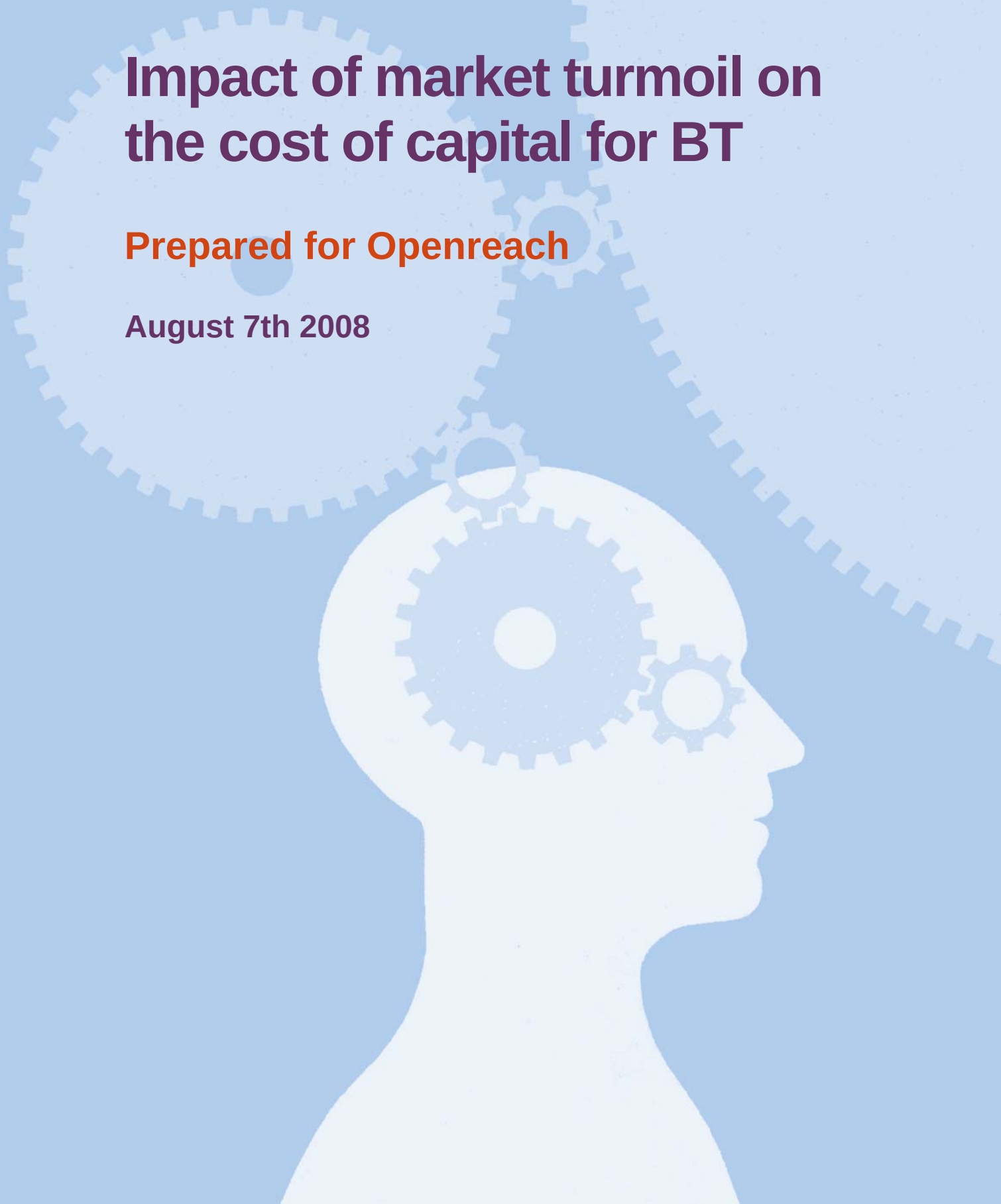
Oxera

Impact of market turmoil on the cost of capital for BT

Prepared for Openreach

August 7th 2008



Executive summary

Ofcom's proposals for BT Openreach's cost of capital make it clear that the impact of the ongoing market turmoil should be considered for the final determination of the allowed cost of capital.[1] In this context, BT has asked Oxera to review the impact of the market turmoil on Openreach's cost of capital so far, and the potential impact in the future. This analysis is presented in this report.

The analysis examines developments in capital markets and considers their direct implications for BT's cost of capital. The evidence suggests that:

– there have been clear and significant negative developments in capital markets over the past year, which have resulted in a reduction in the number of financing options available to companies such as BT Group, an increase in the cost of raising capital, and a re-pricing of risks;

– there is no clear indication at present that the market turmoil is abating or that it has reached its peak—indeed, on the basis of a number of indicators, the crisis has worsened over the past 3–6 months;

– the forward-looking indicators of conditions in debt and equity capital markets, as well as prices of relevant financial instruments, do not suggest that investors expect the crisis to end in the near future;

– BT can access capital markets and has been able to do so recently; nevertheless, the developments have significant implications for the forward-looking estimates of individual cost of capital parameters and the range of financing options available to the company.

The ongoing turmoil implies that there has been a significant increase in the uncertainty associated with the cost of capital estimates and an increase in the cost of funding for Openreach. In the context of the cost of capital determination, it is important to reflect the impact of this uncertainty in the cost of capital estimates in order to allow a rate of return that is required by investors for assuming the additional risks. It is also important to take into account the increased uncertainty about the cost of capital range and any potential point estimate within that range.

This report highlights that both the long-term cost of debt and the cost of equity have been affected by the ongoing turmoil. Substantial and specific empirical evidence from several segments of capital markets indicates that the ongoing market turmoil is having a significant impact on the cost of raising capital for all market participants in general, including BT.

The nature of the market turmoil is complex, affecting many parts of the economy to varying degrees. For this reason, it has been necessary to present a broad range of both quantitative and qualitative evidence, across a number of market indicators, to inform Ofcom of the potential impact of the current market turmoil on the cost of capital parameters going forward.

This evidence includes the following.

[1] Ofcom (2008), 'A New Pricing Framework for Openreach', May.

Market for government debt

– Gilt yields have been characterised by high volatility, the primary implication of which is greater uncertainty surrounding the risk-free rate in future.

– There is a higher inflation expectation and potentially higher inflation risk premium, which may be one reason why current nominal yields are higher than the range proposed by Ofcom.

– There is some evidence of a 'flight to quality' in the market for government securities, reflecting the mismatch between supply and demand, potentially driven by behavioural factors.

Corporate debt capital markets

– There are fewer financing options available to BT now than before. This is due to some markets being virtually shut (eg, the index-linked market) or having limited liquidity (eg, the sterling bond market) at various points in time, or becoming more costly, as in the case of currency swaps.

– The spreads and yields for corporates with credit quality similar to that of BT have increased substantially both since the start of the turmoil and since the publication of Ofcom's proposals.

– There has been a considerable increase in the spreads and yields (as traded in the secondary markets) as well as the launch spreads (as observed in the primary markets) on the debt of BT and other large European telecommunications companies.

– The fees charged on debt issuance have increased.

– Credit conditions are tighter due to the turmoil, as reported by a number of independent institutions, including the Bank of England and Standard & Poor's.

– Adverse developments in the market for monoline insurers (ie, continuous downgrades of monolines) have led to structured finance solutions, including external credit enhancement, no longer being available to companies. This limits the range of financing options available to companies; it might also prevent them from adopting the most efficient financing solutions and hence lead to an increase in the cost of debt.

– There has been a marked decline in debt issuance in the UK and Europe since the start of the turmoil. This reflects the limited liquidity in the market for corporate debt, which is likely to lead to price distortions. In particular, yields in observed transactions exclude companies that cancelled or postponed planned debt issuance due to current costs and/or limited demand.

Equity capital markets

– The equity market has recently experienced high volatility by historical standards, which has led to expectations of high volatility going forward, as reflected in the sharp rise in the implied volatility (IV) on derivative instruments. This is expected to translate into higher required returns on equity.[2]

– There is evidence of a higher equity risk premium (ERP), as, for example, reported by the Bank of England. Also, empirical research in corporate finance suggests that increases in IV imply higher ERP, as expected.

[2] The currently observed IV levels are as high as those observed at the time of the dot.com bubble.

Likely duration of the turmoil

– Indications from previous financial crises (such as the end of the dot.com bubble) suggest that this current credit crisis is unlikely to be short-term. A number of metrics based on current prices in capital markets indicate that the turmoil might persist for some time.

– Continuous downgrades of monoline insurers, persistently high spreads for high-quality corporate bonds (AAA rated) and persistently high spreads and yields for UK corporates with credit quality comparable to BT (BBB and A rated)—indicating a long-term re-pricing of credit risks and higher required liquidity premiums—seem to suggest that the crisis might persist for some time.

Overall, the above evidence indicates that the ongoing market turmoil has a significant impact on the access to, and cost of, raising capital for BT. Ofcom might therefore consider the following.

Risk-free rate

The upper end of Ofcom's proposed range for the risk-free rate (4.6%) seems low compared with both current yields and historical averages. Moreover, the range around the central estimate of the risk-free rate needs to take into account high forward-looking uncertainty in yields on government securities driven by the ongoing turmoil. In the absence of mechanisms for linking the allowed cost of capital with observed market rates (eg, indexation), appropriate headroom above the current spot rates needs to be incorporated in the assumptions about the risk-free rate if the company is to be compensated for the underlying uncertainty. The appropriate headroom depends on the assumed level of forward-looking uncertainty.

Cost of debt

As a result of the ongoing turmoil, BT's cost of raising debt has increased, while the set of available financing options has decreased. Ofcom's upper end of the debt premium range is lower than the implied average spreads for BBB rated UK companies at present.[3] With regard to BT's specific evidence, the upper half of Ofcom's proposed range is in line with the long-term spread for BT's bonds. In light of this, it would be appropriate for Ofcom to set a range for the debt premium with the central estimate in the upper half of the proposed range in order to compensate BT Group for the likely average cost of debt over the next regulatory period.

Cost of equity

The current level of forward-looking uncertainty (volatility) in equity markets is more than twice that at the time of Ofcom's previous cost of capital determination.[4] In this context, there is clear evidence, supported by theoretical and empirical research in corporate finance, that higher forward-looking uncertainty (measured by IV) is likely to be associated with a higher ERP. This is intuitive, as equity investors require higher expected returns in order to commit capital at a time of greater uncertainty. Moreover, an increase in the cost of debt implies an increase in the cost of equity, by definition, given the order of priority of financial claims on companies' cash flows. Therefore, where no specific quantitative evidence is available on the changes in the required returns to equity following from the financial turmoil, the link between debt and equity markets means that the cost of equity has increased.

[3] Ofcom's upper end of the range for the debt premium is 300bp. The implied spread for BBB rated corporate bonds with maturity of 1–5 years is 322.5bp as at June 30th 2008 (based on Datastream, ML£N8C£ and MLUK4Y£).

[4] According to Bloomberg, the 3-month implied volatility as at August 19th 2005 (one day after the publication of Ofcom's determinations for the previous price control) was 10.2%, while as at June 30th 2008 it was 22.0%.

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1 Introduction

BT has asked Oxera to analyse how the ongoing market turmoil might affect the cost of capital for Openreach. Oxera has reviewed evidence on the current conditions in capital markets and compared this with historical levels in order to inform the economics of the ongoing turmoil. The implications of the current conditions for BT Openreach's cost of capital going forward have also been assessed.

The objective of this analysis is to assist Ofcom in its determination of the cost of capital for Openreach. In this context, it is useful to consider the conclusions of this analysis in light of the May 2008 proposals.[5] In these, Ofcom highlighted that the ongoing financial crisis might have an impact on BT's cost of capital, and made it clear that this impact should be considered for the final determination of the allowed cost of capital:

> There is a great deal of uncertainty in global credit (and, to a lesser extent, equity) markets at the present time. The timing of this review of cost of capital presents some challenges, not least in terms of our approach to cost of debt. It is not our intention at this early stage to limit our scope of analysis during a period of flux.

Oxera's analysis supports Ofcom's conclusions on the impact of market turmoil on some of the cost of capital parameters, and identifies areas where Ofcom's conclusions may not have fully reflected the impact of the turmoil.

Overall, there have been clear and significant changes in financial markets over the past year, and there is broad consensus that these changes have had a significant negative impact on the availability and cost of raising finance. At the same time, there is little evidence to support the conclusion that the turmoil is abating or that it has reached its peak.

The ongoing turmoil has been largely triggered by developments in financial markets—in particular, the problems related to the funding of financial institutions. A direct implication of the financial crisis is that funding has become less available, and therefore more costly. An indirect implication is the impact of the turmoil on the real economy (ie, the non-financial sector), such as the economic downturn and the possibility of a recession, on the business risk of BT, and, hence, on the required rate of return to investors (ie, not only the lowering of demand for telecoms, but also the increasing uncertainty of demand). This report focuses on the former—ie, the direct impact of the turmoil in financial markets on BT Openreach's cost of capital. However, in practice, the two effects are not easily distinguishable.

Some of the evidence presented in this report provides Ofcom with a quantitative standard that could be used directly to inform the regulator as to the appropriate level of a cost of capital parameter going forward. In addition, the qualitative evidence presented below might be helpful to understand the nature of the market turmoil. In the case of the latter, Ofcom will need to interpret the significance of this evidence for individual cost of capital parameters.

The report is structured as follows.

– Section 2 examines the gilts market and considers the implications for the central estimate for the appropriate risk-free rate assumption, as well as the confidence interval.
– Section 3 analyses developments in debt capital markets, drawing out implications for BT's cost of debt given the evidence from the markets, and outlines how Ofcom might take this evidence into account.

[5] Ofcom (2008), 'A New Pricing Framework for Openreach', May.

– Section 4 examines the evolution of forward-looking uncertainty in equity markets and estimates the impact of higher uncertainty on the equity risk premium (ERP).

2 Government debt market and estimates of the risk-free rate

2.1 Impact of the market turmoil on estimates of the risk-free rate

The market turmoil has had a considerable impact on the market for government securities and the risk-free rate. This section looks at the volatility and level of gilt yields.

– **The volatility of yields has increased considerably**. The main implication of higher volatility in yields on government bonds is greater uncertainty about the current level of the risk-free rate and its likely evolution over the next few years. In the context of the cost of capital determination, this means that the range around the central risk-free rate estimate needs to take into account considerable uncertainty about its true level and that historical data may underestimate forward-looking uncertainty. In the absence of a mechanism to update the risk-free rate over the regulatory period, sufficient headroom above the central risk-free rate estimate would need to be incorporated in order to compensate BT for the risk of changes in yields, given high volatility.

– **Current spot yields and historical averages are higher than the upper end of the range proposed by Ofcom**. This may be driven by increases in real yields and expected inflation, as well as in the inflation risk premium, although the latter effect is not directly observable. Despite recent increases, current real yields are lower than long-term historical averages. This seems to be the result of large movements of capital into low-risk assets—commonly referred to as the 'flight to quality'. In the absence of this flight to quality, real yields would be likely to be higher. This is important since, to the extent that it represents a behavioural factor rather than economic fundamentals, it might not accurately reflect the underlying real risk-free rate. This suggests that the spot rates are currently above the upper end of Ofcom's proposed range; moreover, it suggests that, from a long-term economic perspective, the observed yields might be biased downwards compared with the underlying risk-free rate.

Overall, the evidence suggests that estimates of the risk-free rate need to take into account significant market volatility, inflation, and the impact of behavioural effects on prices associated with recent flows of capital.

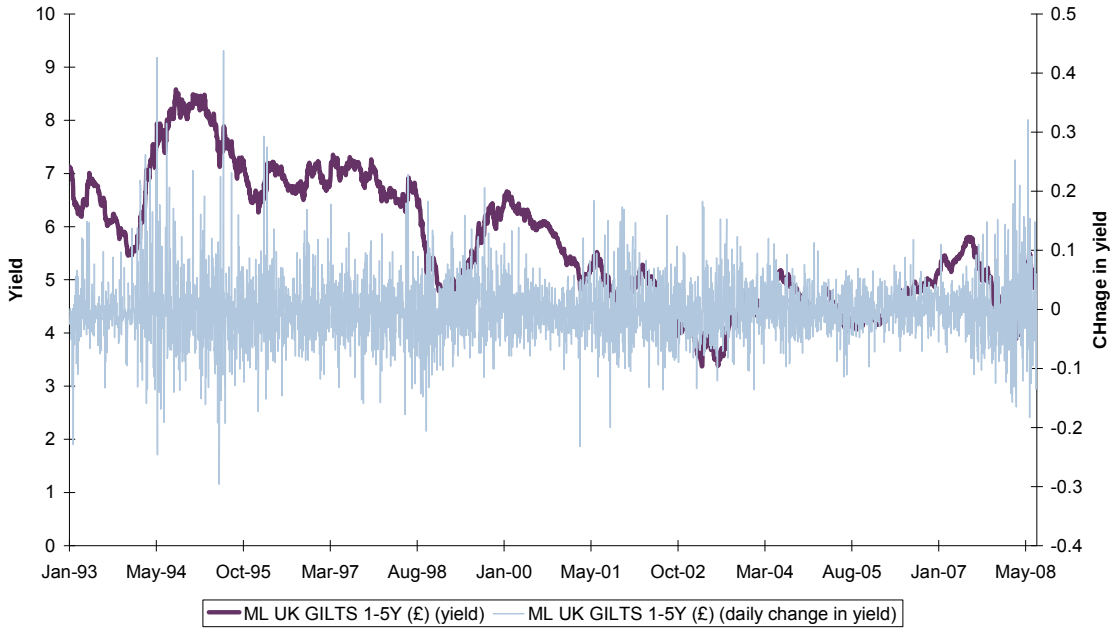
2.2 Gilt market: volatility of yields

How has the volatility of the risk-free rate been affected by the market turmoil and what does this imply for the uncertainty about the level of the risk-free rate at present and in future?

