its likely future value (the potential future exposure (PFE)). For organisations with less complex derivatives activities, the minimum standard should be to estimate current exposure using the mark-to-market value of the transaction, and adjust this by a simple add-on estimate of the potential for change in mark-to-market value.¹⁰ Various standards (e.g. the BIS add-ons) may be used for the PFE.

These include straightforward percentage add-ons, based on the product, tenor or both. For organisations with large, complex derivative portfolios, PFE should be modelled using historical volatilities (this is known as the historical method). Organisations requiring a more sophisticated and encompassing approach may adopt measures for estimation which use simulation methods such as Monte Carlo simulations, but which are atypical for most endusers.

It is common even for sophisticated players to use a combination of approaches matching the materiality of the exposures in each product portfolio.

Settlement risk occurs when value is given without confirmation that value has been received in return. It materialises when a counterparty fails before it can deliver countervalue, leaving the organisation to pursue its claim for payment as an unsecured creditor. The risk lasts from the point at which an irrevocable instruction has been given to pay funds away until irrevocable confirmation that value has been received. This risk exists in some form for all trading activities at the point of trade settlement. The fundamental differences between settlement risk and pre-settlement risk are that the window of time over which settlement risk exists is typically much shorter (e.g. 2 days), much greater in magnitude, more certain (in the sense that the amount is fixed and easily identifiable), and it represents a loss of cash rather than unrealised profit.¹¹

¹⁰ Cf., Smithson, C. W., *Credit Portfolio Management*, John Wiley & Sons, New York, 2003.

¹¹ Cf., Basel Committee on Banking Supervision, *Risk Management Guidelines for Derivatives*, Bank for International Settlement, 1994.

For most end-users, settlement risk exposure should be measured as 100% of the value to be received (e.g. the value of the security or cash flow due at settlement). Potential change in value over the settlement process is generally not a critical issue, except for complex portfolios comprising transactions with particularly long settlement period windows.

4.2. Netting and Collateral

The use of netting agreements and collateral offsets to mitigate credit risk are recommended, where practicable, as good proactive credit risk management practice. However, an organisation should first consider the costs of arranging the legal agreements, confirming their legal enforceability, establishing the methodologies and systems capability necessary to calculate net exposure and employing sufficiently competent staff to monitor, control and perfect collateral on a daily basis. For many end-users, particularly those with few derivative transactions or those dealing in one-off transactions with a number of different counterparties/customers, the cost may outweigh the benefit if the use of these arrangements is expected to result in insignificant reductions in pre-settlement credit risk exposure.

Payment netting is a mechanism designed to limit settlement credit risk, by which the parties agree that if, on any date, amounts are payable between them in the same currency under the same transaction or a specified group of transactions (as the parties may agree), then such payment obligations are to be determined on a net (and not gross) basis. Prior to agreeing to its application, organisations should consider carefully the extent to which payment netting is to apply i.e. whether it should apply to obligations under one and the same transaction or across transactions, bearing in mind that this is largely a matter of law, regulation and systems capability.

“Close-out” netting is a mechanism designed to reduce net pre-settlement exposure in the event of counterparty failure. It applies only upon early termination of the transactions upon an event of default whereby obligations (whether for payment or delivery) under all outstanding transactions, entered into pursuant to the relevant master agreement, are required to be terminated, valued and converted (if appropriate) into the termination currency agreed by the parties, and determined on a net (rather than gross) basis. It is designed to stop liquidators cherry picking contracts and avoiding payment on unprofitable transactions (i.e. where the failed counterparty owes money).

When providing for close-out netting in the relevant master agreement, organisations should adopt a “full two-way” (as distinct from a “limited two-way”) payments approach (an additional option provided under some Master Netting Agreements¹²), which means that if the close-out calculation results in an amount payable by one party to the other, that first party is obliged to make the payment regardless of whether the other party is the defaulting party. On the other hand, under the “limited two-way” payments approach, the first party is not required to make any

¹² Cf., Harding, P. C., *Mastering the ISDA Master Agreements (1992 and 2002): A Practical Guide for Negotiation*, Financial Times -Prentice Hall, New Jersey, 2003.

such payment if the other party is the defaulting party. The “full two-way” payments mechanism is increasingly recognised in the market as the preferred approach. Many perceive it to be a fairer mechanism and that regulatory capital benefits, which flow from using a netting agreement, will not be available if “limited two-way payments” is used.

Organisations should be aware that the issue of close-out netting often raises complex issues of enforceability, particularly in relation to entities organised overseas.

Many banks and brokers will demand that collateral be provided in relation to OTC derivatives transactions. A customer with considerable bargaining power (e.g. through a stronger credit rating than that enjoyed by many banks and brokers) may be able to insist on mutualised collateral arrangements. If a pre-agreed number is hit, other collateral must be provided by one party to the other or, less commonly, by each party to the other simultaneously.

