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Empirical analysis of the credit cycle

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Forecastable dynamics

'Crunch', 'meltdown', 'black hole': the credit crisis has had writers scrambling for ever stronger metaphors to describe what has been widely perceived as an unprecedented series of events. Some of these terms, however, appear to exaggerate the unpredictability of this cycle. In fact, when taken at an aggregate level, this one has shown remarkable consistency with previous cycles. While specific causes and consequences have undoubtedly differed from anything we have seen before, a number of the macro credit drivers have displayed quite familiar patterns.

We have found that, when carefully analysed, these patterns provided surprisingly accurate forecasts of the first part of this cycle. This evidence suggests that an empirical approach to modelling the credit cycle should be central in positioning for the second half of this downturn and in the years to come.

In this collection of articles, we illustrate alternatives for robust empirical modelling of the relationship between credit and various macro-economic forces. Among other things, we separately analyse the linkage between credit, growth, rates (real and nominal), corporate default rates and equity valuations. We detail forecasting models for turning points of the credit cycle, as well as methods for analysing bear cycles in particular. We also dedicate a section on how best to implement views on the credit cycle.

Our approach is an empirical one, and as such, is particularly suited for forecasting. We strongly believe that the benchmarking of any forecasting must be based on out-of-sample predictive accuracy. These articles were written between 2006 and 2008 and hence should provide a solid basis for evaluating the accuracy of these methods during a time when it has been most needed, and in a truly out-of-sample context.

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1. Projecting the credit cycle in 2009-10

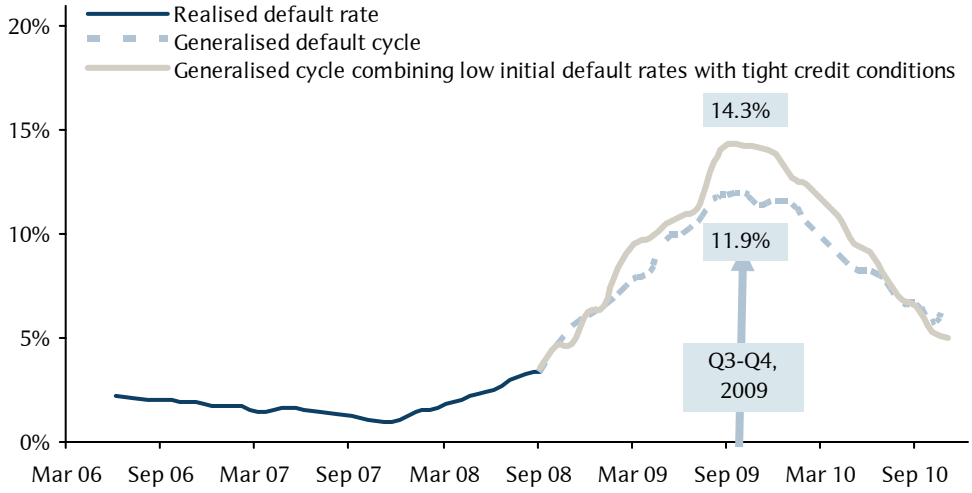
Generalised dynamics in bear cycles[1]

The credit and growth-cycle downturns exhibit surprising regularity across time. We observe relatively consistent behaviour of macro aggregates, such as defaults, credit conditions or growth rates in the year before and after the cyclical trough. Once we have established that we are in a downturn cycle, these regularities can be used to forecast dynamics up to two years out. We use the general dynamics of downturns together with particulars of the current downturn to make projections of credit cycle dynamics over 2009-10.

Key results are:

- *We forecast a peak in 12m US speculative grade default rates of 14.3% in Q3/Q4 09 with continued elevated levels into 2010. This projection is based on a combination of a generalised default cycle with tight credit conditions and current default rate dynamics.*
- *We find that current growth projections are significantly more negative compared to growth trajectories in a generalised downturn cycle. We specifically analyse the 1991/2001 downturns with a similar result, which has negative implications in terms of our default rate forecast. Defaults peaked at 10-12% in the two previous cycles.*
- *We show a strong lead-lag dynamic between credit conditions and defaults. This suggests the effect of any thawing of the current credit freeze may not be fully felt until H2 09. There would be further downside potential resulting from a failure to do so. The Swedish experience of the early 1990s provides an illustration of both these points.*
- *Early warning indicators, such as incremental tightening of credit conditions and an inversion of the Treasury curve, were efficient in predicting the turn of the cycle in 2007-08, which is similar to the experience of the previous 40 years.*

Figure 1: Speculative grade default cycle trajectory forecast



Source: Moody's, Barclays Capital

This is a top-down approach to default rate forecasting and we refer to the *Global Credit Market Strategic Outlook 2009,* 10 December 2008, for contrasting bottom-up approaches. Empirical methods proved remarkably effective in mapping out the first part of the credit crunch, and should, we believe, be a core element in formulating views on the remaining evolution of this cycle.

[1] *This article was originally published as Projecting the credit cycle in 2009-10. 16 December 2008.*

A familiar experience, after all

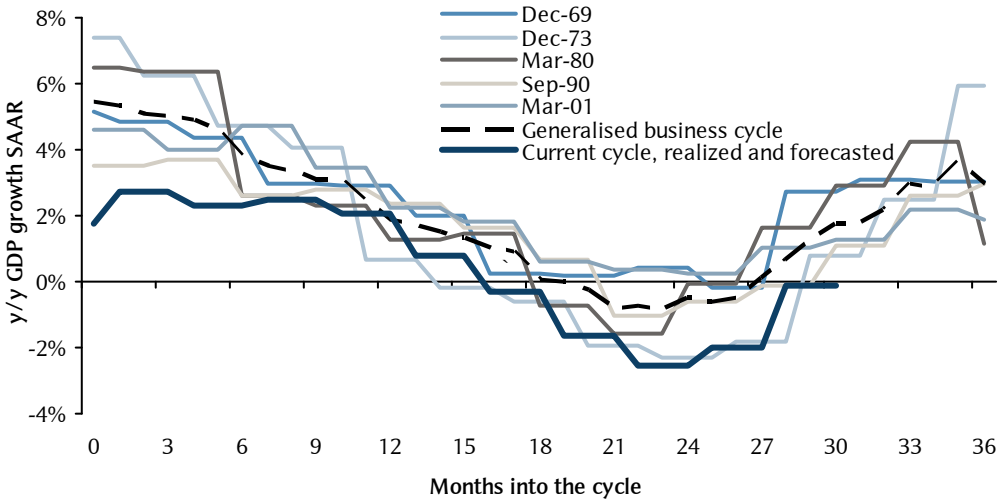
Cyclical downturns exhibit surprising regularity…

When sentiment is at all-time lows, it may be worth remembering that cyclical downturns are generally relatively short. In fact, the economic cycle exhibits surprising regularity in downturns, with growth trajectories following a fairly similar path, as illustrated in Figure 2. The variation of year-on-year real GDP growth over the five recessions that we track in the graph is small. The timing of when the actual turn of the cycle occurs is also surprisingly regular. What this suggests is that once we have established that we are in a cyclical downturn, and have identified its starting point, we can have a fairly good take on the trajectory of growth throughout this part of the cycle. It is also noteworthy that the current (December 2008) projection of growth, taken from the Barclays Capital economics team, is well below the generalised cycle, and close to the trajectory of the 1974-75 recession. Prior to Q4 08, the 1974-75 recession had been preceded by the tightest credit conditions on record according to Federal Reserve's surveys.

… something we use to project the shape of the credit cycle in 2009-10

Economic growth is a core component of the credit cycle, something we discuss at length in *The tale of two cycles*, 8 October 2008. In the following sections, we create a framework where we use the regularity of downturn growth cycles to make projections on the credit cycle. To pre-empt questions of where this will eventually lead us, please refer to Figure 1, where we graph our projections of US speculative grade default rates based on our generalised cycle framework. Our approach indicates that following the trajectory of previous downturns, credit should take the brunt of pain in the second half of 2009, in term of defaults. Comparing this with the experience of the two past decades, we look likely to suffer a relatively severe downturn, unless there is a faster-than-usual relief in terms of bank credit provisioning.

Figure 2: Not unique – Economic downturns, 1967-2008



Note: In the graph, we have used an econometric procedure to create attachment points of each downturn cycle, and then plotted how y/y real GDP growth has moved from that attachment point. Further detail on the procedure is provided below. Source: Bloomberg, Barclays Capital

Our generalised cycle framework provides a baseline forecast – variations can be overlaid

The usefulness of the generalised cycle framework sits not only in its potential for providing empirically robust predictions of default rates over time, but also in that it allows a benchmark cycle on which you can overlay other cyclical dynamics, or qualitative views on how the cycle should progress. For example, our cyclical projections in Figure 1, combines the generalised default cycle with the conflicting forces of initially very low default rates and but also extremely tight credit conditions.

The downturn that started in 2007/08 was remarkably predictable from a quantitative standpoint…

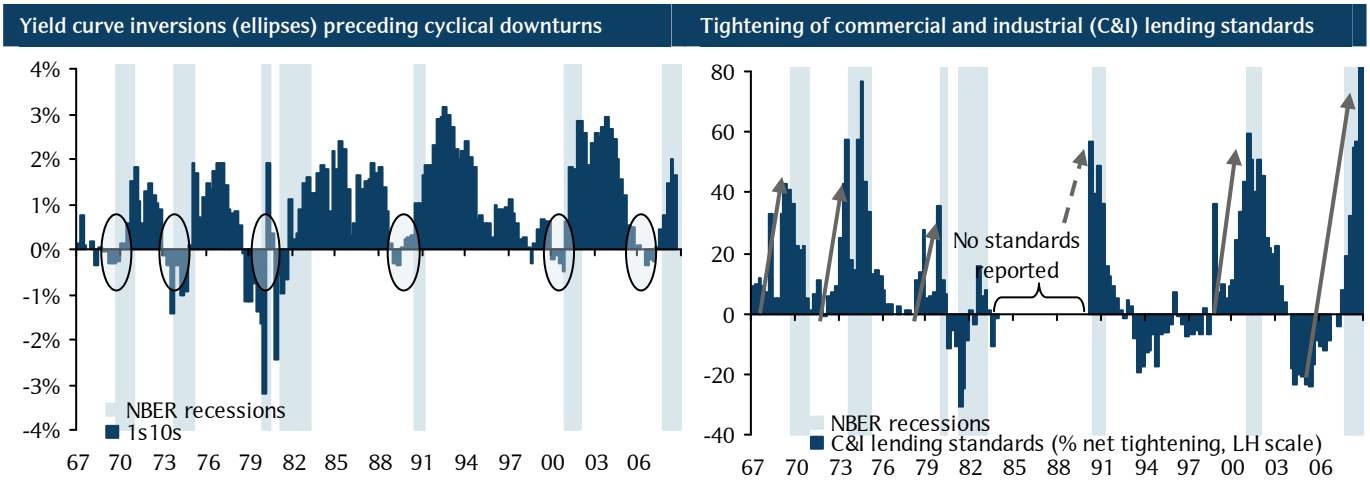
But isn't this downturn something out of the ordinary and cannot be viewed in light of previous downturns? If anything has been proven by the credit cycle downturn in 2007-08, it is actually that old lessons do apply. For example, in November 2006, we saw a significant inversion of the Treasury curve, which traditionally has been a bearish signal, but at a four- to five-quarter lag (see 'Approaching the turning point?' *Global Credit Market Strategic Outlook 2007,* December 2006). This happened at a point where there were almost uniform projections of benign conditions for the foreseeable future. In the same article we noted that credit conditions, as measured by banks' willingness to lend, had started to turn their cycle (see right hand panel of Figure 3). Historically, this has been a reliable indicator of entering more volatile credit valuation regimes. These indicators did flag that the probability to enter a higher volatility regime in 2007 was on the rise and correctly anticipate the valuation deterioration that began in Q4 07.

… with the yield curve and credit conditions deterioration playing a similar part as in each downturn over the past 40 years

Another lesson we derived from studying historical data is that deterioration in credit conditions precedes a pick-up in default rates[2] by around four to five quarters. At the cyclical trough of US speculative grade default rates (1%) in November 2007, bank surveys indicated a fivefold increase in default rates one year ahead (see *Lending standards and default rates: Some numbers*, 5 October 2007, and 'Default rate' outlook, *Global Credit Market Strategic Outlook 2008*, December 2007). Again, as illustrated in the right-hand panel of Figure 3, the dynamics of credit conditions appear to have had a bearing on a cyclical downturn. For a more detailed study on these early warning indicators, please refer to *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007.

Consequently, we assert that the historical experience, carefully framed in quantitative frameworks, was indeed very relevant in order to project the cyclical downturn that we are currently in the midst of. It would appear more likely, rather than not, to have a continued proficiency of empirically based approaches to understand cyclical dynamics.

Figure 3: Could we see it coming? Downturn early warning indicators, 1967-2008



Note: In the chart we overlay the NBER recession that started in December 2007 to have continued throughout all of 2008.This latest recession, or to be more correct "peak in economic activity" dating was announced in December 2008.
Source: Federal Reserve, National Bureau of Economic Research (NBER), Barclays Capital

Benchmarking the current cycle to the 1990-91 and 2001-02 downturns

The first stage of this analysis will be to collect stylised facts on how the current cycle compares with more recent cycles, such as the downturns in 1990-91 and 2001-02.

[2] *For the following analysis, where we mention the generic term 'default rate', we are referring to Moody's 12-month rolling, issuer-weighted US speculative grade default rates.*

This recent history provides us with more granular data sets, as well as lesser structural economic differences compared with earlier history. The conclusion of this comparison is that although default rates are lower today compared to when we were in this part of the downturn cycle in 1990/2001, current growth projections are well below the actual growth trajectories back then, as well as credit conditions being significantly worse.

Comparing default rates in the current cycle versus 1990/2001: defaults are lower today than at similar points in historical cycles

In Figure 4, top panel, we compare the default dynamics as they stand today versus the two previous cycles. If the default cycle exhibits similarities over time, we should be able to overlay the current cycle to previous cycles, and by connecting the shape of the cycle seen so far, we can estimate where we are in the cycle currently. The figure illustrates how to go about this in practice: we rebase the current cycle according to the indicated "attachment points" so that, for example, August 2004 gets rebased to January 1997.

In the current cycle, defaults hit a cyclical trough in November 2007, at a rate of 1%. We have since witnessed a rapid increase in defaults – as indicated by the dotted line in Figure 2. Comparing this to the 1990-91 cycle, we note that the uptick in default rates today has a similar, but slightly lower pace than seen in 1990-91. We saw the cyclical trough of a 2.1% default rate in May 1989 followed by defaults increasing substantially to peak at 12.1% in June 1991.

Turning to the 2001-02 cycle comparison, the issue becomes somewhat thornier. We could argue, not least on the back of the evidence in the top right panel of Figure 4 that the default cycle hit its cyclical low in 1997, when default rates were temporarily below 2%. However, we argue that the cyclical downturn really did not take effect until 2000, as growth was quite strong up until then: for example, default rates remained in a fairly tight interval of around 6% between mid-1999 and mid-2000. As long as default rates remain relatively constant, such as in the 1999-2000 cyclical interlude, we would conclude that that period is not associated with a turn in the cycle. Hence, we attach our current cycle so that the connection point between the two cycles sits at August 2004 = January 1997 as shown in Figure 4. This makes the offset in absolute default rates between 2000 and 2007 fairly large (6% in 2000, 1% in 2007), but captures the moves/deltas of the cycles much better.

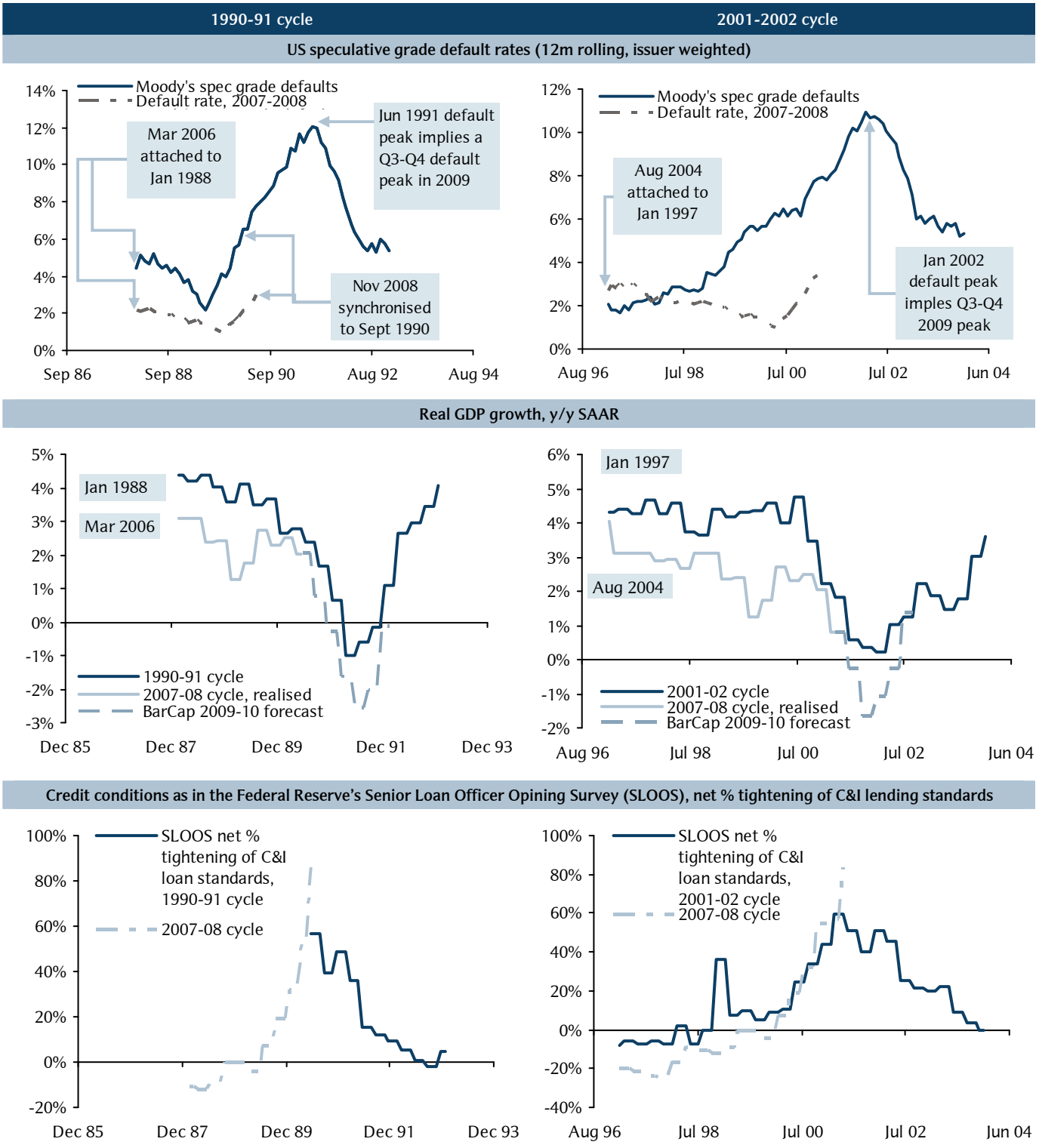
Comparing real GDP growth in the 1990/2001 cycles to today: current projections even worse than1990-91 recession

We discussed the relationship between the credit and the growth cycle at length in *The tale of two cycles,* 8 October 2008. We believe it makes sense to triangulate some of the credit cycle dynamics with default and growth data alike. In Figure 4, we plot GDP evolution with the same connection points between the cycles as for the default cycle. GDP numbers are on a y/y basis and seasonally adjusted. Like the default-cycle analysis, we find greater similarities comparing 1990-91 to current data than comparing it to 2001-02. In 1990-91, there was a gradual decrease in growth similar to the current cycle (left-hand panel of Figure 4). In contrast, the 2001-02 cycle exhibited much higher growth in the run-up to the downturn, and then a much quicker reduction in growth rates as the economy went into recession. Growth remained, on a year-by-year basis, positive throughout the 2001-02 period. We note that the current growth projections for 2009-10 anticipate a steeper drop in real GDP at the trough than seen in either 1990-91 or 2001-02.

Sharper tightening in lending standards today compared to 1990/2001 cycles

Finally, in the bottom row of Figure 4, we show the moves in credit conditions through these cycles according to the Fed's credit conditions survey. This survey was re-started in mid-1990, which is why we lack data of the behaviour in the run-up to the 1990-91 cyclical downturn. Still, based on the data we have, lending standards are tightening at a substantially higher pace than what was seen in 1990. The tracking in the 2001-02 cycle is fairly close, with a gradual build-up of tightening as we were approaching the onset of the recession.

Figure 4: Dynamics of the current cycle versus the cycles in 1990-91 and 2001-02



Note: The x-axes refer to the historical cycle, and we then overlay the current cycle's number using the attachment points. For the 1990-91 cycle, we use the connection point Mar 2006 = January 1988. For the 2001-02 cycle we use the connection point Aug 2004 = January 1997. In this way, we match the shape of the current cycle with that of the historical cycles. Source: Moody's, Barclays Capital

Creating a generalised business cycle from growth data

Real GDP data give many more downturns to observe dynamics in

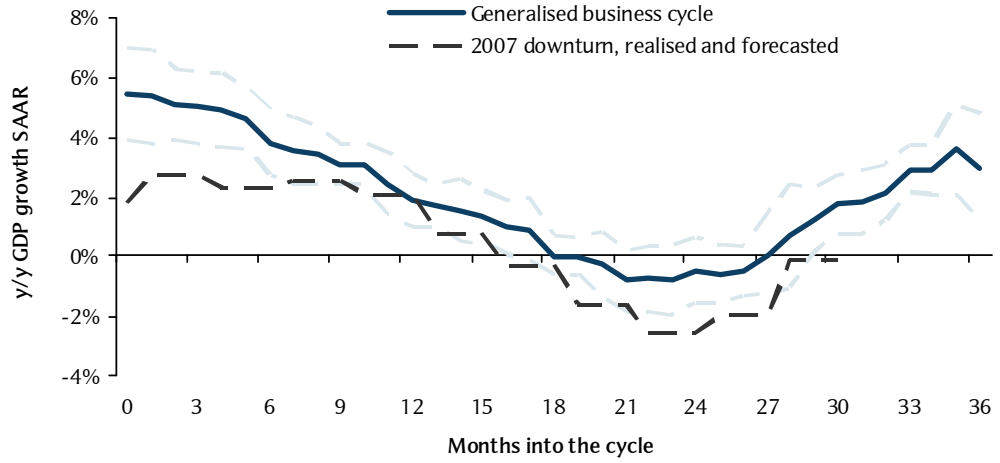
The 1990/2001 experiences are valuable in terms of synchronising with the current cycle, but we actually have a much large number of cyclical downturns than we can use, in order to make more general statements around downturn cycles. We already mentioned that a lack of good default data prior to the 1990-91 and 2001-02 cyclical downturns impair the inference we can draw from these isolated cycles. The problem becomes one of overfitting to these two data points. These default cycles look well correlated with GDP growth, and we have a much larger sample size in terms of cyclical downturns in GDP data, so can the business cycle dynamics not be used in some way? We argue that it can, under the assumption that there is a fairly high correlation between growth and defaults.

For a more general default cycle, we first create a generalised contractionary economic cycle. Uncorrelated analysis, such as the Barclays Capital Economics team forecast of GDP growth (Figure 5), as well as our own analysis (*The tale of two cycles,* 8 October 2008), makes the statement that we are going into a contractionary growth stage less than controversial.

A statistical procedure to find the best attachment points for the downturn growth cycles

We look at previous recessions, as defined by the National Bureau of Economic Research (NBER), and look to find the optimal connection points for each of those cycles in order to get a generalised cycle. Our optimisation criteria involve minimising deviations from individual cycles around the generalised cycle line plotted in Figure 2, where we allow our algorithm to vary the attachment points in order to reach an optimal cycle.

Figure 5: Generalising the business cycle, average y/y GDP growth with 1 standard deviation confidence interval.



Source: Barclays Capital

The optimisation procedure (the technical outline is provided for completeness sake, non-technical readers can skip to the proceeding paragraph without loss of intuition) involves optimising the off-set timing factor vector κ through maximising:

$$\arg\max_{\kappa,\sigma} \ell = \sum_{t\in T}\sum_{i=-12}^{24} \ln \frac{1}{\sqrt{2\pi}\sigma} \cdot \exp\left\{\frac{-\varepsilon\left(\kappa^t\right)_{t,i}^{\ 2}}{2\sigma^2}\right\} \text{ where } \varepsilon\left(\kappa^t\right)_{t,i} = y_{t+i+\kappa} - \bar{y}_{t+i} \quad (1)$$

for all $T \in$ initial month of official NBER recessions, 1965-2006. This discrete maximum likelihood procedure consequently finds a vector κ with offsets (or similarly, adjustments to initial attachment points) and associated volatility σ to attain the maximal statistical fit between the individual cycles and the derived generalised cycle.

The results indicate what we already said in the introduction: the cycle appears surprisingly similar over the past 40 years, with a fairly tight confidence interval around the generalised business cycle line as seen in Figure 5. Starting two years before the trough of the cycle, the growth rate decreases at a ratio of 0.28% per month. At the trough of the cycle, the growth rate is negative by about -0.8% y/y, and the trough has lasted on average three quarters. Overlaying the current (December 2008) growth projections with the generalised cycle, we note that we are on much more negative trajectory. Indeed, the current projections appear to fairly closely track the 1 standard deviation confidence interval on the downside, but with even more negative trough growth rates 21-24 months into the cycle.

Contrasting the growth downturn with official recessions

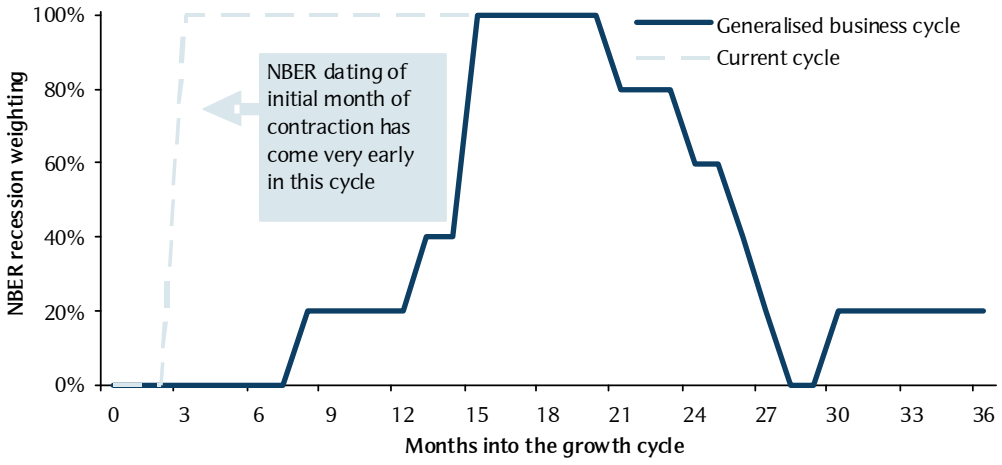
Checking the generalised business cycle to NBER recession timing

As a check, we can see how well our stylised business cycle matches the National Bureau of Economic Research (NBER) Business Cycle Committee's dating of contractionary growth periods. Using the attachment points we obtained from synchronising the growth cycle, we match up previous NBER contractionary periods to form the graph in Figure 6. The line simply shows the average value of a set of variables that take on the value 1 when it is a month that the NBER has defined as a contractionary month, and 0 otherwise. We see that all cycles where NBER contractionary periods between 15-21 months into the cycle, fairly similar to where we also saw the trough growth rate for the generalised cycle.

