

Agenda

Advancing economics in business

Malaise in the markets: the impact of equity volatility

The current financial turmoil has led to a significant rise in volatility in the equity markets. Current levels have not been observed since the telecom bubble burst. Does this suggest that the turmoil has led to a fundamental change in the underlying risk of companies and sectors? The answer to this question might have implications for corporate financial management, asset valuation, credit analysis and regulation

Current financial market conditions have led to an increase in volatility in the equity markets, and a reduction in value, as reflected in the evolution of the FTSE 100 index (see Figure 1). The implied volatility of the FTSE 100 in February 2008 has been almost twice as high as was experienced a year ago, and the current level has not been observed in the market since the telecom bubble burst.

The impact of the financial turmoil on the debt markets has also been significant. There is evidence that spreads on corporate bonds have widened considerably, volumes of issuances of debt securities have been reduced, and the liquidity of certain segments of the secondary market has evaporated to the extent that few transactions are taking place.

These developments have significant implications for investors, companies and sector regulators. From the perspective of investors, a key question is how the

underlying economic value of investments has been affected. From the corporate financial management perspective, an important question is how the financial turmoil affects options for financing, and how different financial policies (eg, target levels of leverage) might need to be adapted in light of adverse market conditions. In terms of implications for regulated infrastructure companies, the turmoil might affect cost of capital and financeability of future investments.

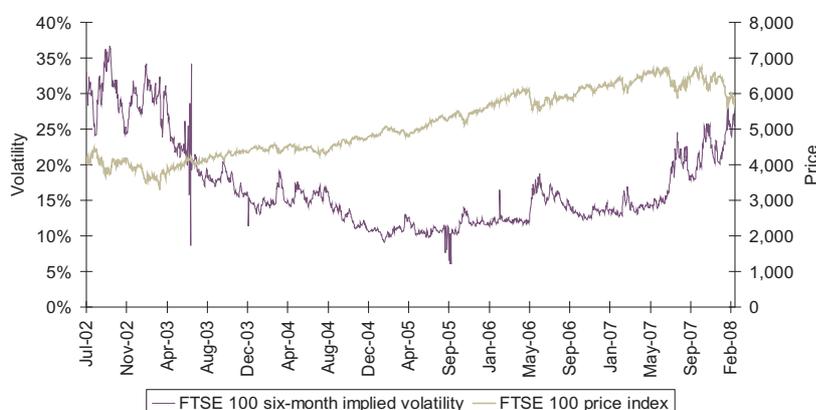
How can market turmoil affect valuations?

In principle, financial turmoil could fundamentally affect investors' expectations of future cash flows and therefore the value of assets. There are two potential ways in which the valuations could be affected—the mean expected cash flows and the discount rate.

Investors' estimates of the mean expected cash flows might change if cash flows decrease across a range of business scenarios due to, for example, a projected downturn in the economy. The discount rate, which should be used to value the mean expected cash flows, might be affected if the variance of projected future cash flows increases, reflecting a wider range of potential outcomes and, therefore, a higher risk.

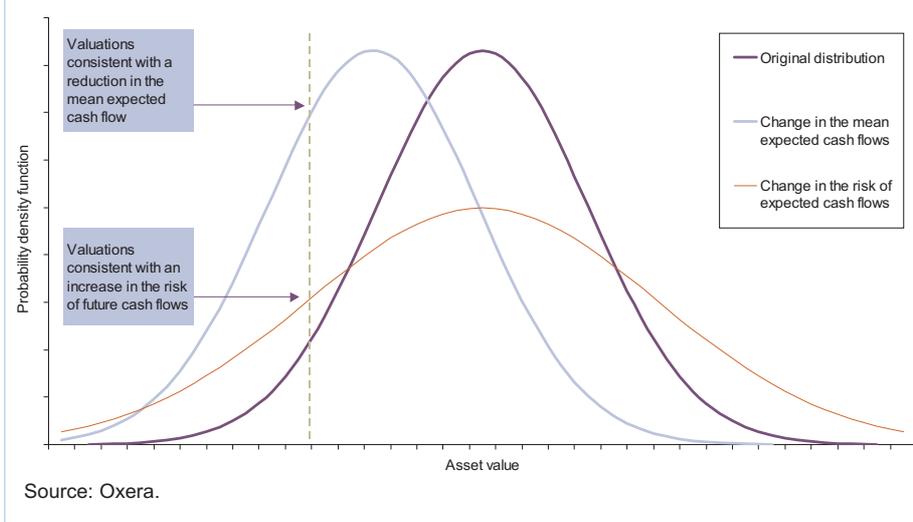
This could be presented in terms of the distribution of future cash flows. A change in the mean expected cash flow *without* a change in risk effectively represents a parallel shift in the distribution. A change in risk represents an increase in the variance of the distribution, as illustrated in Figure 2.

