REFLECTIONS ON THE PREDICTION, MANAGEMENT AND MEASUREMENT OF (PRIMARILY FINANCIAL) RISK

by

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Introduction

A good working definition of risk is "the chance of an unwanted outcome".[1] This sidesteps the technical debate concerning the definition and focuses on what makes the concept important. Risk and the response to risk have historically been central to a wide range of individual, organisational and societal decision processes. Managing risk is not only a constant feature of the daily lives of individuals and families but is also "big business" in a broad sense, which "involves government, commerce, and industry...and employs actuaries, ambulance drivers, toxicologists, engineers, policemen, mathematicians, statisticians, economists, chaos theorists, computer programmers and driving instructors – to name but a few".[2] Clearly I can touch upon only on very limited aspects of so pervasive a subject in a short paper, and I shall confine myself primarily to snapshots of subjects bearing on the evolution of prediction and of the control and measurement of risk. Hopefully this will provide historical perspective on regulation and risk management for today's financial sector. It also leads naturally to some concluding observations on the way in which changes in risk management have had effects on financial firms and those who work for them with implications for ethical dimensions of their performance.

Early approaches to risk[3]

Each of the three subjects – prediction, management or control, and measurement – is to be found in people's response to risk in early history, though the last only in ways not yet involving well defined concepts and procedures. Prediction and management or control were frequently linked to practices attesting the continuing importance of superstition. These points can be illustrated with a few examples.

- Rolling astragali (heel bones of animals) with sides corresponding to different numbers and later also dice was done not only for gaming but also for divination and obtaining advice from the Gods. Inscriptions in Asia Minor give names to various throws of five astragali: for example, in the case of 4.4.4.6.6., the throw of child-eating Cronos, the advice was "God speaks as follows: abide in thy house, nor go elsewhere, lest a ravening beast come nigh thee, for I see not that this business is safe. But bide thy time."
- Such divination was used as part not only of the decisions of individuals but also of States, for example, when divine counsel was thought to be required for certain military decisions or decisions involving other matters of statecraft. The superstitious dimension of decisions of the State and of individuals where risk was involved existed side by side with more practical approaches – but approaches not based on abstract conceptualisation - as ancient achievements in building, irrigation, agriculture, and weaponry testify.
- There is evidence of widespread recourse to contracts and transactions directed at the management of risk. In one case often cited the philosopher, Thales of Miletus, correctly foreseeing a good olive crop – his prediction being based astronomical knowledge and not on the throws of astragali or dice - acquired options on the use of olive presses which at harvest time he rented out at a handsome profit. Later I shall describe at greater length other early use of hedging contracts.

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[1] See L.Rahl, *Hedge Fund Risk Transparency: Unravelling the Ccomplex and Controversial Debate* (London: Risk Books, 2003), p.3.
[2] See J.Adams, *Risk* (London and New York: Routledge, 2001), p.4.
[3] My principal source here has been F.N.David, *Games, Gods and Gambling: the Origins and History of Probability from the Earliest Times to the Newtonian Era* (London: Charles Griffin, 1962), chapters 1 and 2.

Greek and Roman thinkers also expressed skepticism that the gods controlled the outcomes of rolling astralagi or dice in games of chance. In his work, *De Divinatione*, Cicero shows his awareness of the concept of randomness in remarks concerning soothsaying and chance which are worth quoting at length:

> "Do you really feel that lots require any discussion? What is a lot anyway? It belongs virtually in the same category as 'guess the fingers', knucklebones and dice. In all these matters audacity and luck win, not reason and thought. As a matter of fact the whole system of peering into the future by means of lots was the invention of tricksters who were only interested in their own financial welfare or in fostering superstition and folly.
> .....
> Nothing is so unpredictable as a throw of the dice, and yet every man who plays often will at some time or other make a venus-cast: now and then he will make it twice and even thrice in succession. Are we going to be so feeble-minded as to aver that such a thing happened by the personal intervention of Venus rather than by pure luck?"[4]

Much later games of chance were to provide for a considerable period the most important stimulus to more systematic thinking about probability from the fifteenth century A.D. onwards. Here the starting-point was the often complex enumeration of all possible outcomes in the game in question and of those favorable to the event whose probability was the subject of the exercise, the ratio of the latter to the former being defined as their probability according to the famous *principle of equally possible cases* attributed to Laplace. Only more slowly were probability and other new concepts of mathematical statistics deployed in subjects such as mortality, the sex ratio of births, census data, data related to public health and poverty, and astronomy.