The really interesting point in matching the NBER cycles is actually with regards to how early the NBER recession inception date came for the current downturn. In December 2008, NBER announced that the peak of economic activity came in December 2007, which also implies a contraction since then. A few notes on this:

- Combining the early date of inception of the contraction and what the generalised cycle analysis suggest will be the future growth path, this cycle looks much more protracted (from an NBER contractionary regime standpoint) at around 20-24 months compared with the average post-war recession duration of about 10 months. This goes together, as seen in Figure 5, a deeper trough than expected in a "normal" cycle.
- However, the first nine months in 2008 will probably turn out to be a less clear-cut contraction than is usually the case, not least as indicated by the otherwise close tracking of the generalised growth cycle in Figure 5 above.

Figure 6: How far into the generalised growth downturn does an NBER recession get called?



Source: NBER, Barclays Capital

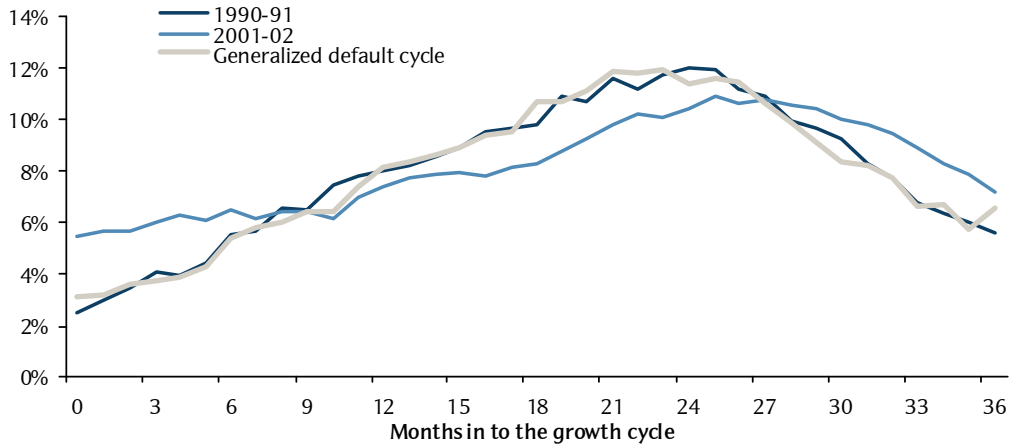
Using the generalised cycle for defaults and credit conditions

Translating the generalised downturn cycle in growth into a default trajectory

Having attained a stylised business cycle, we now convert our linkages between growth and default rates into a generalised default cycle. This cycle is less robust than the generalised business cycle as it will still be dependent on only two real default cycles, but the qualitative argument for these two to correlate is very strong. What may differ most across cycles is the outright level of defaults: as we noted previously, there are considerable differences between the 1990-91, 2001-02 and 2007-08 cycles in terms of the levels of defaults both at the onset and end of a downturn. It is also hard to gauge outright what the maximum level of defaults may be, as this can be highly dependent on structural factors – such as legislation for bankruptcy protection, leverage and covenant structures at the peak of the cycle and so on. Still, the growth-based default rate projection may offer the baseline default level from which to deviate on the basis of such structural factors.

Using a regression approach where we connect growth and defaults in the 1990-91 and 2001-02 downturn we obtain a set of regressors that allow us to link the generalised business cycle into a generalised default cycle (Figure 7). At inception (the trough) in this cycle, average default rates stand at around 2.5%, increasing at a rate of roughly 0.4% per month for approximately 20 months, to reach a peak of just below 12%.

Figure 7: Generalising the default cycle

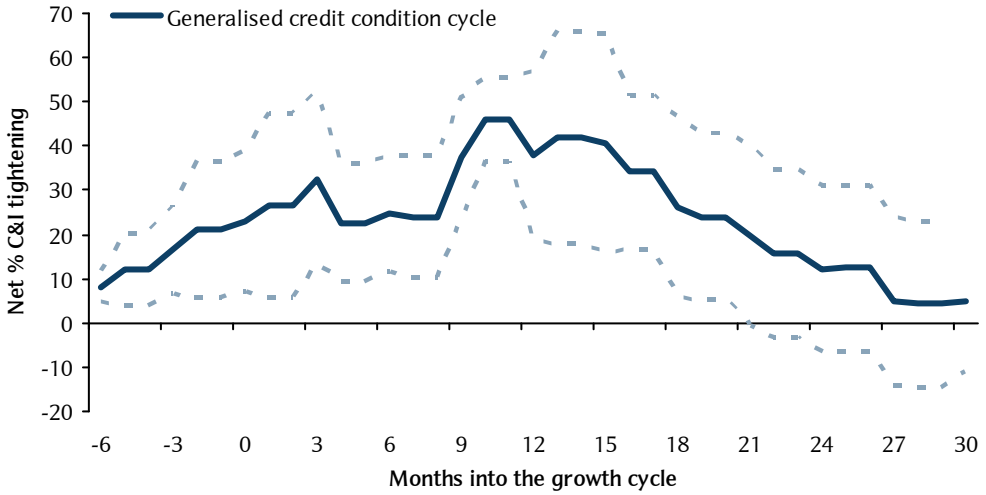


Source: Moody's, Barclays Capital

Credit conditions through the generalised cycle

Can we undertake a similar generalisation of the credit conditions cycle? We use the GDP-based attachment points to compute how C&I tightening has evolved over the cycle (Figure 8). The C&I cycle is more idiosyncratic compared with the GDP cycle, which is not surprising – it is, after all, survey data, which is why we choose to illustrate variations around the generalised cycle with a 1 standard deviation confidence band rather than plot all individual cycles. We note that this cycle peaks much earlier than either the default or growth cycles, even after we adjust the x-axis by lagging it six months.

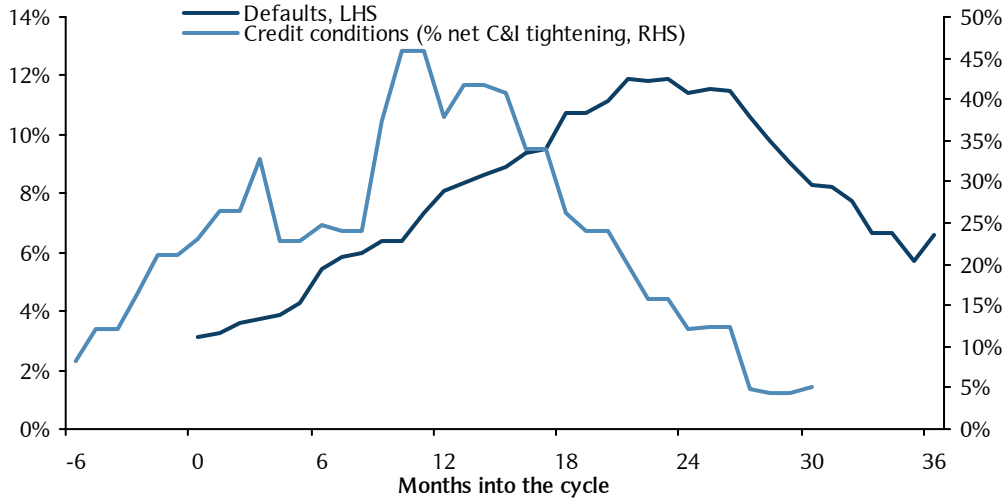
Figure 8: The generalised C&I tightening cycle



Source: Barclays Capital

We have previously found compelling evidence of credit conditions, as measured by C&I tightening, being a leading indicator of the default and business cycles (see *The tale of two cycles*, 5 October 2008). We can confirm those conclusions in the generalised cycle framework too. In Figure 9, we plot the generalised cycles; they appear almost side-by-side, with the default cycle clearly lagging the C&I cycle. Using a battery of statistical tests, we confirm the lead-lag dependency to be strongest at the 10-12mth horizon.

Figure 9: Lead/lag relationships in the generalised credit condition/default cycles



Source: Barclays Capital

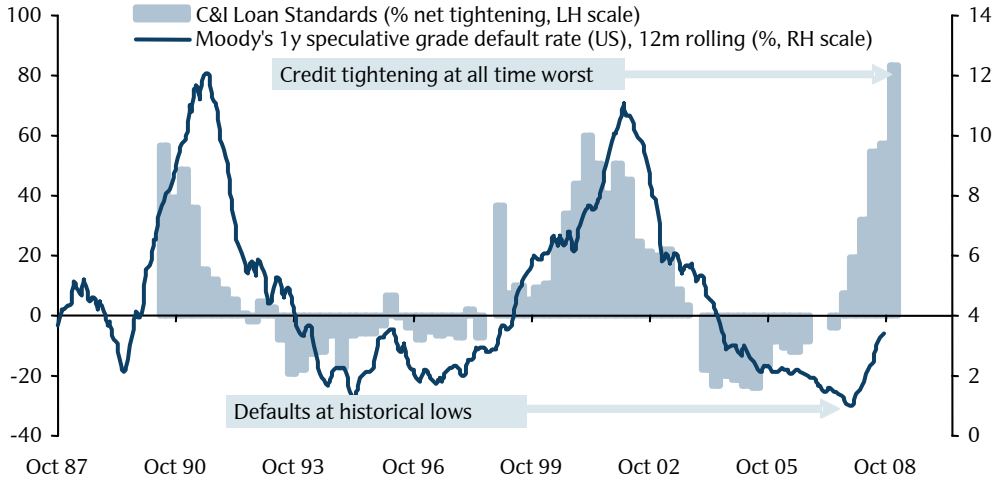
The 2008-10 cycle – reconciling low default rates but tight credit conditions

A generalised cycle gives us a strong baseline case upon which we can overlay other factors that we believe will impact a cycle.

It is interesting, and important, to note the historically unique combination of all-time low default rates over the past few years combined with all-time high levels of credit restriction, highlighted in Figure 10. The trough of defaults was recorded at 1%, compared with 2.5% in the generalised cycle. This could potentially reflect structural changes in the market that may lead to generally lower default rates throughout this coming cycle than in previous ones. However, when accompanied by the extreme pace

of lending standards tightening, a more plausible explanation is that the low default rates were due to an excessively lax lending regime which is being abruptly brought back in line. In this case we might anticipate higher-than-normal peak default rates. We consider both these possibilities in the scenarios below.

Figure 10: A unique combination in the current cycle



Source: Federal Reserve, Moody's

In Figure 11 we plot a number of scenarios for the default cycle based on some of this information. The scenarios are as follows:

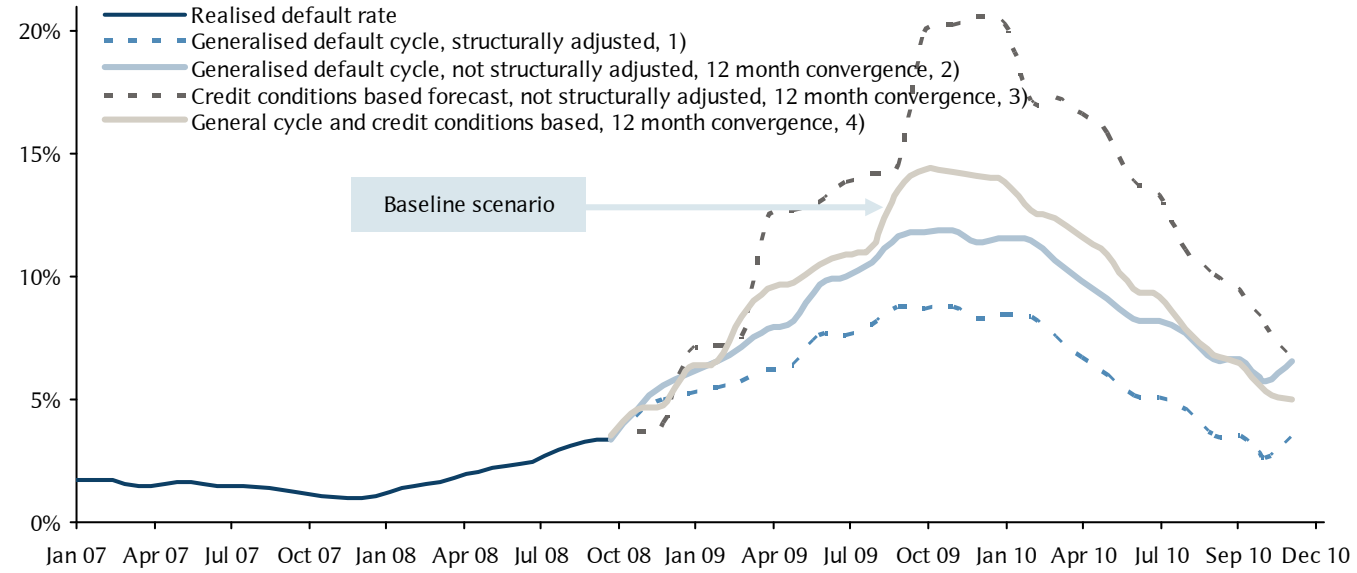
- We follow the generalised default cycle (blue, dashed line) but with a structural adjustment of -3% to account for potential structural changes, pushing down our default expectation in this cycle.
- The next scenario (solid light blue line) follows the generalised default cycle, but with a convergence from currently low default rates into the standard default cycle spread out over the next 12 months.
- The non-structurally adjusted credit conditions-based forecast (dashed dark grey line) uses the relationship between C&I lending standards and forward default rates, as highlighted in Figure 9. In order to extend the C&I tightening series, we assume that the credit conditions cycle will start to converge to the generalised credit conditions cycle from Q1 09.
- The final scenario is a straight average between scenarios (1) and (3), and allowing for a 12-month convergence period between current low default rates and the projected one.

Please note that the structural adjustments that we apply are not necessarily our preferred method to model this, but are shown as an alternative way to approach the cycle.

The figure outlines substantial differences across these approaches in terms of how elevated the peak of default rates go, but on the other side they have fairly similar shapes, with the peaks centred around Q3/Q4 09. Based solely on the all-time high C&I tightening seen in our latest (Q4) Loan Officer survey, we would project HY default rates to come close to 20% at that point in time. Using the generalised default cycle, but adjusting for potential structural differences, gives us a peak of default rates at 8.8%. These two scenarios reflect the possibilities referred to above, of coming out of an extremely low default period but with credit condition deterioration at an all-time high.

We suggest using a straight average of these, as was done in case (4). We can see that the resulting trajectory resembles the generalised default cycle (non-adjusted), with the difference being that the peak is higher (14.3% in (4), versus 11.9% in (2)). Following the higher peak, however, the two trajectories are very close.

Figure 11: Default projections



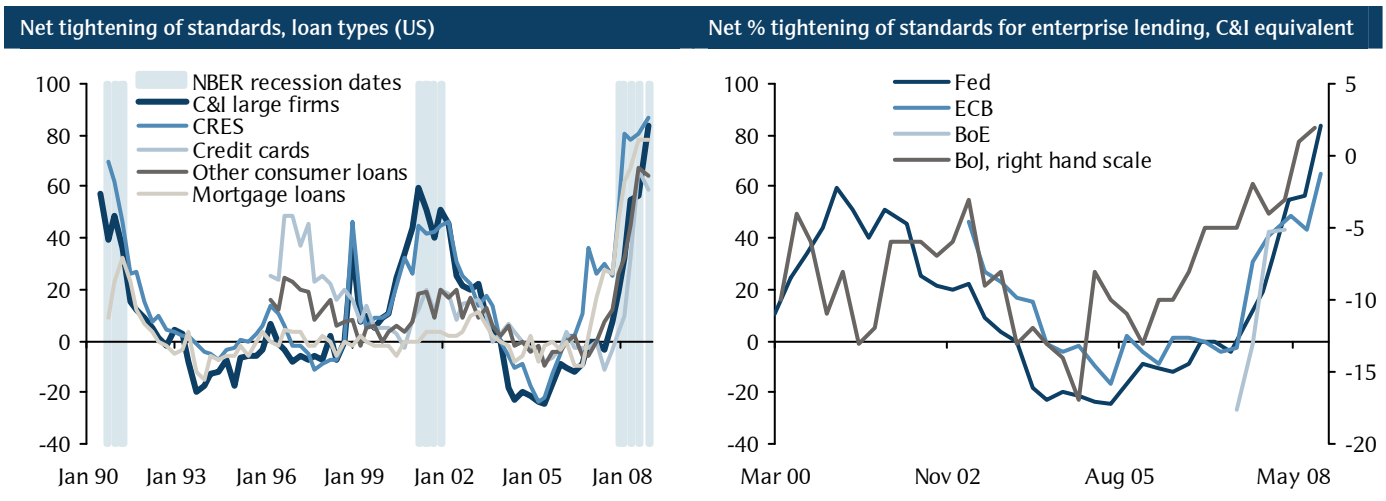
Source: Moody's, Barclays Capital

A special focus on credit conditions

A primary focus going into 2009 will be the evolution of credit conditions. From the policymakers' perspective, reinvigorating credit provisioning is seen as a crucial hurdle in order to mitigate the downturn, as evidenced by the Term-Auction Lending Facility (TALF) introduced in November 2008. In the framework presented above, the currently extremely tight credit conditions made us turn onto a more negative path compared with the generalised cycle. Hence, it is worthwhile dedicating a bit more attention to how credit conditions are evolving.

Credit conditions, as we prefer to measure them via the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS), for commercial and industrial lending have been tightening at record pace, see Figure 3 and Figure 10. This process of constraining credit is neither limited to C&I lending nor to the US alone, as we illustrate in Figure 12.

Figure 12: Credit tightening across loan types and geographies.



Source: Federal Reserve, ECB, Bank of England, Bank of Japan, Barclays Capital

It is illustrative to imply growth scenarios on the back of these extreme credit tightening levels. Using the correlations between the generalised credit condition cycle and the generalised growth cycle, we can look at an implied growth cycle just based on current credit conditions. This exercise should have a caveat in the sense that we have not been at such extreme conditions before, and the empirical correlations have never been calibrated to such a scenario.

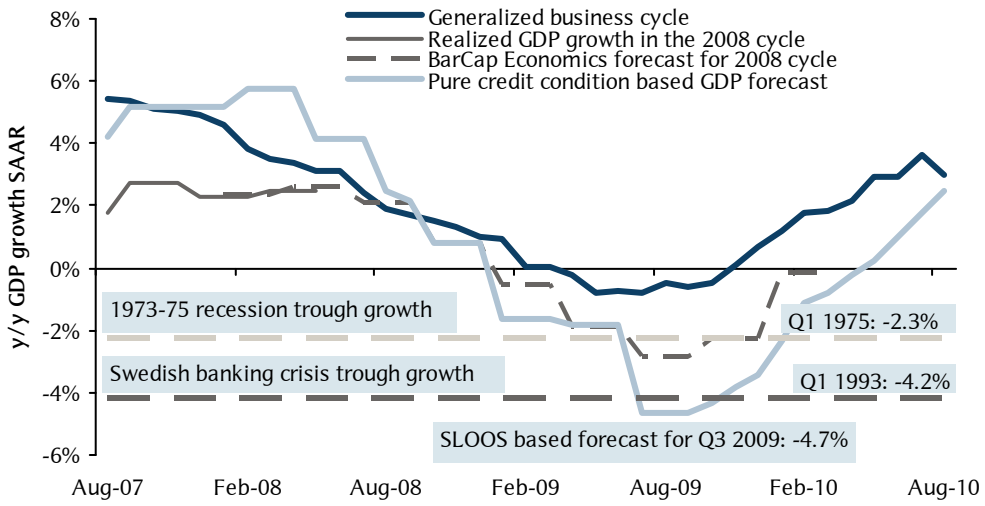
In Figure 13, we can see that similarly to the very large 20% default rate number that we arrived at in terms of forecasting default rates solely based on current C&I number, we arrive at fairly extreme numbers in terms of a growth trajectory. The unconstrained (with caveats) model points to a 4.7% year-on-year decline in real GDP. In order to contrast this number to other data, we overlay the following:

- The trough growth rate of the 1973-75 recession, which saw a maximum C&I tightening rate of 76% versus today's 84%. During this recession, growth troughed at a rate of -2.4% y/y. We see that the current growth projections are close to that period of time in terms of trough y/y growth, with the current forecasted trough rate being -2.8% in Q3 09.
- Swedish banking crisis in 1990-93: The Swedish experience was similar in that there was a very substantial contraction in credit availability due to a similar poor asset problem in the banking system as is currently seen on a global scale. Year-on-year Swedish real GDP growth was -4.2% in Q1 93, just after the krona was devalued, and the positive effects from that started to come through in macroeconomic aggregates.

The conclusions we draw from these points are that: 1) it looks likely that the empirical growth and default correlations with the credit conditions cycle are not well calibrated (they overshoot) for extreme values; 2) the relative direction given by the credit conditions correlations are valid: where we historically, or by foreign analogy, have seen similar tightness, growth has tended to be well below the generalised cycle.

The downside risk of a protracted freeze in credit availability thus becomes clear, and the efforts on policy maker's behalf to start easing credit standards and get a free flow of credit again are both understandable and laudable.

Figure 13: Potential effects of extremely tight credit conditions



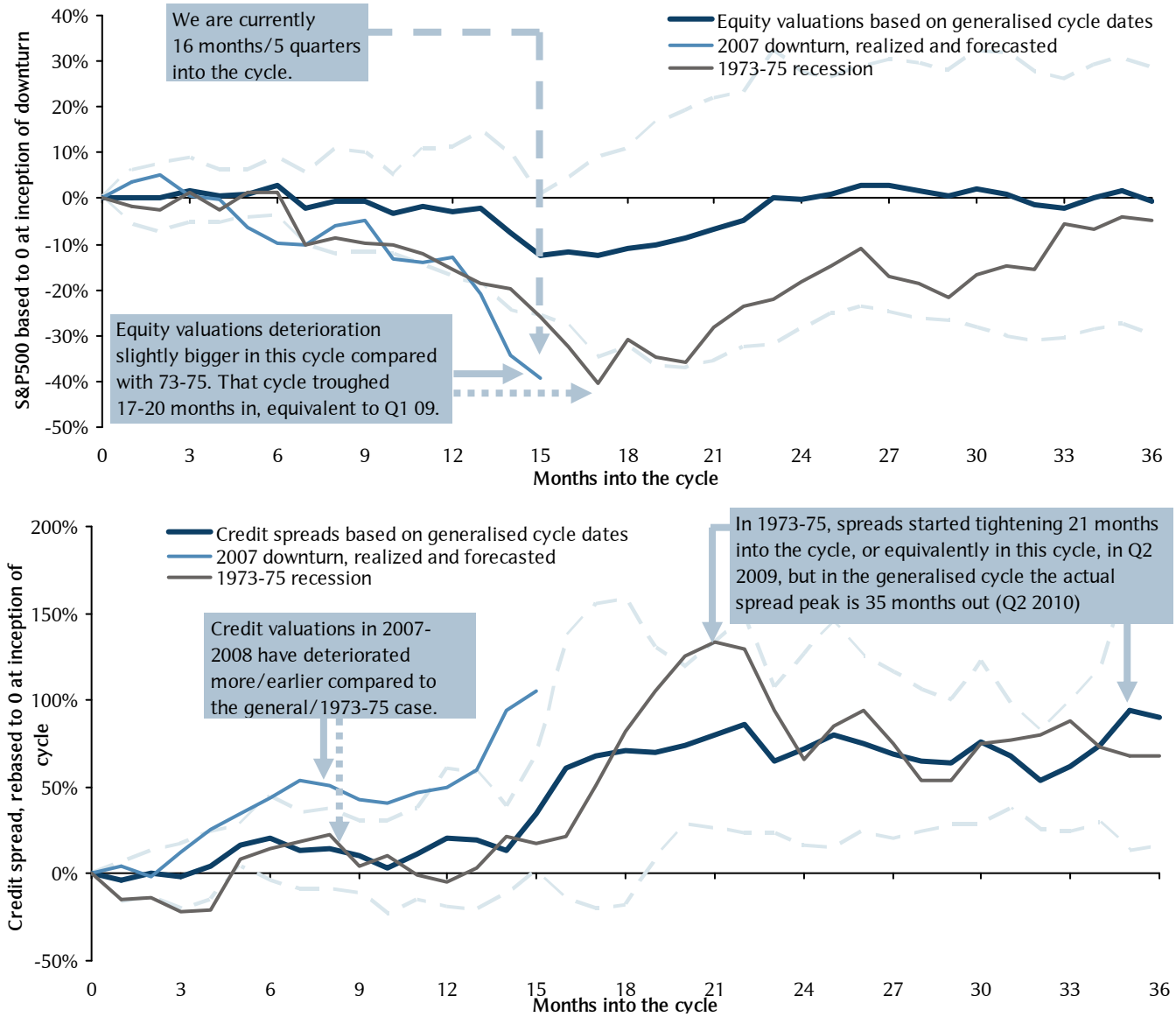
Source: Barclays Capital

2. Credit and equity valuations in a generalised cycle

When can we expect the trough?[3]

Our recent piece *Projecting the credit cycle in 2009-2010*, 16 December 2008, introduced a "generalised downturn cycle" in order to create forecasts of trajectories of speculative grade default rates in downcycles such as the current one. A natural extension to this analysis is to study how valuations are changing in the face of a downturn cycle. Figure 14 summarizes performance of credit and equity in three ways: 1) how the current cycle has looked; 2) how the 1973-75 recession looked; and 3) how the typical/generalised downturn cycle has looked according to this framework. Please note that these are results from one specific empirical model, and we would refer readers to *Global Outlook: Implications for Financial Markets*, 17 December 2008 for a broader assessment of current equity and credit valuations.

Figure 14: Equity and credit valuations through the current, the 1973-75 and the generalised cycle



Note: For the current downturn, the 0 month mark in the graphs above corresponds to August 2007. For the 1973-75 recession, the 0 mark corresponds to December 1972. Source: Bloomberg, Moody's, Barclays Capital

[3] *This article was originally published as Credit and equity valuations in a generalised cycle, 18 December 2008.*

What are the key takeaways from these graphs?