Figure 1 Implied volatilities on options of FTSE 100



Source: Datastream and Oxera calculations.

Figure 2 Potential impact of financial turmoil on valuation of cash flows



the FTSE 100 index, are often used to estimate investors' assumptions about the future level of risk in the equity market.

To summarise, the turmoil might affect valuations of assets by changing the mean expected cash flows and the risk. The implications of changes in the level of risk might be different than those of changes in the expected cash flows. For example, the maximum level of gearing consistent with the target level of financial risk might decrease if the risk or uncertainty about

The impacts of these two effects could differ. A lower mean expected cash flow would lead to a reduction in the value of an asset. From a corporate financial management perspective, revised cash-flow projections might require a reduction in the level of debt while maintaining a constant level of gearing. However, an increase in the uncertainty of this cash flow might require an even greater reduction in the level of debt, in order to reduce gearing and hence maintain the target level of financial risk. From an investor's perspective, changes in risk might affect investment strategies based on a target risk level.

Given that the implications of changes in cash flows might differ from those of changes in risks, it is likely to be important for companies, investors, regulators and analysts to be able to separate these two effects. In practice, it is difficult to assess changes in expected cash flows using empirical data, and it might be easier to find measures of investors' assessment of risk. This could be done using prices in derivatives markets.

Derivatives prices are based on the probability of a certain outcome occurring in the future. One of the parameters affecting the probability of the outcome, and therefore the price of a derivative, is the volatility of the underlying asset. It is possible to imply the market's estimate of the volatility of the underlying asset from prices of a derivative on this asset observed in the market using a valuation model, such as an option-pricing model. The implied volatility represents an estimate of the uncertainty about the value of the underlying asset.

For example, volatilities implied from such derivative instruments as European call and put options, written on

the value of assets increases, but not with a level change in mean cash flow.

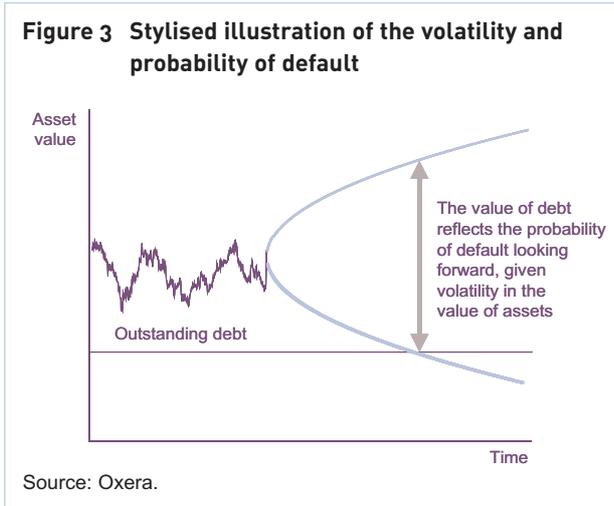
Volatility of equity and the value of debt

Corporate debt securities are one of the asset classes that might be affected. The implications of higher volatility in equity markets for the value of debt and corporate financial management decisions depend on whether the turmoil leads to a reduction in mean expected cash flows on the one hand, or an increase in the risk of cash flows on the other (or both).

In both cases the value of debt would decrease. In terms of the impact on corporate financial management, an increase in the risk of cash flows (ie, an increase in the uncertainty around the mean) might decrease companies' gearing at market values.¹ An increase in the risk might also reduce the maximum level of gearing, consistent with the same level of financial risk.

It is useful to consider the latter effect, given that the volatility of equity markets has increased considerably over recent months.

Conceptually, the value of corporate debt depends on the required return on riskless debt and the probability that the firm will be unable to meet its obligations—ie, the probability of default.² The critical driver of the probability of default is the volatility of the firm's assets. The greater the volatility of assets, the greater the probability that the asset value will fall below the value of debt. When this happens, a situation of default arises.³ Thus, all else being equal, an increase in the volatility of assets leads to a decrease in the value of debt as the



probability of default increases. This is illustrated in Figure 3.