From description to analysis[5]

The opening up of mathematical statistics to these new subjects was followed by the development and refinement of concepts which are now standard building-blocks of the subject. The process was one in which efforts to improve the description of statistical data were associated with work, often proceeding more on a heuristic than a planned basis, which was to lead to the identification and elaboration of techniques of statistical analysis and inference. Much of the initial focus was on sampling, averages, other measures of central tendency, and empirical frequency distributions. Deployment of these concepts was accompanied not only by increasingly rigorous theoretical investigation into the conditions governing the validity of inference from sample data concerning the properties of the underlying populations and their frequency distributions but also by more philosophical controversy concerning the usefulness and limits of such inferences in fields such as public health and poverty.

Impressive though the resulting conceptual edifice is, it still does not provide a comprehensive set of rules for all circumstances and problems. Human judgement and ad hoc

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[4] The quotation is from *ibid.*, p.25.

[5] This and parts of the following sections draw freely from H.Cramér, *Mathematical Methods of Statistics* (Princeton: Princeton University Press, 1946), chapters 13-14 and 25-26; B.V.Gnedenko, *The Theory of Probability* (New York: Chelsea Publishing, 1962), chapter I; P. Bernstein, *Capital Ideas the Improbable Origins of Modern Wall Street* (New York, etc.: The Free Press, 1992), *passim*; and A.Desrosières, *The Politics of Large Numbers: a History of Statistical Reasoning* (Cambridge and London: Harvard University Press, 1998), chapters 1-4.

procedures continue to have an essential role in practical inference and risk management. Taking a leap forward in time to the rules on the capital and risk management of banks currently in the process of being finalised by the Basel Committee on Banking Supervision, the project known as Basel II, we find an extensive treatment of the conditions which must be met for data concerning the probability of default on banks' loans, their exposure to such loans, and the loss experienced on default of such loans if the data are to be acceptable to regulators as part of the conditions to be met by banks if they are to permitted to adopt approaches to setting levels for their regulatory capital based on their own internal ratings and estimates.[6] In their pure form these conditions may be difficult to meet in practice. Thus in a release only a few weeks ago the Basel Committee addressed the issue of the treatment of categories of loans for which levels of recorded defaults are too low to constitute an adequate sample to serve as the basis for regulatory estimates.[7] The solution proposed – which, as one would expect, follows arguments put forward in the historical debate about inference and sampling – consists of recourse to various kinds of other data on ad hoc basis selected in the light of expert judgment.

Concepts from insurance

Mortality tables and other data on the probability of various events are prerequisites of insurance, as are the techniques of statistical inference. I shall have to leave aside the fundamentals of insurance in my remarks but not without referring to two subjects under this heading whose systematic conceptualisation, I think, preceded that elsewhere in financial economics.

- *Risk versus uncertainty*. The distinction here turns on the novelty of outcomes. Risk refers to situations where the outcome, though unknown, does not represent a novelty with the result estimates of statistical frequency can be based on substantial experience. Thus risk is closely related to the concept of expected losses in financial risk management which, since they are quantifiable, are a standard part of a bank's cost of doing business through their incorporation in loss provisions and are treated as such for the purpose of loan pricing, etc. Uncertainty is closer to the concept of unexpected losses which in the literature and now also in Basel II are supposed to covered by a bank's capital.
- *Conflagration hazard*. This refers to fires which spread from structure to structure over a large area of a city and may be serious enough to overwhelm its facilities for fire fighting. Such events present difficult problems for insurance owing to their infrequency (which would generally lead to their classification under uncerttainty rather than risk), and will often be a source of demands for financial support from the government for meeting losses and rebuilding as well as for official measures designed to prevent future recurrences.[8]

Conflagration hazard would appear to have much in common with the concepts of systemic risk and contagion now used more generally in financial analysis. Systemic risk has historically had a big influence on rules for monetary policy and is an important part of the rationale of regimes for financial regulation. Conflagration hazard is of special interest here as