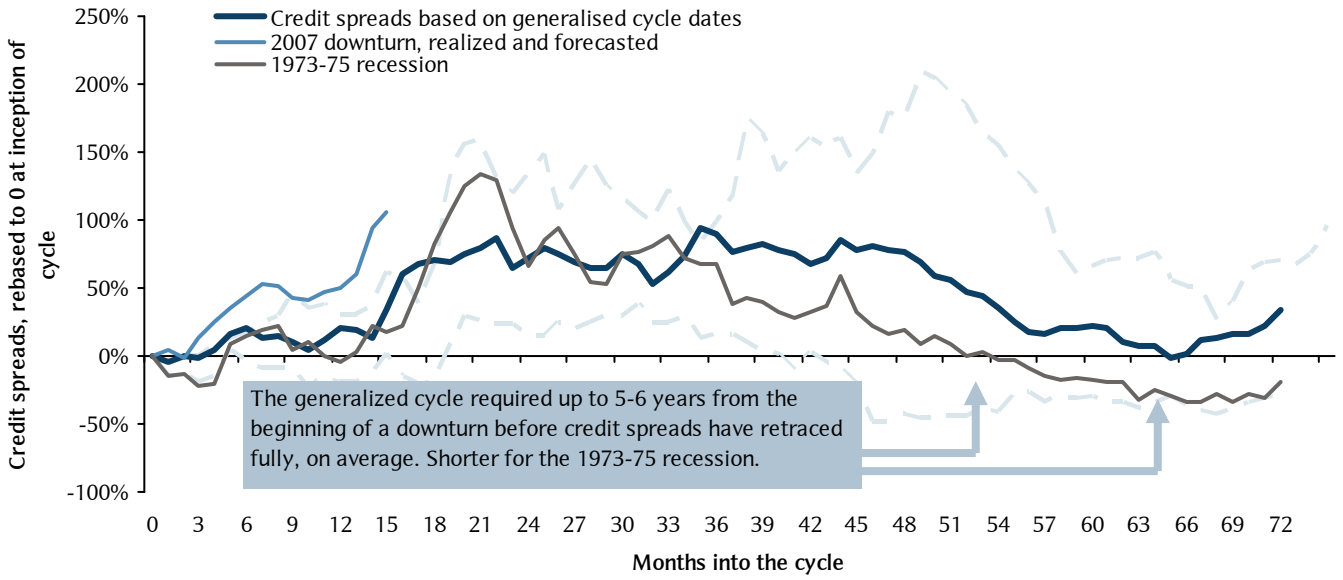
Our generalised cycle model uses an econometric framework to fit real GDP growth trajectories through previous downturn cycles as closely as possible. This gives us the start dates of each cycle. We then line up other variables of interest, such as default rates, using the start dates of the real GDP cycle fitting procedure. This is what has been done in Figure 14, where we have used the start date of the current cycle, August 2007, as a benchmark month 0 date, and then have plotted equity and credit valuations to date[4]. Similarly, we look at the 1973-75 recession with December 1972 as the baseline month. The generalised valuation cycles are plotted with the dark blue line. Our key takeaways from the graphs are:

- In terms of equity valuations, if we follow the trajectory of the 1973-75 recession, we would actually expect the trough in the next 2-4 months. A generalized downturn cycle would indicate an equity turnaround that is even closer in time, but with a slower rate of recovery.
- In terms of credit valuations, the spread peak[5] has tended to come about 11-12 quarters into the cycle, which would translate into Q2 2010 in the current cycle. Hence, this would suggest that a credit turn around is substantially further back in time compared with the equity side. We note though that the spread turn around in 1973-75 was more frontloaded: if we were to follow that example, we would expect a turn around in Q2 2009.
- However, the widening in spreads in this cycle has been more severe than in 1973-75 or the generalized case. This should be considered in the context of turnaround points as it may potentially indicate that credit deterioration has been frontloaded/priced in earlier in the cycle compared with the historical benchmark.
- If the empirical evidence in this analysis proves correct, the turnaround in credit valuations will be less well defined compared with what we would expect in equities. Figure 15 show how credit spreads have, in the typical cycle, taken up to 4 years to come back to where they initially started in the cycle.

We note that valuations in individual cycles have been more dispersed around the generalized cycle line compared with, for example, real GDP growth or default rates. This can be seen from the width of the confidence intervals (dotted lines) in the figures. Furthermore, these calculations are in index level/spread space and the actual return profiles could potentially look different from what we show here.

[4] Note that the start date, or month 0, of the cycle is not an important point, and should also not be seen as a start date of a downturn. Our month 0 benchmark date can be pinned to any month preceding the actual downturn.
[5] This is a fairly coarse data set, and should only be used as approximations of market credit spreads.

Figure 15: The credit cycle has generally taken longer to recuperate spread widening



Source: Moody's, Barclays Capital

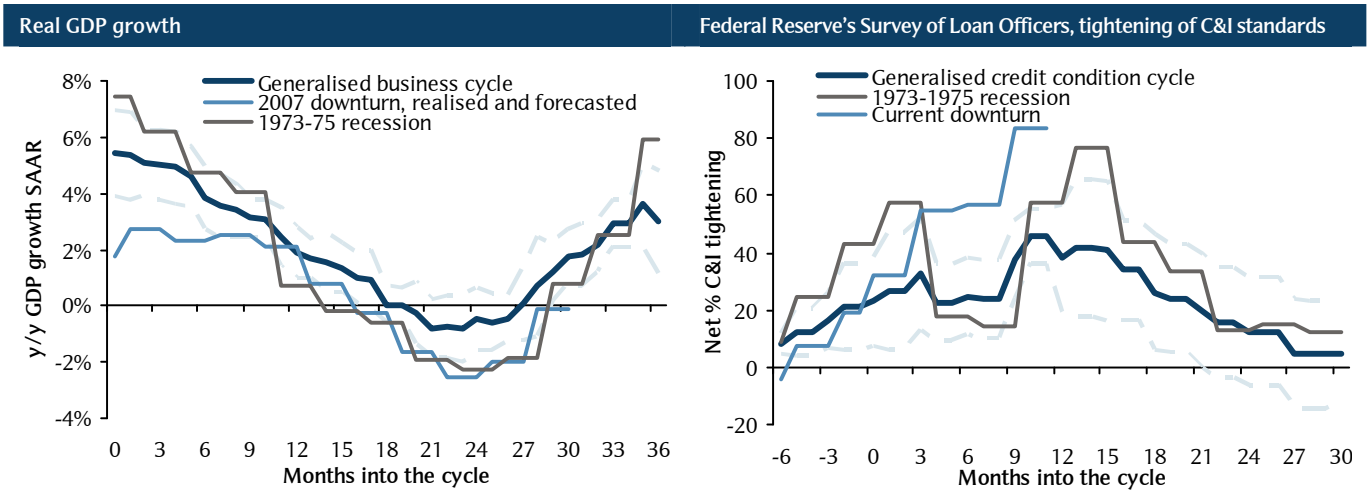
Why a comparison with 1973-75 specifically?

The figure illustrates specifically highlights the dynamics in the 1973-75 recession with the current cycle. In the original piece, we found particular similarities with the current downturn to the 1973-75 recession:

- Forecasted real GDP growth rates for this downturn look very similar to the realised GDP trajectory in 1973-75 - Figure 16, left hand panel.
- Credit tightening reached its previous historical high in the 1973-75 recession, indicating a similarly tight credit market environment compared with today's all-time highs - Figure 16, right hand panel.
- The 1973-75 recession was one of the longer in post-war history, starting in November 1973 and ending in March 1975 (16 months) – Figure 17. NBER called a "peak in economic activity" – ie, start of a recession – for December 2007. Current growth projections suggest this recession would last until Q3 09, around 18 months.

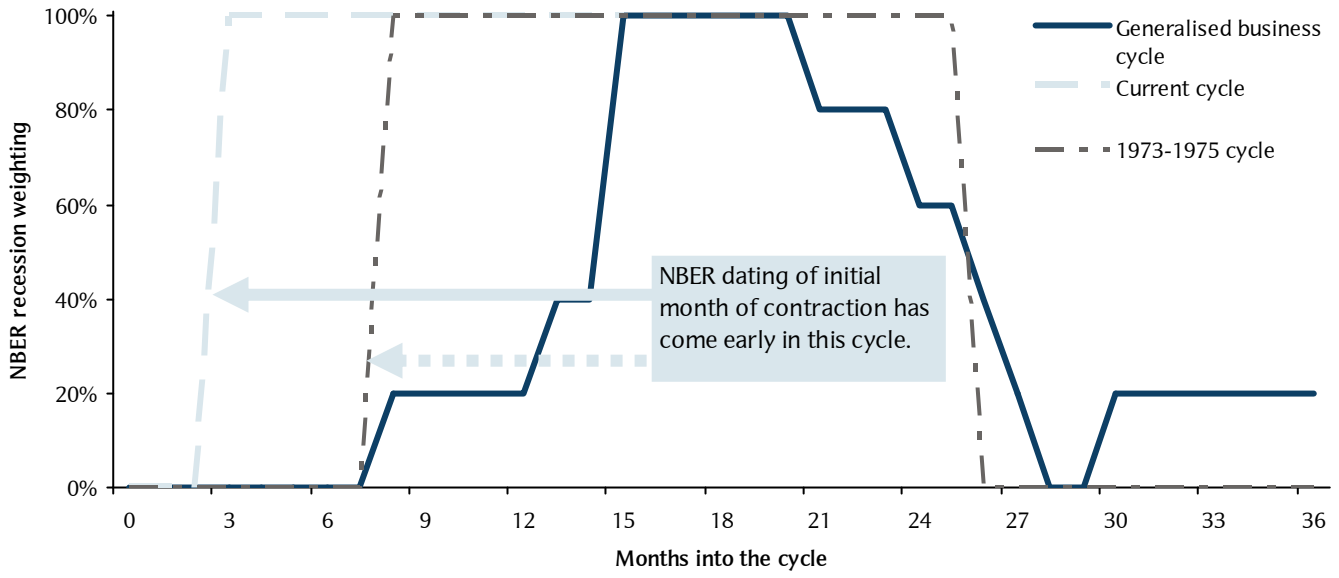
At this point, we refrain from quantifying similarities or dissimilarities in suggested drivers for either of these cyclical downturns, such as the OPEC embargo and oil shock in 1973-75, or the implosion of the housing market in this cycle.

Figure 16: Real GDP growth and credit conditions in historical downturn cycles



Source: Federal Reserve, Bloomberg, Barclays Capital

Figure 17: Recession dating in the current, the 1973-75 and the generalised business cycle



Source: Bloomberg, Moody's, Barclays Capital

3. The tale of two cycles

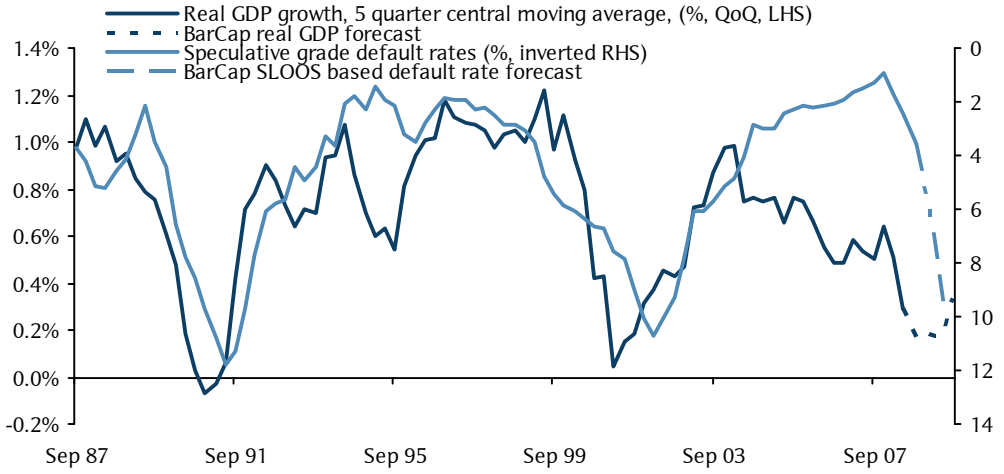
Credit and growth: A quantitative link[6]

Physicists may want us to believe that no black holes were generated when the Large Hadron Collider was turned on this summer, but credit markets seem to disagree. In the past few weeks they have been nearing event horizon – the point at which risk-aversion is so strong that nothing but overnight liquidity can escape balance sheets.

Earlier in the year economic growth looked happily isolated, but as the maelstrom in credit has expanded, this isolation has become more tenuous. In recent weeks, consensus economic growth forecasts have been written down (see for example Market Strategy Americas: Credit goes from storm to hurricane, 3 October 2008) given the intensification of the credit crunch.

For credit investors the growth picture is especially important around turning points of the business cycle as economic contractions push default rates upwards. This report provides quantitative evidence of links between turning points in the credit and business cycles, complementing our earlier work of forecasting corporate default rates.

Figure 18: Correlation of speculative-grade defaults and growth



Source: Barclays Capital

Moving towards a weaker outlook

The consensus appears to have moved toward a weaker growth outlook for 2009. For credit investors, the fundamental outlook for corporate credit worsens with weaker growth, but they have at least had the benefit of a warning, as credit conditions – now being cited as a key driver behind a more negative outlook – have been tightening for over a year.

We have previously shown strong statistical linkages between tightening credit conditions and increases in corporate default rates throughout a number of publications, see for example *Lending standards and default rates: Some numbers*, 5 October 2007. Historically, an increase in the rate at which banks are tightening credit conditions has led to an up-tick in corporate default rates around four to five quarters later. This has been shown to be relatively insensitive, in the short term, to even quite forceful central bank actions: for example, the surprise rate cut that occurred on 21 January or 8 October 2008. For a further analysis of the rate cut impact on the credit

[6] *This article was originally published as The tale of two cycles, 8 October 2008.*

cycle, please refer to *Fed rate cuts and the default cycle: Assessing the empirical evidence*, 22 January 2008.

The business cycle and the default cycle obviously correlate: in Figure 18 we plot how quarterly growth and defaults moved together until 2004, when a divergence appeared. Post 2004, real growth rates remained strong but declined, whereas default rates continued to press down until November 2007. With the benefit of hindsight, we believe that the generous availability of credit during this period is likely to have had an effect on this unprecedented decline in default rates.

Over the past few quarters, however, the link has been resurrected, with the average growth rate declining along with default rates picking up significantly. A further projection of lower growth rates, as derived by the Barclays Capital Economics team forecasts (Figure 19), is plotted as the dotted line in the figure, together with our default rate projection on the back of our credit conditions model. The projections suggest a trajectory for both variables not too different from the cyclical turn of 2001-02.

Figure 19: Barclays Capital real GDP forecast (q/q % chg, saar)

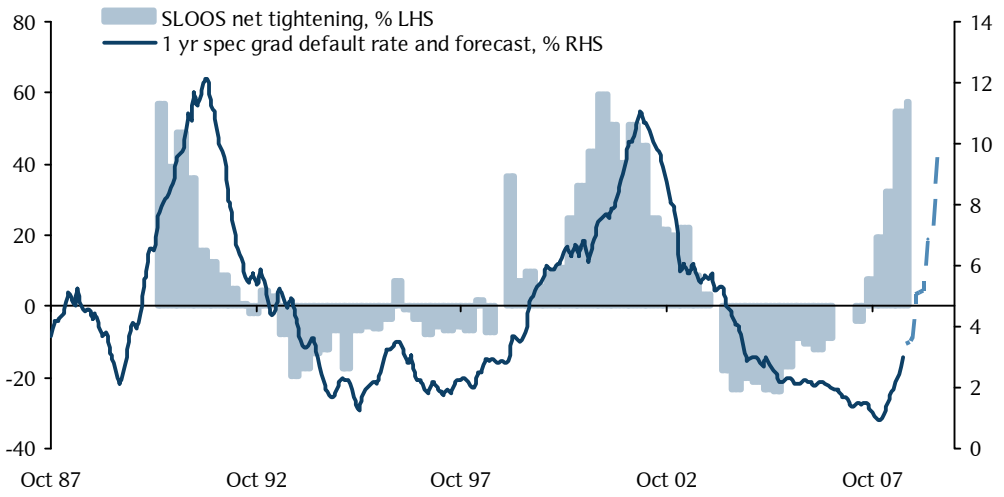
Q3 08	Q4 08	Q1 09	Q2 09	Q3 09	Q4 09
0.5%	-1.0%	0.0%	1.5%	2.5%	2.5%

Source: Barclays Capital

The evidence is still out on whether this downturn will move into a fully-fledged economic contraction or not. This will be the key determinant of how far default rates will move from their current fairly low, in a historical context, levels.

For credit investors whose return profile is typically left skewed with downside risks being large but far between, a situation where credit conditions are tight and growth – and hence corporate profitability – is low must be analysed perhaps even more carefully than for other investor bases. An up-tick in default rates from the current annualised rate of 3.6% to an H2 09 number of 9.7%, as projected by our simple forecast model, is partly conditional on a substantial slowing of growth if one observes the historical evidence (Figure 20).

Figure 20: C&I tightening and speculative grade default rates (with Barclays Capital forecasts)



Source: Federal Reserve, Moody's, Barclays Capital

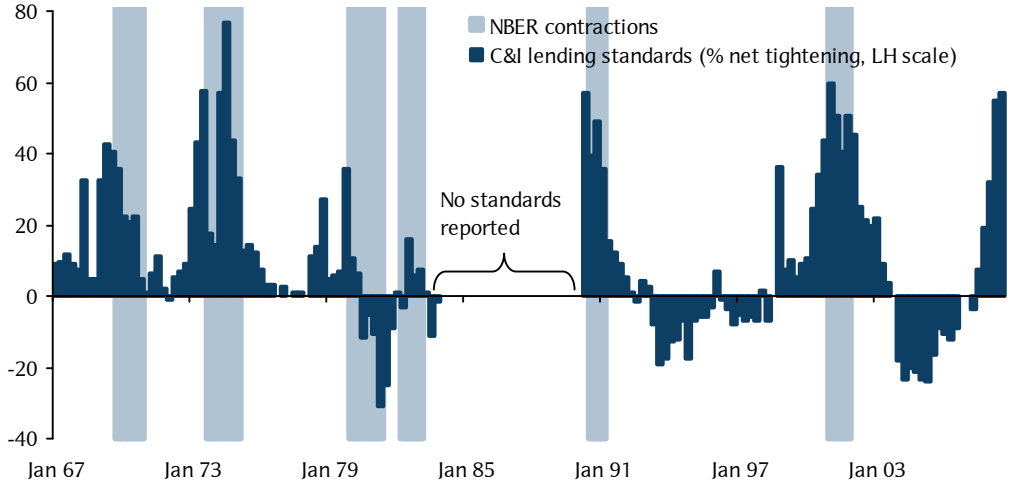
In the sections below, we provide the tools to make projections with regards to the downside risks in a scenario where the current credit market distress continues. These are not to be seen as full-fledged projections of growth trajectories, but merely serve to illustrate the potential tail risk of a feed-back process when tight credit conditions start to affect growth and vice versa, which should be of concern to most credit investors.

A model for the NBER business cycle dating using SLOOS

A traditional approach to the business cycle is to use the National Bureau of Economic Research's business cycle date. We benchmark the credit conditions, as measured by the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS), to the official NBER business cycle dates in the right hand panel of Figure 21. The credit conditions are proxied by the survey response on banks net percentage tightening of lending standards for commercial and industrial companies. The light blue bars in the graph indicate the periods defined as economic contractions by the NBER.

It is noteworthy that the NBER business cycle dates are established significantly ex-post, meaning that the business cycle dating committee actually decides on, for example, a recession between 6-18 months after its inception. As Figure 21 shows, lending standards – a variable that is available in real time in the sense that it is published only a few days after its two-week survey period – do indeed peak at or around the start of the periods demarcated as contractions.

Figure 21: Tightening of credit conditions and the corporate cycle.



Source: Federal Reserve, National Bureau of Economic Research, Moody's, Barclays Capital

Also interesting is the consistently gradual increase in tightening in the run-up to the contractionary periods. For each of the cyclical downturns in the sample there has been a build-up of tightening lending standards that appear to be highly predictable. At the inception of each contraction, lending standards tightening has always exceeded 35%, except for the second part (1981) of the double header recession of 1980-83. In our statistical analysis below, we quantify the link visible in the graph.

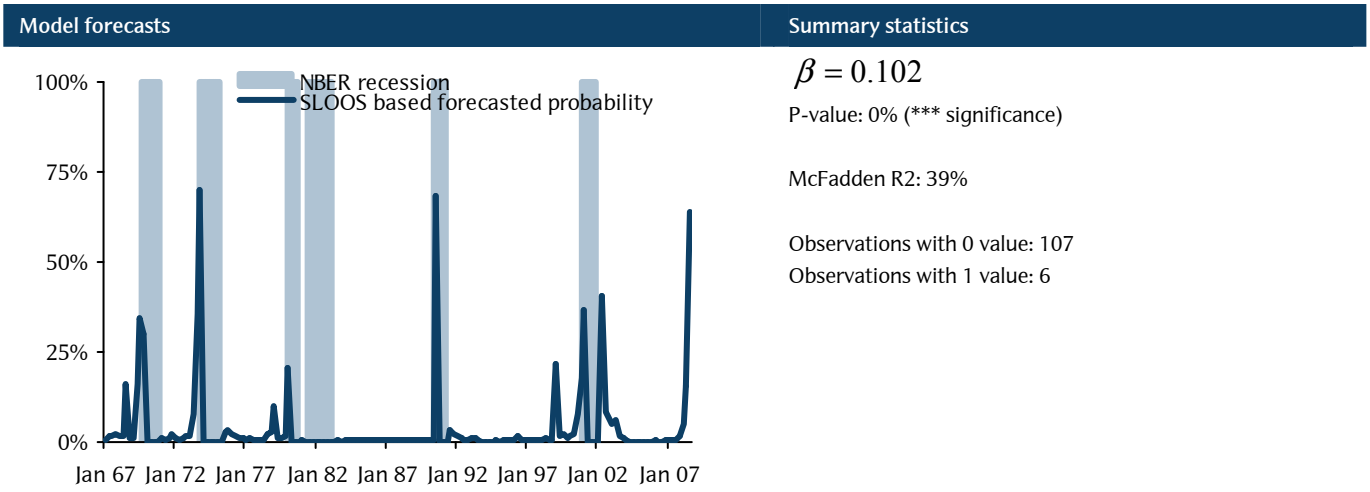
Our first econometric approach to gauging the usefulness of the SLOOS data to determine the state of the business cycle uses the NBER business cycle dating only. We apply the following logit model to estimate the likelihood that NBER will classify the current quarter as a "contraction":

$$\Pr(D_t = 1) = \frac{\exp(c + \beta \cdot SLOOS_{t-i})}{1 + \exp(c + \beta \cdot SLOOS_{t-i})} \qquad (1)$$

D_t is a variable that takes on the value of 1 when the economy enters an NBER-defined contractionary period and 0 when the economy is not in recession, according to the NBER recession dates. The right hand side of the expression of equation (3) gives us a probability measure that D_t will take on the value 1. Hence, we see how the past quarters' SLOOS results can be used to determine if the economy will be in recession in the current quarter. Again, it is worth highlighting that the NBER recession dating works on a lagged basis.

The results of this regression are provided in Figure 22. We can see a clear pattern where probabilities from (1) a spike in the inception of the NBER-defined contraction periods. The coefficient β is positive (tighter credit conditions mean a higher probability of entering an NBER downturn) and highly statistically significant.

Figure 22: Logit model of SLOOS and the business cycle, 1967-2008



Source: NBER, Barclays Capital

An alternative model of flat versus positive growth

The drawbacks of the NBER dating are that 1) it is in effect not applicable for trading purposes, as recessions dates are generated with a lag; and 2) it adheres to a potentially subjective definition of 'recessions (a third point might be added for readers sceptical of anything coming out of a committee).

As a secondary econometric approach, we let the data speak for itself in terms of shifts in the business cycle. This allows us to get a less subjective definition of the business cycle. Specifically, we fit a Markov regime-switching model to quarterly real GDP growth, similar to Hamilton (1989). We used a similar model to define the credit cycle in *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007. The model is as follows:

$$y_t = \mu_1 \cdot \text{Prob}(\text{Low growth}) + \mu_2 \cdot \text{Prob}(\text{High growth}) + \varepsilon_t \qquad (2)$$

where the coefficients μ_1, μ_2 are the average growth rates in their respective regime. The residual ε_t is assumed to be normally distributed with volatility σ. By using this model, for each date we obtain a probability that we are in either a low growth or a high growth state. We fix all probabilities to switch between the different states, except the probability to enter a low growth period following a high-growth period. The latter probability is modelled as follows:

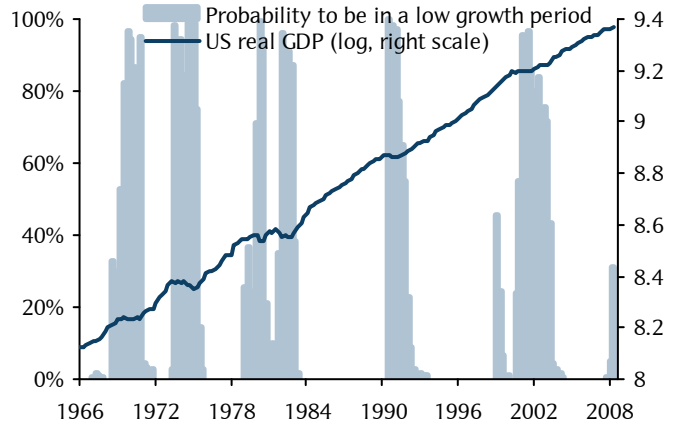
$$\text{Prob}(\text{Low growth}_{t+1} \mid \text{High growth}_t) = \frac{\exp(c + \beta \cdot SLOOS_t)}{1 + \exp(c + \beta \cdot SLOOS_t)} \quad (3)$$

Hence, if β is significant, we can infer that the SLOOS variable is relevant for forecasting the probability to be in a low growth state in the coming quarter. This specification is quite similar to equation (1), but the regime-switching model comes around with NBER data. Results are presented in Figure ***23***.

In the left hand panel of the figure, we can see the probabilities that we are in a low growth state. Based on the current Q2 data (+2.8%), we estimate, on a probability of 31%, that we are in a low growth state currently. This is based on the data as is today and cannot include any revisions that may be made in the future.