2.2.1 Volatility of gilt yields

Figure 2.1 below shows the evolution of yields and daily changes in yields for nominal gilts with maturity of 1–5 years over the period from January 1993 to July 2008.

Figure 2.1 Evolution of yields and changes in yields



Source: Datastream and Oxera analysis.

The figure indicates that the volatility of gilts yields increased after the start of the current turmoil. It is currently higher than in 2005, at the time of Ofcom's previous cost of capital determination for BT, and higher than in 2002, at the time of previous market turmoil associated with the dot.com bubble.

In addition to visual exploration of the data, four approaches have been used to demonstrate how the volatility of yields—and hence the uncertainty about the level of the risk-free rate—have evolved over time.

Approach 1 Comparison of standard deviations of yields on government bonds (gilts) measured over a number of fixed time periods before and after the start of the market turmoil.

Approach 2 Analysis of the evolution of the standard deviation of yields on gilts measured using a rolling window over time. This approach measures changes on a continuous basis and examines to what extent standard deviation has changed since the start of the turmoil.[6]

Approach 3 Comparison of standard deviations of changes in yields on gilts measured over a number of fixed time periods before and after the start of the market turmoil. (This approach is similar to the first approach insofar as it considers time periods before and after the turmoil.) The use of first differences focuses the analysis on the impact of short-term trends.

Approach 4 Evolution of the volatility implied by a time series model. This approach uses the GARCH (1,1) model to estimate the conditional volatility of gilt yields and examines its evolution over time.

[6] Given that yields are typically modelled as a random walk, the volatility of the level of yields may be less informative than the volatility of the changes in yields.

Approach 1: standard deviation of yields before and after the start of the market turmoil

Table 2.1 summarises the volatility of yields on five-year gilts over the 12 months leading up to July 1st 2007, as a counterfactual, and the volatility over the most recent 12 months associated with the market turmoil. It shows standard deviations calculated over the periods of 12 months, three months and one month prior to June 30th 2008 and prior to June 29th 2007. The results for the periods until the second date represent the counterfactual to the results for the periods up to June 30th 2008.

Table 2.1 Standard deviation of yields on five-year nominal gilts before and after the start of the turmoil (bp)

	12 months	3 months	1 month
Period ending:			
June 30th 2008	40	31	11
June 29th 2007	29	18	7
% difference between 2007 and 2008	+39.8%	+77.2%	+72.6%

Source: Datastream and Oxera analysis.

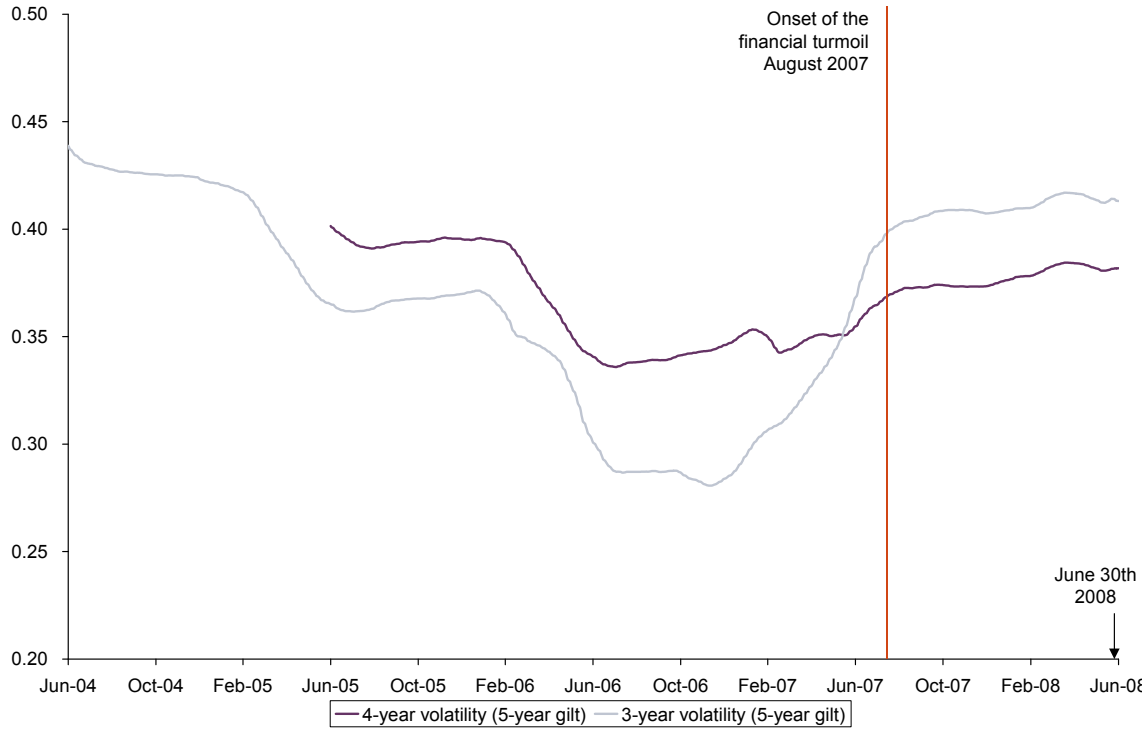
The evidence demonstrates that the five-year gilt has become 39.8% more volatile in the past year compared with the year preceding the turmoil. This result is even more pronounced for the three- and one-month windows. Similar results were observed for the 10- and 20-year gilts. Overall, there is clear evidence that the volatility of gilt yields in the year preceding the market turmoil was lower than over the last 12 months.

Approach 2: standard deviation over a rolling window

It is possible to extend the above analysis by taking a longer-term perspective. This has been done by taking the standard deviation of the five-year gilt on rolling four- and three-year windows over the past three years (see Figure 2.2 below).[7]

[7] Effectively, the dataset covers seven years, as the volatility is estimated using a four-year window for the period dating back three years from now.

Figure 2.2 Evolution of yield volatility (standard deviation) for five-year nominal gilts (%)



Source: Datastream and Oxera analysis.

High levels of volatility observed before 2006 reflect the impact of the previous turmoil associated with the end of the dot.com bubble. This is because volatility at a given date is measured as a standard deviation over the four- and three-year periods ending on this date. Hence, the volatility measured as a four-year standard deviation in, for example, February 2006 is based on the data for the period from February 2002 to February 2006.

The four-year historical volatility of yields has increased markedly since the start of the turmoil. The highest value since the beginning of the turmoil to date was reached in late April 2008, and, following a short period of decline, started to increase again. A similar pattern is observed for the three-year volatility, with the main difference being that the three-year volatility in June 2008 is higher than the four-year volatility. This is consistent with the overall upward trend in volatility in recent years.

Figure 2.2 also indicates that current volatility has increased to a level not seen since 2005 (using the four-year measure) and 2004 (using the three-year measure), at which point in time the four- and three-year windows were still capturing the variation in yields associated with the dot.com bubble.

Overall, the current levels of volatility in gilt markets are similar to those observed at the time of previous market turmoil.[8]

Approach 3: standard deviation of changes in yields before and after the start of the market turmoil

To control for short-term trends in gilt yields, which may increase the estimates, volatility was also measured on the basis of first differences (ie, changes in levels between subsequent observations). This approach measures volatility by the degree to which the daily changes in

[8] The four-year volatility in 2004 covers the period from 2000 to 2004.

gilt yields diverge from the mean value. A high value indicates large day-to-day changes in gilt yields.

Table 2.2 below repeats Table 2.1 for first differences.

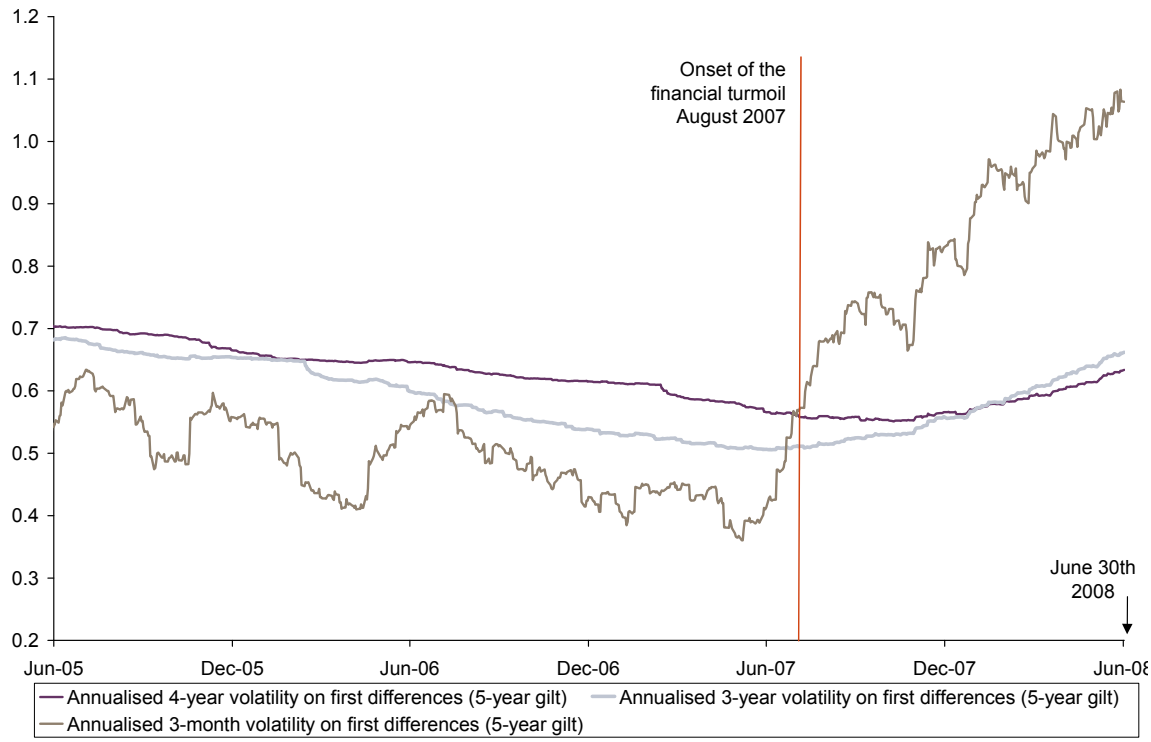
Table 2.2 Annualised volatility (standard deviation) of daily changes in five-year nominal gilt yields before and after the start of the turmoil (bp)

	12 months	3 months	1 month
Period ending:			
June 30th 2008	92	106	125
June 29th 2007	45	41	53
% difference between 2007 and 2008	+102.8%	+157.4%	+137.8%

Note: The values for the standard deviation of first differences have been annualised by multiplying by the square root of the number of trading days in one year—in this case, assumed to be 255.
Source: Datastream and Oxera analysis.

It is also possible to present a longer-term perspective of the volatility of first differences. Figure 2.3 shows three- and four-year as well as three-month rolling windows of the annualised volatility on the first differences on the five-year gilt, and supports Table 2.2, detailing the increase in volatility since the beginning of the turmoil.

Figure 2.3 Evolution of volatility of changes in yields (standard deviation) for five-year nominal gilts (%)



Source: Datastream and Oxera analysis.

The volatility of the three-month window shows a more rapid increase than the four-and three-year window. This is because the high volatility observed during the period of the market turmoil makes up a greater proportion of the data in the time series of the three-month window.

As with the evidence on the volatility of yields in the gilt market, there has been an increase in the volatility of first differences in nominal gilt yields since the start of the market turmoil. **In particular, the volatility of first differences of the five-year gilt has more than doubled in the past year compared with the year preceding the market turmoil**. **The results are more pronounced for shorter windows and similar for 10- and 20-year maturities**.

Approach 4: volatility of gilt yields implied by GARCH model

Instead of calculating volatility of yields directly, the GARCH time series model could be used to estimate the evolution of conditional volatility of gilt yields. This allows the evolution of the mean of the series to be controlled for, when estimating the volatility.[9]

The GARCH (1,1) model has been estimated for changes in yields for nominal gilts with maturity of one to five years.[10] The model is based on the following equation:

$$r_t - r_{t-1} = \alpha_1(r_{t-1} - r_{t-2}) + \varepsilon_t$$
$$\text{Var}(\varepsilon_t) = \sigma_t^2 = \mu + \beta_1\varepsilon_{t-1}^2 + \beta_2\sigma_{t-1}^2$$

Where:

– r_t is daily yields for nominal gilts with maturity of one to five years;
– σ^2_t is the variance of daily changes in nominal yields for gilts with maturity of one to five years.

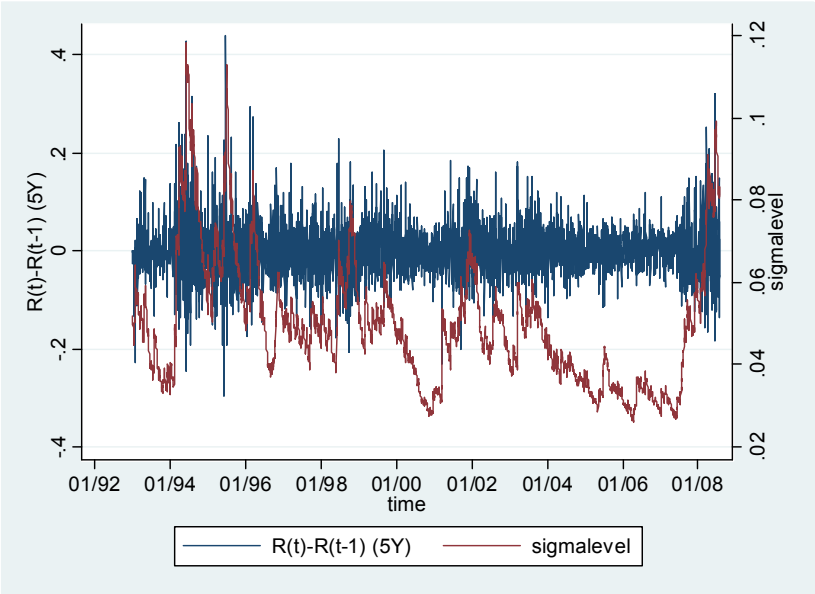
The ARMA (1,0) was used to fit the regression for the daily changes in yields. The choice of the lag (one day) was based on the exploration of the partial autocorrelation function.

As shown in Figure 2.4, the model suggests that conditional volatility of daily changes in yields on nominal gilts (standard deviation) increased considerably after the start of the market turmoil.

[9] The results presented below are based on a GARCH (1,1) model for volatility and ARMA (1,0) model for the mean of the series, which represent reasonable specifications for modelling the volatility of changes in nominal yields. Statistical specification tests for these models were not undertaken.

[10] The Dickey–Fuller test indicates that the evolution of yields on gilts follows a non-stationary process. Hence, the model was specified in differences to avoid biases from non-stationarity.

Figure 2.4 Standard deviation of daily changes in nominal gilts implied by the GARCH (1,1) model and daily changes in nominal gilts



Note: The model, specified in logs, suggests even greater difference between current and historical levels of volatility.
Source: Datastream and Oxera analysis.

As can be seen from Figure 2.4, current levels of volatility (standard deviation implied by the GARCH (1,1) model, controlling for the evolution of the mean of the series) are higher than when Ofcom set the previous cost of capital determination for BT in 2005, and higher than at the time of the previous turmoil in 2002 (the dot.com bubble).