[6] See Basel Committee on Banking Supervision (BCBS), *International Convergence of Capital Measurement and Capital Standards* (Basel: BIS, June 2004), paras. 444-505.
[7] See BCBS, "Validation of low-default portfolios in the Basel II framework", *Basel Committee Newsletter No. 6*, September 2005.
[8] On this hazard in the context of fire insurance see C.O.Hardy, *Risk and Risk-Bearing* (London: Risk Books, 1999), chapter XIV. (This is a reprint of a classic treatise published in 1923.)

an analogue because of the role accorded to the spreading outward of a fire from its original source and to the links – in this case in the form of contiguity – of the entities affected. One set of events with features analogous to a huge conflagration which had a searing impact on the nation's consciousness and thus on the reform of its banking law as part of the New Deal was the series of banking crises in the United States at the beginning of the 1930s.[9] Three periods in 1930-1931 marked by large increases in the number of bank suspensions were followed in early 1933 by a crisis which started in Michigan in February and spread outwards to other states so that by early March bank holidays or restrictions on the withdrawals of deposits were in force in 48 states, a situation which led the newly inaugurated President Roosevelt to declare a nationwide bank holiday.

Changes in financial economics

Aside from a few pioneering efforts the systematic deployment of concepts from mathematical statistics in econometrics only took off in the 1930s, its most important manifestation being the increasingly pervasive spread of regression analysis throughout empirical economics. In financial economics widespread recourse to the concepts of mathematical statistics came a little later. As late as the 1950s work in finance still focussed largely on description of corporate practices such as those for the evaluation of the profitability of investments and on organisational and institutional issues. Here too there had been pioneering exceptions, the most notable being a little known doctoral treatise by Louis Bachelier on the statistical properties of stock prices which was so far ahead of its time that both his professor, Henri Poincaré, the great French mathematician, and financial economists during the following fifty years had difficulty in understanding the importance of his message.[10]

The eventual incorporation of the concepts of mathematical statistics into financial economics, when it came, had features which distinguished it from that pursued elsewhere in economics. Early work included the attribution of a key role to the distribution of rates of profit of alternative investments and the trade-off between their mean and variance (the latter being the key measure of measure of risk) in the theory of portfolio choice associated with the names of Markowitz, Tobin and Sharpe. The achievement which probably played the most important role in attracting mathematical talent into financial economics and in alerting the financial sector itself to the opportunities for profiting from the new ideas was the development of a theory of, and formulas for, option pricing by Black, Scholes and Merton which in addition to its immediate practical application opened up a whole new area of the economics of contingent decision making.

The story of the "quantification" of financial economics and of parallel innovations in transactional practices within the sector itself has been well told by others better qualified than I am and closer to the process itself, and I don't intend to try and summarise it here.[11] But for the purpose of my remarks I should like to draw special attention to two features of financial markets which are not only building-blocks of the new financial economics but also have important practical implications – the randomness of prices and the dependence of valuation on arbitrage between different financial instruments and markets.

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[9] On the unfolding of these crises see E.Wicker, *The Banking Crises of the Great Depression* (Cambridge: Cambridge University Press, 1996).

[10] An English translation of Bachelier's thesis, *Theory of Speculation*, is included in P.H.Cootner (ed.), *The Random Character of Stock Market Prices* (London: Risk Books, 2000).

[11] For a vivid and remarkably accessible account see Bernstein, *op. cit.* at note 5.

The theory of stochastic processes is now a standard tool in the analysis of markets in the new financial economics – following the lines pioneered by Bachelier.[12] As part of investigations inspired by this theory there has been much analysis of whether the time series for the prices of certain assets or commodities are random processes. If the prices are viewed as such processes, there are important implications for the issues of the efficiency and fairness of the markets in question. This is because prices where upward and downward movements are equally probable at any time are consistent with the hypothesis that pertinent information is available to all market participants and has already been absorbed in existing prices.

Arbitrage in the pricing of financial instruments used for risk management has a crucial role in both the theory of the new financial economics and the actual functioning of the markets for these instruments. This is the result of the way in which the links furnished by arbitrage between the markets for contracts serving the same purpose are the source of chains of valuation for instruments used for financial risk management, in particular for derivatives, the most important category of such instruments.[13] Arbitrage is essential not only to the generation of prices of these instruments individually but also to that of the more complex products of financial engineering which are constructed from combinations of such instruments. In the absence of arbitrage much of the theory breaks down. And when real markets become disorderly and the arbitrage relationships cease to hold, dealers and traders' valuation of their positions becomes difficult or impossible with the consequences that can include panic selling and consequent wiping-out of large amounts of value.