The terms on which collateral is provided must be examined closely. Can it be pledged by the broker to a third party such as a clearing house? Is it co-mingled with property belonging to the broker or to other clients of the broker?

4.3. Credit Risk on Over-the-Counter (OTC) Transactions

In the case of OTC transactions, both pre-settlement and settlement credit risk arise. Generally, settlement risk is monitored and controlled separately from pre-settlement risk and other credit risks such as repayment risk. Pre-settlement and other non-settlement credit risks are usually aggregated by counterparty and the total picture of exposure considered when setting credit limits. To achieve this, the credit risk inherent in a position stated on a basis that is equivalent to the credit risk inherent in a lending transaction – this is achieved by adding together the CE and PFE to create total exposure (TE), a risk amount which is regarded as a loan equivalent exposure, sometime called credit equivalent exposure (CEE).¹³ It is good practice to set limits on the aggregate CEE permitted for all derivative transactions, and to set such limits taking into consideration the range and aggregate amount of credit risks which arise through other transactions (such as placement of deposits or lending).

Settlement risk for different transactions involving the same counterparty are usually controlled by way of daily settlement limits. These limits measure the total settlement amount due on any particular day across all transactions. Although it is good practice to measure the risk from the point at which irrevocable payment instructions are issued to the point at which counter value receipt is confirmed, it is common for systems to be unable to identify these points with certainty. Daily settlement limits therefore commonly operate on an assumption that settlement takes a certain average, or sometimes worst case, number of days and apply the limit utilisation accordingly, with manual adjustments for trade fails.

¹³ Cf., Arvanitis, A. and J. Gregory, *Credit: The Complete Guide to Pricing, Hedging and Risk Management*, Risk Books, London, 2001.

Where such assumptions are made in the programming of daily settlement limit systems, it is good practice for organisations to understand the limitations of the assumptions and to check periodically that they remain sound.

For OTC derivatives it is therefore important to understand that transactions use both presettlement and settlement limit capacity. There are two limits which therefore have to be respected before a trade can be accommodated. In this way, credit exposure is managed within tolerance levels both before and at settlement. At present, most OTC transactions proceed uncleared and without either party placing cash margin or any form of collateral with the other as security for its obligations. However, if an OTC transaction is cleared or an organisation does place margin or collateral with its counterparty, credit risk issues similar to those arising in connection with exchange-traded contracts are likely to exist.¹⁴

4.4. Credit Risk on Exchange-Traded Transactions

It is a common perception that exchange-traded derivatives carry no credit risk. In reality, while the transparency of an exchange's price mechanism, coupled with daily marking to market of positions, may reduce risk, it does not eliminate credit risk.

The risk management function provided through the monitoring and margining procedures of clearing houses/clearing divisions of exchanges is an important benefit to the market as a whole. Indeed, a clearing house/division of an exchange will generally stand behind a transaction (either as a counterparty to it once the transaction is cleared or by some other "guarantee" arrangement). In some markets, the benefit of this "guarantee" may be extended to cover a broker's customers. More usually, the benefit of clearing is restricted to the exchange member through whom the customer organisation will gain exchange access and execute its transactions so the organisation will not itself enjoy the benefit of any clearing "guarantee" i.e. the organisation's real credit risk will be with the broker.

Credit risk arises in such circumstances by virtue of the fact that margin payments are paid to the broker and may be lost if the broker fails.

5. MANAGING OPERATIONAL RISK

Senior management should ensure that procedures and controls for derivatives are in place to identify, measure, manage, monitor, report on and, where practical, mitigate operational risk, including technological risk.

¹⁴ Cf., Smithson C.W., and C.W. Smith, Jr., *The Handbook of Financial Engineering*, Harper & Row, New York, 1990.

Operational Risk is defined as the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events¹⁵.

Senior management should have oversight responsibility to identify and analyse all types of existing and potential operational risks faced by the organisation, which may arise from, for example¹⁶:

- the introduction and development of new products;
- changes in management and/or the organisation's operations;
- the management of third parties, particularly in the context of the outsourcing and procurement of IT services;
- the development, introduction, security and use (and failure) of automated systems, particularly in relation to key business processes;
- human resource failures, particularly as regards people-related processes such as recruitment and training of staff;
- any loss in business continuity due to events such as natural disasters, terrorist acts;
- changes in regulatory and/or legal environment.