Figure *23*: Regime-switching model of low/high growth periods

Low growth regimes



Summary statistics

$\mu_1 = 0.96(0.00)$
$\mu_2 = 0.01(0.94)$
$\sigma = 0.70(0.00)$
$c_1 = 8.25(0.55)$
$\beta = -0.24(0.00)(*)$
$c_2 = 1.59(0.00)$

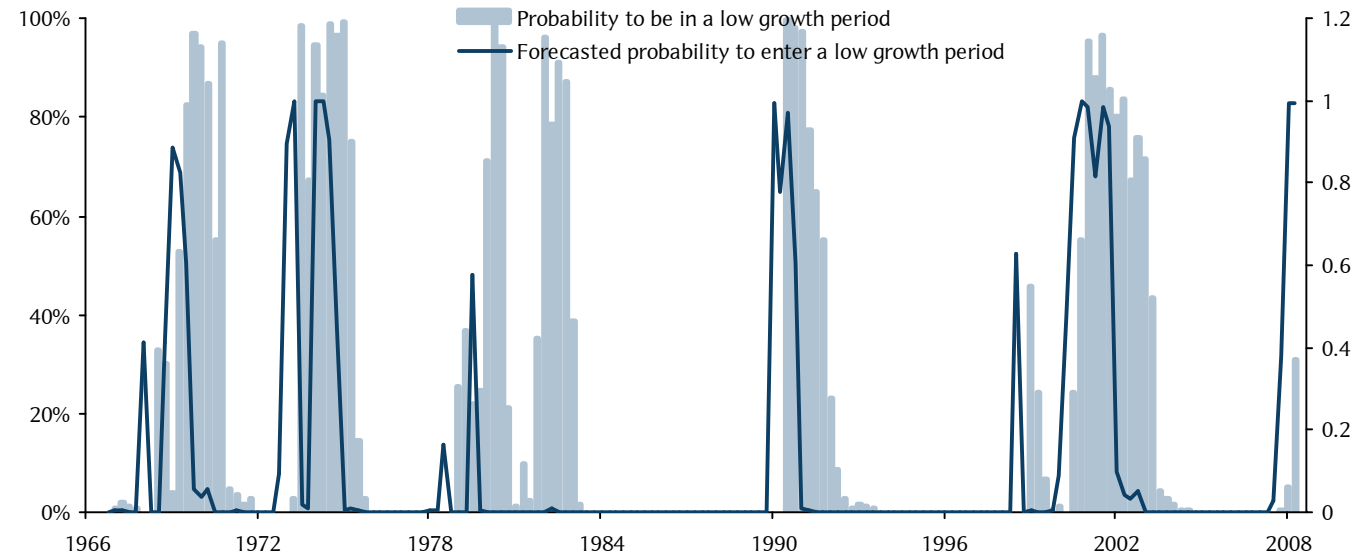
Log-likelihood: -185.23
R2: 57.6%

(*) the β parameter significance value tested via a likelihood ratio test rather than an inverted Hessian approach, due to non-linearity effects.

Source: NBER, Bloomberg, Barclays Capital

Finally, in Figure 24, we plot probabilities that we will enter a low-growth state in the next quarter, based on the SLOOS variable. As the chart shows, there are increases in probabilities prior to actually entering the low growth state. For the current cycle, the transition probability from high to low growth is 2.5% in Q3 07, 40% in Q1 08 and 99.6% in Q2 08. Using Q2 GDP numbers and Q3 SLOOS, we continue to project a close-to100% probability that we will be in a low growth period for the next quarter.

Figure 24: Forecasting power of SLOOS-based model for lower growth periods



Source: Barclays Capital

References

For other analyses on the SLOOS and the credit cycle, see for example, *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007; *Sub-prime volatility: Implications for the credit cycle turning point*, 30 March 2007; Default rate outlook 2008 in *Global Credit Market Strategic Outlook*, 12 December 2007; *Fed rate cuts and the default cycle: Assessing the empirical evidence*, 22 January 2008; and *The Crunch: Is it losing its bite?*, 2 May 2008. Please refer to *Lending standards – rate of tightening back to 2001*, 5 May 2008, for a comment on the Q2 SLOOS numbers.

Technical notes on regime switching

The underlying process driving the switches between regimes in equation (1) is, in this framework, assumed to be a hidden Markov process, using two states with transition matrix **P**. Each i,j, element in **P** refers to the probability of switching into state j conditional on being in state i. The model is estimated via maximum likelihood.

We do not formally test for the significance of two or more separate regimes since this requires extensive Monte Carlo simulation, or similar computationally demanding procedures (see for example Cheung and Erlandsson, 2005). The likelihood ratio statistic between the single state and two-state models is very high, which does not provide final evidence in favour of a two state rather than one state model, but definitely indicates the former.

Technical references

Cheung, Y.W. and Erlandsson, U.G. (2005) 'Exchange Rates and Markov Switching Dynamics', *Journal of Business and Economics Statistics*, 23:314-320.

Hamilton, J.D. (1989). 'A New Approach to the Econometric Analysis of Nonstationary Time Series and the Business Cycle', *Econometrica*, 57:357-384.

4. The Crunch – Is it losing its bite?

What we can learn from lending surveys[7]

The tightening of lending standards continues to be a central theme in the credit crunch. As central banks appear to have averted immediate disaster in the financial system, the next question is: how will traditional corporate lending be affected, with banks' balance sheets still under some pressure? Recent weeks have seen record corporate bond issuance, but is this due to issuance backlog, the anticipation of worse to come, or to a fundamentally improved willingness to extend credit? Lending standards surveys can be very informative in this regard.

With the next round of survey data due in the coming weeks, starting with the Federal Reserve Senior Loan Officer Opinion Survey (SLOOS), expected on 5 May, we present a framework for assessing the implications for credit markets.

- *The net tightening of C&I lending standards has proven a reliable leading indicator of new-loan growth and credit spreads' dynamics, as well as for speculative grade default rates, over the past 40 years, as shown in our analysis.*
- *Based on patterns of standards in the real estate markets, we see a further likely increase in lending standards tightening following the Q1 survey results. This would have negative implications, and we find a lag of about 12-18 months between reported tightening and increasing default rates.*
- *However, we also believe that the lending standards variables will be valuable in terms of signalling the next – positive – turning point in the credit cycle. As a highly persistent variable, any change in the trajectory of standards towards an easing could be informative.*
- *We analyse a number of secondary lending standards studies, which provide perspectives of both the banks and demand side of credit.*
- *We discuss the factors that we believe differentiate the current crisis from previous episodes of tighter lending. We conclude that, although this crisis is unique, willingness to lend to corporates is likely to be at the heart of a potential forthcoming corporate slowdown.*
- *Lastly, we highlight – through recent statements on monetary policy – central banks' concerns that tighter lending standards may potentially affect the broader macro picture.*

[7] *This article was originally published as The Crunch – Loosing its bite?, 2 May 2008. A follow-up, commenting on the next round of lending surveys referred to in the title is available in the next section.*

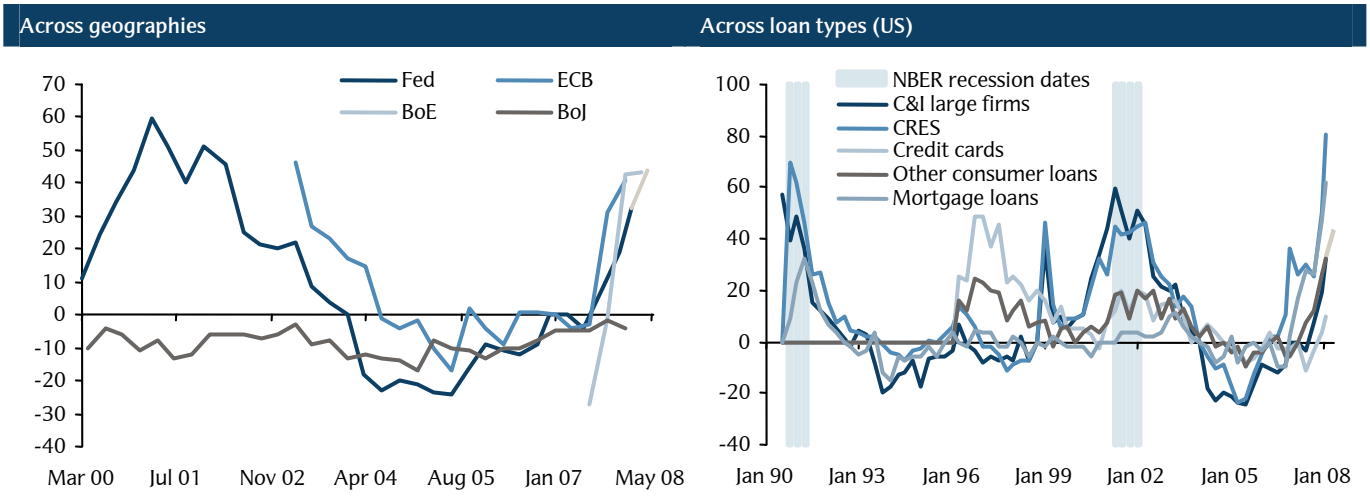
The leading, leading indicator in 2007

Lending standards were one of few efficient indicators of a turning point in the credit cycle last year. The shiver that began with the subprime mortgage market in late-2006 and early-2007 prompted a gradual shift into tighter and tighter lending standards in almost all loan types, see Figure 25. In the January surveys on lending standards, each of the Federal Reserve, Bank of England and European Central Bank found significant proportions of banks having tightened lending standards on commercial and industrial/enterprise loans. Further on in this report, we review other surveys, such as the Duke/CFO Magazine survey, the Survey of Terms for Business Lending and the Greenwich Associates and National Federation of Independent Businesses survey, which all confirm, to a varying degree, the picture of tighter standards for corporate credit.

As this credit crunch unfolds, a key question will be whether central banks' liquidity provisioning actions will be enough not only to save the financial system from a meltdown, which we believe currently seems likely, but also to what extent banks' traditional corporate lending will be affected. We believe the upcoming SLOOS will provide a key data point to form a view of fundamental credit market dynamics. For example, it appears that this has been an important concern in recent monetary policy and financial market actions, as recent comments from the Federal Reserve and the FOMC minutes indicate – we analyse this in more detail below.

In the sections below, we show that tighter lending standards have historically been a leading indicator of increasing high-yield default rates (see Figure 26 right-hand panel), lower new-loan growth rates (left-hand panel), as well as for wider credit spreads. This is not done with the comfortable benefit of hindsight, as the key conclusions about the leading indicator strength were already documented in, for example, *Approaching the turning point? in Global Credit Strategist*, December 2006, or *Subprime volatility: Implications for the credit cycle turning point*, in *Global Credit Strategist*, 30 March 2007, and *Lending standards and default rates: Some numbers,* 5 October 2007. The results are surprisingly robust across different data sets, time periods and methodological approaches.

Figure 25: An unequivocal trend towards tightening of lending standards in H2 07-Q1 08



Source: Federal Reserve, European Central Bank, Bank of England, Bank of Japan, Moody's, Barclays Capital

The Q2 number – For better, for worse

Our model-based forecast: a net tightening of 44% in Q2…

In Figure 25, our central forecasts include data from the following reports: the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices (henceforth under the acronym SLOOS) and specifically, its survey on the tightening of Commercial & Industrial (C&I) lending standards. The forecast is based on a straightforward historical correlation between the commercial real-estate lending standards (currently very tight) and C&I. We forecast a 44% net tightening for Q2 08 versus 32% achieved in Q1 08 based on this. Given the general view on credit today compared with one year ago, this does not seem outrageous per se. The Bank of England's Q2 number, at 42%, and the Q1 08 ECB number is broadly in line with this forecast. The ECB is also due to publish its lending standards survey soon.

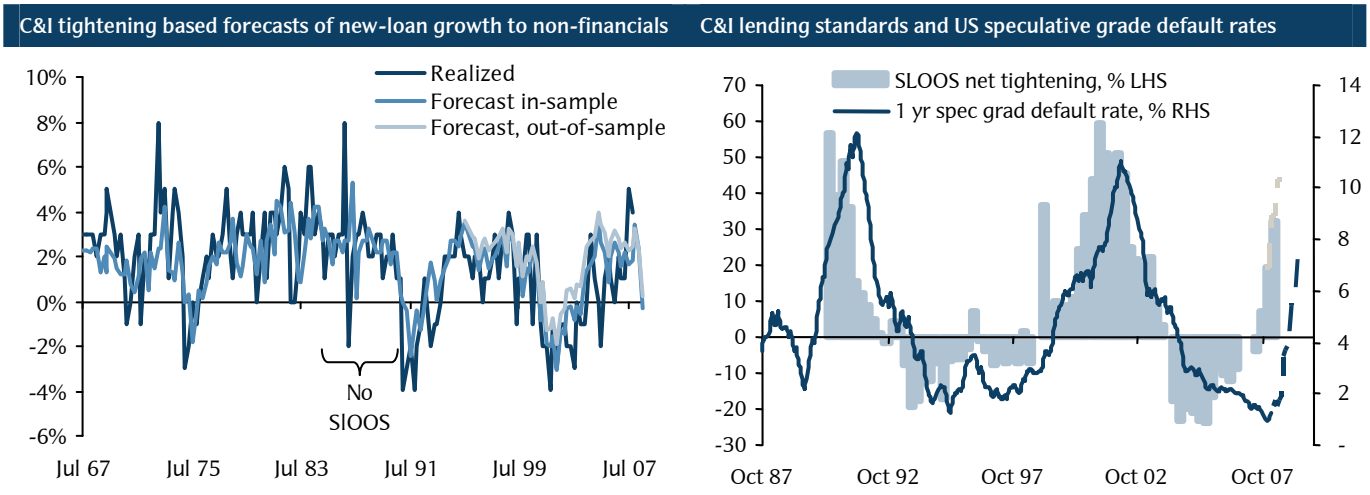
… but less tightening should be seen as a positive indicator for the credit cycle…

We would view a decline, in other words a lower rate of tightening, in the Q2 number versus Q1 as a positive sentiment indicator for the credit cycle. Should this occur, the recent tightening could be viewed as having been a necessary, but short-lived, re-set of credit standards. These can be argued to have been too lax over the past few years, with the subprime loan and leveraged buy-out markets being some of the main beneficiaries. If banks believe the credit environment is improving and hence are less inclined to restrict lending, this is definitely a good sign. However, our empirical framework still suggests a degree of wash-through in the system, as generally, we do not expect positive signs of less strict lending for 12-18 months in some of the slower moving variables, such as new-loan growth, or default rates.

… potentially as a result of the Fed's liquidity provisioning actions

Some of the Fed's and the federal government's actions in the financial markets and economic space over the past few months could drive increases in tightening below what our forecast posits. As we show in one of the sections below, it appears that tight credit conditions has been a key concern for the Federal Open Market Committee (FOMC) in recent discussions on rate decisions in general, and the financial market condition in particular. If the Fed's liquidity injection into the banking system is working, a diminishing rate of lending standards tightening could be a first tentative positive sign.

Figure 26: C&I lending standards as a leading indicator for credit cycle dynamics



Source: Federal Reserve, European Central Bank, Bank of England, Bank of Japan, Moody's, Barclays Capital

Is the credit cycle of 2008 different?

However, isn't this credit cycle different, and thus some of the historical parallels less relevant? Well, yes and no. Traditionally, we would expect a tight credit cycle to be

characterised by corporate profits falling and banks' loan criteria becoming more stringent to avoid losses, making credit dearer for companies and instigating further difficulties in a vicious circle.

Financial innovation: the decoupling hypothesis

The financial innovation in credit over the past few years, definitely involved novel ways of slicing and dicing risk so as to decrease the feedback in this circle. This allowed for a potential diversification of risk away from banks and hence increases in credit availability. As banks became more decoupled from lending risks, the vicious circle became less self-reinforcing. The securitisation engine was the prime example of this, with banks offloading loans by packaging their future cash flows to outside investors, and then using the "freed up" balance sheet space to grant even more loans. On the surface, this resulted in banks decoupling from actual default risk in mortgages, for example.

Financial innovation: the recoupling

Nevertheless, the cycle appears to match historical cycles. When default risk in some of these products eventually picked up, banks were stuck either with large exposures in "the pipeline", ie, in between loan giving and the finalisation of securitisation. Or in other cases, they needed to take on swathes of the risk through reputational concern, as funds and/or special purpose vehicles linked to them were threatening to implode. In effect, the constructs to keep the risks off balance sheet were not operating as intended. Combined with the sheer amount of credit, which banks assumed would not come back onto the balance sheet, these factors have driven banks to a precarious situation. Granting new loans will compete for balance sheet space with the backlog of existing product. As a natural seeding-out process, banks will be less likely to take on lower-quality loans and/or only at considerably higher rates. This will eventually hit borrowers, who will pay higher financing costs, or not receive financing at all. Either way, borrowers at the margin would be more likely to go into default.

A full account of our relevant publications on this topic, as well as other academic papers in this space, is available in the appendix.

Lending standard surveys – The context

The credit condition surveys have been conducted by the Fed since 1967, with a recent uptake on behalf of the European Central Bank (2003), the Bank of Japan (2000) and the Bank of England (2007), and other central banks. Although slightly dissimilar in form, each of the surveys seeks an answer to the question of how banks have *changed* the terms of lending, financial and non-financial, over the past quarter. Therefore, the responses should not be interpreted as a level indicator – eg, we cannot say that lending standards are twice as tight today as last year – but rather as an indicator in changes of sentiment. However, this sentiment is highly persistent, making any changes from previous trends potentially strong predictors of turning points.[8] In the context of the imminent release of the Q2 numbers, if the trend were to budge towards easing of standards, through the rate of tightening decreasing rather than a net easing, this could be the turning point of this credit crunch.

The numbers emerging from the surveys take the form of "net % tightening of lending standards". [9]

[8] *Despite being a "change"/delta variable, the lending standards tightening time-series exhibits many of the traits of a persistent, auto-regressive process. For a technical discourse on the statistical properties of the data please refer to the next section.*

[9] *For further analysis of the latest SLOOS survey in areas beside C&I, please refer to* ***Federal Reserve Commentary: January Senior Loan Officer Survey,*** *4 February, 2008.*

Figure 27: Excerpt from the Fed's Senior Loan Officer survey

January, 2008

Questions 1-6 *ask about commercial and industrial (C&I) loans at your bank. Questions 1-3 deal with change in your bank's lending policies over the past three months. Questions 4-5 deal with changes in demand for C& loans over the past three months. Question 6 asks about changes in prospective demand for C&I loans at your bank, as indicated by the volume of recent inquiries about the availability of new credit lines or increases in existing lines. If your bank's lending policies have not changed over the past three months, please report them as unchanged even if the policies are either restrictive or accommodative relative to longer-term norms. If you bank's policies have tightened or eased over the past three months, please so report them regardless of how they stand relative to longer-term norms. Also, please report changes in enforcement of existing policies as changes in policies.*

1. Over the past three months, how have your bank's credit standards for approving applications for C&I loans or credit lines--other than those to be used to finance mergers and acquisitions--to large and middle-market firms and to small firms changed? (If your bank defines firm size differently from the categories suggested below, please use your definitions and indicate what they are.)

a. Standards for large and middle-market firms (annual sales of $50 million or more):

	All Respondents		Large Banks		Other Banks	
	Banks	Percent	Banks	Percent	Banks	Percent
Tightened considerably	1	1.8	1	3.0	0	0.0
Tightened somewhat	17	30.4	8	24.2	9	39.1
Remained basically unchanged	38	67.9	24	72.7	14	60.9
Eased somewhat	0	0.0	0	0.0	0	0.0
Eased considerably	0	0.0	0	0.0	0	0.0
Total	56	100.0	33	100.0	23	100.0

Source: Federal Reserve

Few question that the current market environment is at least partly responsible for banks' unwillingness to lend, for several reasons. For example, in the inter-bank markets rates have been spiking and in debt-financed private equity deals have been pulled. The subprime mortgage and structured credit markets are seen by many as the main culprits for this dramatic shift from accommodating credit to withdrawing it. Conducting a more in-depth review here is not the purpose of this report. However, it is useful in the context of our analysis that this volatility seems driven, or "caused", by banks starting to restrict credit, rather than an actual downturn in the economy, or a commensurate increase in corporate defaults and loan losses.

Our view that these surveys are significant leading indicators of the credit cycle is supported by several macro-credit indicators – we specifically benchmark the SLOOS data versus credit spreads, new-loan growth rates and default rates. Admittedly, these factors are correlated, but having applied a variety of techniques, we are confident that the historical signalling power of lending standards is non-spurious. In the context of the current market, we also draw conclusions from a number of alternative data sources to ascertain the state of the credit market, and especially the availability of credit for corporates via the banking system. These sources have pros and cons but they all indicate a similar level of credit restriction to the SLOOS in their latest updates.

There are a few academic articles that also review the Senior Loan Officer Survey. Lown and Morgan (2006), discusses the SLOOS in an econometric framework and draws several important conclusions. For example, it finds that lending standards are a much more dominant factor than the loan rate in explaining variations in business loans and output. Weinberg (1995) discusses the cyclicality in lending standards, which is very apparent when looking at the SLOOS data. Bernanke and Lown (1991) look at the impact of tighter credit on a number of macro variables in the context of the 1990-91 economic downturn.

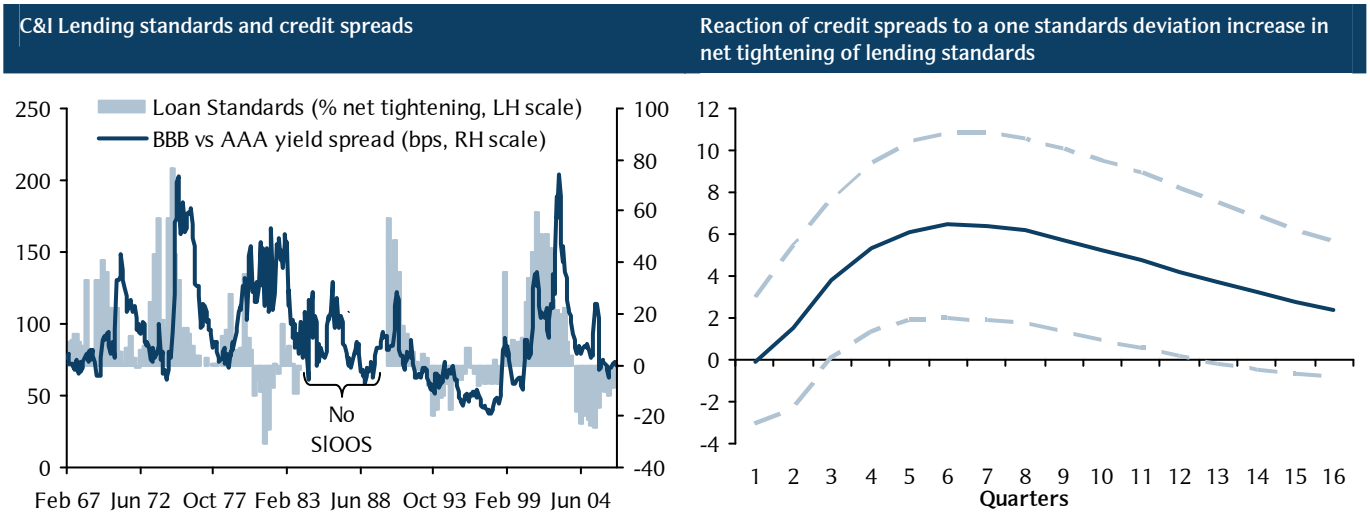
Greenlaw et al. (2008) uses the SLOOS variable in order to identify the credit supply's (rather than demand) effects on GDP in an instrumental variable framework.

Credit valuations

We first explored the linkage between credit spreads and the survey response results in *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007. In the report, we saw a robust empirical link between the probability of entering a high-spread, high-volatility credit environment and the extent of standards tightening in the previous quarter, as well as the shape of the yield curve up to one year previously.

Figure 28 illustrates the evolution of credit spreads versus the survey data over the past forty years.[10] The left-hand panel shows an optical pattern of lending standards tightening increasing well in advance of credit spreads increasing and becoming more volatile. There is a strong cyclical pattern in lending standards, making them even more useful. For example, during the past two cycles, once net % tightening has become positive it has trended towards more and more tightening, giving plenty of advance notice that downside risks were increasing. The right-hand panel of Figure 28 illustrates how a one standard deviation increase in lending standards tightening propagates into wider credit spreads over the forthcoming quarters. We see the maximum effect in five-to-six quarters after the tightening occurs. We also conclude that the relationship is straightforward over time in that tighter standards give wider spreads.

Figure 28: The Senior Loan Officer Survey net C&I tightening and credit valuations



Source: Federal Reserve, Moody's, Yield Book, Barclays Capital

New loan growth

Another important diagnostic of the state of the credit market is new-loan growth. This measure should be more precisely related to banks' willingness to lend, as total loan growth includes draw-downs of revolver facilities, which should be negatively correlated with banks' willingness to lend.

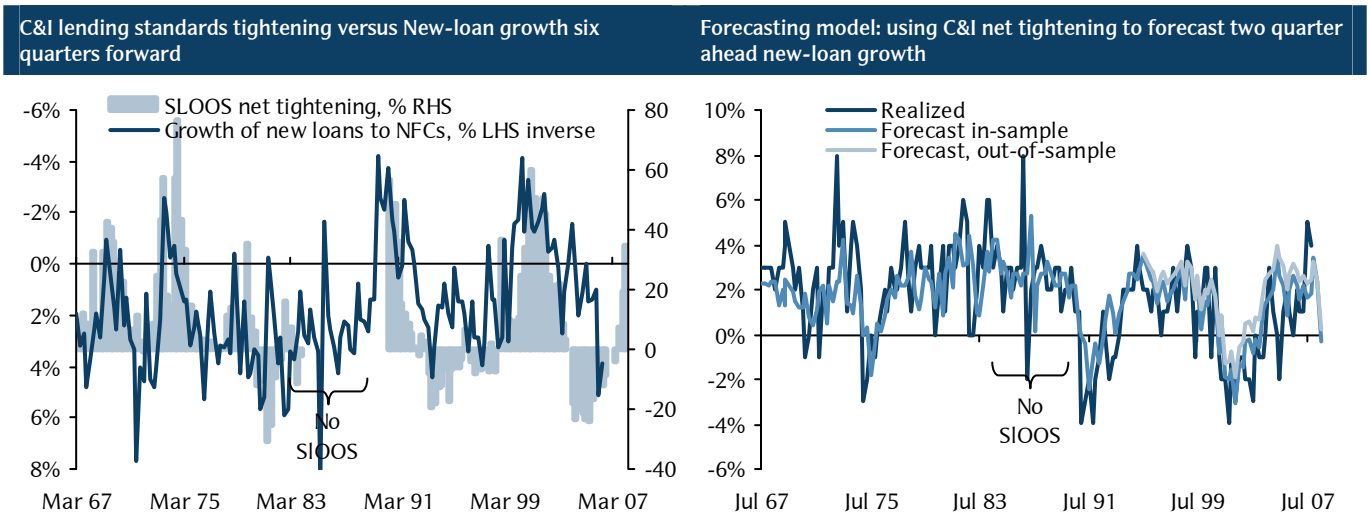
In Figure 29, we plot an extended version of the analysis conducted in *Euro Weekly: Why euro area bank loan growth to companies is bound to slow*, 28 March 2008. The right-hand panel shows that new-loan growth has been fairly volatile, especially in the earlier part

[10] *The credit spread data is by no means perfect, as it is only very approximately duration matched, and contains switches between different data providers and hence switches between credit universes. We believe, however, that it reflects the best possible compromise between precise data and a long-time series for the purposes of this article.*

of the sample. Still we see – note that the loan- growth scale is inverted – a clear pattern of troughs in loan growth, with around six quarters lagging peaks in C&I tightening.