This relationship between the volatility of assets and the probability of default is captured by, for example, credit rating agencies in their indicative thresholds for financial ratios. According to Standard & Poor’s business and financial risk matrix, the higher the business risk (volatility of assets), the more stringent the indicative thresholds for the financial ratios required for a given credit rating.

For example, as shown in Table 1, a company with 45–55% gearing and an ‘Excellent’ business risk profile would be expected to have a BBB credit rating. At the same time, if business risk increases and the profile changes to ‘Satisfactory’, the company would need to reduce its gearing to 35–45% in order to achieve the same credit rating and avoid devaluation of debt.

Greater volatility in the value of equity, as currently observed in the markets, reflects greater volatility in the underlying value of the assets. Thus, given the relationship between the volatility of assets and the value of debt (probability of default), greater volatility of equity

might be indicative of an increase in the probability of default and could lead to a reduction in the value of debt.

There is considerable empirical evidence on the positive relationship between the volatility of equity and bonds yields, implying a negative relationship with the value of debt. For example, Campbell and Taksler (2003) find that volatility in equity markets can explain as much of the credit spread as the credit rating.⁴ Similarly, Campbell, Lettau, Malkiel and Xu (2001) find that increases in equity volatility explain increases in bonds yields.⁵ Bednarek (2006) finds that this effect is particularly strong for low-rated bonds.⁶

Estimating the effect of volatility on the probability of default

Deriving the estimates of the potential impact of a higher volatility of assets on the probability of default on corporate debt may provide an indication of the potential impact of increased volatility of equity markets, as reflected by the higher implied volatility of the FTSE 100 on the value of debt.

The relationship between the volatility of assets and probability of default can be examined using a stylised model. Such a model estimates the probability of the asset value falling below the value of debt (probability of default), assuming a particular distribution of assets. The relationship between the volatility of assets and the probability of default can be estimated by changing the variance of distribution of assets and re-running the model.

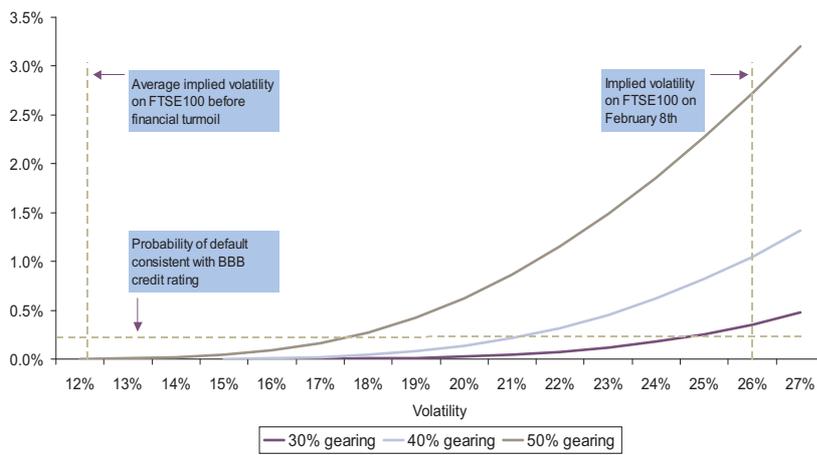
One of the critical drivers of the probability of default is the shape of the distribution of returns. The model assumes normal distribution. Empirical evidence suggests that, in general, the actual distributions have fatter tails. This means that the probability of default, based on normal distribution, might be underestimated. Furthermore, probability of default would be also affected

Table 1 Standard & Poor’s business and financial risk matrix

	Financial risk profile (gearing ratio, %)				
	Minimal	Modest	Intermediate	Aggressive	Highly leveraged
Gearing ratio	Below 25	25–35	35–45	45–55	Over 55
Business risk profile					
Excellent	AAA	AA	A	BBB	BB
Strong	AA	A	A–	BBB–	BB–
Satisfactory	A	BBB+	BBB	BB+	B+
Weak	BBB	BBB–	BB+	BB–	B
Vulnerable	BB	B+	B+	B	B–

Source: Standard & Poor’s (2005), ‘Corporate Ratings Criteria—Rating Methodology: Industrials & Utilities; Cyclical; Loan Covenants; Country Risk’, June.

Figure 4 Probability of default (one year) as a function of volatility



Source: Standard & Poor's (2008), '2007 Annual Global Corporate Default Study and Rating Transitions', February; Bloomberg; and Oxera analysis.

by the structure of debt, covenants and a number of other factors.