Markets for hedging instruments

In the new financial world innovations incorporating ideas from the new financial economics and developments in communications technology linking different markets more closely have made possible an enormous expansion of the use and trading of hedging instruments. But it is important to bear in mind that these innovations build on a long historical evolution that extends back to civilisations before Christ. This evolution has involved both over-the-counter (OTC) or bespoke instruments with terms designed to meet the special requirements of particular clients and more standardised instruments traded in organised markets.

Examination of the historical record of the second millennium B.C. indicates the existence of contracts with the characteristics of forwards. For example the Code of Hammurabi, King of Babylon between about 1792 and 1750 B.C., contains provisions dealing with contracts for the sale of goods whose delivery is to take place in the future and for the transferability of rights under such contracts.[14] The classification of such contracts as forward contracts rather than loans against future delivery involves subtle points of legal interpretation, and there has been controversy over the classification of similar contracts as loans or forwards in our own

[12] Stochastic process is an elastic term which can cover practically any process of probability theory in which outcomes are random, but in practice is used mainly when the random variable has an explicit time dimension.
[13] Derivatives are conventionally defined as contracts identified by reference to another obligation and whose value is "derived" from another financial instrument, index or measure of economic value. They include futures and forwards, options, swaps. But the adequacy of this definition is increasingly questioned owing to the difficulty of applying it to contracts whose payments are driven by the incidence of specified events.
[14] See E.J.Swan, *Building the Global Market a 4000 Year History of Derivatives* (The Hague, etc.: Kluwer Law International, 2000), chapter 2.

time.[15] Nevertheless key elements of forward contracting were clearly present well before 1000 B.C.

There are various historical candidates for the role of the first organised markets for the trading of futures contracts. One is medieval fairs where documents called *lettres de faire* served as forward contracts specifying delivery of goods at a later date. Because of the difficulties of transportation merchants often preferred to bring only samples of their merchandise to the fairs, and the *lettres de faire* facilitated trading on the basis of samples. These evolved into negotiable instruments which might be transferred between several parties before arrival at the warehouse where the specified goods were stored. As such they had characteristics of both bills of exchange and warehouse receipts which are used today. However, although the meeting places at which *lettres de faire* were negotiated and bought and sold became increasingly well organised institutions, the contracts still lacked the standardisation of modern futures contracts.[16]

Perhaps the most widely accepted candidate for the first futures market in the modern sense is the Dojima Rice Market established in Osaka in the late seventeenth century. This market had the sanction of the government, strict trading rules, and standardised contracts. Trades were cleared through a clearing house at which traders had lines of credit. A major difference as compared with modern futures markets was that delivery of cash commodities was not permitted. Limiting the market to futures trading led to divergences between cash and futures prices and erratic price fluctuations which led the government to close the market in 1869. However, the more chaotic price conditions which ensued led to the market's reopening after a short period but this time with provisions for physical delivery.[17]

The network of organised markets for the trading of futures and options is now global with locations in trading centres in both developed countries and in those with emerging financial markets. This can be seen from the following bird's eye view of exchanges where futures and options were traded in 1998.[18]

- There were 65 futures and options exchanges. Of these the great majority were in developed countries but 11 were in emerging financial markets: one in Brazil, two in Hungary, one in Hong Kong, one in Israel, one in South Korea, two in Malaysia, two in Singapore, and one in South Africa.
- There were 192 contracts on agricultural products for some of which there were several contracts differentiated by grade or location as well as options on futures.
- There were 44 energy contracts including 22 electricity contracts (mainly traded on United States exchanges but some also on exchanges in Australia and New Zealand) as well as oil, gas, gas oil, gasoline and propane contracts.
- There were 40 metal contracts.
- There were 132 currency contracts, i.e. contracts on exchange rates. These included contracts not only on exchange rates for major currencies at different maturities but also some for the currencies of countries with emerging financial markets such as Czech koruna/Hungarian forint, Deutschmark/Hungarian forint, Euro/Hungarian