Having identified and analysed areas of potential operational risks, senior management should ensure that appropriate internal controls and procedures are established to measure, manage, monitor, mitigate and report on such risks on a continuing basis, including:

- setting risk indicators and limits for operational areas (e.g. to ensure senior managers are advised of any escalation in risk);
- carrying out independent internal audits to assure management of the adequacy and effectiveness of the organisation's controls and procedures;
- ensuring segregation of duties, confirmations and reconciliations, reporting and monitoring. For example, individuals responsible for entering into derivatives transactions should be segregated from those responsible for transaction processing, calculating profit and loss, monitoring risk, performing reconciliations and transactional reporting;
- timely reporting covering:
 - details of authorised and unauthorised changes in and/or access to IT systems;
 - information on staff issues, e.g. turnover rates, disciplinary events and changes in individual responsibilities;
 - trading activities.

¹⁵ Basel Committee on Banking Supervision, *The New Basel Capital Accord*, Bank for International Settlement, 2001.

¹⁶ Basel Committee on Banking Supervision, *Sound Practices for the Management and Supervision of Operational Risk*, Bank for International Settlement, September, 2003.

5.1. IT Systems Management

Computer systems used for the initial recording, processing, valuing and risk modelling of derivatives transactions should be subject to the same procedures and controls as other systems used by the organisation. In particular, there should be a systems outline that sets out how the systems used for any process within the life cycle of a derivatives trade are controlled. Any such outline should include:

- systems and data architecture, setting out the interfaces between the various systems;
- clear levels of responsibility have been assigned, particularly over systems development, system operation, technical support and security administration;
- logical access to system programs and data is limited to authorised individuals (including the use of firewalls and encryption technology where the organisation is connected to the external environment); and access violation attempts are monitored and reported;
- physical access to computer equipment, storage media and programme documentation is limited to authorised individuals through the use of appropriate security devices;
- estimations are made (and periodically reviewed) of current and future systems capacity, based on current utilisation levels and anticipated growth rates, to ensure that adequate processing and capacity continues to be available at each processing location;
- systems processing is scheduled appropriately and deviations are identified and resolved in a timely manner;
- systems disaster recovery plans are developed, updated and tested regularly to enable the organisation to recover systems and data in a timely manner, and aligned to the organisation's business continuity plans;
- clear change control procedures are in place and adhered to when system developments, modifications and testing are being made.

In cases where spreadsheets and/or manual workarounds are used for reports (for example, for position keeping or valuation), procedures should be developed to ensure that access is carefully controlled and the spreadsheets are used only for their intended purpose. In addition, independent validation of the models underlying the spreadsheets and/or manual workarounds should be carried out to ensure that these models are tested, reliable and consistent with the standards of external models.

An organisation should ensure that its business strategy is translated into specific system requirements so that systems needs can be analysed and specified and appropriate systems selected. Once specified, design and development activity should ensure that systems are developed to a consistent standard and that systems documentation provides for long-term support and maintenance. Successful implementation of systems requires adequate testing, quality assurance, change controls and project management to ensure that systems meet business requirements on time and within budget. In addition, the development, planning and testing of

contingency and disaster recovery strategies are crucial to ensure the timely recovery of key business processes and supporting systems.

5.2. Use of Electronic Order Routing Systems

Derivatives transactions are increasingly being conducted electronically and more and more business operations are able to process transactions from start to finish with minimal manual intervention. Direct connectivity with third parties (such as brokers) through the use of electronic order routing systems (EORS) is now commonplace. Although use of these systems can deliver many advantages to the end-user (e.g. more cost efficient and rapid transaction processing), dealing activities must be monitored closely to ensure that transactions are processed completely, accurately, on time and without duplication. It is also vital that controls are built into the systems covering, for example, trade input, verification and release to minimise errors and unauthorised trading. Management should also be able to access real time information about the precise status of each transaction and monitoring systems should be capable of providing early warning of potential difficulties in processing.

Given the extent of and the degree of reliance based upon automation, all electronic systems should be subject to thorough testing prior to implementation.

When using EORS, due attention should be given to the following:

- Lack of compatibility – the organisation must ensure that it meets the IT hardware specifications and network configuration recommended by the EORS provider, as this can directly affect the EORS's performance;
- Adequate training – the organisation should ensure that all EORS users are aware that efficient performance can be inhibited by their own activities e.g. running additional software applications on dedicated EORS hardware. As a result, reference to best practice user guides issued by the EORS provider is essential. The effective communication of these best practice criteria to EORS users through training will help maximise EORS's performance;
- Security risk – the EORS provider will accept no liability for a systems failure that results from the introduction of viruses or similar items by an employee of the organisation (and may hold the organisation liable and seek appropriate damages). The organisation must ensure therefore that it has adequate procedures in place to raise awareness of the dangers of viruses and to minimise the risks of their introduction into the system.
- Security features should be in place to restrict trading access to authorised personnel only (e.g. through the use of user names and passwords) and there should be procedures for managing access to and invalidating codes when authorised personnel leave the organisation;
- Systems failure and contingency arrangements – in the event of a systems failure, the organisation must ensure that it can swiftly access alternative

mechanisms to support its trading activities. Particular care should be taken to check whether individual orders were executed prior to the systems failure before re-entering them via the back-up system;

- Incorrect or erroneous orders – directly inputting orders via an EORS exposes the organisation to potential losses where orders are incorrectly submitted to the exchange's central order book. To minimise these risks, it is vital that authorised personnel are properly trained in the use of the EORS and are aware of the procedure for correcting/amending incorrectly or erroneously entered orders.