Figure 4 shows the estimated relationship between the probability of default and the volatility of assets for three companies with three different levels of gearing. The results provide a number of observations:

- recent increases in volatility might have significantly increased the probability of default;
- higher volatility has a more significant relative effect on companies with lower gearing, although this is in part due to a low probability of default;
- recent increases in volatility might have a considerable impact on credit rating.

The modelling shows that, for a company with 50% gearing, an increase in the volatility of assets from 12% (average implied volatility on the FTSE 100 before the crisis) to 26% (implied volatility on the FTSE 100 in February 2008) increases the probability of default from 0.02% to 2.72%. The empirical probability of default for BBB-rated companies is approximately 0.23%, and for A-rated companies it is 0.06%. Thus the model suggests that, as a result of the increased volatility of assets from 12% to 26%, a company with 50% gearing could be at risk of being downgraded from A/AA to below investment grade, given the assumptions made. Alternatively, a company might have to reduce its gearing in order to retain an investment-grade rating.

Another observation relates to the impact of higher volatility on companies with different gearing. An increase in the volatility from 18% to 20% more than doubles the probability of default for a company with 40% gearing, while for a company with 50% gearing, the probability of default increases by only 1.3 times.

The modelling also shows that a company with business risk that is broadly consistent with that of FTSE 100 prior to the crisis (ie, having a similar implied volatility), and with a gearing of 50%, would have an estimated probability of default that might be seen as consistent with a BBB credit rating. If the business risk of this company were to increase in line with the increase in the implied volatility for the FTSE 100, the probability of default would exceed the level that might be seen as consistent with the BBB rating and require a reduction in gearing to almost 15%.

As expected, the modelling shows that the probability of default is greater for

companies with higher gearing. For example, for companies characterised by a volatility of assets of 20%, the probability of default at a gearing of 50% is almost five times greater than the volatility of default at 40% gearing.

What are the implications?

The ongoing turmoil in financial markets might have a considerable impact on asset valuations. This effect could vary depending on whether the turmoil changes the mean expected cash flows or the risk of those cash flows.

In general, it is difficult to assess the impact of the turmoil on the expected cash flows because comprehensive information about revisions to the base-line projections is not readily available from the market data, and cannot be easily proxied. In terms of risk and uncertainty, however, recent increases in the volatility of equity markets indicate that the value at risk has increased considerably for many different types of asset—ie, that the distribution of potential outcomes has become wider and possibly more uncertain.

One of the asset classes affected is corporate debt. Greater uncertainty about the underlying value of assets has a number of critical implications for corporate financial management.

- The value of debt securities would decrease due to an increase in the expected future volatility of the underlying asset values.
- The thresholds for financial tests (ratios) used by investors and credit rating agencies might need to change to reflect a higher probability of default. Similarly, trigger ratios in debt contracts might be

raised. This is because the level of gearing consistent with a target level of financial risk decreases as the volatility of assets increases.

As a result of the above, the maximum level of gearing that can be supported by the same assets would decrease considerably for any given target level of credit-risk.

The critical issue that might affect the size of this impact is the extent to which the current high levels of volatility are expected to persist in the long term. In particular, implied volatilities on options for longer maturities, which reflect market estimates of uncertainty over longer time periods, suggest that the market might be expecting the uncertainty to persist for at least another year.

¹ Higher volatility of assets might increase the value of equity because of the option features of equity. In particular, higher volatility increases the probability of positive outcomes, while negative outcomes for the equity are limited due to limited liability. See, for example, Merton, R.C. (1974), 'On the Pricing of Corporate Debt: The Risk Structure of Interest Rates', *Journal of Finance*, **29**, May.

² Other factors that affect the value of corporate debt include recovery rate, liquidity and provision and restrictions contained in the indenture (eg, maturity date, coupon rate, call terms, seniority in the event of default, sinking fund, etc).

³ This is a simplification. For example, it would be important to distinguish between short-term lack of liquidity and long-term insolvency.

⁴ Campbell, J. and Taksler, G. (2003), 'Equity Volatility and Corporate Bond Yields', *Journal of Finance*, **58**.

⁵ Campbell, J.Y., Lettau, M., Malkiel, B.G. and Xu, Y. (2001), 'Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk', *Journal of Finance*, **56**, pp. 1–43.

⁶ Bednarek, Z. (2006), 'Equity Volatility and Credit Yield Spreads', University of California, November.

If you have any questions regarding the issues raised in this article, please contact the editor, Derek Holt: tel +44 (0) 1865 253 000 or email d_holt@oxera.com

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