[15] Classification of contracts of this kind as loans as opposed to forward contracts was the point of contention in litigation concerning insurance payments on contracts involving a Special Purpose Vehicle set up by JPMorgan Chase Bank for transactions with Enron after the collapse of the latter.
[16] See, for example, R.J.Teweles, C.V.Harlow and H.L.Stone, *The Commodity Futures Game: Who Wins ? Who Loses ? Why ?* (New York, etc. : McGraw-Hill, 1974), chapter 1.
[17] See *ibid.*
[18] See N.Battley (ed.), *The World's Futures and Options Markets* (Chichester, etc.:John Wiley and Sons, 2000).

forint, Indonesian rupiah/US dollar, New Israeli shekel/US dollar, Mexican peso/US dollar, Malaysian ringgit/US dollar, Russian ruble/US dollar, South African rand/US dollar, Swiss franc/Hungarian forint, and Thai baht/US dollar.

- There were 208 interest-rate contracts, mostly on government notes, bills and bonds and Eurocurrency and interbank deposits. Most of the instruments were denominated in the currencies of developed countries but several were also denominated in those of countries with emerging financial markets such as Brazil, Hong Kong, Hungary, Malaysia, and Mexico.
- There were 325 contracts on equities and stock indexes[19]. These included broad and narrower (often sectoral) indexes as well as contracts on individual shares, as contracts in several countries with emerging financial markets.
- There were also miscellaneous other contracts linked to bankruptcy indexes, freight rates, insurance losses from catastrophic events, and weather temperature.

This list refers to a time now several years ago. In the meantime there will have been significant expansion of both categories of obligations or events covered by futures and options, and perhaps also of locations where they are traded.

The notional value of outstanding exchange-traded contracts (USD 46,592 billion at the end of December 2004) is now dwarfed by that of OTC contracts (USD 248,288 billion excluding the value of credit derivatives).[20] OTC contracts have a longer history than exchange-traded contracts, the earliest historical contracts described above mostly having a non-standardised or customised character. Forward contracts and options which have long been available to the clients of banks also belong to this category. But the modern expansion of OTC derivatives is usually dated from the introduction of interest-rate swaps[21] at the end of the 1970s, which were to become the most extensively used OTC derivative and which now constitute 60 per cent of the total at the end of 2004 just mentioned. Such swaps exemplified ways in which the swapping of assets and obligations between two parties could help not only in the managing of exposures to risks in firms' balance sheets but also in concealing the true nature of transactions from regulators and tax authorities. They were followed by the extension of the swap concept to contracts to cover new categories of assets and obligations, by rapid expansion of the outstanding stock of such contracts, and by further innovation in the form of more complex contracts or of sets of linked contracts for the transfer of risk between different parties.

One should not be mesmerised by information on the range of contracts for the control and redistribution of financial risks now available into forgetting that they constitute only some of the techniques which can used for these purposes. Risk management in the non-financial as well as the financial sphere comprises a range of possible methods which include tackling risks at their source and various forms of collective action as well as the supply of contracts for risk management in the form of derivatives and insurance. Control of financial risks can be achieved by greater reliance on restrictions of certain activities and by procedures for the

[19] Where contracts on individual stocks are available, such contracts were counted as a single category for the purpose of this list.

[20] See BIS Monetary and Economic Department, *OTC derivatives market activityin the second half of 2004*, May 2005, table 1. Notional values do not measure the amounts at risk due to positions in such contracts. A better measure of these amounts is the gross market value of outstanding contracts, i.e. the replacement value of outstanding contracts at current market prices when this positive (which, if the contracts were settled immediately would be the value of claims on counterparties). However, gross market values are not available for exchange-traded contracts.

[21] An interest-rate swap is an agreement to exchange one stream of interest payments for another, more often than not with no principal changing hands.

redistribution of risks amongst economic actors that give greater priority to various forms of collective action and to mutual trust than the increasingly dominant financial model whose emphasis on the independent action of firms and individuals has given an enormous impetus to use of derivatives. Models giving greater emphasis to relationship-based lending and explicit or implicit commitments to mutual financial support among banks, which in various forms have played a significant role in Japan and some other Asian countries, are often cited in this context. Moreover the history of financial sectors in different countries, including those now conforming to the dominant model, reveals a remarkable variety of ways of managing financial risks which involve action at different levels of economies and societies.[22] But exploring this variety would take this paper too far afield, and the concluding observations focus on some implications of techniques of risk management which are especially important in the increasingly dominant financial model.