We develop a small forecasting model for new-loan growth on the basis of the SLOOS. The forecasts, for two quarters ahead, are plotted in the left-hand panel of Figure 29. If the SLOOS survey of previous quarters and the current one have the same relationship to new-loan growth as over the past 40 years, it appears likely that new-loan growth rates will drop to close to zero in the coming quarters.

Figure 29: C&I lending standards and non-financial loan growth six quarters ahead



Source: Federal Reserve, Barclays Capital

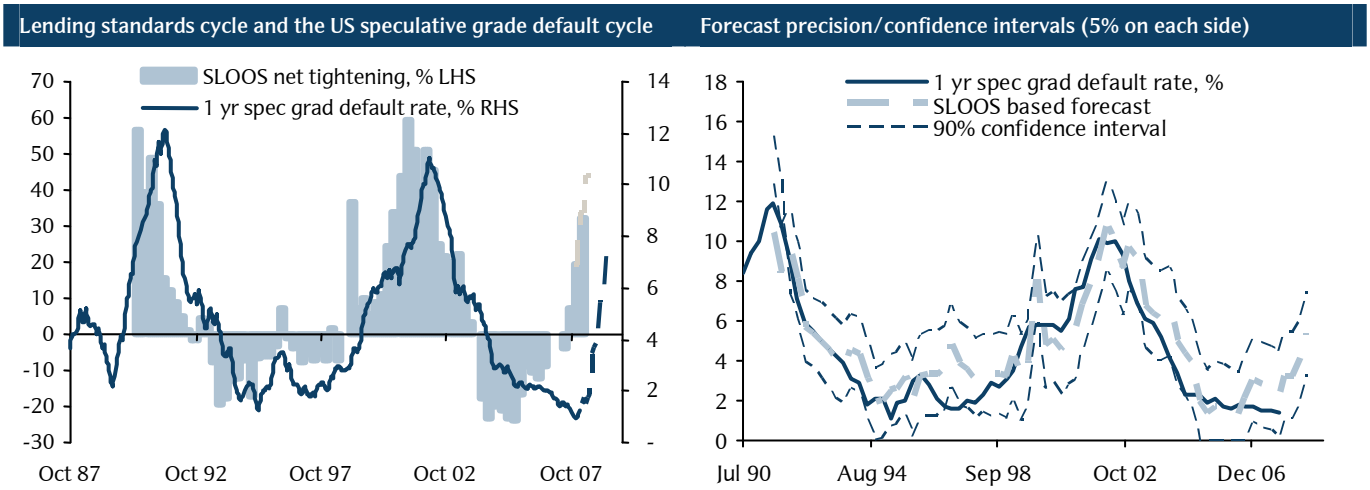
The default cycle

Financial valuations, such as credit spreads, will entail a certain degree of time-varying risk premia, which may distort the linkage between tighter credit conditions and valuations. Defaults, however, are absolute and do not suffer from a valuation bias, making them an interesting alternative with which to gauge whether lending standards are useful in formulating a view on fundamental corporate health. If banks are more restrictive in terms of lending, the marginal borrower becomes more constrained in refinancing debt and hence has a heightened probability of default – but how strong is this variation?

Remarkably strong, based on the evidence of the past two cycles – Figure 30. Both in 1990-91 and 2001-02, we saw C&I lending tightening peak (at around 50-60% net tightening) approximately four quarters before default rates reached their cyclical peaks. For a quantitative dissection of this dynamic please refer to *Rate cuts: A bearish signal for credit?* 22 January 2008.

High-yield default rates are close to their historical lows, although they have nudged up a bit lately. Our US high-yield strategist calculates a current run-rate of around 3.1% in terms of issuer-weighted default rates (see *High Yield Advisor*, 26 March 2008). Recently, Moody's released an update default rate forecast, with a US speculative grade default rate forecast to be around 6% by year end. Current CDX.HY index levels imply default rates in the same in line with Moody's forecast.

Figure 30: Credit conditions and the default cycle, 1987-2008



Source: Federal Reserve, Moody's, Barclays Capital

As we can identify a strong empirical relationship between forward speculative grade default rates and current tightening of standards, see *Lending standards and default rates: Some numbers*, 5 October 2007, our forecast for Q2 08 tightening can also be translated into a default rate forecast for Q2 09 12mth rolling. Previously, we forecast US speculative grade default rates to rise to c.5.3% in the final months of 2008 (on a 12mth rolling basis). Given even further tightening of lending standards along the lines of our forecast Q2 number of 44%, we see defaults rising to 8% in H1 09. As shown in Figure 30, this default rate would still be significantly below the peaks in 1991 and 2002, albeit a very drastic rise from current historical levels. We would require as swift a rise in default rates as in 1990-91 to actually achieve such levels. We also overlay the confidence interval for the forecast (5% on each side) in the right-hand panel of Figure 30, showing the interval rather than just the point forecast.

FOMC statements

Another interesting question is: how will policy makers respond to these historically effective pieces of information? The evidence is mixed. For example, the ECB has indicated that it prefers to observe direct loan growth to non-financials rather than using the lending standards surveys to ascertain credit availability to corporates (see *Euro Weekly: Why euro area bank loan growth to companies is bound to slow*, 28 March 2008). From the Federal Reserve's side, anecdotal evidence suggests that historically, these surveys have not played a major part. However, with the current difficult decision situation emanating from the credit market, it appears that the FOMC has started to pay attention to the surveys.

In Figure 31, we tabulate the first paragraph of the FOMC statement over the past year together with some relevant data points on net tightening, credit indices, rate decisions and the timing of information. We highlight the references to "tighter", "tight" or "tightening" credit conditions, whereby we can see that it has been a component in all of the four latest statements, and in seven out of the 12 statements over the past year. The latest two statements note that tight credit conditions have a potential impact on growth – "tight credit conditions and the deepening housing contraction are likely to weigh on economic growth over the next few quarter."

We think that the rate decision taken on the inter-meeting cut on 22 January 2008, is particularly useful to illustrate how the table works. The SLOOS was conducted up until 17 January, which makes it likely that the FOMC had the survey results (from 19.2%

tightening in Q4 to 32.2% in Q1 08) when the surprise cut decision was taken. As can be seen in the highlighted text, the FOMC explicitly relates its decision for a further tightening of credit conditions to the 75bp rate cut. Additionally, the actual SLOOS was not made public until 4 February.

More details on the concerns surrounding, and the signalling value of the SLOOS in the eyes of the Fed, can be gained from the following excerpt from the FOMC minutes, 18 March 2008:

FOMC discussions in terms of credit availability

"*Evidence that an adverse feedback loop was under way, in which a restriction in credit availability prompts a deterioration in the economic outlook that, in turn, spurs additional tightening in credit conditions, was discussed. Several participants noted that the problems of declining asset values, credit losses, and strained financial market conditions could be quite persistent, restraining credit availability and thus economic activity for a time and having the potential subsequently to delay and dampen economic recovery.*"

Another account of the concerns surrounding lending standards is available in Governor Mishkin's statement:

Mishkin's statement on credit supply, 14 April 2008

*"The trend toward tighter credit supply conditions for small businesses has continued since last fall. For example, in the Board's most recent Senior Loan Officer Opinion Survey, conducted in January, a net one-third of the domestic banks surveyed – a larger net fraction than in the October survey – reported that they had tightened their lending standards on commercial loans to small firms over the previous three months. Significant net fractions of banks also indicated that they had tightened price terms on commercial loans to both small and large firms. The net fractions of banks reporting tighter lending standards and pricing terms on commercial loans in the January survey were relatively high by historical standards going back to 1990." S*tatement before the Committee on Small Business and Entrepreneurship, US Senate on 16 April 2008.

Another data point that has been added in, just to illustrate the leading effect of yield curve inversions and the credit cycle, as highlighted in *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007, is the slope of the Treasury 2s10s on that date one year earlier. As we can see, the 15bp inversion one year earlier almost anticipates this shift to much more negative sentiment in the credit market. We have also added a final column to the on-the-run CDX.IG credit index level given at each FOMC meeting, as a sentiment indicator of credit valuations at that time.

Figure 31: Following the Fed – comments on credit conditions tightening in the 2007-08 downturn

FOMC statement date	Federal Funds target chg	FOMC statement, 1st paragraph	C&I tightening (BarCap forecast)	C&I tightening from cyclical trough	Date of latest SLOS available to FOMC	Treasury 2s10s, 12 months prior (bps)	CDX.IG 5y level
21 Mar 2007	0	Recent indicators have been mixed and the adjustment in the housing sector is ongoing. Nevertheless, the economy seems likely to continue to expand at a moderate pace over coming quarters.	0%	24.1%	5 Feb	-2	35
9 May 2007	0	Economic growth slowed in the first part of this year and the adjustment in the housing sector is ongoing. Nevertheless, the economy seems likely to expand at a moderate pace over coming quarters.	-3.9%	20.2%	17 May	16	36
28 Jun 2007	0	Economic growth appears to have been moderate during the first half of this year, despite the ongoing adjustment in the housing sector. The economy seems likely to continue to expand at a moderate pace over coming quarters.	-3.9%	20.2%	17 May	-3	40
7 Aug 2007		Economic growth was moderate during the first half of the year. Financial markets have been volatile in recent weeks, credit conditions have become tighter for some households and businesses, and the housing correction is ongoing. Nevertheless, the economy seems likely to continue to expand at a moderate pace over coming quarters, supported by solid growth in employment and incomes and a robust global economy.	7.5%	31.6%	13 Aug	-2	72
17 Aug 2007	n/a, inter-meeting comment	Financial market conditions have deteriorated, and tighter credit conditions and increased uncertainty have the potential to restrain economic growth. In these circumstances, although recent data suggest that the economy has continued to expand at a moderate pace, the Federal Open Market Committee judges that the downside risks to growth have increased appreciably.	7.5%	31.6%	13 Aug	-4	73
18 Sep 2007	-0.5%	Economic growth was moderate during the first half of the year, but the tightening of credit conditions could intensify the housing correction and restrain economic growth more generally. Today's action is intended to help forestall some of the adverse effects on the broader economy that might otherwise arise from the disruptions in financial markets and to promote moderate growth over time.	7.5%	31.6%	13 Aug	-7	60
31 Oct 2007	-0.25%	Economic growth was solid in the third quarter, and strains in financial markets have eased somewhat on balance. However, the pace of economic expansion will likely slow in the near term, partly reflecting the intensification of the housing correction. […]	19.2% (19.5%)	43.3%	5 Nov	-10	60
11 Dec 2007	-0.25%	Incoming information suggests that economic growth is slowing, reflecting the intensification of the housing correction and some softening in business and consumer spending. Moreover, strains in financial markets have increased in recent weeks. Today's action, combined with the policy actions taken earlier, should help to promote moderate growth over time.	19.2% (19.5%)	43.3%	5 Nov	-14	78
22 Jan 2008	-0.75%	The Committee took this action in view of a weakening of the economic outlook and increasing downside risks to growth. While strains in short-term funding markets have eased somewhat, broader financial market conditions have continued to deteriorate and credit has tightened further for some businesses and households. Moreover, incoming information indicates a deepening of the housing contraction as well as some softening in labour markets	32.2% (34%)	56.3%	4 Feb	-15	117
30 Jan 2008	-0.50%	Financial markets remain under considerable stress, and credit has tightened further for some businesses and households. Moreover, recent information indicates a deepening of the housing contraction as well as some softening in labour markets.	32.2% (34%)	56.3%	4 Feb	-9	104
18 Mar 2008	-0.75%	Recent information indicates that the outlook for economic activity has weakened further. Growth in consumer spending has slowed and labour markets have softened. Financial markets remain under considerable stress, and the tightening of credit conditions and the deepening of the housing contraction are likely to weigh on economic growth over the next few quarters.	32.2% (34%)	56.3%	4 Feb	-6	160
30 Apr 2008	-0.25%	Recent information indicates that economic activity remains weak. Household and business spending has been subdued and labour markets have softened further. Financial markets remain under considerable stress, and tight credit conditions and the deepening housing contraction are likely to weigh on economic growth over the next few quarters.	na (44%)	na	30 Apr	2.9	95

Source: Federal Reserve, Barclays Capital

Contrasting data and surveys

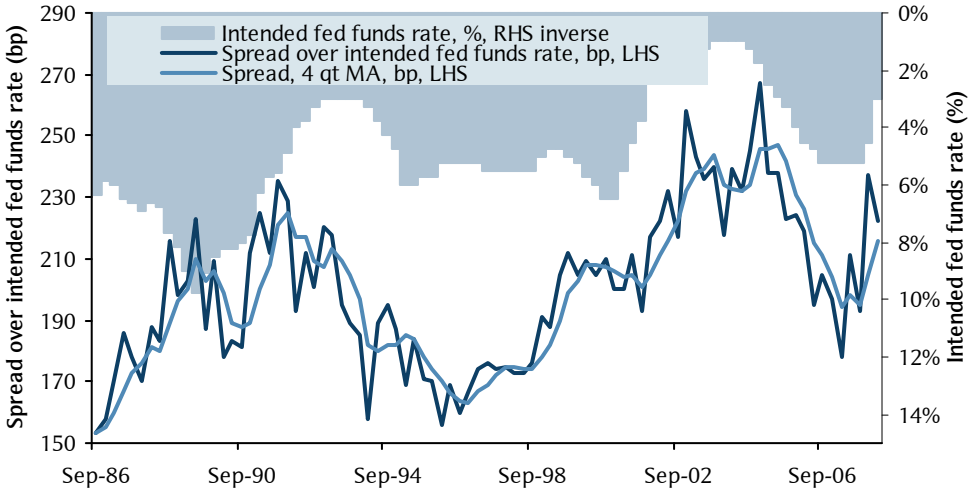
The SLOOS is just one survey among several in lending standards, with the – for the statistician at least – immense advantage of a long time series. It is useful to also study the current results of related data that can capture potential dimensions in which the SLOOS could be misleading.

Survey of Terms for Business Lending

Spread over fed funds' rate increasing on C&I loans, but the Fed has cut very aggressively

The Federal Reserves also conducts surveys on the actual loan costs across the US. This is slightly different from the SLOOS, as it focuses purely on the price charged for a loan rather than any on the conditions. We plot the key results on C&I loan spreads over time in Figure 32. The historical dynamics of this series appear somewhat ambiguous, not least, in our view, because we are looking at quite different levels of the fed funds' rate over the two different cycles. Nonetheless, there is an undeniable increase in the spread over the fed funds' rate in the past two quarters. However, this should be taken in the light of the Fed cutting rates at an unprecedented pace over this period, and the question is: how quickly has this been reflected in banks' calculations of loan spreads? We would hence be sceptical of this as a signal towards "harder-to-come-by" credit, if used in isolation.

Figure 32: C&I average loan spread over fed funds according to Survey of Terms for Business Lending



Source: Federal Reserve

Greenwich Associates

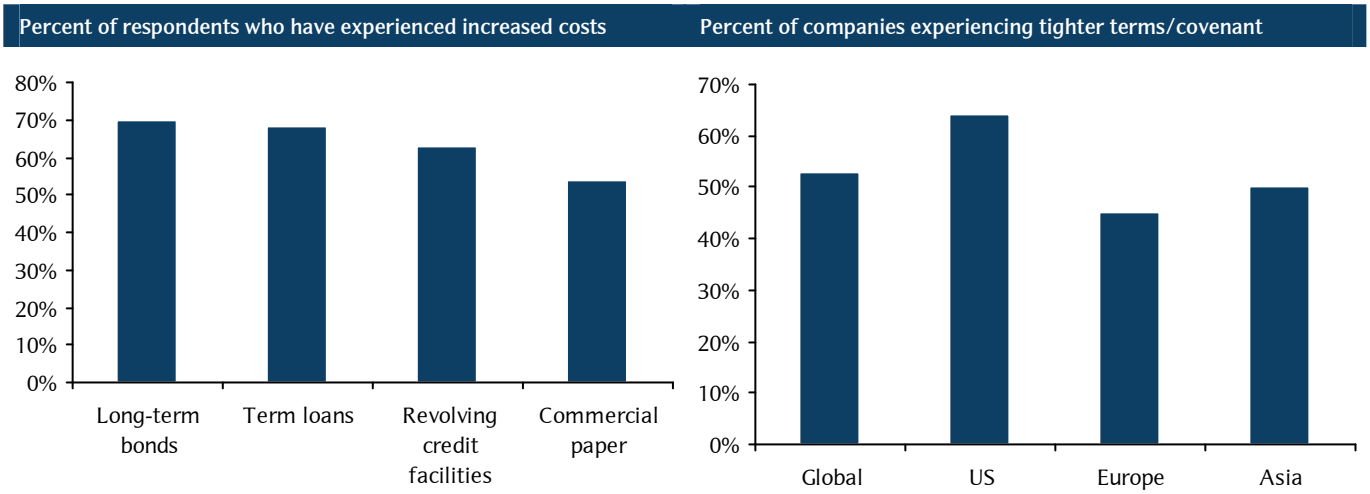
Large corporates see increased borrowing costs globally…

Greenwich Associates conduct a survey of large companies (200+) globally, which makes it quite useful to gauge the demand-side sentiment on lending standards, on a global scale. The latest survey was conducted in March 2008 and conveys a somewhat bleak picture in terms of the credit provisioning that currently prevails. Some key points are shown in Figure 33. The left-hand panel shows how the cost side of borrowing has deteriorated for the majority of companies, and across several types of financing. Interestingly, in the commercial paper category, 54% of responses indicate increased costs. This is actually the lowest number among the four categories in terms of respondents seeing higher costs, somewhat different from what many market observers seemed to believe during the (asset-backed) commercial paper market stress this year and last. With regard to the C&I loan category in the SLOOS, the categories on term loans and revolving credit facilities are probably the most relevant, with 68% and 63% of respondents, respectively, replying that costs have increased.

… Terms and covenants: 54% respond "tighter" globally, 64% in the US

In the right-hand panel of Figure 33, we plot the Greenwich Associates data on how corporates have seen their lending standards change. The response is uniform in that in all regions, more than 40% of corporates have tighter terms and covenants. In aggregate, the global numbers reach above 50% – the US is the most affected, with 64% of corporates responding that they are seeing tighter terms and covenants.

Figure 33: Greenwich survey of large companies globally, March 2008



Source: Greenwich Associates

National Federation of Independent Businesses NFIB

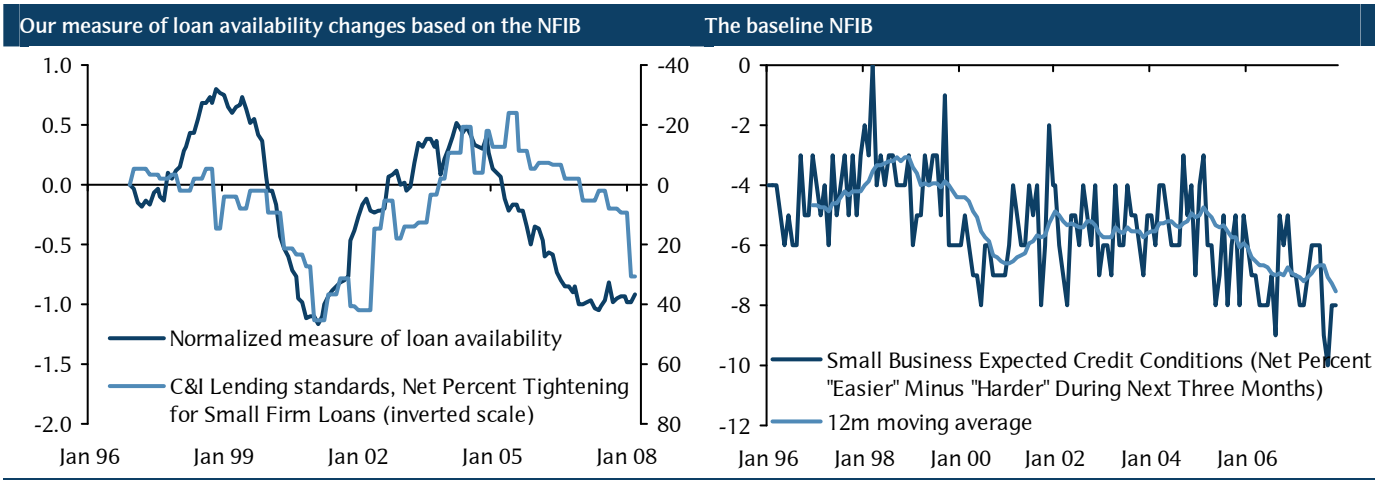
Immense negativity in the NFIB surveys – questionable

The NFIB conducts surveys across a large number of small US businesses, asking a diverse set of questions. We focus here on the set of questions regarding credit conditions. Some sample results are available in Figure 34. First, we note the persistence negativity in this survey. It has never (!) indicated that small businesses expect credit to be easier to come by, which is quite a feat in one of the most credit friendly cycles seen in history. This may be due to how the questions in the survey are posed, or other methodological issues. To obtain a somewhat more cyclical number, we instead take the expectations number in a normalised form through the following calculation:

Normalised NFIB number = (availability today minus four-year average) divided by four-year standard deviation

We plot this number in the left-hand panel of Figure 34. Still, by this measure, small businesses were quite negative on expectations for obtaining credit even in 2006, before the subprime problem surfaced. Over the past 10 years, however, we see that this normalised measure correlates fairly well with the SLOOS C&I tightening of standards, as measured by the small firm category. From that perspective, it seems as if the SLOOS is catching up with the NFIB's negativity rather than vice versa.

Figure 34: NFIB survey: expected credit conditions



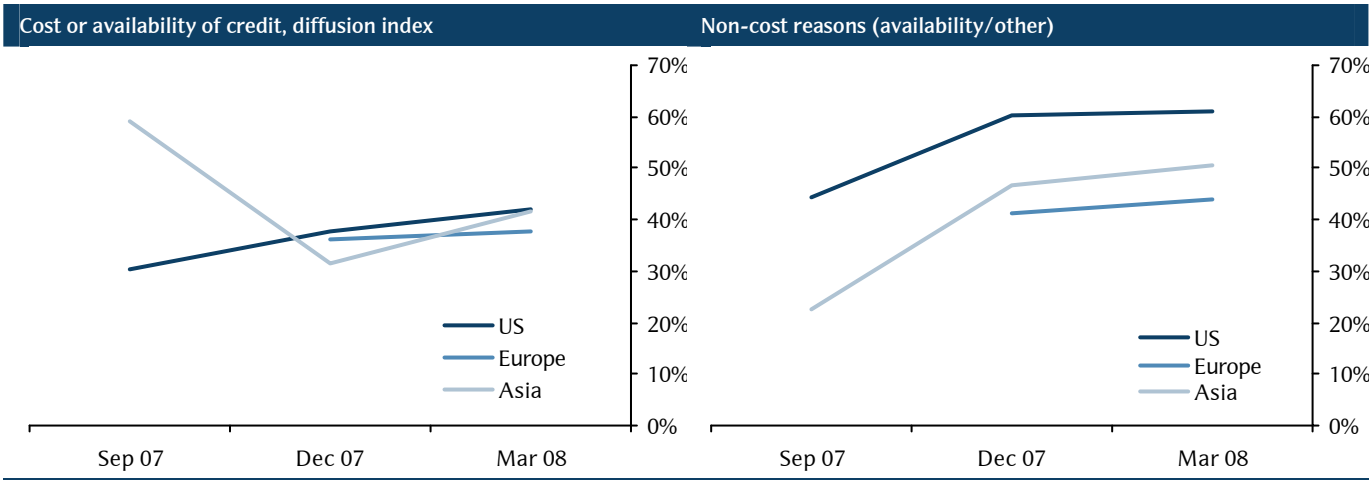
Source: National Federation of Independent Businesses, Federal Reserve, Barclays Capital

We also note, however, that the NFIB survey looks at "actual" – how respondents have perceived changes in credit availability over the past few months – rather than "expected" availability. The "actual" number, currently standing at net -7% (for March), is relatively low compared with the historical average (-3.8%) but is up from the historical low of -9% in September 2007.

Duke/CFO Magazine Global Business Outlook Survey

The Duke/CFO magazine survey is also a global survey, which has added specific questions on credit availability/cost in the past three surveys. This gives us little historical comparison on the survey, as it only captures responses after the inception of the current credit crisis. We can see in the left-hand panel of Figure 35 how credit has become dearer, according to around 40% of CFO surveyed globally.[11] The level has slightly increased over the past two quarters. In the right-hand panel, we gain some more information on how credit has become tighter. For respondents answering "Yes" in the previous question, around 50% globally answered that non-cost factors, ie, availability and other factors, were behind the affirmative response on dearer credit. This has been increasing over the past few quarters, indicating that non-price factors are important in this tightening.

Figure 35: Duke/CFO Global Business Outlook Survey



Source: National Federation of Independent Businesses, Federal Reserve, Barclays Capital

[11] *We use a diffusion index for this calculation, whereby the weight on CFOs responding "Yes, very much" is twice that of those responding "Yes, somewhat". The remaining alternative is simply "No".*

An eloquent discussion about recent SLOOS results and other credit-related variables confirming, or disproving, those numbers is available in Governor Mishkin's statement to the Committee on Small Business and Entrepreneurship, US Senate on 16 April, 2008.