2.2.2 Implications for forward-looking uncertainty

The historical volatility of gilt yields can be translated into forward-looking estimates of uncertainty on yields in the future. This can be done by estimating the forward-looking confidence interval around the current yield level. The following approach was adopted:

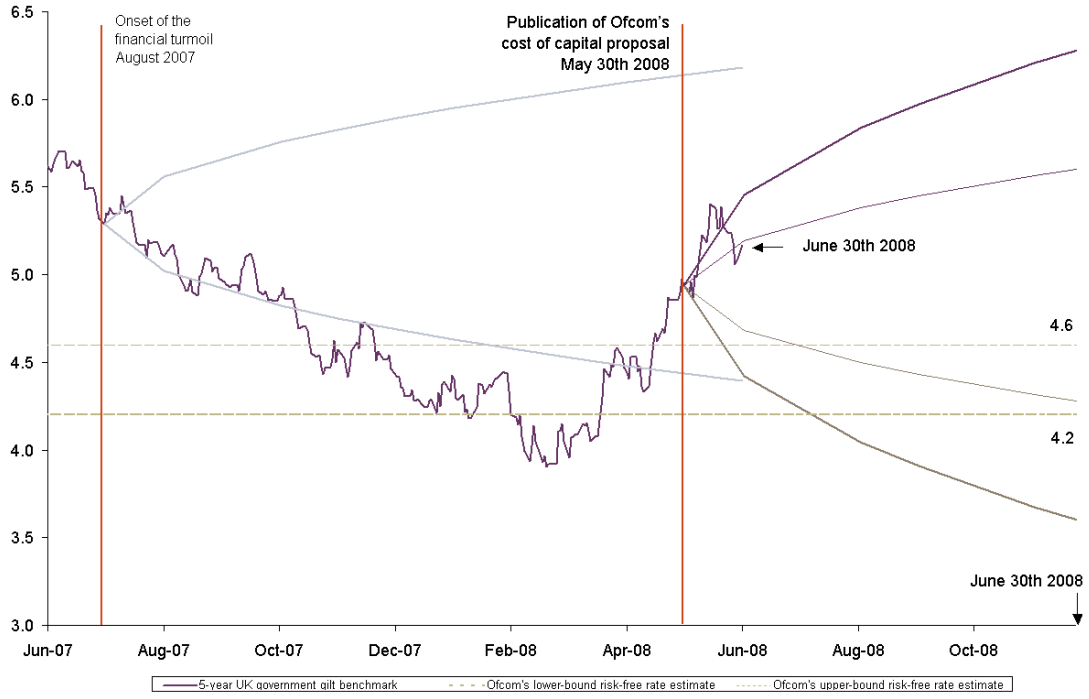
– **assumed random-walk model**—the 95% confidence intervals were constructed assuming that yields on gilts follow a random-walk process, where the best forecast of the future yield is the current yield.

The random-walk model assumes that all of the 'innovation' in gilt yields (ie, differences between the current yield and the yield in the next period) is permanent. Therefore, the confidence intervals under the random-walk model are considerably higher than under the estimated time-series model.

Figure 2.5 constructs the 95% confidence interval of the path of future gilt yields. The start date chosen was May 30th, the date of publication of Ofcom's proposed cost of capital for Openreach.

The confidence interval was constructed by assuming that the data-generating process for yields follows a random walk, with no mean reversion. This approach provides the highest confidence interval among the different potential time-series models that can be used in this context.

Figure 2.5 95% confidence interval around projections of gilt yields (%)



Source: Datastream and Oxera calculations.

Figure 2.5 shows three 95% confidence intervals: two starting from May 30th 2008 and another on July 30th 2007. Of the two confidence intervals starting on May 30th 2008, one is calculated using the standard deviation of gilt yields for the 12-month period up to May 30th 2008 ('dark lines') and the other using the standard deviation of gilt yields for an equivalent 12-month period before May 30th 2007 ('light lines'). An additional confidence interval has been included starting on July 30th 2007, around the onset of the market turmoil. This confidence interval uses the volatility of yields for the one-year period from July 2006 to July 2007. These values are summarised in Table 2.3.

Table 2.3 Volatility of changes in the risk-free rate used to construct confidence intervals (%)

	May 2007–May 2008	May 2006–May 2007	July 2006–July 2007
Annualised standard deviation of first differences	0.91	0.45	0.48

Note: The values for the standard deviation of first differences have been annualised by multiplying by the square root of the number of trading days in one year—in this case, assumed to be 255.
Source: Datastream and Oxera analysis.

Figure 2.5 above depicts the effect of the increase in volatility due to the market turmoil on the width of the confidence interval. For example, comparing the width of the confidence intervals on June 1st 2009—a point approximately one year ahead of the date of publication of Ofcom's consultation—the volatility figure associated with the period covering the market turmoil gives a confidence interval that is 102.2% wider than the equivalent confidence interval using the volatility measured over a period before the start of the turmoil.

Furthermore, the fact that within one month of the publication of Ofcom's report, observed yields crossed the boundary of the wide 95% confidence interval (based on a random-walk model) highlights considerable forward-looking uncertainty surrounding the risk-free rate. This suggests that either a 5% probability event has occurred, or that historical estimates of volatility significantly underestimate the forward-looking uncertainty.

The confidence interval starting in July 2007 also indicates the speed with which gilts declined after the onset of the market turmoil. For the first three months after the turmoil began, gilt yields remained roughly within the lower bound of the 95% confidence interval, but around October 2007 they fell further, outside the 95% boundary. This evidence once again indicates the extent to which the volatility of yields has increased since the onset of the market turmoil.

Overall, the analysis suggests that, in the absence of indexation, significant headroom would need to be incorporated into the assumptions about the risk-free rate in order to accurately reflect the considerable forward-looking uncertainty about nominal yields, and to compensate the company for the assumed risk of changes in yields over the regulatory period.

2.3 Gilt market: level of yields

This section examines evidence on the level of nominal yields. It first considers the key components of nominal yields: real yields, inflation and the inflation risk premium. Nominal yields are then compared with the range for the risk-free rate proposed by Ofcom. Repeating the two methodologies used by Ofcom to calculate the upper and lower bounds of the risk-free rate shows that, with updated data to June 30th 2008, both approaches yield values above the high end of Ofcom's proposed risk-free rate.

2.3.1 Nominal yields—decomposition

The nominal yield on a bond comprises the real yield, inflation and an inflation risk premium. The inflation risk premium forms a part of nominal yields because the holder of a nominal bond will have to receive not only the real yield plus inflation, but also an additional premium to compensate them for inflationary risks. An alternative way of interpreting the inflation risk premium is as an insurance policy against inflation. That is, it is equal to the amount that a risk-averse investor, if investing in real gilts, would give up in exchange for protection against inflation.

A number of studies have examined inflation risk premium. Based on monthly data for government index-linked and nominal bonds over the period 1983–95, Evans (1996) finds strong evidence of the presence of a time-varying inflation risk premium.[11] Other authors have attempted to quantify the inflation risk premium: Remolona, Wickens and Gong (1998) fit a factor pricing model to data on UK government index-linked and nominal debt over the period July 1982 to July 1997. They estimate that the average inflation risk premium in two-year nominal yields over the whole sample is 100bp, which fell to 70bp when sterling left the ERM.[12] A more recent study by Buraschi and Jiltsov (2004), albeit using US data, finds that over the past 40 years the ten-year inflation risk premium has averaged 70bp.[13]

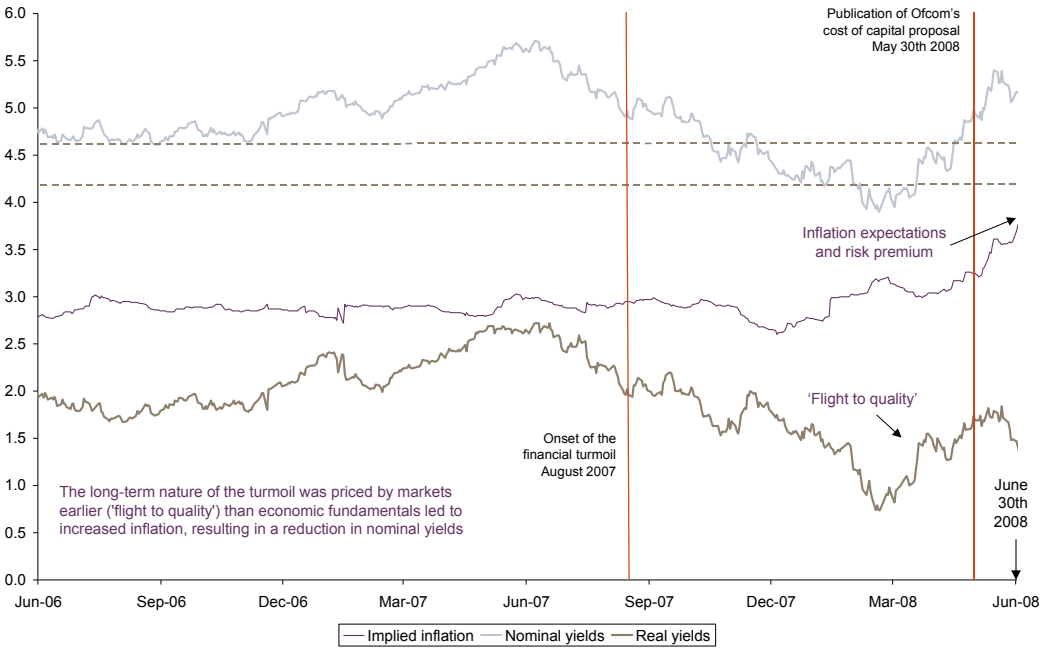
Figure 2.6 presents the evolution of nominal and real yields in the gilt market, as well as implied inflation, since June 2006. In the figure, the implied inflation is calculated as a straightforward subtraction of the real and nominal gilts yields. It therefore contains the inflation risk premium as a component of it. The figure demonstrates that since the start of the market turmoil, the nominal yields on government securities initially experienced a period of decline, but have increased substantially from March 2008. This increase has been reflected by higher implied inflation and real yields, although the rate of increase of real yields has been somewhat lower and there have been recent falls in its value.

[11] Evans, M. (1996), 'Index-linked Debt and the Real Term Structure: New Estimates and Implications from the UK Bond Market', LSE Financial Markets Group Discussion Paper no. 244.

[12] Remolona, E., Wickens, M. and Gong, F. (1998), 'What was the Market's View of UK Monetary Policy? Estimating Inflation Risk and Expected Inflation with Indexed Bonds', working paper.

[13] Buraschi, A. and Jiltsov, A. (2004), 'Inflation risk premia and the expectations hypothesis', *Journal of Financial Economics*, **75**, 429–90.

Figure 2.6 Yields on nominal and real five-year gilts and implied inflation (%)



Source: Bank of England and Oxera analysis.

Due to the components of nominal yields, it is possible to decompose the increase in nominal yields into two effects:

– changes in expected inflation and the inflation risk premium;
– changes in real yields.

Over the period from June 2006 to the start of the market turmoil, nominal yields varied from around 4.6 to 5.7%.[14] It is possible to decompose this yield into an implied inflation component of between 2.7% and 3.0% and a real yield component of around 1.7% to 2.7%.[15] Over the period since August 2007, the start of the market turmoil, two effects can be observed (as illustrated in Figure 2.7):

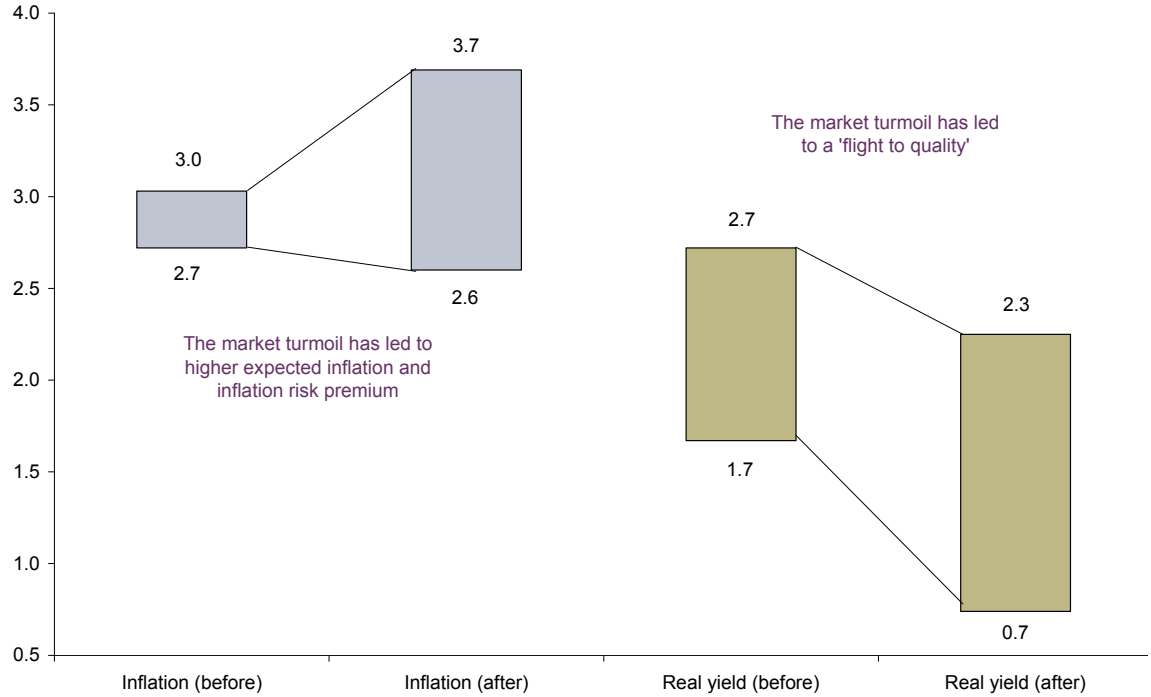
– the implied inflation component has widened to 2.6–3.7%, primarily due to the upper end of the range increasing;
– the range of values for the real yield component has fallen to 0.7–2.3%.

As a result, the range for nominal yields over the period of the market turmoil has been 3.9–5.4%.

[14] The range reflects the maximum and the minimum levels over the period.

[15] The sum of inflation and real yield is lower than the nominal yield due to the Fischer effect.

Figure 2.7 Decomposition of nominal yields: inflation and flight to quality (%)



Note: 'Before' relates to the period from July 3rd 2006 to August 31st 2007; 'After' relates to the period from September 3rd 2007 to June 30th 2008.
Source: Bank of England and Oxera analysis.

The first effect, the increase in the implied inflation component, may be due to an increase in inflationary expectations or in the inflation risk premium, or both. In the six months since the start of 2008, RPI rose from around 4% to around 4.5%, implying that investors may be incorporating higher inflationary expectations going forward.[16] The Bank of England's analysis of CPI inflation provides some indication of the near-term outlook for inflation. The Bank has reported that CPI inflation is expected to continue to increase over 2008.[17]

While not directly observable, the implied inflation component of the nominal yield may also have increased. This would result if investors in nominal securities were seeking a higher return due to greater inflationary uncertainty. The Bank of England's May Inflation report provides evidence that this may be the case. The Bank reports that CPI inflation may increase above its own forecasts if customer-facing companies pass on increases in import and fuel costs, or if high inflation persists and feeds into higher inflationary expectations. On the other hand, the Bank reports that higher prices may reduce demand, opening up spare capacity that would reduce inflation in the first half of 2009.[18]

The second effect, the reduction in real yields, may be as a result of the flight to quality. During periods of high market uncertainty, investors tend to reallocate capital from the corporate sector to less risky investments, such as gilts. Such large movements in capital increase the demand for gilt securities, raising their price. The result is a fall in the yield of real gilts, which is due, in part, to a mismatch between the supply and demand for gilts, leading to a distortion in the true real interest rate.

As a result, the price signals associated with changes in real yields might partly reflect temporary behavioural effects rather than the true price of the cost of debt in the future. Thus, it might be reasonable to assume that, in the absence of the supply and demand

[16] Source: Datastream.
[17] Bank of England (2008), 'May Inflation Report'.
[18] Ibid.

effects in the gilt market, the level of real yields would be even higher than is currently observed.

This has two important implications for estimating the cost of capital:

– the fact that the long-term nature of the turmoil was reflected in the market data earlier than the underlying economic fundamentals led to increased inflation (ie, the 'flight to quality' occurred earlier than inflation expectations and the increase in the inflation risk premium) should not affect the estimates of the allowed risk-free rate;

– the extent to which the flight to quality reflects a mismatch between the supply and demand of gilts, driven by behavioural factors, should be adjusted for when estimating the risk free-rate.

Therefore, it could be argued that, in the absence of an adjustment for the flight to quality, more emphasis should be placed on nominal yields. This would ensure that the time period when economic fundamentals (inflation) are more in line with forward-looking market prices (flight to quality) is not averaged out by the time period when there was a mismatch between these two effects.

Alternatively, if the flight to quality is driven by behavioural factors then nominal yields may need to be estimated as the sum of the real yields, based on the data before the turmoil, and current inflation.

In any event, the allowed risk-free rate should be at least in line with current yields.

2.3.2 Current nominal yields—comparison with Ofcom's proposed range

The evidence on nominal gilt yields suggests that Ofcom's proposed range of 4.2–4.6% is low. Only over the period from October 2007 to April 2008 was its proposed range in line with nominal yields. Before and after that period, the range does not fully reflect prevailing market rates.

Table 2.4 presents nominal yields as of June 30th 2008, as well as averages over a number of time periods from the start of the period to June 30th 2008.

Table 2.4 Average yields on 5-, 10- and 20-year gilts (%)

Averaging period ending June 30th 2008	5-year gilt	10-year gilt	20-year gilt
Spot rate on June 30th 2008	5.2	5.1	4.8
3-month	4.8	4.9	4.7
1-year	4.8	4.8	4.6
5-year	4.7	4.7	4.5

Note: If zero coupon bonds from the Bank of England were used, then the yields shown above (corresponding to 5-year gilts) would be on average 10bp lower.
Source: Datastream and Oxera analysis.