Regulation

Box 1 contains a listing of major financial risks and can serve as a backdrop to my brief discussion of financial regulation. Most derivatives business is in theory subject to some form of regulation. Financial firms are subject to regulation as institutions and also as part of their participation in exchanges, which are themselves regulated. Non-financial firms are also subject to direct regulation to the extent that they participate in exchanges and to some degree of surveillance owing to their transactions with regulated institutions. Moreover some non-financial firms are subject to regulation as part of that of the sectors in which they operate, such as energy in the United States. However, there are gaps in regulatory coverage of OTC derivatives business.

The relatively broad coverage of regulation is, however, no guarantee as to its adequacy. Major problems here are the complexity of derivatives transactions, which means that they can be difficult to understand and thus to regulate and supervise. Moreover owing to financial innovation the target of regulation is subject to rapid change which not only poses new problems regarding the understanding of the transactions in question but can also render uncertain the applicability to them of existing law. For similar reasons there are also impediments to adequate surveillance by lenders and investors, investment analysts and credit rating agencies, agents included amongst the "watchdogs" upon whom the efficient functioning of financial markets is supposed to depend. And these impediments are likely to apply *a fortiori* to sectoral regulators whose specialised knowledge will generally concern the sector itself rather than contracts used for hedging risks.

Box 1. Banking risks

There is no unique classification of financial risks. The following financial risks figure frequently in discussion of risk management and regulation for banks. The classification also includes brief observations on techniques used by banks to control the different risks and on their coverage by regulation.

- *Credit risk*, the most pervasive of banking risks, is due to the possibility that a counterparty will be unable to meet its obligations. A central concern of banking regulation, it was the subject of the 1988 Basel Capital Accord and is one of the three risk categories (along with market and operational risk) that are the subject of the

[22] Some implications of alternative models for the regulatory capital and risk management of banks are reviewed in A.Cornford, "Capital requirements for banks in non-standard contexts", *Finance & Bien Commun/Common Good*, 21, Spring 2005.

proposed revision of this Accord, Basel II. It is now possible to hedge certain types of credit risk with credit derivatives.

- *Liquidity risk* can be defined as having two dimensions – *cash liquidity* or *funding risk* and *market liquidity risk*. The first is due to periodic needs for liquid funds which cannot be precisely forecast in advance. The second is the risk that a bank's own transactions will have an adverse effect on the prices at which it buys or sells assets. Traditionally this risk was controlled as part banks' management of their assets and liabilities through appropriate degrees of maturity matching, etc., and was a subject for regulatory rules and supervisory surveillance. Interest-rate derivatives are now included among the instruments used for the management of assets and liabilities.
- *Settlement risk* is due to the possibility that a bank may not receive according to the agreed timetable the funds or other assets owed it by a counterparty. A major regulatory concern since some glitches in the 1970s, settlement risk has been the subject of initiatives of the Committee on Payment and Settlement Systems of the BIS, which are directed at controlling threats to a vital part of what has been described as a financial system's "plumbing", where four key dimensions of an economy's flow-of-funds process interact, namely the activities of economic agents, the markets for financial assets and liabilities, supporting infrastructure (of which payments and settlements is an integral element), and the conditions binding markets together and ensuring that they clear.
- *Market risk* is that of loss resulting from changes in the market value of a position before it can be offset or liquidated. Like credit risk, market risk is a central concern of the regulation of banks' trading books and was the subject of the 1996 amendment of the 1988 Basel Capital Accord, which is also to be part of Basel II. Numerous derivatives are available to hedge constituent risks under this heading.
- *Interest-rate risk* overlaps market risk since a major part of such risk concerns the effect of changes in interest rates on the value of a bank's assets and liabilities. But it also reflects the effects of such changes on net interest income, here overlapping cash liquidity risk. As such its management is a central concern of bank supervision, and several derivatives can be used to hedge it.
- *Currency risk*, which covers various risks due to a bank's exposures to foreign currencies, overlaps market risk owing to the relation of both to movements of exchange rates. It also figures in the management of banks' assets and liabilities since mismatching here can result from differences in the currency denominations of assets and liabilities. Currency risk may also include that due to exchange controls. It is a subject covered by supervision of banks' asset and liability management and can be hedged with exchange-rate derivatives.
- *Operational risk* can refer to any of several hazards to which a bank is exposed simply as a result of being in business. For the purpose of Basel II it is defined as the risk of loss due to inadequate or failed internal processes, people and systems or from external events. As such it includes legal but excludes strategic and reputational risk. It is a major subject for banks' internal controls and policies for employee remuneration and incentives.
- *Legal risk* covers uncertainties as to the enforceability and other legal aspects of contractual performance. This too is a subject for banks' internal controls and its compliance department.
- *Reputational risk* is associated with poor performance, management failings, weak internal controls, and scandals involving banks, and can also result from government interference. Its results for a bank include reductions in the availability of interbank financing, loss of investor support as reflected in its share price and its access to