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5. Lending standards – rate of tightening back to 2001

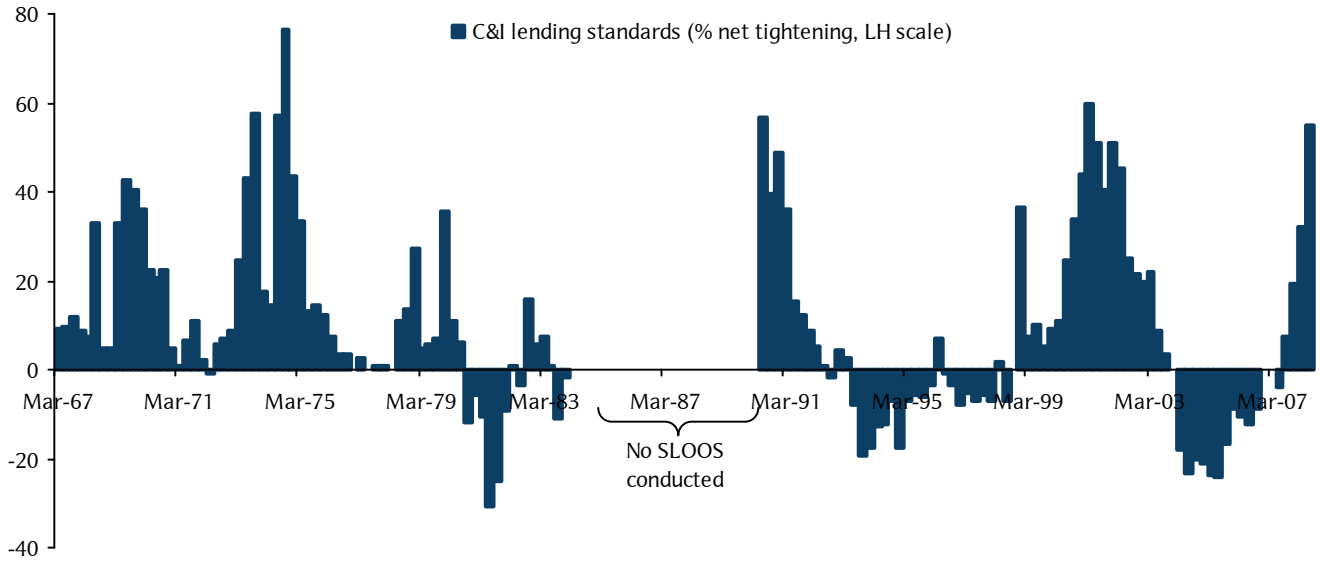
Evidence from the Q2 08 SLOOS[12]

Net tightening of commercial and industrial (C&I) lending came in at 55.3% for the survey conducted in April. This is very elevated and has clear negative implications for credit. As can be seen in Figure 36, this reading is the highest since Q1 01, the third highest reading since the SLOOS was restarted in 1990 and the sixth highest reading since the survey was originally started in 1967. It can also be compared with 32.3% net tightening in the Q1 survey, 41% in the Q1 ECB survey and 43.2% in the Bank of England Q2 survey.

In *The Crunch: Losing its bite?* 2 May 2008, we highlighted some of the empirical evidence with regards to the survey results being a strong forward-looking indicator of the credit cycle dynamics. We update some our forecasts using the Q2 numbers in Figure 38. For example, due to the 55% tightening, we would project a speculative grade default rate of about 9% in H1 09 (12mth rolling). Please be advised that these forecasts are based on a non-complex lead-lag correlation between lending standards and macro-credit variables without taking technical specifics of the current credit market into account. Still, they have proven to be robust over 20-40 years in terms of indicating the general direction of credit dynamics, as well as being truly leading indicators.

We forecasted net C&I tightening to come in at 44% based on recent tightening in commercial real estate standards (CRES) and a closure of the gap between C&I and CRES, which has previously given very precise forecasts. We assumed the extremely high levels of tightening in CRES would abate, but this has not happened, which explains why we underestimated the extent of C&I continuing to tighten. The tightening appears to happen across all types of lending, as shown in left hand panel of Figure 37.

Figure 36: Net C&I tightening over the past 40 years – back to cyclical highs of tightening



Source: Federal Reserve

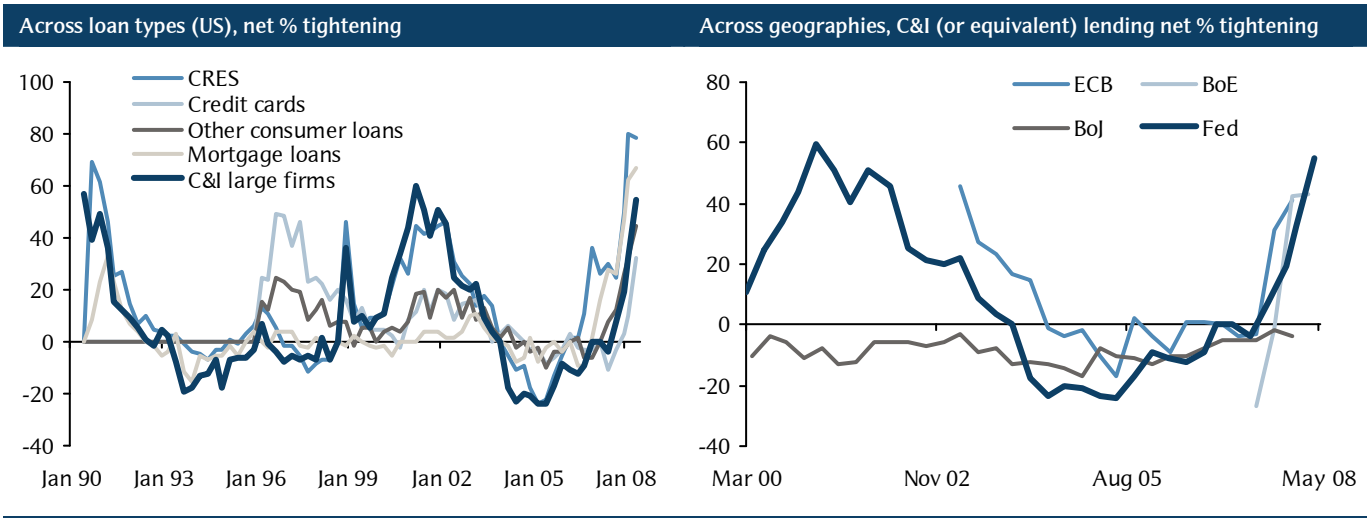
Other interesting points in the survey include:

- Mortgage loans: Q1 was 62%, Q2 reading is 67%. Tightening in prime mortgages goes up to 62%, whereas the number for non-traditional is 75% (down from 85% in Q1) and 78% for subprime (up from 71% in Q1).

[12] *This article was originally published as Lending standards – rate of tightening back to 2001, 5 May 2008.*

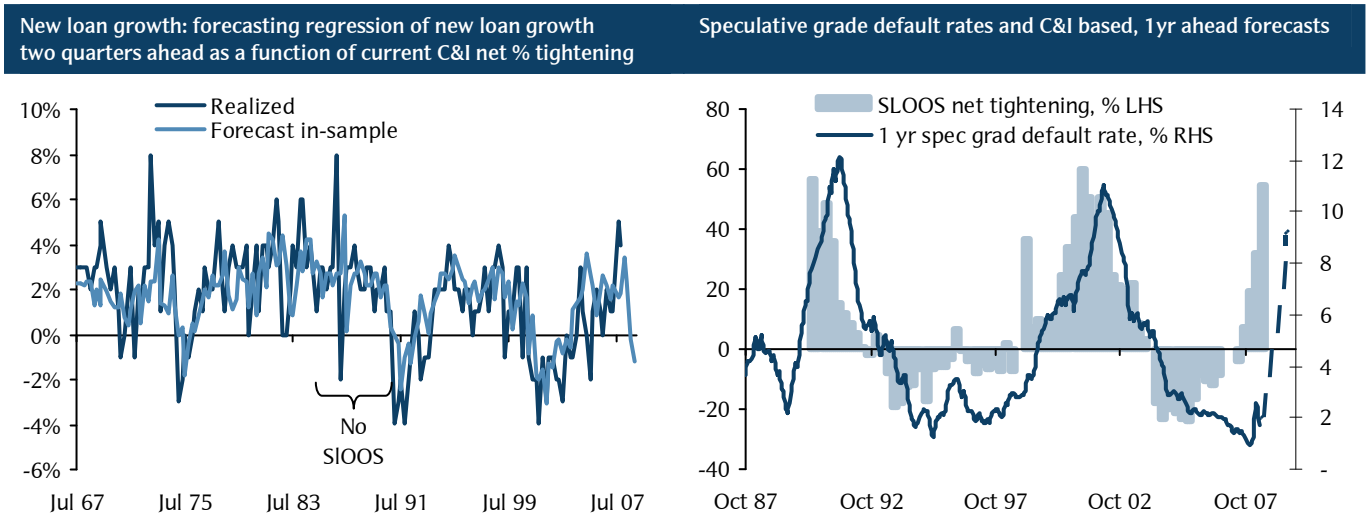
- Commercial real estate: Q2 hit 78%, down from 80% in Q1. This almost unchanged reading suggests continued very restrictive tightening of lending
- Credit cards: increase in tightening from 10% of respondents in Q1 to 32% in Q2. This suggests the beginning of a significant spillover from real estate and corporate tightening into the consumer sector.
- Other consumer loans: Q2 is 44%, up from 32% in Q1. Again, appears to reflect a fair bit of spillover effects.
- C&I for small firms (annual sales of less than $50mn): Q1 was 30% and Q2 goes to 52%. This is particularly important as these corporates, being relatively small, cannot tap into debt capital markets as easily at the larger firms. Hence, although there has been record recent issuance in corporate bond markets, smaller firms may be hitting quite different financing conditions.

Figure 37: The lending standards perspective – across time, loan types and geographies



Source: Federal Reserve, Bank of England, Bank of Japan, European Central Bank, Barclays Capital

Figure 38: Lending standards and credit cycle dynamics – increasing rate of tightening implies slower new loan growth and higher future speculative grade default rates



Source: Federal Reserve, Moody's, Barclays Capital

6. Rate cuts – A bearish signal for credit?

An empirical assessment[13]

The Federal Reserve's 75bp surprise cut of the fed funds rate this week has important implications for the credit market. Empirically, there is a strong link between the inception of a sustained period of rate cuts and increases in speculative-grade default rates over the short to medium term. Moreover, with lending standards being flagged explicitly as a growing concern, we revisit our quantitative frameworks for analysing survey data. We project the January 2008 C&I lending standards net number of respondents reporting a tightening to be 34%, a significant uptick to the bearish side from the November number of 19%.

Bearish signal or forcefully pre-emptive move?

Although the timing and scale of the FOMC's inter-meeting rate cut this week may well have been motivated by the extreme equity market volatility over the preceding days, there are also indications from the Fed that they do see further concerns in the credit markets. Specifically, the second sentence of the FOMC press release of 22 January 2008 says:

"While strains in short-term funding markets have eased somewhat, broader financial market conditions have continued to deteriorate and credit has tightened further for some businesses and households."

These concerns come at a time when there is increasing interest from a broad range of commentators on lending standard surveys from the world's central banks. The highlighting of this comment in the press release suggests to us that the tightening in corporate lending standards, non-economical as well as economical, that we saw in H2 07 may well have continued. Potentially, the Federal Reserve has some preliminary indications on the outcome of the Senior Loan Officer Survey, due to be around the official FOMC meeting on 29-30 January. In normal circumstances, the closing date of the survey would be around now, as it is conducted (with some discretion) in the two weeks prior to the FOMC meeting.

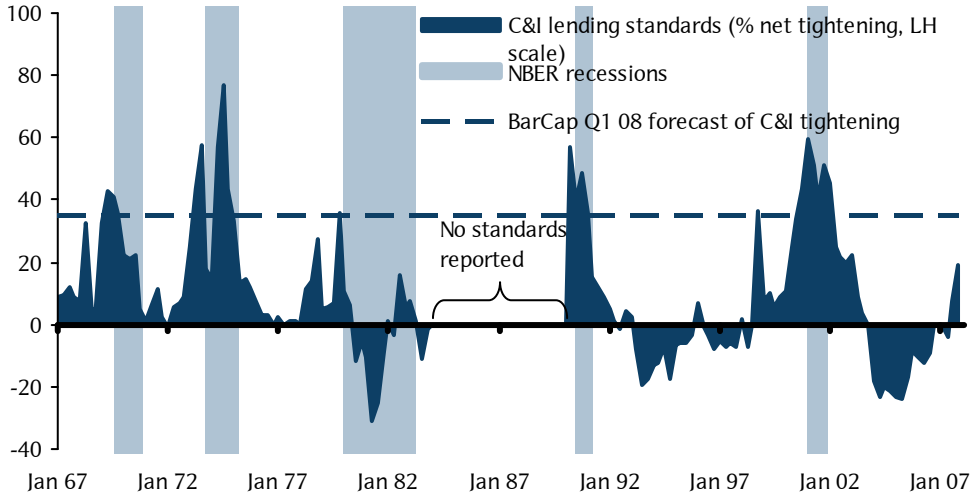
Based on a quantitative approach, not taking into account the FOMC statement, we estimate that the January survey will show around a net 34% commercial and industrial (C&I) lending standards tightening, with most of the risk to this forecast on the upside. We base this forecast on the Q4 data together with recent negative lending standard numbers in Europe and the UK (see ***ECB Lending survey – the credit perspective***, 18 January, 2008 and ***Lending standards constriction: The UK joins in,*** 4 January 2008). If our forecast materialises, tightening would be markedly up from 19.2% in November 2007. Further detail on the methodology behind the forecast is provided below.

Figure 39 gives an idea why a number in the 30%+ range could be worrying as a signal for an economic slowdown. It overlays C&I lending standards net tightening with NBER official recession dates over 1967-2007. The dashed line indicates the 34% forecast based on our statistical model. As we can see, the past five recessions have been preceded by significant tightening of lending standards with the only false signal around the LTCM crisis in 1998. Obviously, this signal should be interpreted in conjunction with incoming macro economic data and a broader economic perspective. Please refer to "Forecast revision: US federal funds outlook" in this *Alpha* for Barclays Capital's house view on the US economic outlook. For a perspective of the recent strong tightening data in Europe, please see 'ECB bank lending survey suggest credit conditions moving to recessionary levels', ***Global Economic Daily I***, 18 January 2008).

[13] *This article was originally published as Rate cuts – A bearish signal for credit? 25 January 2008.*

A further exposé of the relationship between the business and credit cycles and the lending standards data can be found in "The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey" (*Journal of Money, Credit and Banking,* 2006) by Donald Lown and Cara Morgan. In an earlier paper: "The Credit Crunch" (*Brooking's Papers on Economic Activity*, 1991*),* Ben Bernanke and Cara Morgan find a significant effect of the 1990-91 credit crunch on the severity of that recession. They argue, however, that the reduction in bank lending effect on growth at that time was fairly small.

Figure 39: C&I lending standards tightening and the business cycle

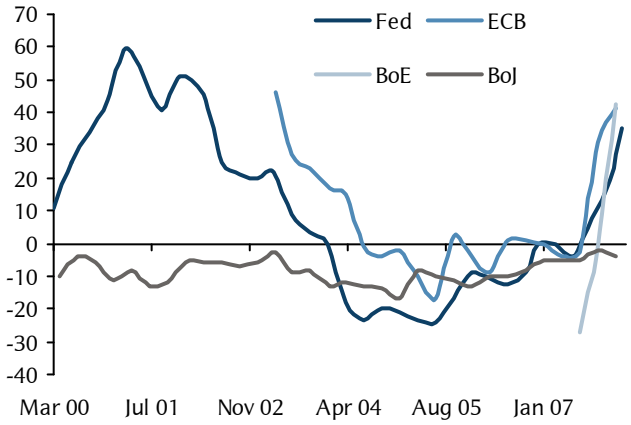


Source: Federal Reserve, Barclays Capital

Taken together, with the recent FOMC statement as the most pronounced data point, these earlier discussions indicate to us that the Federal Reserve is cognisant of the tightening in credit standards that is occurring. Global lending standards trends are clearly indicating a rapid tightening too (Figure 40).

Figure 40: Global C&I lending standards tightening monitor

Region	Tightening	Date	Historical
Euro	41.0%	17 Jan 07	
UK	42.2%	3 Jan 2008	
US	19.5% (frc 34%)	5 Nov 07	
Japan	-4.0%	23 Jan 08	



Source: Federal Reserve, European Central Bank, Bank of England, Bank of Japan, Barclays Capital

The tightening of corporate lending standards indicated in survey studies last year appears to have correctly anticipated the downturn in the credit cycle. With the default of Quebecor, a Canadian company in the CDX.HY9 index, the increase in speculative grade default rates postulated in our empirical model of lending standards and the

default cycle, gives the first tentative signs of an actual turn in the default cycle as well. Recently, Moody's upgraded its default projection for US speculative grade to 5.3% for FY 08, just a shade south of our forecast of 5.4% (see *Q4 lending standards: Tighter again*, 6 November 2007).

Forecasting the C&I tightening of the Q1 08 survey

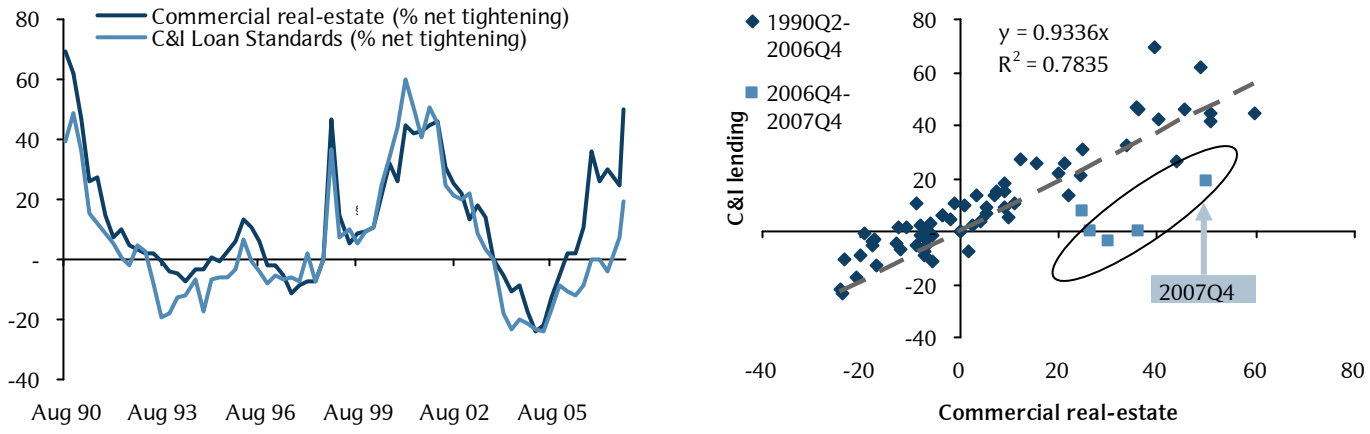
Similar to earlier studies, we project a C&I tightening number in the new survey based on a displacement between commercial real-estate lending standards and C&I lending standards. As Figure 41 shows, these variables have correlated very closely over the past two years, with only a displacement in the past few quarters. This displacement appears to be driven by commercial real estate being hit earlier and harder than C&I lending, which sits well with the subprime crisis being the initial driver of the current credit woe.

In the right hand panel, we see the direct statistical relationship between the variables. Using the estimated correlation coefficient, we can infer that the Q4 commercial real-estate tightening number of 50% net tightening should imply a C&I tightening of 46%. We believe that this gap will not close instantaneously[14], but potentially close by a factor of ½ per quarter. So, if the net 50% tightening in commercial real estate remains over this quarter, a scenario which is not implausible in our view, we would compute our forecast as 19.2% + 0.5·(46%-19.2%) = 34% of net C&I tightening.

One can vary the assumptions a bit on this. For example, if commercial real-estate tightening hits 60%, we would expect a number around 38% of C&I instead. If there is a quicker catch up (change the factor from 0.5 to 0.75), the number would be 40%. The recent European numbers certainly suggest a higher number than the 34% in the basic forecast.

We do not incorporate the recent rate cut into this forecast as it has come very close in time to the actual survey. There is a further discussion on the empirical relationship between rate cuts and adjustment in lending standards in the section below.

Figure 41: Historical correlation between commercial real-estate and C&I lending (LHS) and regression analysis (RHS)



Source: Federal Reserve, Barclays Capital

[14] *We see strong auto-correlation in the regression errors over the past few quarters. There is no "best way" to treat this temporary auto-correlation from an econometric standpoint, hence we resort to a more ad hoc approach in terms of the reversion of this error term.*

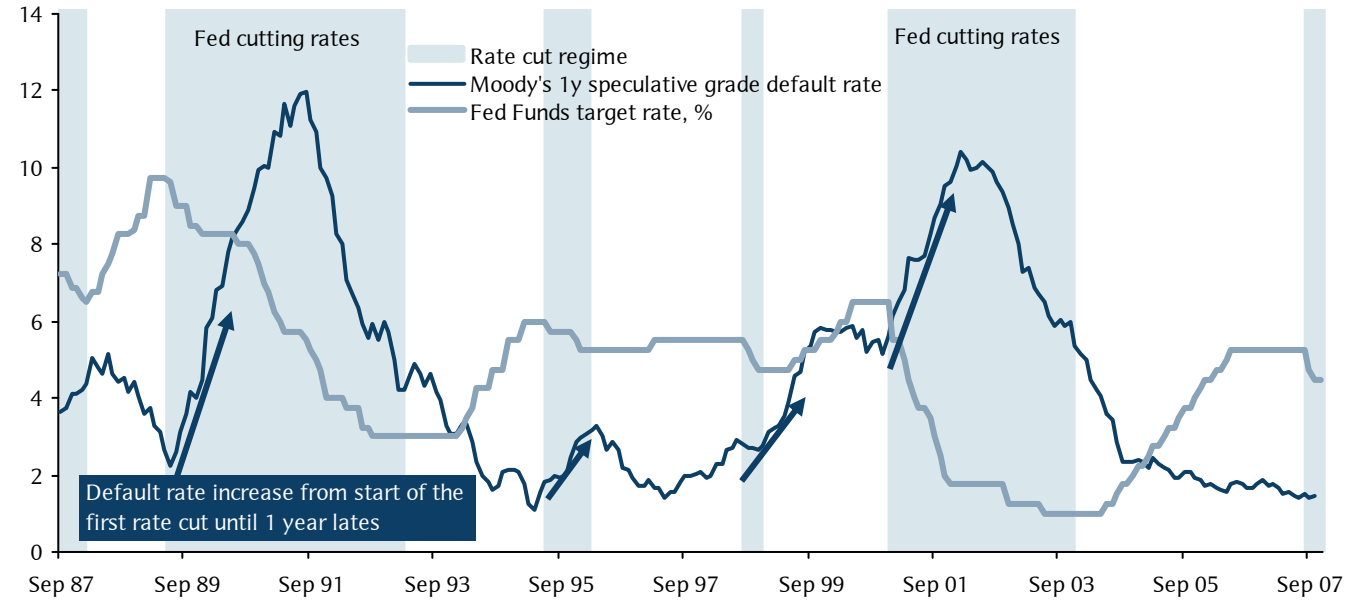
The rate cut and the default cycle – assessing the empirical evidence

What effect can the Fed's reduction of the fed funds target rate be expected to have on the credit cycle? The initial reaction in credit markets was positive, but with a quick reversion. Markets may come to agree with most central bankers that monetary policy is a fairly blunt instrument with a substantial lagging effect. It is often assumed that there is a lag of around 12-18 months before interest rate decisions actually affect the "real" macro-economy.

Figure 42 tells an interesting story of how the Fed has, or has not, managed to avoid downturns in the credit cycle/upturns in default rates. In 1991 and again in 2001/02, the Federal Reserve was cutting rates fairly aggressively for a sustained period, and we see default rates peak in the middle of those cuts. Hence, history from the two latest credit cycles suggests that the Fed has not been able avoid rapid increases in default rates in the initial stage of the downturn despite being quite active. This is hardly surprising. If one expects a lagging effect of monetary policy, and the central bank does not have perfect foresight, then the rate cuts should be seen as measures to reduce the severity of a coming trough rather than avoiding a downturn completely.

Today's situation shows up as an important juncture in this chart. We are seeing fairly rapid cuts after prolonged stability in rates. This type of rate cut regime (highlighted in Figure 42) has historical precedents in 1989, 1996, 1998 and 2000. On each of these occasions, default rates appear to have risen from recent historical lows in the year following the inception of the rate cut regime, as shown by the arrows in the figure. In 1989 and 2000, we see a full-blown downturn in the credit cycle, whereas 1995 and 1998 saw far more moderate increases in default rates that eventually retraced to some extent.

Figure 42: Rate cuts and the default cycle



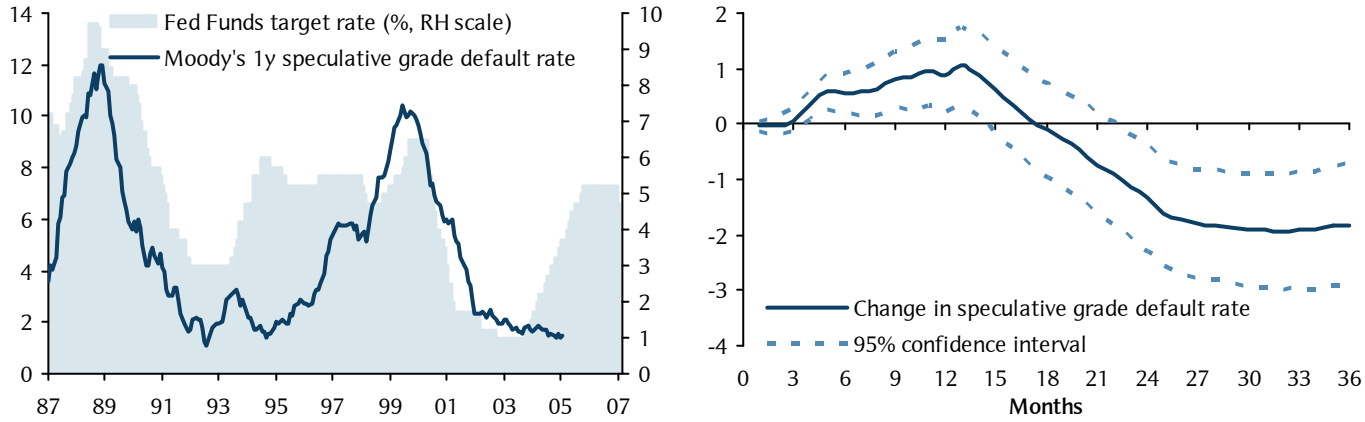
Source: Federal Reserve, Moody's, Barclays Capital

Lead/lag relationship between rate cuts and changes in default rates

We provide some more detail on the lead/lag dynamics between rate cuts and default rates in Figure 43. In the left-hand panel, we overlay the fed funds target rate with default rates two years forward, and see a close relationship between the two. Hence, from this fairly simple exercise, we can identify a strong leading relationship where Fed cuts appear to have the largest effect at a two-year horizon. Cutting rates appears to decrease defaults roughly 18-24 months forward, pretty much as one would expect on the basis of the central bankers' rule of thumb of monetary policy. 1995 proves to be slightly different: we can see that the lead/lag relationship in that period was substantially shorter as the pick-up in default rates (on a forward basis) appears to the left of the rate cut period of 1995-1996.