The current spot yield and the three-month average on gilt yields of 5-, 10- and 20-year maturities are above the upper bound of the range for the risk-free rate proposed by Ofcom. The recent increases have meant that the observed yields have breached the upper bound of the range proposed by Ofcom for the risk-free rate within two months of Ofcom's proposal.

The five-year gilt is the specific maturity used by Ofcom in its determination of the risk-free rate. Recent market evidence shows that, even in the short period since the publication of Ofcom's WACC proposal on May 30th 2008, there have been significant movements in the

gilt yield. This is shown in the first column of Table 2.4, where the spot rate as at June 30th 2008 is some 84bp above the spot rate as at May 9th 2008, the date used by Ofcom in its analysis.

The result is that, over a period of less than two months, the risk-free rate has moved from below the midpoint of Ofcom's suggested range (4.2–4.6%) to a value some 57bp above the upper end of this range.

In its consultation document, Ofcom takes the value of the three-month average (4.2) to be the lower bound of its range for the risk-free rate and the five-year average (4.6) to be the upper bound. Repeating this exercise using the updated data shows that the three-month average has increased by 48bp to 4.68, while the five-year average is some 5bp higher, at 4.65. This means that the values of both proxies used by Ofcom to calculate the range on the risk-free rate now lie above the upper bound of its original range estimate (4.6).

3 Corporate debt capital markets

The ongoing market turmoil has had a number of wide-ranging implications for the corporate debt capital markets and for the cost of raising debt financing. This is evident from the analysis of yields and spreads in primary and secondary markets, the evolution of credit default swap (CDS) spreads and the amount of corporate debt issuance, as well as changes in transaction costs in debt markets. The turmoil has also been reflected in the decoupling of LIBOR from the Bank of England's base rate. This highlights the uncertainty in the interbank lending market and an increase in the reluctance of banks to lend to each other, which has led to a higher cost of capital for banks and a higher cost of bank loans for corporations.

The market turmoil so far has lasted approximately one year, according to various indicators, such as levels of corporate debt spreads or market volatility. At present, there is no clear evidence that it is abating or has reached a definite peak. In particular, the evidence suggests that the crisis has worsened over the past three to six months. At the same time, the impact of the crisis has been disproportionately concentrated in the financial sector, and it is currently unclear how significant the impact of the crisis on the real economy might be.

The evidence presented below suggests that the turmoil could continue to have an impact on debt capital markets for some time. This is reflected in the current prices on a variety of financial instruments. It is also supported by the persistence of high spreads on high-quality corporate bonds (AAA rated); the persistence of high spreads and yields on UK corporates with investment-grade credit rating (including those with credit quality comparable to BT—ie, BBB and A rated); continued downgrades of monoline insurers and the subsequent crisis in structured finance; and high price volatility.

The evidence also suggests a long-term re-pricing of credit risks and higher required liquidity premiums. This is coupled with the increase in risk. Although the precise distinction between the increase in risk and the re-pricing of the existing risk is difficult to delineate, both are likely to be costly to BT in terms of their impact on debt premia. Furthermore, the greater volatility in equity markets has also had an effect on the cost of debt.

In this context, it is important to note that the analysis carried out for this report does not consider to what extent the underlying economic conditions in the real sector of the economy have changed, or might change in the future, as a result of the turmoil in financial markets (eg, what is the likelihood of a recession). Rather, it examines the developments in capital markets and the re-pricing of risks observed in those markets, as well as their direct implications for BT in terms of the cost of raising capital.

The primary implications of the market turmoil for BT are an increase in the cost of raising debt and a reduction in the number of financing options available to the company. **In the context of Ofcom's proposals for BT's cost of capital, the evidence suggests that the upper end of the range for the debt premium (300bp) is lower than the average spreads for BBB rated UK companies (322.5bp as at June 30th 2008 for corporate bonds with maturity of 1–5 years) and that the cost of debt range is in line with evidence on the current yields of BT's traded debt**.

3.1 Impact of turmoil in debt capital markets

It is widely acknowledged that the market turmoil has resulted in an increase in the cost of debt financing for corporations. For example, the assessment by Standard and Poor's (S&P) of the impact of the turmoil on companies in December 2007, a few months after the start of the turmoil, noted that:

> The deteriorating macroeconomic environment and continuing tensions in the financial markets will likely strain credit quality among European corporates and banks in 2008… As a result, Standard & Poor's Rating Services expects rating downgrades to outnumber upgrades, reversing the trend of the past two years that was led by improvements in credit quality within the financial sector.[19]

Recent evidence from the Bank of England in its Quarterly Bulletin and Financial Stability Reports (both issued approximately four months after the S&P report and nine months after the start of the turmoil) confirm that the cost of debt continues to remain high:

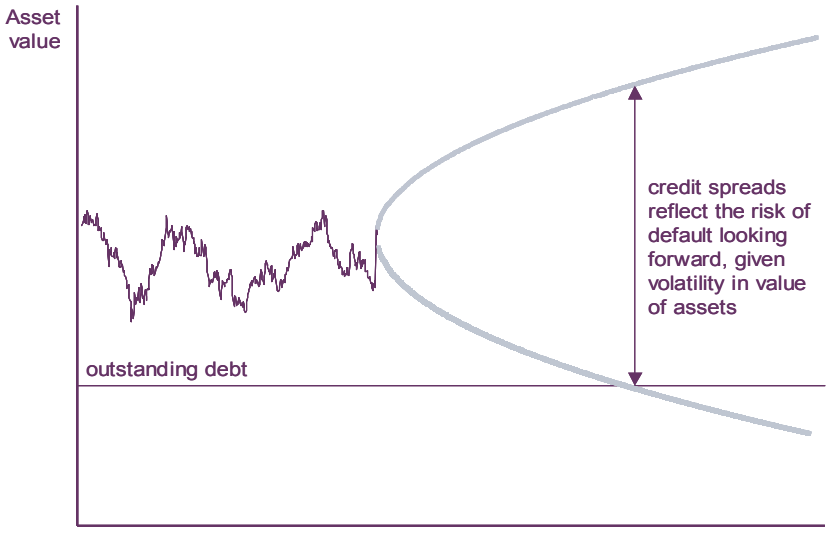
> Lenders reported a further significant widening in spreads on corporate lending. They expected spreads to increase further.[20]

> investment-grade corporate bond spreads are at their highest level since the early 1980s[21]

As discussed in section 4 below, the turmoil has also resulted in an increase in the volatility of equity markets. This implies a higher cost of debt since credit and equity markets are linked such that more volatile equity markets are a reflection of greater volatility of the value of assets, which is associated with a higher cost of credit. (Greater volatility in share prices reflects greater volatility in the underlying value of the assets, which means that the probability that the asset value will fall below the face value of debt increases with volatility.)[22]

Where the value of assets is lower than the face value of debt at maturity, a situation of default arises. An increase in the probability of default represents an increase in the risk to debt holders. This increase in risk can be expected to be largely systematic since asset volatility in this case is predominantly driven by market volatility and hence highly correlated with the market-wide volatility. Assuming that the correlation between the market and the value of assets does not diminish significantly, volatility increases the cost of debt (see Figure 3.1).

Figure 3.1 Stylised illustration of the probability of default reflecting forward-looking asset volatility



Source: Oxera.

[19] S&P (2007), 'Market Tensions and Economic Uncertainty Cloud the Outlook for European Credit Quality in 2008', *Ratings Direct*, December 19th.
[20] Bank of England (2008), 'Credit Conditions Survey', Q2, p. 2.
[21] Bank of England (2008), 'Financial Stability Report', April, p. 24.
[22] Campbell, J. and Taksler, G. (2003), 'Equity Volatility and Corporate Bond Yields', *Journal of Finance*, **58**.

There is considerable market evidence derived using several metrics suggesting that the cost of debt has increased over the past 12 months as a result of the market turmoil and subsequent developments. This is reflected in the following changes in indicators, which are discussed in greater detail below:

– the increase in yields, debt spreads and CDS spreads on market-traded securities of UK and European corporates;

– the increase in launch spreads and yields on bonds issued by BT and other European fixed-line telecoms companies before and after the start of the turmoil;

– the increase in transaction fees on bonds issued by European fixed-line telecommunications companies before and after the turmoil.

A number of other non-price market indicators point to the underlying drivers of the turmoil in debt markets. These indicators are discussed in section 3.2 below and include the following.

– The Bank's of England's credit surveys provide evidence on the reduction in the supply of credit during the period of the turmoil and on the worsening of credit conditions.

– Recent adverse developments in the market for monoline insurers indicate that the number of financing options available to companies has decreased (eg, wrapping and hence the availability of structured finance using external credit enhancements).

– The decoupling of the LIBOR from the Bank of England's base rate highlights the uncertainty in the interbank lending market, which leads to a higher cost of capital for banks and therefore higher-cost bank loans for corporations.[23]

– The reduction in the volume of bond issuance since the start of the turmoil compared with the period before the turmoil, which indicates that the number of financing options available to companies has declined and/or the cost has increased.[24]

The evidence discussed below also suggests that the higher cost of debt might persist for some time (although this is uncertain).

As indicated by BT to Oxera, this is in line with BT's assessment of the conditions of debt capital markets. In particular, BT does not expect that the cost of debt will fall in the near future.

3.2 Quantitative evidence on the conditions in debt capital markets and the evolution of the cost of debt financing

This section presents quantitative evidence from debt capital markets on the impact of the market turmoil on BT's cost of debt. The evidence discussed below includes the evolution of prices for BBB and A rated corporate debt, as well as debt issued by BT and its peers—large European telecoms incumbents. For BT and its comparators, the analysis includes evidence from primary as well as secondary markets.

[23] See, for example, Dan Peirce (2008), 'High Tor for Libor', April, State Street Global Advisers: 'Because Libor directly reflects the cost of funds available among major banks, it is a natural benchmark for many forms of lending. Corporations often borrow at floating rates set to Libor plus a specific spread. In consumer lending, many adjustable-rate mortgages are tied similarly to Libor, with the maturity of the Libor benchmark corresponding to the frequency of adjustment. The interest-rate swap market enhances this marketplace by allowing borrowers and lenders alike to swap floating Libor payments for fixed amounts' (available at http://www.ssga.com/library/esps/danpeircehightorlibor20080521/page.html).

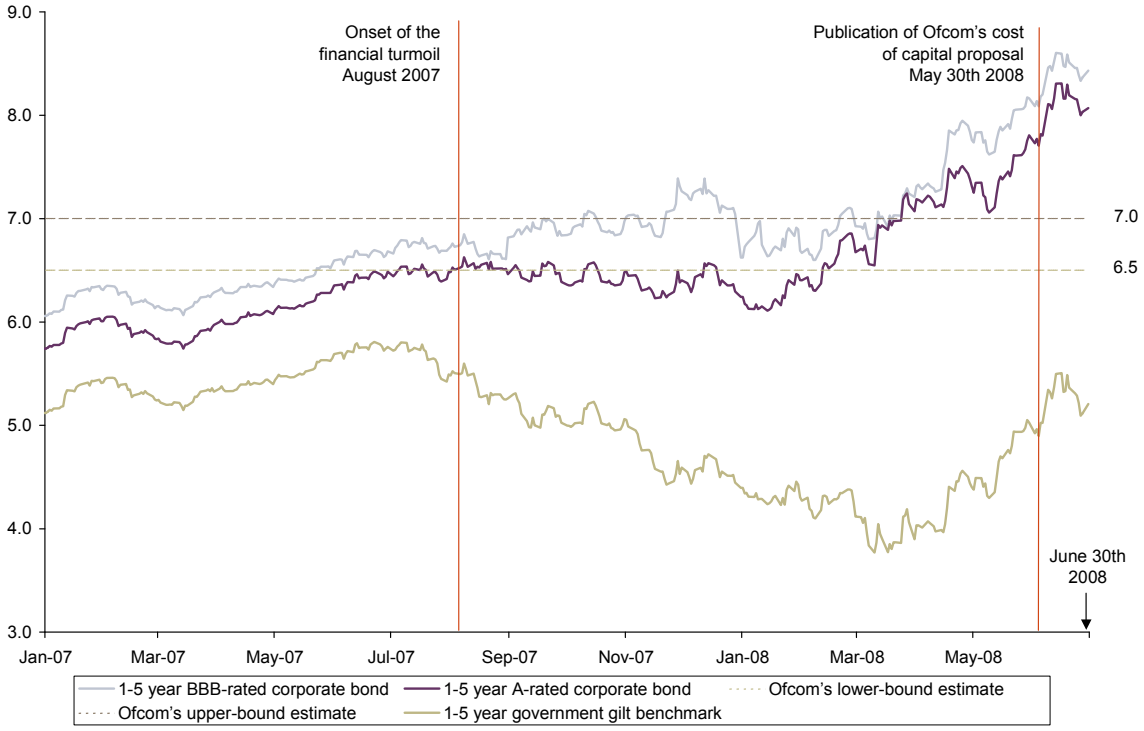
[24] See Figures 3.9 and 3.10.

3.2.1 Market evidence on corporate spreads and yields

BT's current credit rating is BBB+ and the company's objective is to maintain a solid investment grade such that its long-term credit rating does not fall below the BBB category, according to information provided to Oxera by BT. Before the onset of the ongoing financial crisis, BT's credit rating was single A; therefore, yields for A rated debt are also examined.

Figure 3.2 below presents the evolution of yields on BBB and A rated debt of 1- to 5-year maturity.

Figure 3.2 UK A and BBB rated corporate yields (%)



Source: Datastream and Oxera calculations.

Table 3.1 below indicates that the average yield on BBB rated debt with maturity of 5–7 years, over the past year, was 7.14%, while the average over the past three months was 7.96%.

Table 3.1 and Figure 3.2 also highlight the large increases in yields on both A and BBB rated bonds across a number of maturities in the month following the publication of Ofcom's report. For example, the increase in yields for BBB rated bonds with maturities of 5–7 years was 78bp, while for A rated bonds with similar maturity the increase was 179bp. A similar pattern can be observed for bonds with shorter maturities.

When analysing the evolution of BT's cost of debt, it might be more appropriate to place greater weight on bonds with maturity of 5–7 years than shorter maturities (eg, 1–5 years), given that BT has issued debt of 5- to 10-year maturity since the start of the turmoil.[25]

[25] This might also be explained by the limited access to sterling markets since the start of the turmoil and the disproportionately high costs of long-term currency swaps, which BT would have to incur when issuing a long-term bond in another currency.

Table 3.1 Merrill Lynch A and BBB rated corporate bond indices (yields, %)

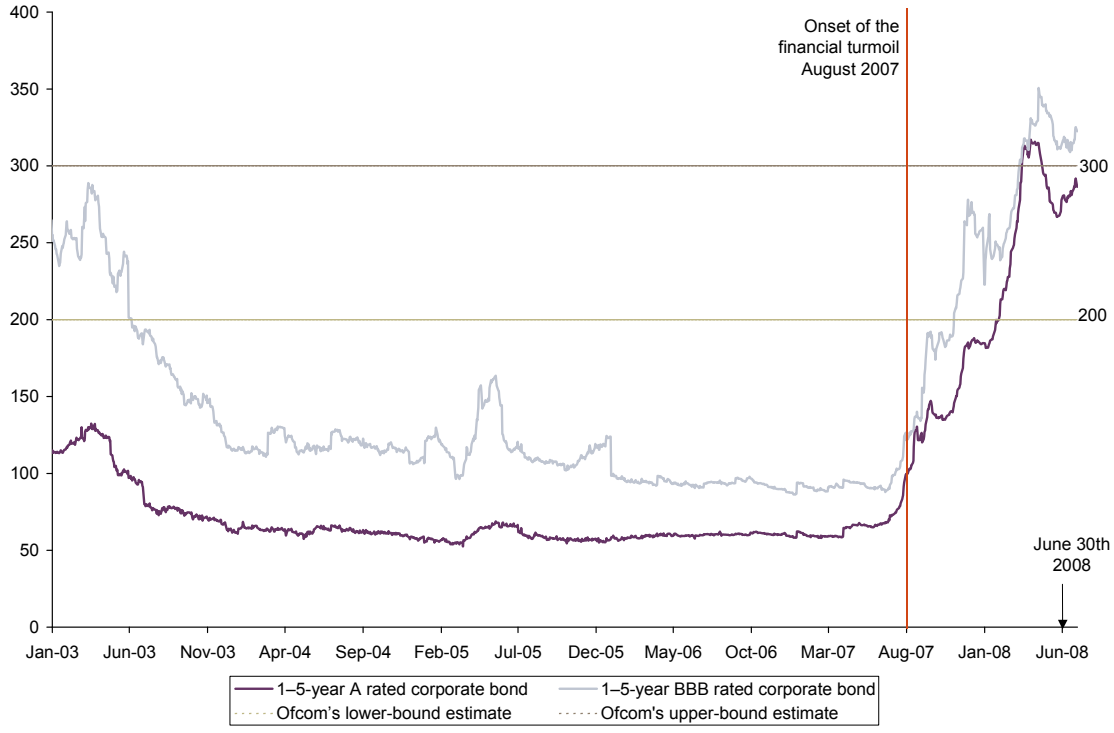
Averaging period ending June 30th 2008	UK A 1–5-year	UK A 5–7-year	UK BBB 1–5-year	UK BBB 5–7-year
Spot rate on June 30th 2008	8.07	8.49	8.43	8.42
Spot rate on May 9th 2008	7.06	7.00	7.62	7.64
3-month average	7.57	7.55	7.93	7.96
6-month average	7.07	7.22	7.41	7.53
1-year average	6.76	6.85	7.16	7.14
3-year average	5.83	5.90	6.21	6.22
5-year average	5.57	5.71	6.06	6.16

Source: Datastream and Oxera calculations.

