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**Next issue:**

October 2009, Special theme: Green ICT

# Quantitative Finance and the Credit Crisis

*“Guns don’t kill people, people kill people.”*  
 (US National Rifle Association).

The thoughts and research of a long line of social philosophers and economists attest to the fact that the current financial crisis is just the latest in centuries of frequently occurring events. Indeed, beginning with Adam Smith in the eighteenth century, Marx, Mill, Marshall, Wicksell, Fisher, Keynes, Schumpeter, Minsky and Kindleberger have all studied the causes and consequences of financial crises which have usually been appropriately ‘global’ in their time. While perhaps not yet generally agreed, the current truly global crisis, now hopefully in its final ‘resolution’ stage, fits virtually perfectly the stages of crisis discussed in Kindleberger’s famous book in an historical context. Usually promoted by different communities and interests in isolation: ‘globalization’ in the form of financial imbalances between developing exporting and developed importing nations, improper regulation of macroeconomic policy and markets by governments and central banks, and greedy ‘Anglo Saxon’ bankers developing ever more complex derivative products in search of personal and corporate profits, have all been blamed for the current situation. The truth is that these three potential causes have all contributed to the current situation and all must be addressed appropriately in its resolution. As a mathematician who has worked with the global financial services industry over the past two decades, I wish to address the third issue here.

First, I would ask the reader to reflect on the fact that banking is the latest of the major industries to go ‘high tech’ in the sense of extensive day to day employment of mathematics and informatics. This follows military logistics in the second world war (operations research), the oil industry, aerospace, manufacturing, airlines, logistics, even film making (Lucas Labs). Although beginning with the breakdown of the Bretton Woods fixed currency exchange rate system and the precise valuation of equity options in the early 1970’s, “modern” banking is at most a matter of the past twenty years.

In no case that I know of, including the nuclear industry, has government regulation – independent of whether or not it is justified – succeeded in reversing technological progress. Nevertheless people in high places are currently considering regulation based on the widely quoted opinions expressed by the world’s most successful investor, Warren Buffet, Chairman of Berkshire Hathaway, ‘Derivatives are weapons of mass destruction’ and Lord Turner, Chairman of the UK Financial Services Authority, who blames ‘excessive reliance on sophisticated mathematical models’ for the crisis. The true explanation of the role of derivative products in its development is more complicated.



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It should also be noted that these simple but popular opinions fly in the face of Mr Buffet's recent investment in Goldman Sachs and the widely acknowledged role of the Basel international capital requirements in the explosion of off balance sheet entities set up by the banks to securitize and structure credit derivatives, most of which ended in disaster. The law of unintended consequences in regulation remains a significant force to be reckoned with!

Good scientists know the truth of Box's maxim that "all models are wrong, but some models are useful". Financial models are no exception. The seminal contributions of Samuelson and his associates, Black, Scholes and Merton, in pricing equity options – albeit under somewhat unrealistic assumptions – is based on the concept of dynamic market equilibrium involving no arbitrage opportunities using a continuously rebalanced portfolio of cash and the underlying stock to replicate the option's value. This approach is the perfect example of Keynes' maxim that "it is better to be approximately right than precisely wrong" and is the principle upon which the pricing and hedging of current complex derivative products are based in the equity, foreign currency exchange and fixed income (government bond) markets. Moreover, the models involved have by and large continued to function properly throughout the crisis.

Alas this is not the case in the credit (mortgage, loan and corporate bond) derivative markets, which have grown over the past decade since their inception by the JP Morgan bank from a few tens of billions of US dollars to \$160,000 billion today, nearly three times global GDP. Throughout, both academic and practitioners have been criticizing, as mere "curve fitting" to market data, the basic Gaussian copula model and its variants used to value over-the-counter (OTC) tranches of synthetic collateralized debt obligations (CDOs) written on

indices of either European or US corporate bonds. As a result, hedging these widely traded derivatives in the absence of theoretical approximate hedges is notoriously difficult and shows that for these products more rather than less complication is needed. The hedging problem for CDOs has led to the unfortunate linking of the banking and insurance industries, involving firms such as AIG and the so-called "monoline" insurers, who wrote tens of billions of dollars of insurance in the form of credit default swaps (CDSs) on corporate bonds which in the end has had to be honoured by the US government.

The recent history of Citigroup, two years ago the world's largest bank and now effectively owned by the US taxpayer, under its previous CEO, Charles "while the music's still playing you've got to get up and dance" Prince, exemplifies the failure of top banking management to understand the true complexities of the structure of – and the risks being run by – their organizations. To quote the late Peter Bernstein, long time Wall Streeter, before the demise of the Bear Stearns investment bank in March 2007, "We have passed through a period where the appetite for returns was so voracious that considerations of riskiness were significantly downgraded" – the undeniable signature of a bubble. But there were even worse anomalies in the derivatives markets as a consequence of the top heavy incentive structures in banks ignored in the bubble period.

My own recent experience concerns valuing structured fixed income and FX products for litigation involving their trusted banks by continental European individuals, corporations and local authorities. It has been said that "30% of derivatives are 'bought', and 70% are 'sold'". The implication is that 30% of instruments are traded between 'consenting adults' who are technically equipped to evaluate the risks involved, but the other 70% are sold to investors "who have no idea what they are buying". The role in the larger proportion of OTC derivative trades of sales and structuring staff who set the parameters of new complex products – many now on the street – must be distinguished from the role of 'quants' who create their valuation and hedging tools in the first place. This egregious aspect of 'financial engineering' of derivatives needs to be examined going forward.

It is not as they say 'rocket science' to require by regulation the visual presentation of the risks involved to the client, which would have precluded purchase in the first place of many 'toxic' assets so revealed as grossly unfair. This of course might call into question the profitability of investment banking in the future – even if the Glass-Steagall act of 1933 separating commercial and investment banking were to be reinstated. With President Obama's current advisors – who were instrumental in the demise of the act in Bill Clinton's second term – this is currently an unlikely event. Nevertheless the proposed risk transparency might eventually lead to the support of true financial engineering, over product structuring at the client's expense, and encourage the widespread valid use of derivatives in reducing global risk.

Whatever happens one thing is certain, 'high tech' banking is here to stay!

*Michael Dempster*