securities markets, reductions in its credit rating, and loss of regulatory confidence leading to restrictions or sanctions.

Links between different financial risks may be important and often ultimately feed into credit risk. For example, price volatility and thus market risk, by causing losses or otherwise threatening parties' capacity to meet their obligations, can increase credit risk. Similarly, short-term exposures associated with settlement risk are connected to this same capacity and thus to credit risk, as are disruptions in the fulfilment of obligations due to problems under the heading of operational and legal risk. These connections are not just one-way, since defaults and temporary failures to meet obligations can cause sharp movements in the prices of financial assets and thus act as a source of market risk. If disturbances due to these risks alone or in combination are large enough, they can be a source of *systemic risk*, that of a severe impairment of the financial system or in the extreme of its complete breakdown, of which an example is furnished by the banking crisis of 1933 in the United States described above.

Fiduciary issues and conflicts of interest

Fiduciary responsibility is defined as the application of judgment and care which men of experience, prudence, discretion and intelligence exercise in the management of their own affairs for investment and not for speculation, giving due consideration to the safety of their capital as well as the income from it. The relevance of this rule to derivatives dealers in relations with their clients concerns primarily their responsibilities in their role as advisers disposing of superior knowledge (an example of asymmetric information). Their duties regarding disclosure and explanation in this context clearly depend on the sophistication of the client, and have been the subject of a number of sometimes high-profile law cases in recent years such as those involving Bankers Trust and Gibson Greetings and Procter and Gamble. Although the extent of and limits to fiduciary responsibilities are not necessarily easy to define in such cases, the derivatives transactions in this cases took place in an environment where the culture of banking and financial markets has been changing. Banking where there is an emphasis wide-ranging, long-term relationships with clients is being increasingly replaced banking which focuses on the costs and profits of particular transactions. There can be little doubt that in such a climate customer service and ethical considerations are in danger of being de-emphasised.

Derivatives have also had important effects on the way in which legal advice is provided and implemented in financial firms.[23] Participation as a lawyer in the derivatives markets requires familiarity with a wide range of different specialties spanning banking and securities law: documentation, advice on credit and enforcement issues, regulation of products and firms, the powers and capacity of different entities to engage in derivatives transactions, taxation, participation in other major categories of financing, and the creation of structured financial products. The number of lawyers in external law firms with the required expertise in these different areas has not expanded to meet the demand generated by derivatives markets. Thus financial firms' reliance on in-house expertise has tended to increase not only because of shortages of required capacity outside but also in response to the documentation requirements for very large numbers of transactions, pressures from the trading floor for speed (even at the expense of increased legal risk), the importance of institution-specific policies regarding the

[23] These points are taken from an account of changes in the role of financial lawyers caused by the growth of derivatives by a derivatives lawyer, Schuyler Henderson, who witnessed them at first hand, in his encyclopedic treatise on OTC derivatives, *Henderson on Derivatives* (London: LexisNexis UK, 2003), pp. 325-332.

coordination and control of complex operations, and – not least – the huge cost of depending on external lawyers in so rapidly expanding a field. Increased reliance on the firm's own employees for these purposes is capable of undermining the objectiveness of the legal advice used by a firm and is thus a potential source of conflicts of interest, though this point should be qualified by acknowledgement that increased competition among external law firms for profitable business is capable of exerting similar pressures.