In the right hand panel, we plot the impulse-response function of defaults to cuts in the fed funds target rate. The function, based on a vector auto-regression, allows us to analyse the time-varying effect of rate cuts in a statistically sound way. We can see that empirically, a rate cut has started to push default rates down only at around an 18-month horizon (where the dark line crosses below the horizontal axis). Before that, we have actually seen increases in default rates. From a statistical viewpoint, this appears to be a strongly significant dynamic, as can be inferred from the relatively tight confidence interval.

Figure 43: Fed funds target rate versus 24-month forward speculative grade default rates (LHS) and behaviour of default rates following a 100bp rate cut (RHS)



Source: Federal Reserve, Moody's, Barclays Capital

Lead/lag relationship between rate cuts and easing of lending standards

As rates are lowered, there is a direct link to the cost of funding. In this credit crisis, however, it seems that it is the banks' relative unwillingness to lend that is the problem rather than the cost of credit. In the FOMC statement, which followed the recent inter-meeting rate cut, Chairman Bernanke explicitly referred to lending standards:

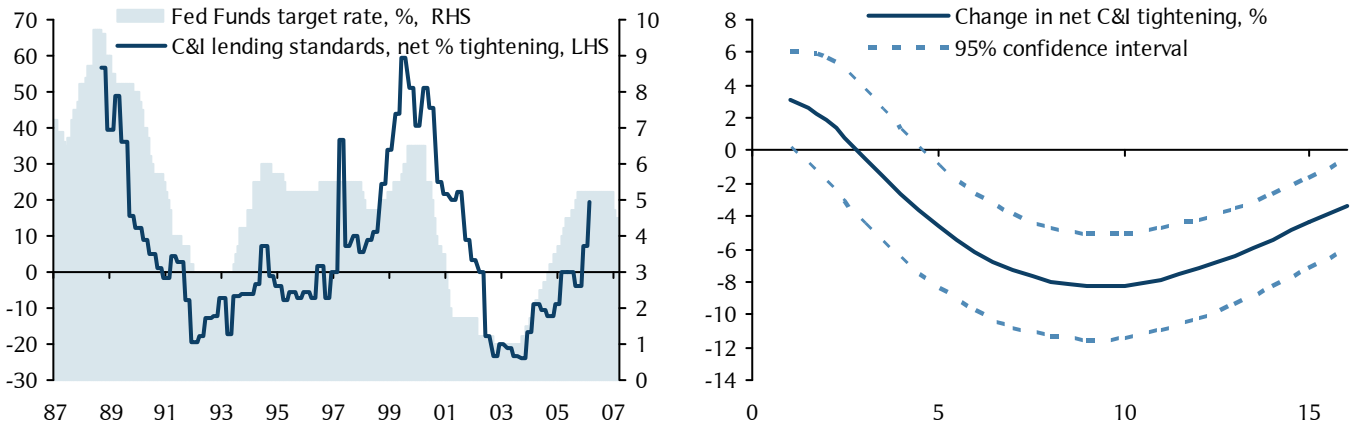
"While strains in short-term funding markets have eased somewhat, broader financial market conditions have continued to deteriorate and credit has tightened further for some businesses and households."

A natural question, then, is how rate cuts affect banks' willingness to lend. An indication of this can be seen in Figure 44, which shows how decreases in the fed funds rate are paired with a reduction in tightening of commercial and industrial (C&I) lending

standards approximately one year after the rate change. This implies that recent rate cuts, if we look at historical evidence, should start having an effect on lending conditions in H2 08 to H1 09.

We have previously argued that a tightening in commercial and industrial (C&I) lending standards appears to be a good leading indicator of a pick-up in default rates (*Lending standards and default rates: Some numbers*, 5 October 2007). The Q4 survey showed a net 19.2% tightening, which in our framework has translated into a projected speculative grade default rate of 5.4% towards the end of 2008.

Figure 44: Fed funds target rate versus C&I lending tightening 12-month forward (LHS) and behaviour of C&I tightening after a 100bp rate cut (RHS)

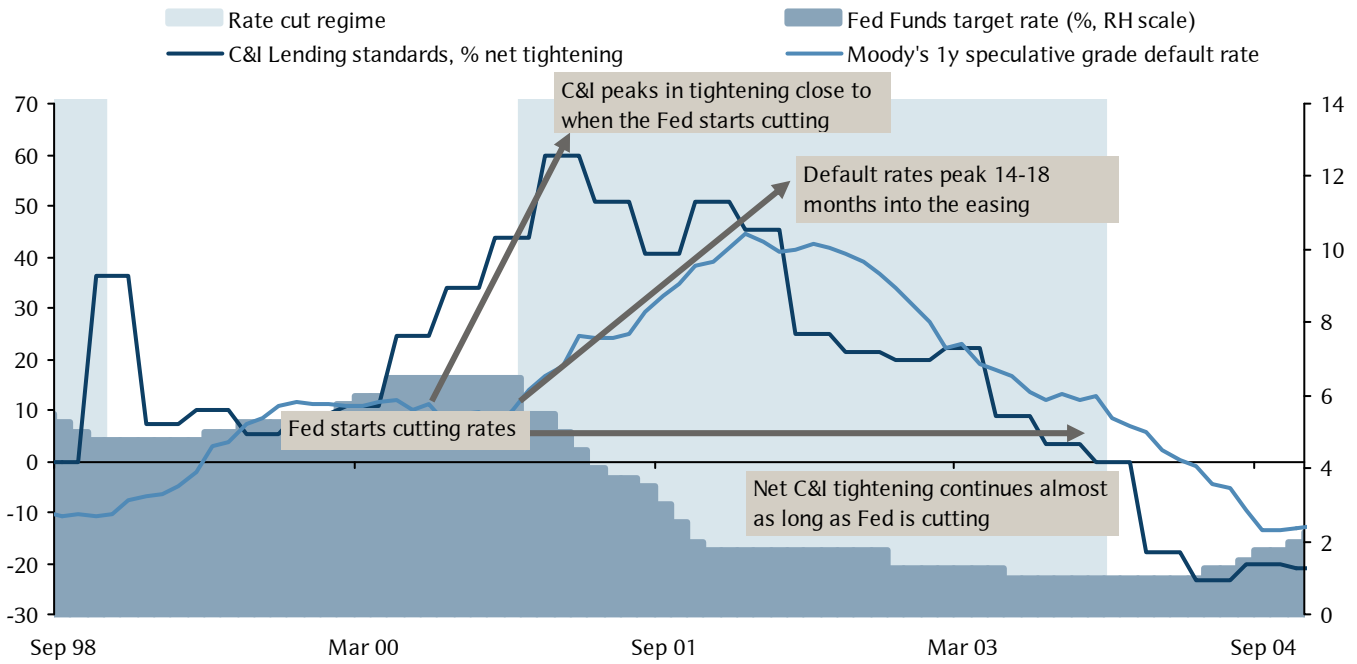


Source: Barclays Capital

The credit cycle turn of 2001/02 – a closer look

Lastly, we take a closer look at the last downturn in the credit cycle, as in Figure 45. In 2000, the fed funds target rate was held constant, whereas the C&I lending was continually tightening. The Federal Reserve starts cutting rates in the first half of 2001, which is the same time at which C&I tightening peaked. Lending standards kept on tightening at a rate of around 50% per quarter for the next 12 months, and really started their trend towards credit easing 12 months later. Secondly, default rates peaked in mid 2002, between 14-18 months after the monetary policy easing had started. Hence, rate cuts were positively correlated with increases in defaults in the short term in the period after the initial wave of rate cuts. Thirdly, we see that the Fed was continually cutting rates throughout the period where default rates were above 6%.

Figure 45: The 2001-02 credit cycle downturn



Source: Federal Reserve, Moody's, Barclays Capital

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Lending standards constriction: The UK joins in, 4 January 2008

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Global Credit Market Strategic Outlook 2008, 12 December 2007

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7. Expressing quantitative macro views

Why it should be done through curves[15]

Graham Rennison, Jose Mazoy, Ulf Erlandsson, Arup Ghosh

- Fundamentals will arguably be an increasing driver of spreads and curve shapes in 2008. Taking the iTraxx Xover index as a proxy, we show that the 5s10s curve actually reflects credit and economic fundamentals more closely than does the 5 yr level. The curve, though not immune, appears less affected by short-term shocks and technical effects and demonstrates greater persistency and predictability. As a result, we encourage investors to consider using curves to express medium-term macro-credit views.
- In this article we use econometric methods to quantify these effects. We establish links between the iTraxx Xover 5s10s curve and fundamental variables such as:
- Equity volatility – credit curves flatten as volatility rises.
- Interest rates – credit curves steepen as rates rise or yield curve flattens.
- Default rates – credit curves flatten as default rates rise.
- We will motivate the use of the first two sets of variables through the effect that they have on default probabilities. We develop a vector error-correction model which indicates that the recent flattening has been overdone relative to fundamentals. A mild 7bp steepening over three months is forecast. Given unpredictable technicals into year-end we would recommend waiting until January 2008 to enter any steepener positions.
- A second part of our analysis uses actual default rates to give guidance of curve shape on a longer time spanGlob. Forecasts of increased defaults for H2 08 would indicate further flattening in the longer term, especially as a turn in the default cycle is priced in. We would look to enter a flattener during the latter part of 2008 based on this analysis.

Linking credit to macro fundamentals in 2008

Monitoring the interrelation between spreads and fundamental variables will be important in 2008

An important question for 2008 is to what extent will spreads and curves be driven by macro credit fundamentals such as the interest rate regime, default rates and the stock markets? We have published a series of macro-credit studies on topics including the yield curve (see *Yield curve regime behaviour in US Credit*, 27 January 2006) and the credit cycle (see *Approaching the turning point? Global Credit Strategy Annual 2007*, 13 December 2006). In this article we take a broader look at how spreads relate contemporaneously to typical macro-variables.

Our main conclusion is striking – we find that the credit curve is in fact a consistently more meaningful trade-able instrument than the spot spread level in terms of demonstrating a relationship with fundamental macro variables, when considering trades over a horizon of months rather than weeks. We recommend, therefore, that index curves – especially the iTraxx Crossover curve – be considered as instruments through which to express macro credit views and we provide examples of such strategies. Indeed, we could argue that for taking longer-term positions, curves are likely to be more stable and more predictable than spot levels.

[15] *This article was originally published in the Global Credit Market Strategic Outlook 2008, 12 December 2007.*

We find that curves show clearer co-movement with fundamental variables than do 5 yr levels

In this article we focus on the European iTraxx Crossover index and its 5s10s curve. We choose to run this analysis on the Crossover given that it is generally regarded as a barometer of the state of the European credit market and is arguably less affected by technical flows than the iTraxx Main index. Additionally, the high yield segment of the market is typically more affected by macro fundamentals like risk premium, the business cycle and – of course – default rates. In all the analysis that follows, we use our reconstructed QCX versions of the iTraxx Crossover index, which use single-name information to extend the time series back to 2001 (see *CDS Curve Trading Handbook 2008*, 6 November 2007, page 145, for further details).

We will carry out the analysis in two stages: 1) we will use two variables motivated by a theoretical argument (given below) as determinants of the probability of default, and 2) we will then use directly a measure of realised default in order to generate longer-term guidance.

We choose two fundamental/macro variables to analyse with respect to the Crossover:

- Equity volatility – we choose the VStoxx index which is based on DJ Euro Stoxx 50 index options implied volatility.
- Rates– we use the Euro Libor 3M rate and Euro Swap 2s10s slope.

Fundamental variables

Fundamental variables link to credit via anticipated default rates

We can motivate the selection of these variables as follows: spreads naturally partly reflect anticipated default rates, especially in speculative-grade. Similarly, curve shapes, are driven by the market's view as to the timing of default risk (see *CDS Curve Trading Handbook 2008*, 6 November 2007, page 14). A flatter curve prices in a nearer-term risk of default as the front-end is bid up for short-term protection. In distressed scenarios this pattern becomes more extreme leading to inversion.

Increasing equity volatility should lead to wider spreads and flatter curves

From a theoretical angle[16], structural credit risk models treat default as an event triggered by economic fundamentals. For instance, in Merton's model, default occurs when the firm value falls below a certain threshold commonly modelled as an increasing function of firm leverage. Hitting such a default barrier becomes more likely if the firm exhibits large fluctuations on their assets. Since a positive relationship exists between the volatility of the firm value and equity volatility, we expect a positive relation between the CDS spread and the equity volatility. In terms of credit curves, therefore, increasing equity volatility should imply increasing shorter-term default risk, leading to curve flattening.

Interest rates also have an economic link with spreads and curves. We discuss these in our empirical studies *Yield curve regime behaviour in US Credit*, 27 January 2006 and *Euro credit and yield curve regimes*, European Alpha Anticipator, 16 February 2006. Using the structural firm model theory again, an increase in the short interest rate should decrease the default probability, all else being equal. This is due to the fact that pricing occurs in the risk neutral world and the short rate influences the risk neutral drift in the firm's value process. Therefore, we should expect a negative relation between the CDS spreads and the short-term rate or the slope of the yield curve. Empirically, falling short-term rates also tend to coincide with a turn in the business cycle towards a more recessionary environment, which naturally leads to higher default rates.

[16] *Please refer to 'Regimes in CDS Spreads: A Markov switching model of iTraxx Europe Indices', Carol Alexander and Andreas Kaeck, ICMA Centre Discussion Papers in Finance.*

Steeper rates curves should be associated with wider spreads and flatter credit curves

When the swap curve steepens, perceived default risk should rise. There are two reasons for this. Firstly, the curve can steepen due to short rates falling – this returns us to the argument of the above paragraph. Secondly, a steeper curve reflects high rate expectations and/or higher risk premium. An increase in market uncertainty will feed into the curve through higher risk premium and a steeper slope. Thus, higher volatility will lead to a steeper yield curve and flatter credit curve.

In the following sections we analyse graphically the relationships of these variables with iTraxx Crossover 5yr level and 5s10s curve. Broadly, we find that curves are better insulated against short-term technical dislocations and trends than the 5yr level.

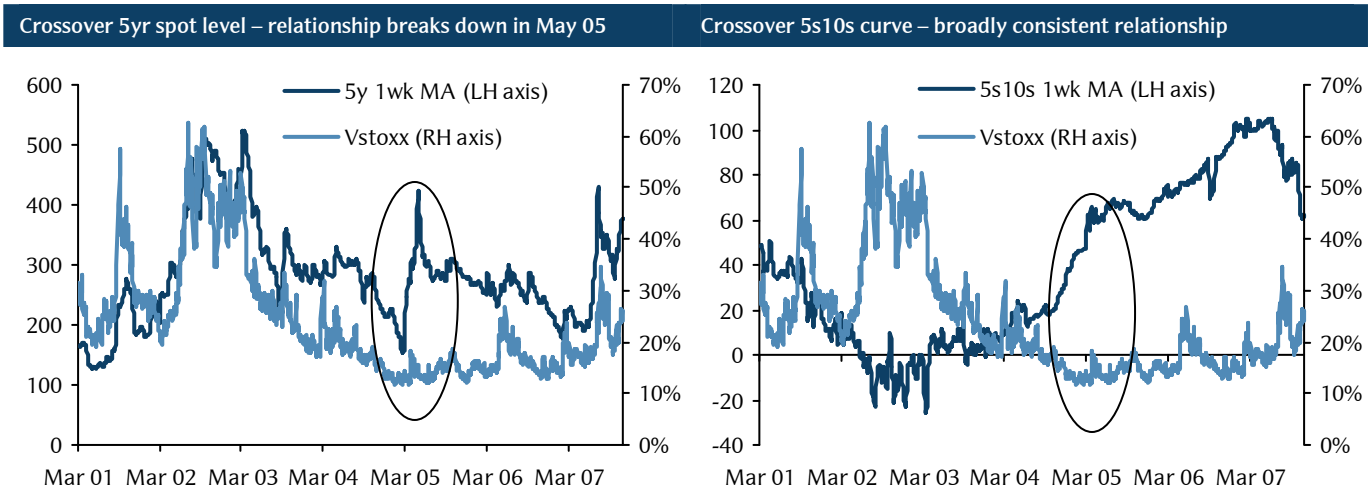
5s10s slope appears more insulated than 5yr spread to short-term technicals…

Figure 46 shows side-by-side plots of VStoxx against iTraxx Crossover 5yr level and 5s10s curve, respectively. In the left-hand chart we find, at first glance, an appealing relationship between 5yr iTraxx Crossover and the VStoxx index. On closer inspection it becomes clear that the relationship between the two is strong (graphically, at least) during periods of high equity volatility – particularly following 9/11, through 2002 and in the recent volatility in H2 07. However, the circled period around the May 2005 correlation storm highlights how credit-market technical driven volatility is naturally not mirrored in equity volatility.

… such as those experienced in the May 2005 correlation storm

In the right hand chart of Figure 46 it is immediately clear that the circled May 2005 period does not stand out as a breakdown in the relationship. Curves in fact moved more or less in parallel during this period, arguably reflecting the fact that fundamental credit had not been dramatically affected and that spot volatility was driven by technical concerns around equity-tranche unwinds. Otherwise, we find the 5s10s curve does have a reasonably consistent relationship with risk premium measured by VStoxx volatility. When volatility is high, the curve tends to be flatter and vice versa. The period around 9/11 appears to be an exception, with high volatility and a less pronounced move in the curve. In fact, the chart obscures slightly the scale of the flattening: about 25bp over the remainder of September 2001.

Figure 46: Relationship between equity volatility and credit spreads

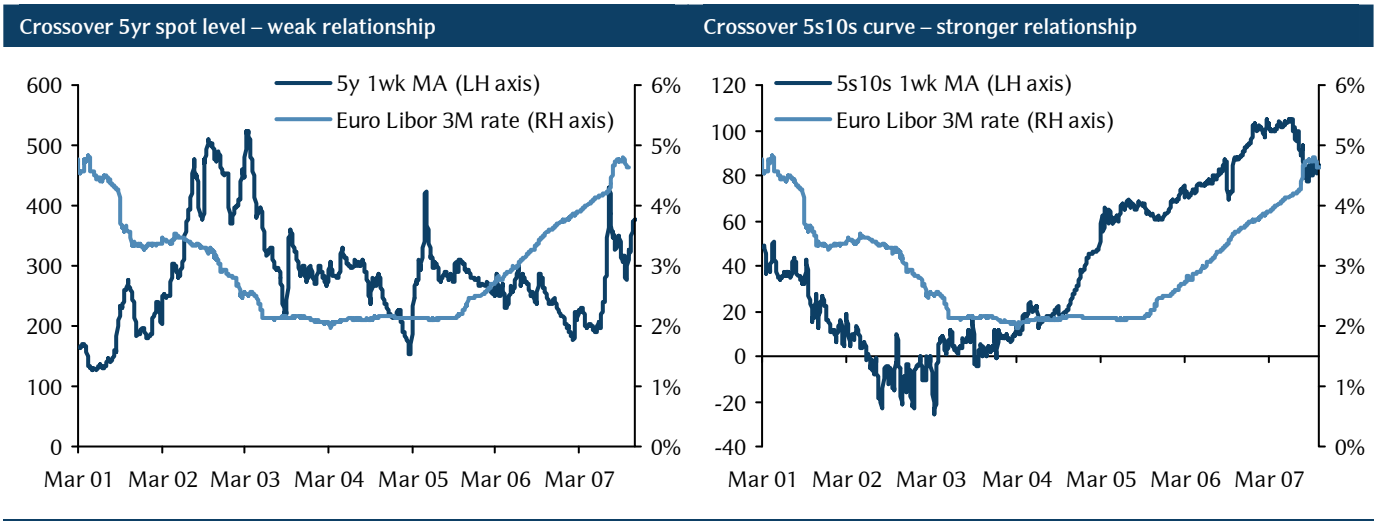


Source: Markit, Barclays Capital

Figure 47 and Figure 48 shows the iTraxx Crossover 5yr level and 5s10s curve versus the euro Libor 3M rate and 2s10s slope of the European swap curve, respectively. In this case the distinction in relationship between the two charts is much more striking. In the left hand chart in each case we see a weak link, at best, with a similar disconnect around May 2005 to that in the left hand chart of Figure 46. The right hand chart shows a

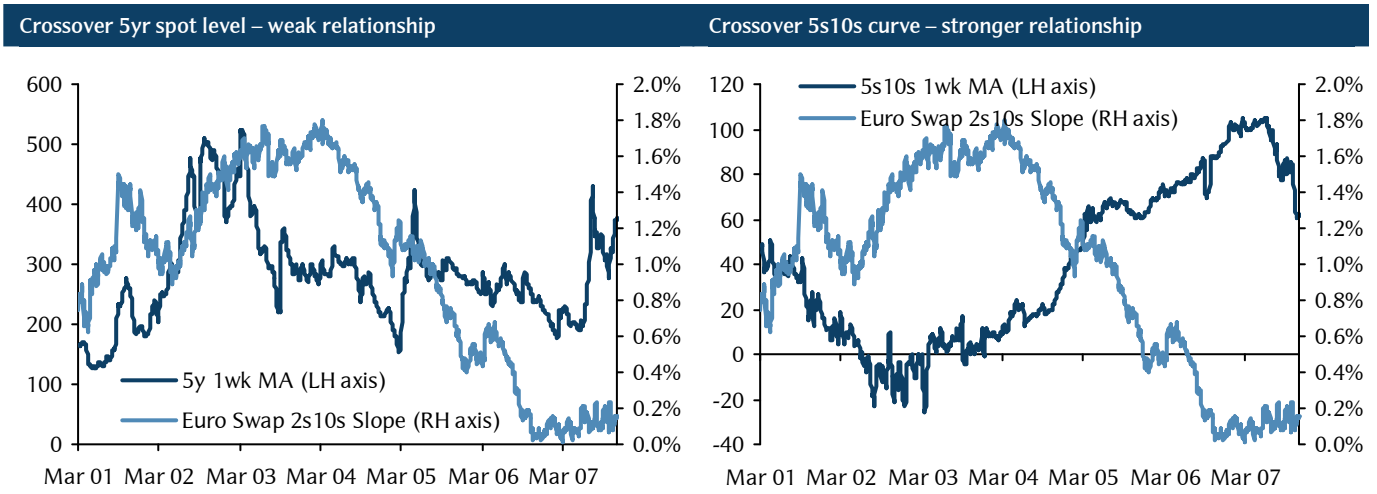
convincing pattern of co-movement which we quantify in the second part of this article for the case of the slope of the swap curve.

Figure 47: Relationship between 3M Euro Libor and credit spreads



Source: Markit, Barclays Capital

Figure 48: Relationship between 2s10s slope of the euro swap curve and credit spreads



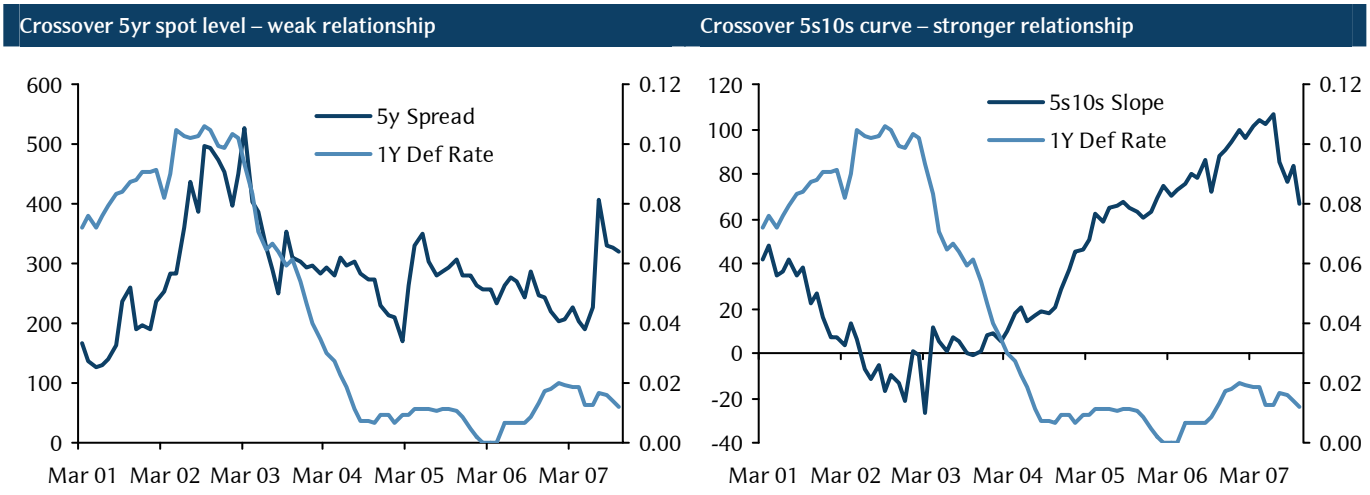
Source: Markit, Barclays Capital

Default cycle using Moody's default rate

Higher realised default rates lead to wider spreads and flatter curves

In the second part of our analysis, we use Moody's Non-US Corporate speculative grade 12-month trailing default rate as a more direct measure of default risk. This variable has the most obvious tie-in with spreads. Figure 49 shows the two charts of iTraxx Crossover 5yr level and 5s10s slope with the Moody's trailing 12-month non-US speculative grade default rate. Both pairs of series show evidence of co-movement. However, we find the 5s10s curve again demonstrates a more compelling relationship, in particular being somewhat immune to the short-term technicals around the May 2005 period.

Figure 49: Relationship between Moody's speculative-grade default rate and credit spreads



Source: Markit, Barclays Capital

Short-term forecasting using error-correction

In order to use the relationships above we need to quantify them using a statistical model

As described above there is a meaningful economic relation between the slope of the CDS curve and variables like the slope of the yield curve and the volatility of the stock market. We now attempt to quantify these relationships by describing the dynamic interrelations that exist among them through a statistical model. To do so we first need to evaluate the time series properties of each of the variables in order to chose a statistically 'appropriate' model specification.