Over the past four months, the yields on BBB and A rated bonds have been consistently above the upper end of Ofcom's proposed range for Openreach's cost of debt. Furthermore, out of 28 estimates of the average yields on A and BBB rated corporate debt over a number of maturities and different averaging periods, 18 estimates are above the upper end of Ofcom's range.

Figure 3.3 presents the evolution of spreads above the UK gilt benchmark for BBB and A rated corporate bonds with a maturity of 1–5 years for the period from January 2007 to June 30th 2008. As shown in Figure 3.2 above, while yields on gilts fell around August 2007, there was no discernible change in A or BBB rated corporate yields. Conversely, as gilts started to rise in early March 2008, yields followed. As a result, the spread between corporate yields over the gilt benchmark widened around March 2008 and then remained broadly flat for three months, with a further increase towards the end of June.

Figure 3.3 Historical spreads above the gilt benchmark on UK A and BBB rated corporate bonds (bp)



Source: Datastream and Oxera calculations.

The decoupling of the yield from the benchmark at the start of the turmoil suggests that the price of the credit risk of BBB and A rated bonds has increased. The subsequent co-movement of corporate yields and the benchmark from March 2008 onwards indicates that the re-pricing has persisted. Moreover, the evidence from Merrill Lynch indices for A and BBB rated corporate bonds with maturities of 5–10 years and 10+ years is in line with that presented in Figure 3.3, where spreads on longer-term debt have also increased significantly since the start of 2008. Furthermore, there is little difference in the observed spreads for A and BBB rated corporate debt with a maturity of 1–5 years and those with a maturity of 5–10 years. This is significant, since all of the debt issued by BT since the start of the market turmoil has maturities of between 6 and 11 years.

The evidence presented above indicates that the current level of spreads on BBB rated corporate debt is above the levels observed in 2002 during the period immediately after the end of the dot.com bubble. Of particular interest is the extent to which A rated corporate spreads have risen in recent months, mirroring BBB rated debt almost exactly. This is in marked contrast to the large spread differentials between A and BBB rated debt that existed in 2002, as shown above.

Figure 3.3 and A1.1 also indicate that spreads on BBB rated corporate bonds with 1–5-year and 5–10 maturities have been consistently above the upper bound (300bp) of the range estimated by Ofcom for BT's debt premium since March 2008.

Overall, the evidence on yields and spreads for BBB and A rated corporate bonds suggests the following.

– Yields and spreads have increased considerably since the start of the market turmoil. Current spreads are at their highest since 2002, indicating the large impact of the ongoing turmoil.

– The evolution of corporate yields and the benchmark since March 2008 suggests that the observed re-pricing of risks has persisted over time and is not abating.

– The yields and spreads observed over the past 3–4 months are consistently above Ofcom's proposed range for the cost of debt and the debt premium.

This evidence suggests that the upper end of the ranges for the cost of debt and debt premium proposed by Ofcom are low compared with the current yields and spreads for BBB and A rated corporate bonds.

3.2.2 Market evidence on corporate spreads and yields for BT and its peers

This section reviews BT-specific evidence on the impact of the market turmoil on the cost of debt. It discusses the analysis of BT's trading yields and spreads over gilts, CDS spreads, comparison of launch yields and spreads before and after the start of the turmoil, and the evolution of transaction costs for raising debt.

Evidence from primary markets

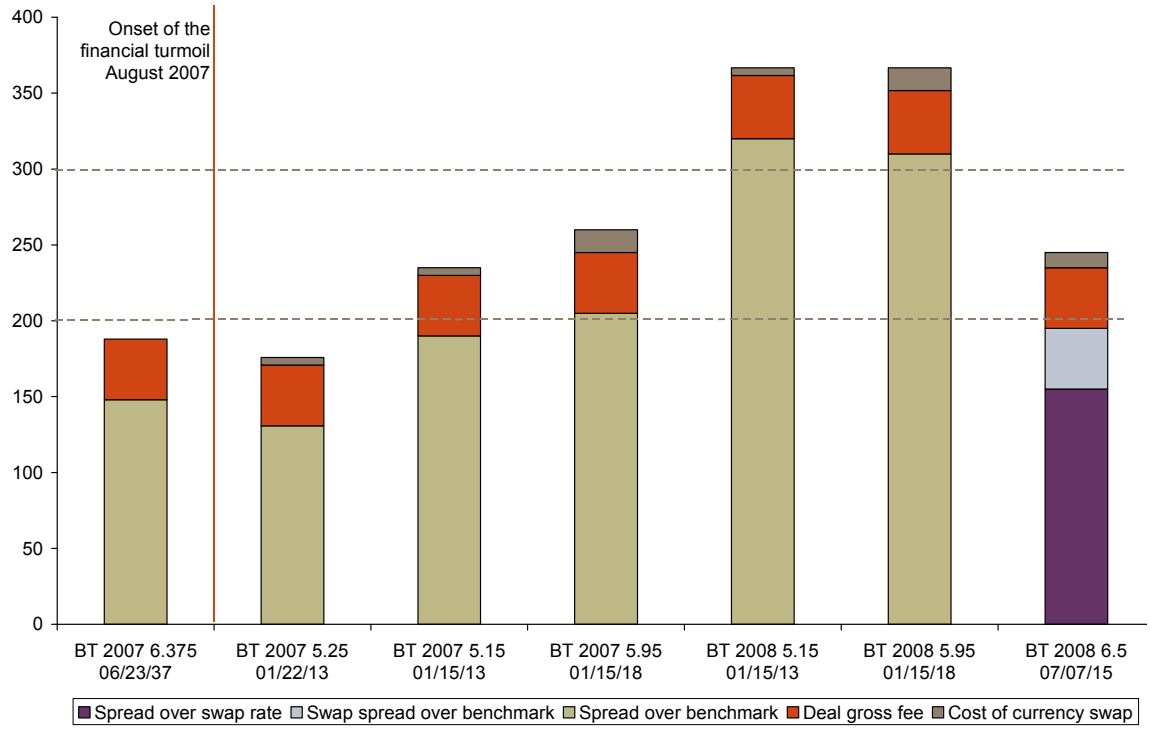
In efficient markets, one might not expect the yields and spreads for comparable debt in primary and secondary markets to differ much. However, in times of market turmoil, potential biases may be introduced in secondary markets due to the impact of trading liquidity. Hence, it is useful to consider primary markets because they show how much it actually costs to the company to issue debt, given the market conditions. Furthermore, analysis of primary markets highlights the importance of the costs of issuance.

The impact of the market turmoil could be examined by considering the difference in launch yields and spreads for bonds issued before and after the turmoil. Launch spreads and yields provide a more accurate estimate of the marginal cost of debt for a company than trading

yields and spreads, since they reflect the price and quantum of debt that a company is able to raise, given the structure of the issue. When facing a downward-sloping demand curve for its debt, a company will not always be able to raise debt at the yields and spreads observed in secondary markets.

Figure 3.4 presents the evolution of launch spreads for bonds issued by BT before and after the start of the market turmoil, including transaction costs.[26] Only one bond issued before the start of the turmoil is shown in Figure 3.4 because BT's other listed bonds were issued in 2001 and before (ie, at the time of high market volatility).[27]

Figure 3.4 BT launch spreads and transaction costs (bp)



Note: The cost of swaps reflects the price of the counterparty risk; it is assumed to be 15bp for ten-year debt nominated in EUR or USD, 10bp for seven-year debt and 5bp for five-year debt. The deal gross fee was estimated as the ratio of deal gross fee to deal total face value converted into basis points. Where data on fees was not available, an average fee of 40bp was assumed. The spread over the benchmark for the bond issued in June 2008 is estimated as the sum of the spread on the swap rate (155bp) and the spread between the swap curve and the UK benchmark of an appropriate maturity on the pricing date.
Source: Dealogic, Bloomberg and Oxera calculations.

In four out of five bonds issued by BT since the start of the turmoil, the launch spreads were significantly higher than for bonds issued before the start of the market turmoil. The maximum difference was 178bp for the bond issued in March 2008; the average difference was 102bp. However, these results should be interpreted with caution since such a comparison does not explicitly control for differences in maturity, currency or credit rating, factors that might have an impact on observed launch spreads.

To control for different bond characteristics, Table 3.2 below presents the results of a comparison of bonds issued before and after the turmoil by BT and the four largest European fixed-line telecoms companies by enterprise value. The bonds have been matched first by credit rating and then by currency of denomination. Only bonds with broadly similar

[26] The estimate of the all-in spread includes the assumed cost of the currency swap and deal gross fees.

[27] The average launch spread for bonds issued in 2001 is 194bp, while the average launch spread for bonds issued after the start of the current turmoil is 225bp, and is increasing. This suggests that, as a result of the current turmoil, BT's cost of debt exceeded its cost of debt in 2001 when corporate spreads were considerably higher than over the past five years.

maturities were considered; that is, the difference between maturities among the compared bonds does not exceed two years.

Table 3.2 Increase in launch yields and spreads above relevant government benchmark on bonds issued by a sample of European telecoms companies before and after the start of the market turmoil (bp)

	Spread	Yield	Rating	Coupon	Maturity	Currency	Increase (spread)	Increase (yield)
BT								
18/06/2008	195	654	BBB+	6.5	7	EUR		
14/06/2007	68	532	BBB+	5.25	7	EUR	**+127**	**+122**
Deutsche Telekom								
02/06/2008	161	596	BBB+	5.75	5.6	EUR		
06/04/2006	51	432	BBB+	4	4	EUR	**+110**	**+164**
France Telecom								
14/05/2008	114	534	A–	5.25	6	EUR		
05/10/2005	30	314	A–	3	5	EUR	**+84**	**+220**
Telecom Italia								
28/05/2008	293	668	BBB+	7	10	EUR		
05/10/2005	112	356	BBB	5.25	10	EUR	**+181**	**+312**
Telefónica								
28/05/2008	127	581	BBB+	5.58	5	EUR		
19/01/2006	70	385	BBB+	3.75	5	EUR	**+57**	**+196**
Simple average							**+112**	**+203**

Source: Dealogic and Oxera analysis.

The evidence presented above indicates that launch spreads and yields on bonds issued by BT and other leading European telecoms companies since the start of the market turmoil have been significantly higher than spreads observed before the turmoil. For example, in June 2007, BT issued a seven-year, euro-denominated bond with a launch spread of 68bp and yield of 532bp. For comparison, a seven-year euro-denominated bond issued in June 2008 was priced at 195bp with a yield of 654bp. Similar evidence is observed for bonds issued on the comparators.

On average, launch spreads on bonds issued by European telecoms companies increased by +112bp, while yields increased by +203bp compared with similar issues from before the turmoil. This suggests that telecoms companies that have successfully raised debt financing in recent months have paid higher yields, indicating that the cost of debt financing for BT and its peers has increased over the past 12 months as a result of the market turmoil.

Swaps and counterparty risk

The analysis of launch spreads and yields on bonds does not take into account a potentially important driver of a company's cost of debt—namely, the cost of currency swaps. Since the start of the turmoil, BT has not issued any bonds denominated in sterling. According to BT, this has reflected a significant reduction in the liquidity of the sterling-denominated debt market since the beginning of the market turmoil. Given that most of BT's revenues are in sterling, the company tends to swap bonds denominated in foreign currencies into sterling.

BT indicated to Oxera that the cost of the counterparty risk in swaps has increased considerably since the start of the turmoil. This effect might be particularly marked for longer-term contracts such that the implicit cost of BT's counterparty risk could be 15bp.

This has two important implications for the analysis of the impact of the market turmoil. First, the effective increase in launch spreads and yields may be underestimated, as it does not take into account the full cost of the counterparty risk. Second, a number of factors limit the set of financing options available to BT; these include the increase in the cost of swaps, the low liquidity of sterling market, and the condition of monoline insurers. In particular, the cost of swapping long-term debt denominated in foreign currencies may be high while raising long-term debt in the sterling market may not be possible due to low liquidity. It is worth noting in this context that all bonds issued by BT since the start of the market turmoil have had maturities of ten years or less.

Evidence from secondary markets

The impact of the market turmoil on BT's cost of debt is also evident from the evolution of trading yields and spreads, which have increased considerably since the onset of the turmoil. Trading yields and spreads also increased in the month after the publication of Ofcom's proposed cost of capital for Openreach.

This evidence should also be considered in the context of the continued increase in yields and spreads since Ofcom's determination in 2005 until the start of the market turmoil.[28]

Figure 3.5 below shows the evolution of yields for BT's bonds with maturity of 5–15 years over the period from January 2007 to the end of June 2008. The average increase in yields from the onset of the market turmoil was 98bp over the period from August 1st 2007 to June 30th 2008.

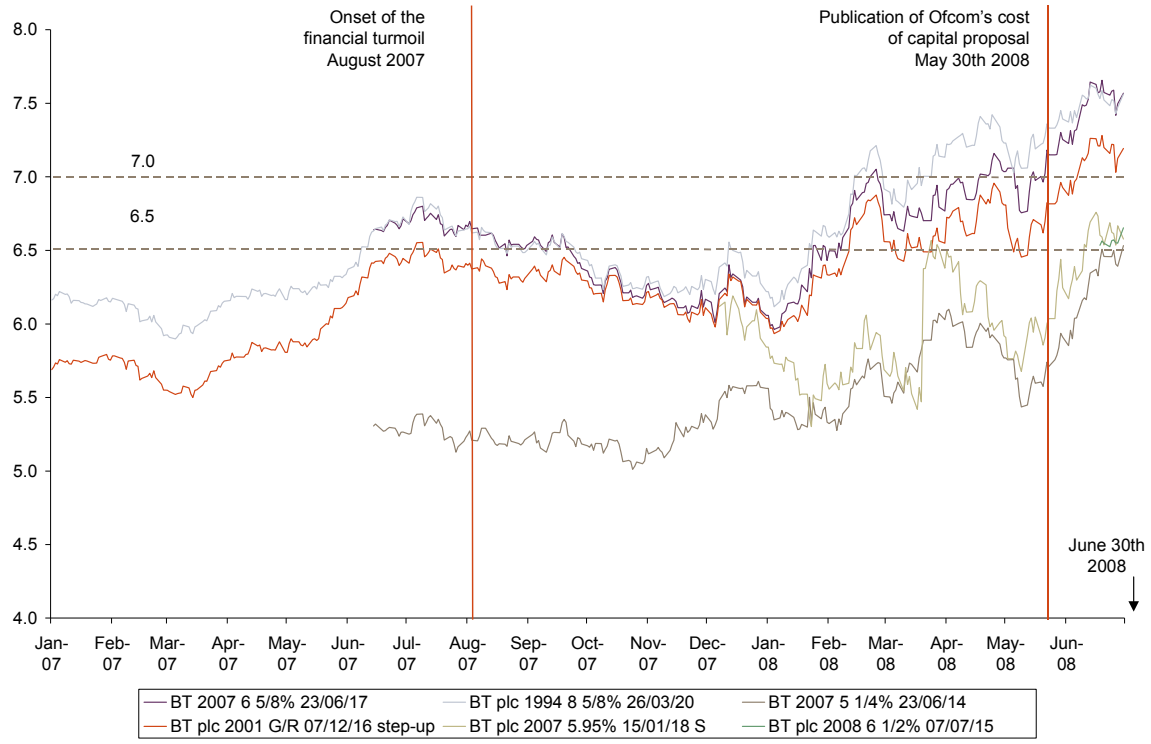
In the context of the price control review, the increase in yields of 98bp from the start of market turmoil should be considered against the background of yields being already considerably higher in August 2007 than Ofcom's determination in 2005.[29]

Declining yields on the benchmark over the period from the onset of the financial crisis to March 2008 were not fully offset by the increases in spreads. After March 2008 the increase in yields on government bonds, in combination with further increases in spreads, have led to a sharp increase in yields. As a result, the net increase of 98bp occurred primarily over the period since March 2008. This is consistent with the evidence on the evolution of yields and spreads on BBB and A rated corporate bonds in general, as discussed above.