When accessing a derivatives exchange electronically, an organisation must ensure that it is able to comply with both the letter and the spirit of that exchange's rules and regulations. The organisation must therefore have procedures in place whereby all employees authorised to use an EORS become familiar with and are able to access directly all applicable rules and regulations and any changes that may be introduced to those rules and regulations.

5.3. Reputational Risk

While reputational risk is often excluded from the definition of operational risk (for example, the New Basle Capital Accord excludes reputational risk for the purpose of calculating capital requirements), recent headline cases such as those involving lack of accounting transparency shows that any form of adverse publicity or perception about the organisation (whether justified or not) which damages its reputation can increase significantly its risk and/or its cost base in some of its key activities resulting in, for example, the withdrawal of credit lines, loss of customers, loss of key staff, the impact of tighter regulatory controls, loss of investment confidence and withdrawal of third party suppliers.

In such circumstances, there has to be careful management of any contact with press, the development of an informed working relationship with any relevant regulatory authority and a very close focus on retaining the goodwill and support of customers and suppliers. Aside from general matters of administration and normal communications, contact should be restricted to or managed centrally by senior managers during the time of crisis.

CONCLUSION

The increasing sophistication of the capital markets and the creativity of investment bankers and other financial institutions have fostered the introduction and use of a wide variety of complex financial instruments and structured financial transactions. Most organisations now use these kinds of transactions, which involve the use of derivatives, to hedge exposures or manage portfolios more efficiently. However, the lesson for others has been that, if used inappropriately or for excessive speculative gain, they can also generate significant losses. While it is true that, when measured

against the enormous volume of business undertaken worldwide, large losses are comparatively few in number, the size of them has sometimes been unacceptably high.

The causative factors are usually any or all of the following: excessive position-taking (in relation to capital), unexpected market moves, fraud, ineffective risk management controls, inadequacies in corporate policy governing their use and/or insufficient product understanding.

The problem for organisations is that by omitting to use derivatives (prudently) for hedging purposes, they may be speculating with underlying values in a way which can be just as risky and dangerous as using derivatives inexpertly or imprudently. This means that the board directors could be construed as failing in their duty to act in the best interests of their companies if, through lack of knowledge, they omit to manage risk which ought to be managed. Conversely, they may also be failing in their duty to so act if they permit the organisation to take positions in these instruments without having the proper controls or staff in place.

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Sažetak

UPRAVLJANJE RIZIKOM FINACIJSKIH DERIVATA

Financijski derivati pojavljuju se u mnogo oblika uključujući futures ugovore, terminske ugovore, swap-ove, opcije, strukturirane zajmovne obligacije i depozite, te i u raznim kombinacijama navedenih instrumenata. Pojedini derivati trguje se na organiziranim tržištima, dok se ostalim derivatima neposredno negocira. Derivati su postali integrirani dio financijskog tržišta zbog toga što oni imaju nekoliko ekonomskih funkcija. Derivati se mogu koristiti za smanjenje poslovnog rizika, kao sredstva trgovine za ostvarenje dobiti, za smanjenje troškova kapitala i financiranja, te za promjenu odnosa rizičnosti i dobiti pojedinih stavaka u bilanci stanja.

Iako su derivati legitimna i vrijedna oruđa za banke i korporacije, oni kao i svi ostali financijski instrumenti sadrže određeni rizik kojim se mora upravljati. Rizici povezani sa derivatima nisu novi u odnosu na druge rizike. U stvari to su rizici koji se pojavljuju i kod ostalih tradicionalnih aktivnosti (npr. rizik cijene, kamatne stope, likvidnosti, kreditni rizik). U osnovi rizici povezani sa derivatima su funkcija vremena i varijabilnosti novčanog tijeka. Stoga je veoma važno razumjeti razne rizične faktore koji su povezani sa poslovnim aktivnostima te prema tome i uspostaviti primjerene sisteme za identifikaciju, mjerenje, monitoring i kontrolu izloženosti rizicima koji su povezani sa derivatima.

Ključne riječi: financijski derivati, rizik, tržišni rizik, kreditni rizik, operativni rizik.