[28] For example, the yield to maturity on BT plc 2001 G/R 07/12/16 increased by 99bp over the period from August 18th 2005 to August 1st 2007 (23 months), and further increased by 79bp to June 30th 2008 (11 months). The total increase was 178bp, which is higher than that in the allowed cost of debt of 140bp based on the upper ends of the ranges.

[29] For example, the yield to maturity on BT plc 2001 G/R 07/12/16 on August 1st 2007 was 6.4%, while the nominal pre-tax cost of debt allowed by Ofcom in 2005 was 5.6%.

Figure 3.5 Trading yields for BT bonds with maturity between five and 15 years (%)



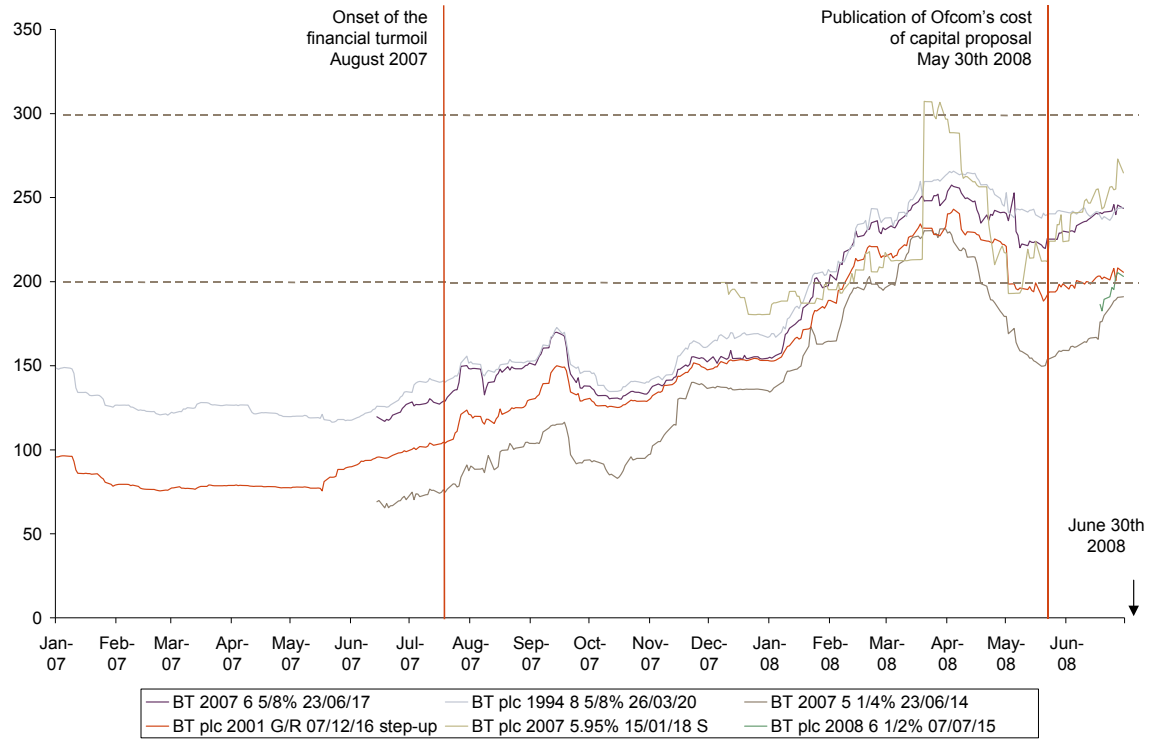
Source: Datastream and Oxera analysis.

Yields on BT's bonds also increased after Ofcom's publication of the proposed cost of capital for Openreach in May 2008. The average increase in yields from May 30th to June 30th (the final date used in this analysis) was 34bp. On June 30th 2008 spot yields for all BT's bonds with maturity between 5 and 15 years were above the lower end of the cost of debt range proposed by Ofcom, and the average yield was slightly above the upper end of the range.

The evolution of spreads for BT bonds provides similar evidence, according to which spreads increased after the onset of the turmoil, as well as after Ofcom's May 2008 publication. The average increase in spreads over the period from August 1st 2007 to June 30th 2008 was 94bp, while after the publication of the Ofcom report it was 19bp.

Trading spreads for five out of six BT bonds with maturities between 5 and 15 years were within the range proposed by Ofcom, as shown in Figure 3.6 below. For one bond, the observed spread was below the lower end of the Ofcom range.

Figure 3.6 Trading spreads for BT bonds above relevant government benchmark with maturities between 5 and 15 years (bp)



Source: Datastream and Oxera analysis.

The majority of the increase in yields has been observed since the start of 2008. The observed effect of the turmoil on debt spreads has been even more noticeable; here, spreads show significant increases and peaks of as much as two times their pre-turmoil figures, at around March 2008. Since then, spreads have declined to level off at values around 50% above their pre-turmoil values.

When interpreting the evidence on trading spreads, it should be noted that BT's actual cost of borrowing might be driven by launch spreads rather than trading spreads. In BT's case, trading spreads might provide a biased estimate of launch spreads if BT faces a downward-sloping demand for its debt securities in the primary market. For example, the launch spread for the last bond issued by BT in 2008 was 195bp, while the trading spread after the first day of trading was 187bp. Therefore, launch spreads rather than trading spreads might more accurately reflect the company's actual cost of borrowing.

The evidence on traded spreads indicates the large and sustained effect the market turmoil has had in the secondary markets for debt. The level of spreads for BT and its European comparators are around double pre-turmoil values, and recent increases in the bond yields for BT's traded debt put the average yield on June 30th 2008 above the upper bound of Ofcom's cost of debt range.

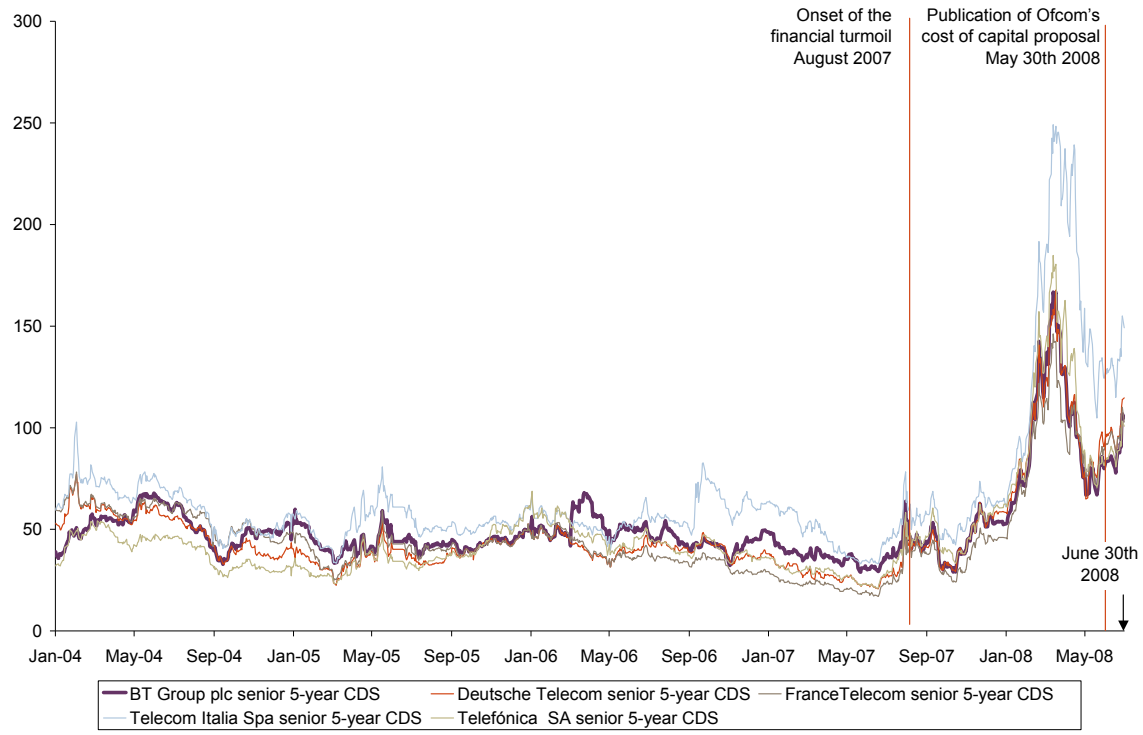
Evidence from CDS spreads

Additional evidence on the impact of market turmoil on the price of credit in debt capital markets comes from the evolution of CDS spreads. In general, the prices of CDS instruments reflect the price of insurance against default and hence the credit risk.[30]

[30] It is important to note that CDS spreads should not be compared with debt premiums or the cost of raising debt since they may not reflect all the components of debt premiums, such as the liquidity premium.

The five-year CDS spreads for BT as well as for other European telecoms companies have increased considerably since the start of the market turmoil and have increased further since Ofcom's May 2008 publication.

Figure 3.7 CDS spreads of a sample of European telecoms companies (bp)



Source: Bloomberg and Oxera calculations.

Over the past 11 months, CDS spreads have been significantly higher than their observed long-term levels. This suggests that the market turmoil has had a significant impact on the cost of credit. This evidence is also consistent with the assumption of the re-pricing of risks in capital markets as a result of the turmoil.

Evolution of transaction costs

The cost of raising debt includes transaction costs, which must be paid by the company. One component of these costs is the gross fees charged by the underwriters. An increase in gross fees would lead to an increase in the cost of debt, even if spreads and yields remained the same. This is relevant since the company must recover the transaction cost from its activities. The transaction costs are a component of the all-in cost of raising debt.

Table 3.3 below presents a comparison of disclosed deal gross fees (where available) for bonds issued by four large European telecoms companies.

Table 3.3 Increase in gross fees on bonds issued by a sample of European telecoms companies since the start of the market turmoil (%)

Company	Date	Market	Currency	Fees (as % of face value)	Increase
BT	March 19th 2008	Global market	USD	0.42%	**+0.17%**
	October 19th 1999	Global market	USD	0.25%	
France Telecom	March 5th 2008	Euro market	Euro	0.23%	**+0.18%**
	October 5th 2005	Euro market	Euro	0.05%	
Deutsche Telekom	June 2nd 2008	Euro market	Euro	0.25%	**+0.16%**
	March 21st 2007	Euro market	Euro	0.09%	
Telecom Italia	May 28th 2008	Global market	USD	0.66%	**+0.25%**
	September 21st 2005	Global market	USD	0.41%	
Average					**+0.19%**

Source: Dealogic and Oxera analysis.

According to the table, the deal gross proceeds have increased in all four cases considered, with an average increase of +0.19% of the deal face value. This evidence suggests that, as a result of the market turmoil, underwriters seem to have increased their fees, which has translated into a higher all-in cost of debt.

3.3 Qualitative evidence on the conditions in debt capital markets and the evolution of the cost of debt financing

In addition to quantitative evidence, there is considerable non-price evidence on the impact of the turmoil in debt capital markets. This section examines this evidence to understand the drivers of the turmoil and their potential implications for BT's cost of capital.

3.3.1 Overall market conditions for corporate borrowers

The Bank of England reports that summer 2007 saw the end of the 'credit boom', where:

> Rising default rates in the US mortgage market led investors around the world to question whether they were being adequately compensated for the risks they were bearing on a wide range of assets — not just those associated with sub-prime mortgages.[31]

The Bank of England Credit Conditions Survey in April 2008 indicated a tightening in the supply of credit to the corporate sector and higher default losses on medium and large corporate lending. Lenders reported that the reduction in availability had been driven by concerns about the economic outlook, changing sector-specific risks and a reduction in their appetite for risk. [32]

In fact, the Bank of England has been reporting a tightening of credit conditions continuously since the onset the turmoil. As early as October 2007, it reported that the availability of unsecured credit had deteriorated over the previous three months, and that lenders expected recent market developments to significantly reduce their capacity to extend corporate credit over the coming period.

[31] Bank of England (2008), 'Quarterly Bulletin', Q1, p. 82.
[32] Bank of England (2008), 'Credit Conditions Survey', Q2.

Furthermore, the Bank England decomposition of credit spreads suggests that there has been a substantial increase in liquidity and other risk premia in UK corporate credit markets over the past six months.[33]

3.3.2 Developments in the market for monoline insurance and structured finance

There are strong signals of structural changes resulting from the turmoil that are likely to affect companies' ability to raise financing over the longer term. Current concerns about the creditworthiness and liquidity of monoline insurers have important implications for companies seeking to raise funding through innovative finance solutions (eg, wrapped debt). This has a particular impact on companies' ability to raise index-linked debt, as most of this debt has been raised with support from the monolines.

According to some market observers, the problems with the monoline insurers suggest that the credit crunch might be entering a 'traumatic phase':

> Fears that the credit crunch might be entering a traumatic new phase grew ... as investors lost confidence in the insurers that guarantee payments on billions of dollars in bonds.
>
> Shares in Ambac Financial and MBIA, the world's biggest bond insurers, fell 52 per cent and 31 per cent, respectively, as Moody's Investors' Service raised the possibility that both might lose the triple-A credit rating on which they depend.
>
> The sector was dealt another blow when Merrill Lynch said it was writing down $3.1bn in hedges with bond insurers, mostly with ACA Capital, a guarantor that has lost its investment-grade rating and needs to raise $1.7bn by Friday to avoid insolvency.
>
> The triple-A credit rating of the bigger bond insurers is crucial because any demotion could lead to downgrades of the $2,400bn of municipal and structured bonds they guarantee.[34]

As a result of the turmoil, monoline insurers have been downgraded by the credit rating agencies a number of times. Over the first five months after the start of the turmoil, S&P downgraded one monoline insurer (ACA Financial Guaranty Corp.) to junk status because of expectations of a default, and revised downwards its credit rating outlook for the ratings of other monoline insurers to negative, as summarised in Table 3.4.

Table 3.4 Standard & Poor's assessment of the monoline insurers, January–December 2007

	Previous rating	Rating in December 2007
ACA	A/Negative Watch	CCC/WatchDev
Ambac	AAA/Stable	AAA/Negative (downgraded to AA by Fitch)
CIFG	AAA/Negative	AAA/Negative
FGIC	AAA/Stable	AAA/Negative Watch
MBIA	AAA/Stable	AAA/Negative
XLCA	AAA/Stable	AAA/Negative

Source: S&P (2007), 'Detailed Results of Subprime Stress Test of Financial Guarantors', December, and Fitch Ratings.

Since the end of January 2008, there have been downgrades of at least a further nine monolines (see Table 3.5 below), highlighting the lasting nature of the turmoil.

[33] Bank of England (2008), 'Quarterly Bulletin', Q1.

[34] *Financial Times* (2008), 'Bond insurers spark new credit concerns', January 17th.

Table 3.5 Rating downgrades by Standard & Poor's of monoline insurers since the beginning of 2008

	Date of downgrade	Previous rating	Rating in July 2008
Ambac	June 5th 2008	AAA	AA
MBIA	June 5th 2008	AAA	AA
XL Capital Assurance	June 6th 2008	A–	BBB–
	February 25th 2008	AAA	A–
CIFG Assurance North America	June 6th 2008	A+	A–
	March 12th 2008	AAA	A+
Financial Guarantee Insurance	March 28th 2008	BB	A
	February 25th 2008	AA	A
	January 31st 2008	AAA	AA

Note: The above ratings refer to S&P Financial Strength Ratings.
Source: S&P and Oxera analysis.

There is evidence that, as a result, the corporate index-linked debt market in the UK is virtually closed. In terms of corporate financial management, lack of access to wrapping (external credit enhancement) might prevent companies from taking on the most efficient financing solution, including those based on tranching and structuring of debt securities. This, in turn, might increase the cost of borrowing.[35]

Empirical studies in corporate finance suggest that structuring and tranching generally reduce the cost of raising debt financing for a number of reasons. For example, Firla-Cuchra and Jenkinson (2005) show that they lower the adverse effects of asymmetric information.[36] The authors show that they can bring down the cost of debt because they allow for certain market inefficiencies to be mitigated, such as market segmentation, incompleteness, and the potential lack of post-issuance liquidity. From the perspective of corporate financial management, the inability to access monoline insurance limits available financing options, and, therefore, implicitly increases the cost of raising debt financing.

In terms of price implications, difficulties with structuring of securities (including external credit enhancement) are likely to increase the cost of debt because paying an insurance premium may no longer be more attractive than issuing a lower-credit-quality bond. For example, in normal credit conditions, a bond that is rated sub-investment grade might be too expensive for the issuer to service; by paying a premium to a financial guarantee, the insurer might be able to enhance it to AAA, while the cost of issuance can be reduced by more than the insurance premium. However, under adverse market conditions, the issuer may have to issue a low-quality bond at a higher cost, and/or may be unable to access some parts of the market where structuring is required.[37]

Overall, the impact of the turmoil on monoline insurance limits the set of financing options available to companies such as BT. The actual impact of these developments on individual companies' costs of debt, and on BT's cost of debt in particular, depends on the extent to which it would be efficient for BT to use structuring or to tap different market segments under different market circumstances.

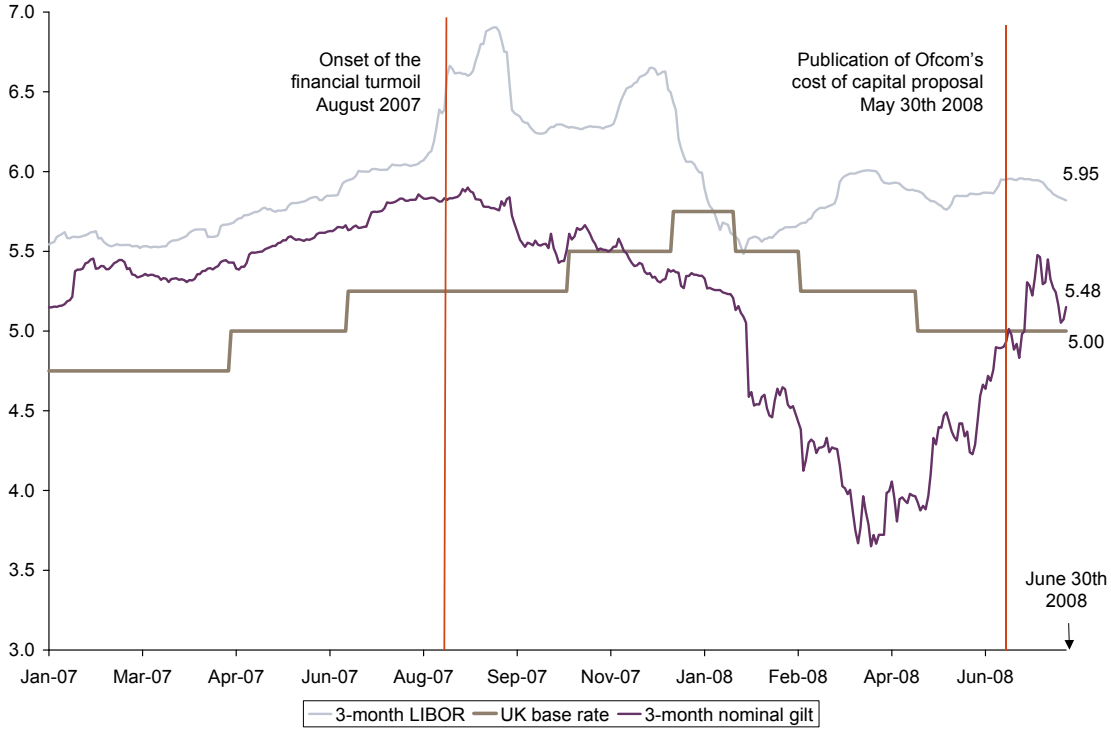
[35] Tranching is the process by which securitisation issues are structured, by creating different securities with different risk, duration or other characteristics backed by the same pool of assets.
[36] Firla-Cuchra, M. and Jenkinson, T. (2005), 'Security Design in the Real World: Why are Securitization Issues Tranched?', July, OFRC Working Papers Series 2005fe04, Oxford Financial Research Centre.
[37] XL Capital Assurance, 'Monoline Financial Guaranty Insurance in Structured Credit Markets'; available at http://scafg.com/xlca/upload/files/EuromoneyGlobalStructuredCreditProducts2005.pdf.

3.3.3 Bank financing and LIBOR

LIBOR represents an important measure of the price of credit, not least because of its role as the primary benchmark for pricing floating-rate debt. As a measure of the price of funds in the interbank market, it could also be seen as the price of general liquidity. Thus, an increase in LIBOR is likely to have a direct impact on the overall cost of borrowing for companies.

Figure 3.8 depicts the evolution of LIBOR since January 2007. The initial rise can be attributed to the drop in confidence in financial institutions' ability to honour unsecured credit. This has led to large decreases in the amount of lending between financial institutions and an associated large increase in LIBOR.

Figure 3.8 LIBOR spread above the benchmark



Source: Datastream and Oxera calculations.

The fall towards the end of 2007 can be attributed, at least partly, to the Bank of England's efforts to inject liquidity into the financial markets in December and January by auctioning three-month funding. The Bank took further steps to stabilise the financial markets in April, releasing a special liquidity scheme that allowed banks to swap temporarily high-quality, but illiquid, mortgage-backed securities for UK treasury bills.

By June 2008, LIBOR had risen by almost a full percentage point above policy rates. The Bank of England reported that this might due to the continued reluctance by banks to lend to each other for periods of more than one month, as a means of conserving balance-sheet capacity.[38]

The Bank of England uses the spread between LIBOR forward-rate agreements and the equivalent maturity overnight index swap (OIS) rates to forecast future developments in the spread between LIBOR and policy rates. Using this proxy, it notes that:

> Going forward, derivatives prices suggested that the LIBOR-OIS spread should narrow, perhaps indicative of a gradual recovery in conditions. But a narrowing has been priced in to derivatives markets for some time without materialising, suggesting that the shock

[38] Bank of England (2008), 'Quarterly bulletin, Recent economic and financial developments', April, p. 126.

to money markets may have been more persistent than market participants had previously expected.[39]

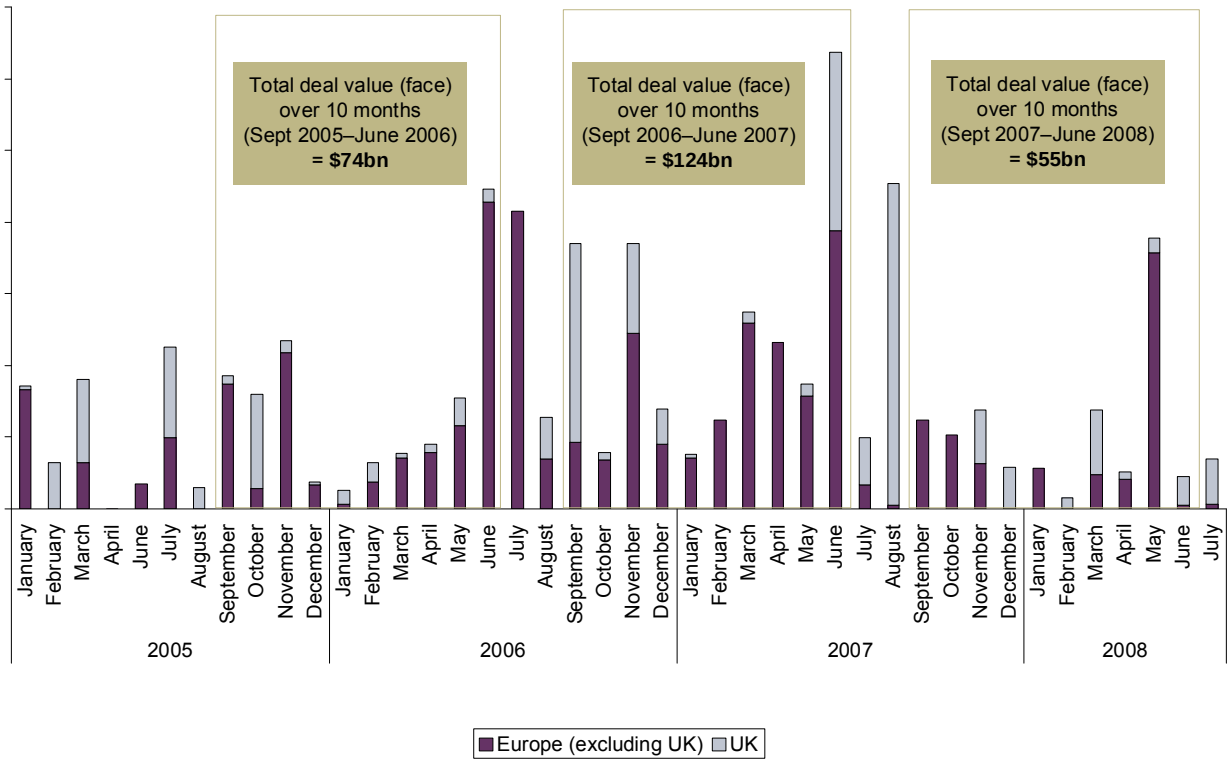
This implies that LIBOR is expected to remain high for some time.[40] This, in turn, could have important implications for the cost of bank borrowing going forward. Given that LIBOR is used as a benchmark for pricing a significant proportion of corporate borrowing (eg, floating-rate debt), an increase in LIBOR translates directly into a higher cost of borrowing.

3.3.4 Recent market evidence on debt issuance

While yields and spreads for BBB rated corporate bonds have been increasing, the issuance of BBB rated debt (including BBB+ and BBB–), in both the UK and Europe, has declined, and a number of companies have delayed or cancelled their planned bond issuance. This trend can be seen by comparing the volume of issuance since the start of the market turmoil with a similar period in previous years.

Figure 3.9 presents the volume of BBB rated corporate debt issuance in the UK and Europe (excluding financial institutions) from January 2005 to July 2007. The total value of bonds issued since the start of the market turmoil has decreased and was equal to only 44% of comparable issuance over the similar period in 2006/07 (74% in 2005/06).

Figure 3.9 Issuance of BBB (including BBB+ and BBB–) rated debt in the UK and Europe ($ billion)



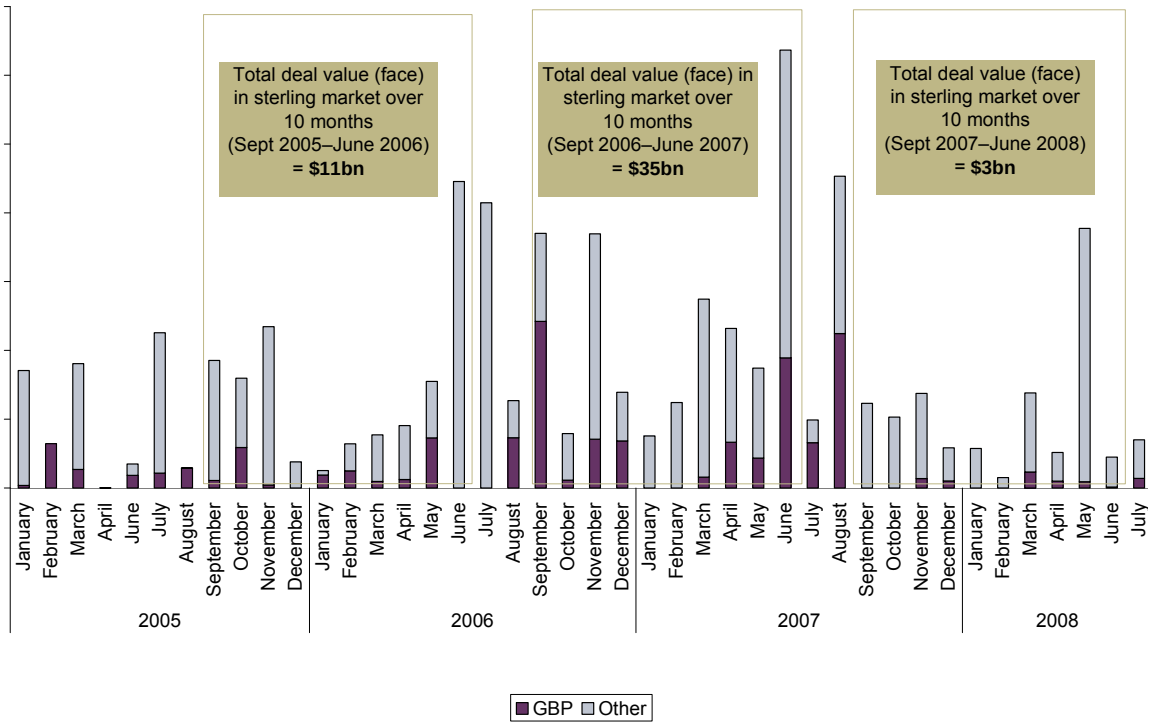
Note: August 2007 is excluded from the analysis as the results may be distorted by Eurotunnel, which raised $22 billion. July 2007 is excluded as it was not a full month at the time when the analysis was undertaken.
Source: Dealogic and Oxera analysis.

[39] Bank of England (2008), 'Quarterly bulletin', April 2008

[40] This is supported by the current swap curve, which suggests that over the next three years the swap rate is expected to decrease by only 20bps.

The issuance of BBB rated debt (including BBB+ and BBB–) in the UK and Europe, as shown in Figure 3.10, is broken down by currency. As can be seen, the value of new bonds issued in sterling has decreased considerably since the start of the turmoil.

Figure 3.10 Issuance of BBB rated debt in the UK and Europe, by currency (€ billion)



Source: Dealogic and Oxera analysis.

The evidence indicates that the total value of bonds nominated in sterling and issued after the start of the turmoil comprised 9% of bonds issued over the similar period in 2006/07 and 27% in 2005/06.

Overall, there is no evidence to suggest that BT cannot access external financing for its ongoing operations. However, the turmoil has limited the set of financing options available to BT, which is likely to increase the cost of financing.

4 Equity capital markets

There are two principal ways in which the market turmoil might affect BT's cost of equity: by affecting the equity risk premium (ERP) and/or its beta. The section focuses on the impact of the turmoil on the ERP.

The impact on the beta is not considered here in detail since beta is a relative, rather than absolute, measure of risk. It might be expected that, as a result of the crisis, investors would require a higher compensation for risk (ie, higher ERP), whereas the market beta must always remain one. An increase in the beta for one company or sector must imply a decrease in the beta for another company or sector. Moreover, any potential impact of the crisis on relative risks of companies is difficult to capture, not least due to the short period relevant for the potential measurement of the beta in this case. At the same time, during the market turmoil associated with sharp increases in volatility, stocks tend to be more correlated and move closer together, which means that the betas of individual securities tend to one. This suggests that the impact of the crisis on the beta of Openreach might be to bring it closer to one, albeit not necessarily reflecting market fundamentals.

In general, the cost of equity represents the *forward-looking* rate of return required by investors to commit equity capital and accept financial and business risks. Reliance on historical rates of return might represent a reasonable approximation of the forward-looking cost of capital in stable market conditions and for a limited period. However, at a time of major market turmoil and the possibility of a recession in the UK, historical rates of return on their own cannot provide a reliable measure of the price that investors demand in order to commit capital over the next five years. In such circumstances, estimates based on historical data need to be supplemented with information from forward-looking measures that accurately reflect current investors' expectations in order to avoid a downward bias.

Implied volatility (IV) is a forward-looking measure of risk that can be used to examine the impact of market turmoil on the ERP. The current level of implied volatility indicates that equity returns are expected to become more volatile in the future than they have been in the recent past, and there is no evidence to suggest that this is going to change in the near term. This indicates that the ERP has increased as a result of the ongoing market turmoil.

The Bank of England highlighted the impact of volatility on the ERP in its quarterly bulletins for Q4 2007 and Q1 2008. For example, in its quarterly bulletin of Q1 2008, it stated that:

> Increased uncertainty about the macroeconomic environment could have prompted a rise in the risk compensation required by equity investors. According to a simple dividend discount model, recent price moves indicated a significant rise in the implied equity risk premium.[41]

According to the Bank of England's analysis, a high-level estimate of the ERP in February 2008 was approximately 5.5%—an increase of around 70bp from February 2007.

The current level of forward-looking uncertainty (volatility) in equity markets is more than twice that at the time of Ofcom's previous cost of capital determination. There is clear evidence, supported by theoretical and empirical research in corporate finance, that higher forward-looking uncertainty (measured by IV) is likely to be associated with a higher ERP. This is intuitive, as equity investors require higher expected

[41] Bank of England (2008), 'Quarterly Bulletin 2008 Q1'.

returns in order to commit capital at a time of greater uncertainty. It should be noted that the determination of the ERP should be consistent with the risk-free rate.[42]

4.1 Implied volatility as a forward-looking measure

The volatility of returns on the market and the volatility on individual stocks are critical parameters affecting an individual company's cost of equity, including that of BT. Higher volatility in an individual company's assets, or debt and equity, implies that investors are exposed to greater risk, and therefore require higher *expected* rates of return. This in turn implies that the cost of raising capital increases for the company, since it has to compensate investors for higher risk in order to secure funding for ongoing operations and investments.

One approach to calculating the volatility of the market, as well as of individual assets, is to examine historical share price data for both the market index and the company (eg, by estimating returns and the CAPM beta from historical market data). However, when the current market conditions are considerably different from past conditions—ie, if there is a significant increase in market volatility and therefore market risk—the cost of equity estimates based on the historical volatility of equity returns are likely to be biased downwards. This is because the 'true' volatilities, based on current investors' risk assessment, will not be in line with historical estimates.

IV is a forward-looking measure of risk and can be used to assess the impact of a financial crisis on the expectations about the volatility of returns on the market portfolio, and therefore on the risk to investors.

The most common alternative to calculating volatility of returns based on historical data is to derive investors' current views about the market risk and uncertainty from an examination of prices in the derivatives market. Since derivatives prices are based on the probability of a certain outcome occurring in the future, they are necessarily dependent on the expected volatility of the underlying asset and therefore the risk faced by investors. For example, it is commonly accepted that derivative instruments, such as European calls and puts written on the FTSE 100 index, reflect investors' assumptions about the current and future volatility of the equity market. This market consensus view of the expected market volatility and risk is known as the IV because it reflects what the current market prices *imply* in terms of investors' assumptions about the future variation in returns when the most recent financial information is taken into account.

4.2 Evolution of implied volatility

The current market turmoil has also led to significant increases in realised volatilities in equity markets. Figure 4.1 below depicts the increase in the IV across 3- to 18-month maturity call options from January 1st 2007 to June 30th 2008. The figure highlights the marked increase in IV at the time of the onset of the market turmoil in August 2007. Since then, the IV across maturities has remained well above the three-year average level (see Table 4.1) and after falling in April 2008 has once again risen so that longer-term maturities (12- and 18-month) are above the trailing six-month average.

[42] See, for example, Jenkinson, T.J. (1993), 'The Cost of Equity Finance: Conventional Wisdom Reconsidered', *Stock Exchange Quarterly*, Autumn, 23-27.

Figure 4.1 FTSE 100 implied volatilities (%)

Note: The six-month rolling average is taken as an average on all volatility values.
Source: Bloomberg and Oxera calculations.

In addition, a widening in the IV across option maturities has been observed in recent months, with longer-term maturities showing higher IVs than short-term ones. This is in contrast to the situation earlier in 2008 when options with shorter maturities showed higher IVs. The current situation implies that investors are still incorporating significant uncertainty into option prices going forward (18 months' maturity).

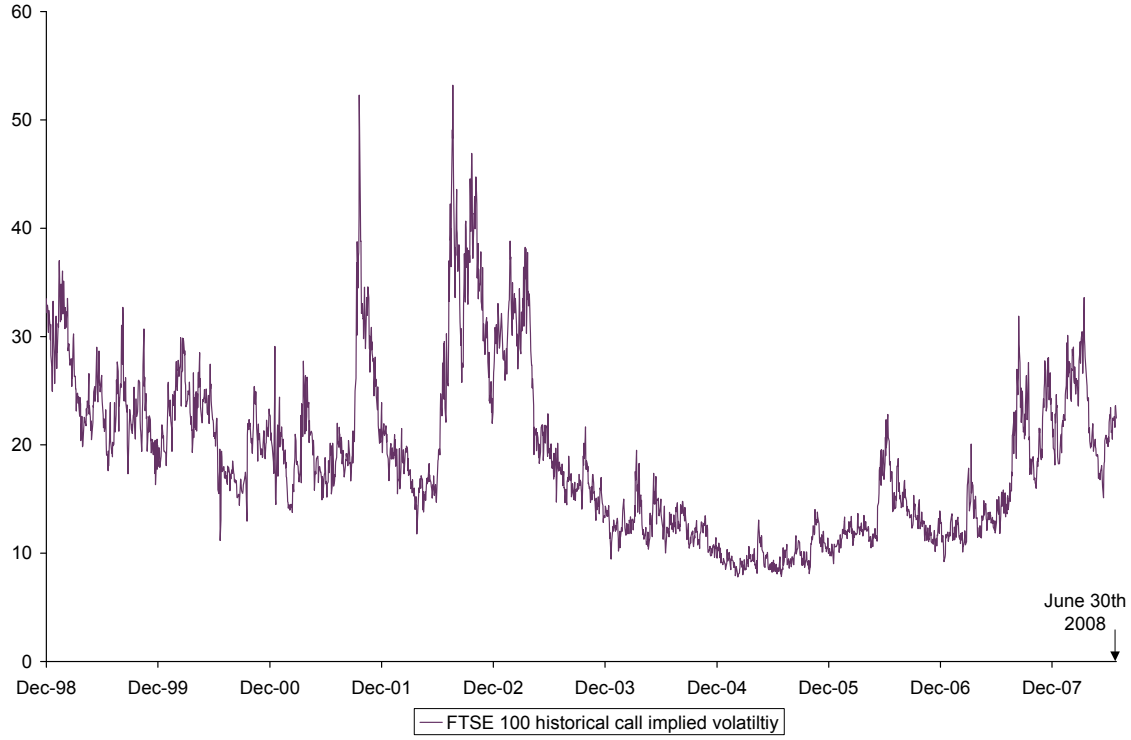
Table 4.1 Implied volatility for FTSE 100 for a number of time periods (%)

	3-month call IV	18-month call IV	Average
Averaging period ending June 30th 2008			
Level on June 30th 2008	22.0	24.8	23.4
6-month average	23.7	25.2	24.4
3-year average	16.0	18.0	17.0

Source: Bloomberg and Oxera calculations.

Figure 4.2 below depicts a ten-year time series of IV data on the FTSE 100 index. The figure highlights that recent volatility levels are broadly equal to average volatility over the previous period of market turmoil, which was associated with 'irrational exuberance' and the end of the dot.com bubble.

Figure 4.2 Long-term implied volatilities for FTSE 100 (%)



Source: Bloomberg and Oxera calculations.

As can be seen, both high and low levels of market volatility can persist for substantial periods of time. For example, the period between 2002 and 2007 was characterised by low volatility, while that from 1998 to 2002 saw high volatility and therefore significant risk. The current levels of volatility, if they persist as they did over the period between 1998 and 2002, would mean that the market risk over the next four to five years would be substantially above the current level.

4.3 Relationship between implied volatility and the ERP

4.3.1 Conceptual and empirical links between implied volatility and the ERP

The relationship between the ERP and the variance in the portfolio returns has been studied extensively. Most of the literature shows that there is a significant positive relationship between the variance of the returns and the ERP. That is, increases in the volatility of the index are accompanied by an increase in the ERP, as suggested by the evidence from the early studies of French, Schwert and Stambaugh (1987), Harvey (1989), Turner, Startz and Nelson (1989), and Baillie and DeGennaro (1990).[43]

More recent studies include that of Campbell and Hentschel (1992), who investigate the effect of volatility on the ERP in the USA over the period 1926–88 and find that the ERP increases with the volatility of the log returns of the market index. Moreover, the authors find that:

[43] French, K., Schwert, G.W. and Stambaugh, R.F. (1987), 'Expected Stock Returns and Variance', *Journal of Financial Economics*, **19**, 3–19. Harvey, C. (1989), 'Time-varying Conditional Covariances in Tests of Asset Pricing Models, *Journal of Financial Economics*, **24**, 289–317. Turner, C., Startz, R. and Nelson, C. (1989), 'A Markov model of heteorskedasticity, risk, and learning in the stock market', *Journal of Financial Economics*, **25**, 3–22. Baillie, R.T. and DeGennaro, R.P. (1990), 'Stock Returns and Volatility', *Journal of Financial and Quantitative Analysis*, **25**, 203–14.

> during periods of high volatility, the feedback effect can become dramatically more important.[44]

In other words, the impact of volatility on the ERP is greatest during periods of relatively high volatility.

Similarly, Campbell, Lo, and MacKinley (1997) point out that this link is intuitive, as an increase in the volatility of the market portfolio leads to an increase in the ERP.[45] Scruggs (1998) also finds that there is a positive relationship between the variance of returns of the index and the ERP.[46] Furthermore, Bliss and Panigirtzoglou (2004) state that:

> An increase in equity volatility generally leads to an increase in the risk premium though the expected change is model dependent.[47]

Conceptually, if the volatility of the market portfolio is zero (σ=0%), the ERP must be zero because a market portfolio with zero volatility is equivalent to holding a risk-free asset.

The precise relationship between the ERP and the volatility of the market portfolio can be seen by inspecting the following formula in a market equilibrium framework (see Cochrane 2005, section 1.4):[48]

$$ERP = E[R_m] - R = -R\sigma_D\sigma_{Rm}\rho$$

where R_m is the gross return on the market index; R is the gross return on a risk-free asset (ie, R=1+r, where r is the risk-free rate); σ_{Rm} is the standard deviation of returns on the market index; σ_D is the standard deviation of the stochastic discount factor m; and σ is the correlation coefficient between R_m and D.

Assuming that the ERP is positive, this is equivalent to assuming that the correlation coefficient ρ is negative. Hence, everything else equal, an increase in the volatility of returns on the market portfolio increases the ERP in a linear way. For example, if σ_m doubles, the ERP also doubles, at least in the short to medium term (eg, for investments in equity up to five years).

4.3.2 Empirical estimates

A number of academic studies have considered how the forward-looking volatility of the market portfolio, proxied by the IV of options on market indices such as the S&P 100 and S&P 500, or by other indices such as BARRA's 'value and growth' stocks, affects the ERP.

Copeland and Copeland (1999) find a positive relationship between movements in the CBOE volatility index (VIX), a measure of market expectations of stock return volatility, and stock returns.[49] Similarly, Guo and Whitelaw (2006) find that there is a positive relationship between market returns and IV.[50]

[44] Campbell, J.Y. and Hentschel, L. (1992), 'No news is good news. An Asymmetric Model of Changing Volatility in Stock Returns', *Journal of Financial Economics*, **31**, 281–318.

[45] Campbell, J.Y., Lo, A. and MacKinley, C. (1997), *The Econometrics of Financial Markets*, Princeton University Press.

[46] Scruggs, J.T. (1998), 'Resolving the Puzzling Intertemporal Relation Between the Market Risk Premium and the Conditional Market Variance: A Two Factor Approach', *Journal of Finance*, **53**:2.

[47] Bliss, R. and Panigirtzoglou, N. (2004). 'Option-implied Risk Aversion Estimates', *The Journal of Finance*, **59**, 407–43.

[48] Cochrane, H.J. (2005), *Asset Pricing*, revised edition, Princeton University Press, pp. 10–25.

[49] Copeland, M. and Copeland, T. (1999), 'Market Timing: Style and Size Rotation Using the VIX', *Financial Analysts Journal*, **55**, 73–81.

[50] Guo, H. and Whitelaw, R. (2006), 'Uncovering the Risk-Return Relationship in the Stock Market', *Journal of Finance*, **61**, 1433–63.

The relationship between IVs and the ERP is also examined by Graham and Harvey (2007).[51] The authors analyse the results of the most recent survey of US chief financial officers, which looks ahead to the first quarter of 2007 and beyond. They present expectations of the ERP measured over a ten-year horizon relative to a ten-year US Treasury bond. Among their findings is evidence that suggests a positive relationship between IV, captured by the VIX and the ERP.

Banerjee, Doran, Peterson (2007) undertook a detailed study of the relationship between the VIX (level and innovations) and the ERP, defined as the difference between S&P index returns and the risk-free rate. Their study encompasses the period June 1986 to June 2005, where they focus on 30- and 60-day horizons to quantify the relationship between the VIX and the (ex post) ERP, and find that this relationship is positive.

To examine the relationship between IV and the ERP, Banerjee, Doran, Peterson (2007) estimated the following regression:[52]

$$R_t = \alpha + \beta_1 \times V_t + \beta_2 \times \sigma^2_{IV,t} + \varepsilon_t$$

where:

– R_t is a proxy for the ERP measured as forward-looking excess equity returns;
– V_t is a measure for the implied variance, orthogonal to the variance innovations at time t, based on the VIX index;[53]
– $\Delta\sigma^2_{IV,t}$ is the innovation of squared IV over the time interval of the study.

In the regression, the coefficient β_1 measures the marginal effect of implied variance (squared IV) on returns over and above the risk-free rate. The interpretation of coefficient β_1 is as follows: a 1% increase in the IV levels (0.01 increase in implied variance) will lead to an increase of (β_1 × 10)% in the ERP. β_2 represents the incremental effect of implied variance innovations. Table 4.2 shows the results.

Table 4.2 The relationship between implied volatility and ERP—Banerjee, Doran, Peterson (2007)

Heading 1	30-day S&P 500	60-day S&P 500
V_t	0.064	0.119
	(1.97)*	(2.22)*
$\Delta\sigma^2_{IV,t}$	–0.003	0.011
	(0.17)	(0.34)
Constant	0.007	0.013
	(3.19)**	(3.21)**
Number of observations	4,490	4,446

Note: Absolute values of t-statistics are shown in parentheses; ** significance at 5% level; * significance at 1% level.
Source: Banerjee, Doran and Peterson (2007), op. cit., Table 1.

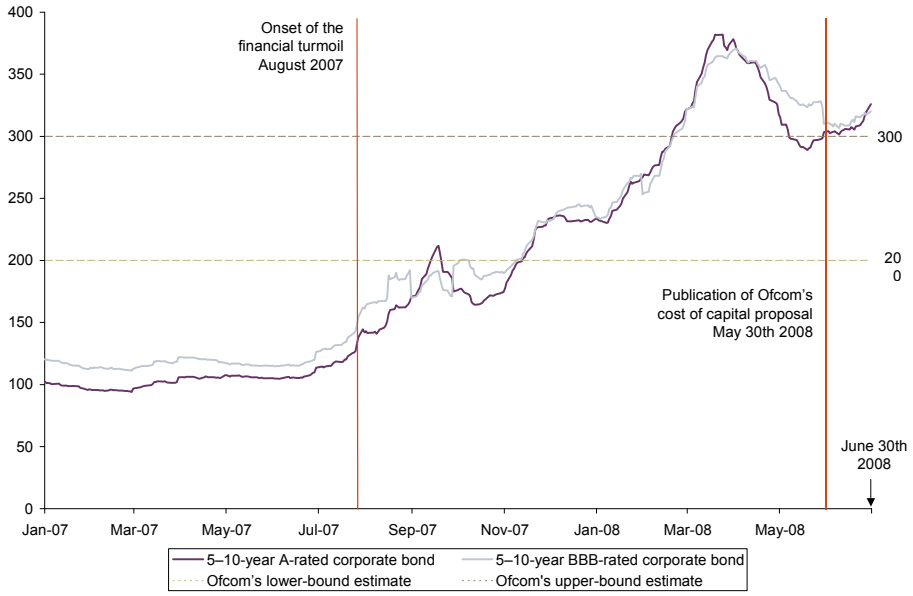
[51] Graham, J.R. and Harvey, C.R. (2007), 'The Equity Risk Premium in January 2007: Evidence from the Global CFO Outlook Survey', working paper, Duke University.
[52] Banerjee, P.S., Doran, J.S. and Peterson, D.R. (2007), 'Implied volatility and future portfolio returns', *Journal of Banking & Finance*, **31**:10, 3183–99, October.
[53] Banerjee, Doran, Peterson (2007) used the instrumental variable for implied variance rather than implied variance itself in order to avoid potential multicollinearity between independent variables. It was measured as the residual from the regression of implied variance on the innovations of implied variance.

As can be seen from Table 4.2, Banerjee, Doran, Peterson (2007) find that for the 60-day horizon a 1% increase in the VIX level is followed by a 1.19% increase in excess market index returns over 60 days.

It should be noted that Banerjee, Doran, Peterson (2007) demonstrated that there is a positive relationship between IV and ERP (proxied by excess market returns) for a period of up to 60 days. The same analysis could be undertaken for the UK for longer maturities. For example, Bloomberg contains data on IV on the FTSE 100 index for up to 18 months.

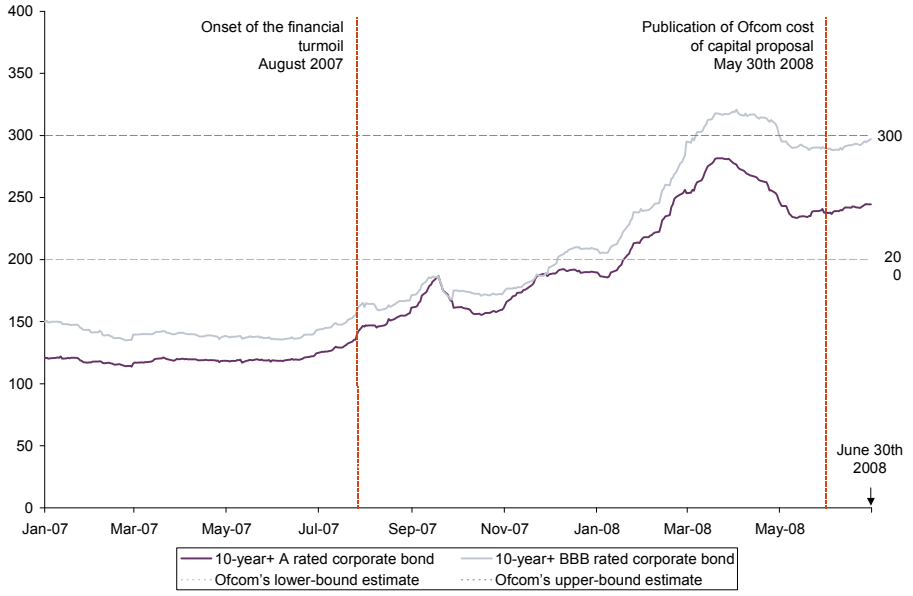
A1 Spreads and yields on UK A and BBB rated companies

Figure A1.1 UK A & BBB rated corporate spreads (5–10-year maturity, %)



Source: Datastream and Oxera calculations.

Figure A1.2 UK A and BBB rated corporate yields ('10+'-year maturity, %)



Source: Datastream and Oxera calculations.

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