Econometric specification

As is often the case with economic time-series, our variables are "non-stationary" – they can trend for long periods…

First, we are interested on knowing whether the variables are stationary[17] or not. By simple graphical inspection it seems that the variables trend upwards or downwards for long periods so they do not seem to be stationary. To assess this formally, we carried out stationarity tests (in particular the ADF and the KPSS tests) on our two variables of interest: CDS slope, EUR 2-10s slope and VStoxx. Given the high correlation between the slope of the yield curve and the 3m Euro Libor rate, we chose to include only the slope. The frequency of the data is weekly. For the sample chosen we conclude that statistically each of the series is non-stationary. In this case, estimating a regression in levels of the CDS slope on the slope of the yield curve and the Vstoxx would give one of two outcomes: 1) a spurious regression, or 2) a consistent estimate of a cointegrating relation. A cointegrating relation is a linear combination of otherwise non-stationary variables that under the appropriate weights would make such combination stationary. A cointegrating relation also has the interpretation of a long-run or equilibrium relation held by the variables. In the short term, the variables that form this relation may deviate from this, but since the linear combination is stationary they should revert back over time. In both cases the usual R-squared or t-statistics criteria are sample size dependent so they are not meaningful, but nevertheless running a simple regression is a consistent and quick way of finding cointegrating relations among the variables.

[17] *A stationary process has the property that the mean, variance and autocorrelation structure do not change over time. Trending series do not exhibit this property and should receive a special treatment when time series analysis is to be performed on them.*

Techniques such as Vector Error Correction allow us to deal with such series

A popular route to model trending behaviour in economic and financial time series is to model them as unit root processes. In order to model the joint behaviour of the variables in the presence of unit roots, we can proceed in one of two ways: 1) We can estimate a VAR (vector auto-regression) in differences, or 2) we can estimate a VECM (a vector error correction model). However, in the presence of cointegration among some of the variables it is not appropriate to model the joint dynamic of the variables as a VAR in differences since the level of the variables is important in forecasting future changes.

We ran a simple regression of the CDS slope against the slope of the yield curve and VStoxx and then perform stationarity tests on the regression residuals. The results of the tests indicate stationarity of the residuals so the regression weights found make the linear combination of the variables stationary, thus we choose to model the joint behaviour of the model as a VECM.

The VECM formulation that we adopt takes the following form[18]:

$$\Delta y_{i,t} = \alpha_i + \gamma_i\left(y_{1,t-1} - \beta_1 y_{2,t-1} - \beta_2 y_{3,t-1}\right) + \sum_j \zeta_{i,j}\Delta y_{i,t-1} + \varepsilon_{i,t} \quad \text{for i=1 to 3}$$

With,

$$y_t = \left[SlopeCDS_t \quad SlopeRates_t \quad VStoxx_t\right]'$$

The vector error correction model is particularly powerful since it allows the estimation of both short-term and long-run effects of time series variables. On the equation above current changes of a variable $y_{i,t}$, $\Delta y_{i,t}$, are a function of recent changes in it $\Delta y_{i,t-1}$ as well as changes in the other variables included within the system $\Delta y_{j,t-1}$ for $j \neq i$.

Vector Error Correction models both the short-term dynamics of the variables and long-term relationship

These terms reflect the short term dynamics of the series. The long-run effects are captured by the cointegrating relation $y_{1,t-1} - \beta_1 y_{2,t-1} - \beta_2 y_{3,t-1}$.

Although the estimates of the cointegrating relation based on a regression are consistent, there often exist alternative estimates that are superior. OLS is only a quick way to obtain an initial estimate of the cointegrating relation. To estimate the parameters of our chosen specification we used Johansen's method. The β_i parameters indicate the weights that achieve stationarity of the linear combination of the variables. The γ_i indicates how strongly each of the variables changes respond to dislocations in the long run-relationship and $\zeta_{i,j}$ is the response of variable i to changes on variable j. This will let us distinguish how each of the variables respond to short-term factors and long-term factors.

Results of the VECM model

The estimated model described above has broadly pleasing statistical properties. Further details of the model and parameters are beyond the scope of this article but will be reviewed in future research. However, it is interesting to plot the cointegrating equation – this is shown in Figure 50. The estimated equation itself is given by

$$\text{Cointegrating equation} = SlopeCDS + 0.43 \times SlopeRates + 2.17 \times VStoxx - 134.10 \quad (1)$$

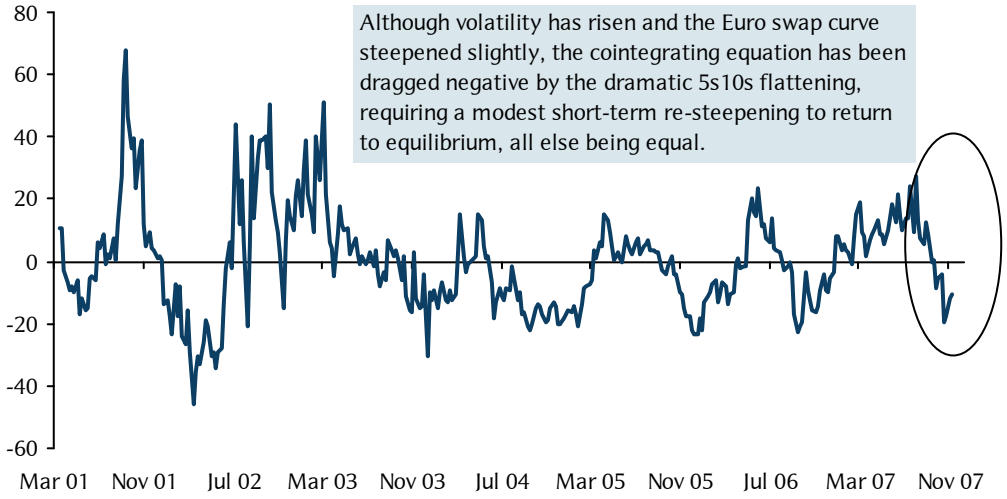
The cointegrating equation tells us about the long-term equilibrium relationship between our variables. As expected, the 5s10s slope has a negative relation with both

[18] *To choose this particular specification we first estimate a VAR in levels and did a lag-length determination test. Using Schwarz information criteria and Hannan-Quinn information criteria we choose one lag. We also carried out a Johansen cointegration test which indicated only one cointegration equation.*

VStoxx and the slope of the swap curve. We can see this from equation (1) by setting the relation equal to zero and rearranging to express in terms of SlopeCDS.

The cointegrating equation is highly mean-reverting, as we see in Figure 50, with a mean of zero (in fact this is a necessary condition for a cointegration model). This helps motivate the model's forecasts. We see currently how the equation is below zero. Therefore, for it to return to equilibrium we need either the rates curve to flatten again and volatility to drop, or the 5s10s to steepen slightly.

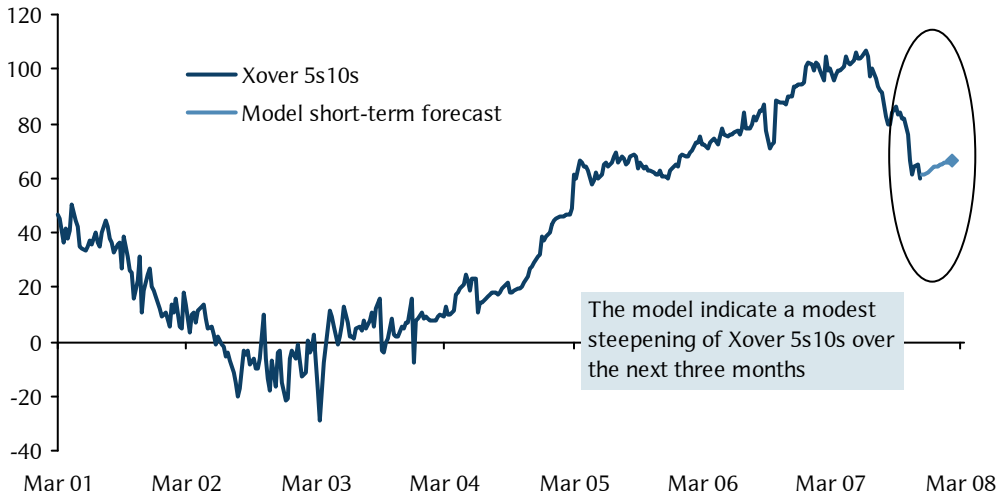
Figure 50: The cointegrating equation – The mean-reverting equilibrium relation between Crossover 5s10s, VStoxx and Euro swaps 2s10s



Source: Markit, Barclays Capital

The model dynamic forecast predicts a mild steepening of the curve of 7bp over the next three months. However, the reliability of forecast (measured by its standard deviation) falls with the forecast horizon. Over a shorter horizon of one month the model predicts a 1bp steepening which is immaterial.

Figure 51: VECM indicates 7bp re-steepening over the next three months



Source: Markit, Barclays Capital

Medium-term curve forecasts using default rates

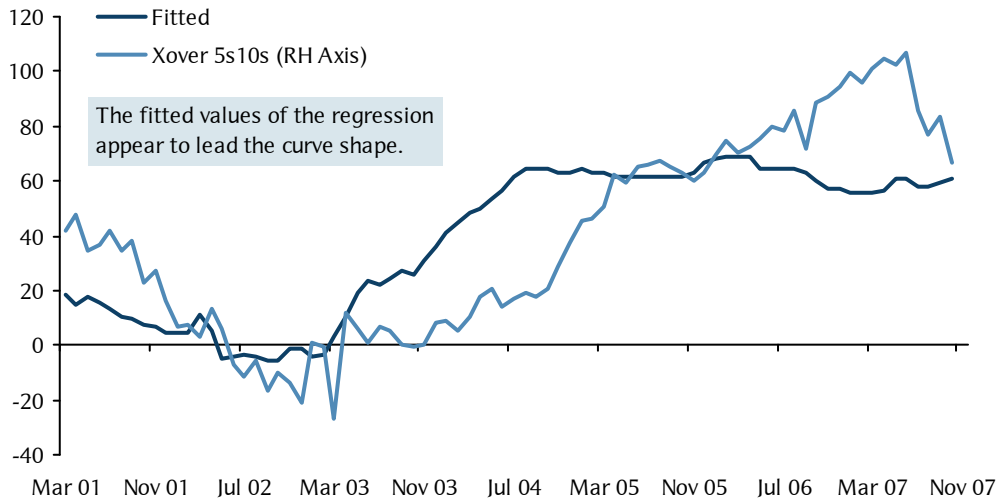
Using default rate forecasts for 2008 we can assess implications for the Crossover curve

In the high yield strategy sections of this annual report we discuss various methods of anticipating likely speculative-grade default rate levels in the second half of next year. Using these default rate scenarios for Q4 2008, and the simple relationship between iTraxx Crossover curve shape and default rates shown in Figure 49, we can give an indication of longer term curve scenarios.

We are unable to find a contemporaneous relation between default rates and curve shape…

The default series, like the other economic variables, is non-stationary for the sample used. As before, we ran a regression on contemporaneous observations of the CDS slope and the default rate but found that the residual series exhibited a unit root. Thus, we could not find a cointegrating relation at least on the contemporaneous observations. However, looking at the behaviour of the fitted values in Figure 52 against the actual we observe some leading effect of the default rates on the behaviour of the slope.

Figure 52: Fitted values from a contemporaneous OLS regression of Crossover 5s10s on default rates – Default rates leading curve shape?



Source: Markit, Barclays Capital

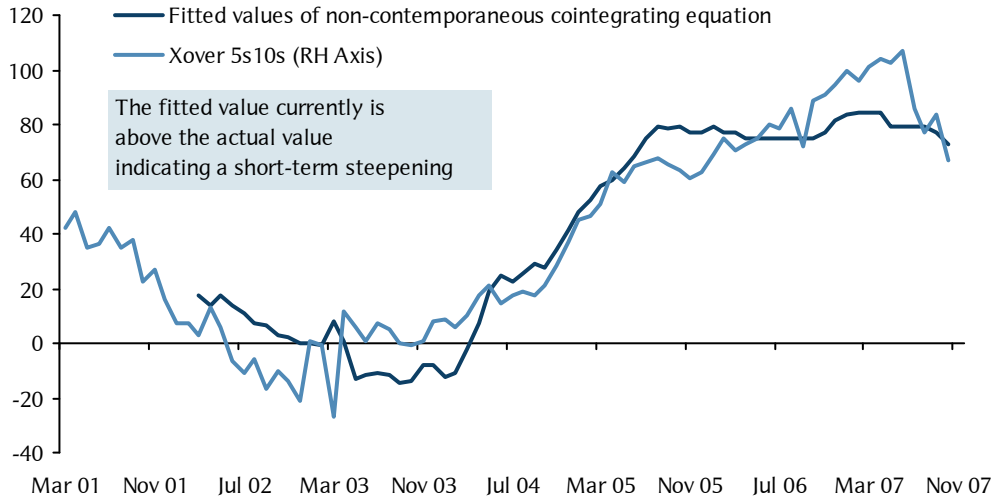
… we can, however, model default rates as a leading indicator of curve shape

As mentioned already, the cointegrating relation has the interpretation of a long-run relationship between the variables. In infinite horizons having lags on the cointegrating relation is not meaningful since in equilibrium the lags are irrelevant since there is no time dependency. However, using finite samples there are good economic reasons to expect lagged relationships. We therefore construct a cointegrating relationship of the CDS slope and the one-year lagged value of the default rate.

This specification has a more robust statistical fit and an appealing interpretation

Again, we ran a regression and this time we could reject the hypothesis of the presence of a unit root in the residuals. Given the current value of the default rate of 1.2% we expect a mild steepening of the curve over the next months. We note this is consistent with our first analysis above.

Figure 53: Using a non-contemporaneous relation improves the fit



Source: Markit, Barclays Capital

If default rates rise in 2008 this will put further flattening pressure on Crossover in late 2008/early 2009

We can now use this model to give guidance on the curve flattening that may result from an increase in default rates in H2 08. As the model identifies a 12-month lead-lag relationship between default rates and curve shape, the impact of any rise won't be felt until end 2008/2009. Naturally, a much sharper/surprise rise in default rates would be followed by a more immediate flattening of the curve. Using the scenario for the default rate in one year's time of 3.5% and assuming that the cointegrating relation would be close to its equilibrium value, the consistent value for the CDS slope would be 53bp in 2009. If default rates reach the higher end of the band, say 5.5%, the associated flattening would be more pronounced, with an indicative target of 34bp.

8. An Analysis of the Q4 07 Senior Loan Officer Survey

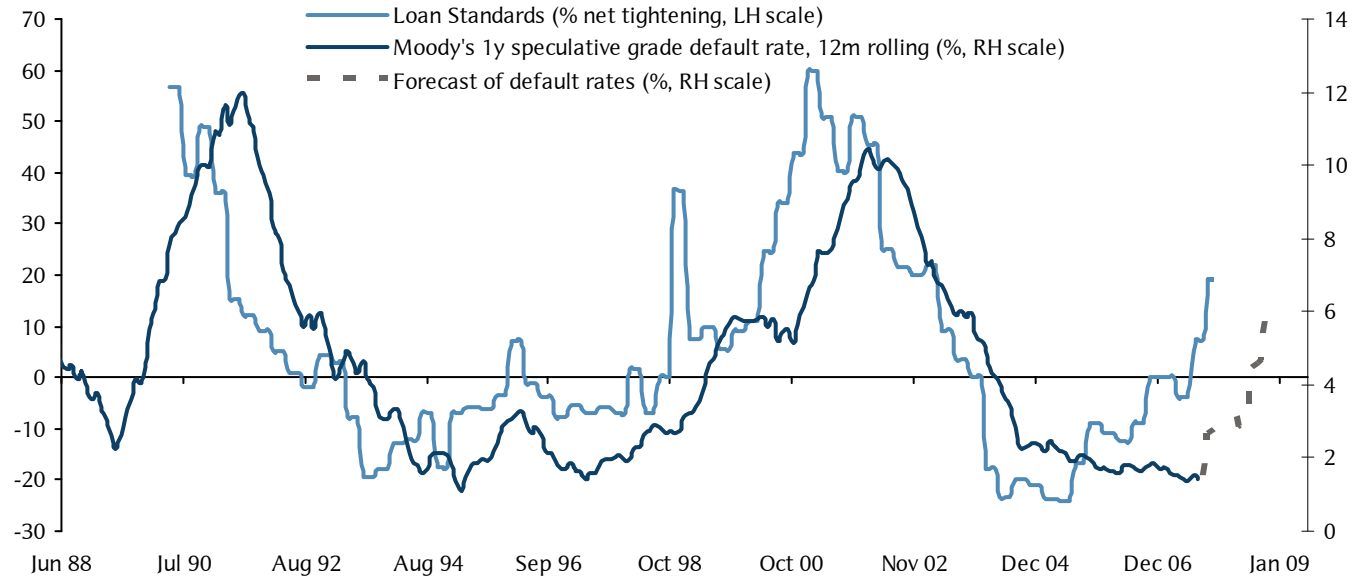
Credit conditions getting tighter[19]

The latest *Senior Loan Officer Opinion Survey on Bank Lending Practices* by the Federal Reserve offers interesting insights into the credit environment:

- Lending standards on commercial and industrial (C&I) loans showed net tightening of 19.2% (cf. our forecast of 20%), up from 7.5% in Q3. Using our model, this translates to a fairly marked hike in speculative grade default rates going into the second half of 2008.
- Standards for commercial real estate lending saw net tightening by 50% of participating banks. After easing standards for these loans slightly during H1 07, banks have now returned to, and even exceeded, the tighter standards that were applied around the turn of the year. We have not seen this degree of commercial real estate tightening since the downturn of 1990/91.
- Residential mortgage standards confirm the picture of a bleak housing market, with the largest net tightening, 46%, on record.

In previous studies (eg, *Lending standards and default rates: some numbers*, 5 October 2007), we found a strong statistical link between current lending standards and forward speculative grade default rates. Figure 54 tells this story well. Using statistical methods, we estimate that the average period between the initial application of more stringent lending standards to the maximum tightening is four quarters. So, with a period of tightening underway, we expect default rates to start to rise towards the end of 2008. The current pace of economic growth and an overall benign liquidity environment for HY companies are likely to moderate the rate at which we shift into the higher default environment suggested by our framework. We also see the emergence of covenant-lite loans at the end of the benign credit cycle as an important factor to consider in this context. These loans are likely to reduce the importance of tighter lending standards, as less bank refinancing is required to keep companies using these instruments liquid. We have made some adjustments to reflect this development in our current model (see below). Further elaboration of these factors could improve the precision of our model's forecasts, but it is beyond the scope of this note.

Figure 54: Speculative grade default rates and C&I lending standards



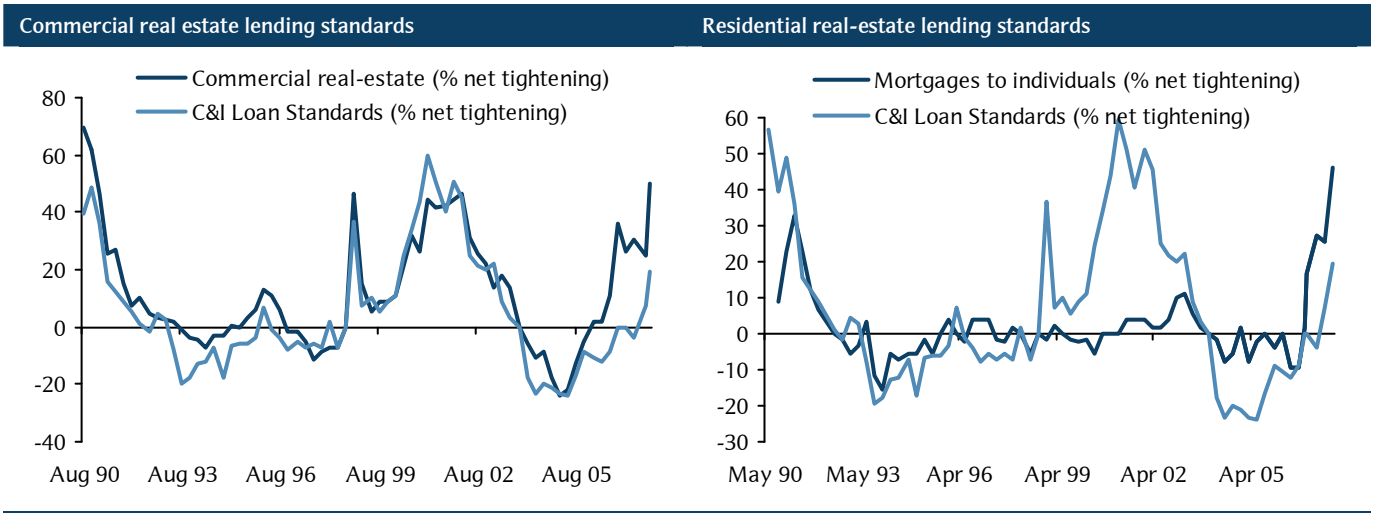
Source: Federal Reserve, Moody's, Barclays Capital

[19] *This article was originally published as Q4 lending standards: Tighter again, 6 November 2007.*

A second topic we have discussed before is the large dislocation between the standards for C&I loans and commercial real estate loans. Historically, these two sets of standards have tracked each other quite closely, but the relationship started to break down as real estate lending standards started to tighten in 2006. The continuing woes in the subprime sector likely exacerbated the divergence, with tighter standards for real estate loans seemingly leading C&I standards. The 50% net tightening on commercial real estate loans in Q4 offers a pessimistic view where C&I tightening might go, if the historical relationship holds true (see Figure 55, left panel).

Pretty much the same picture emerges in the residential market. We calculate an overall net tightening in the sector of 46%, based on a weighted average of prime (net 40% tightening), non-traditional (55% tightening) and subprime (net 60% tightening) mortgages. Figure 55, right panel, shows that this is the highest degree of tightening on record. The strong tightening, especially in prime mortgages, is surprising as it has increased from a more modest degree of tightening – in the 15% area – during Q2 and Q3 07. In addition, we believe that the subprime tightening number actually underestimates the drying up of credit in this area. In the Q3 survey, 16 out of 54 banks indicated that they engaged in subprime mortgage lending. In Q4, that number had shrunk to 9 out of 49. It is likely that the decline includes some banks that have ceased subprime operations altogether, which must be seen as the ultimate tightening of credit.

Figure 55: Real estate and C&I standards – converging or playing catch up?



Source: Federal Reserve, Barclays Capital

More notes on the October survey

We briefly summarise some interesting other features of these numbers:

- C&I standards for small companies (annual sales of less than USD50mn) tightened by a net 9.6%. This is substantially lower than the 19.2% tightening for the large corporates, but still within the normal (and relatively small) range of variation between the two types of companies.
- When asked about reasons for tightening standards for C&I loans, the two reasons cited as the most important were the more uncertain economic outlook, and, interestingly, a decrease in liquidity in the secondary market for these loans. The senior loan officers' stance on the economic outlook is not surprising, but their view on secondary market liquidity is interesting, and warrants further analysis which is beyond the scope of this short note.
- Large banks have been imposing marginally tighter C&I standards than other banks.

- There has been distinct tightening of standards for asset-backed commercial paper backup lines of credit, with 42-50% of net tightening of the standards for these programs in the October survey.
- Standards for backup lines of credit for companies with an A2/P2 unsecured commercial paper rating saw net tightening of 25%. For A1/P1-rated programs, there was a modest 7% net tightening.

Translating the new numbers into forward default rates

We used our forecast of net tightening in C&I lending standards of 20% in Q4, to project a speculative grade default rate of 5.5% for H2 08. Given the results of the Fed survey, we revise our default rate forecast to 5.4%, based on the empirical relationship estimated as:

$$\text{Default rate}(t + 4\ \text{quarters}) = \lambda \cdot \text{CI}(t) + c \qquad (1)$$

Our model makes use of the strong lead-lag relationship between C&I tightening and defaults, which is apparent in Figure 56. Closer statistical inspection confirms that the lag between rising defaults and the initial tightening of standards is roughly four quarters (Figure 56). Again, we refer to ***Lending standards and default rates: some numbers***, 5 October 2007, for a more in-depth quantitative analysis.

Figure 56: The C&I tightening/default rates relationship

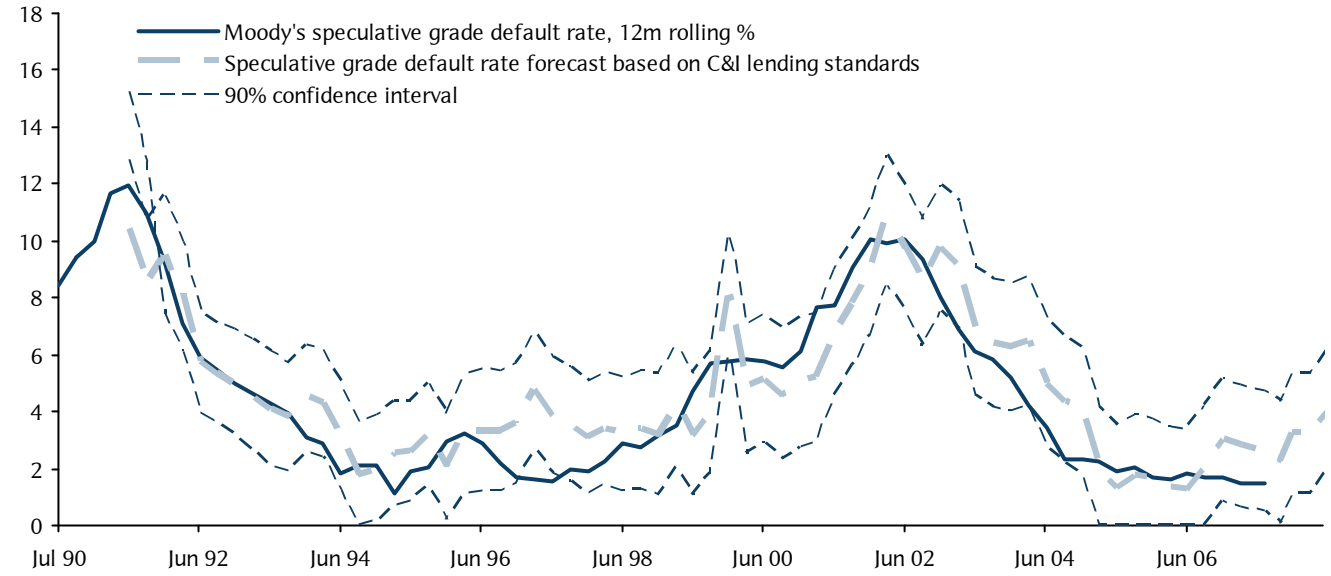
Parameter	Coefficient	t-stat
λ	0.116	9.4
c	4.07	16.1

Source: Barclays Capital

Given that current default rates are extremely low from a historical perspective, we believe they are unlikely to reach the level forecast by our model in just one year. We allow for just half of the current dislocation between default rates and C&I tightening to play out in the next 12-15 months, In effect, this shaves 0.75% off the forecast default rate.

We also believe that the key messages of our forecast involve the direction and magnitude of move in default rates. In Figure 57, we show the standard error band around our forecast default rate. The confidence interval reflects the range within which we believe the actual default rate will fall with a 90% probability. For example, using our model, we forecast that the speculative grade default rate will be between 3.3% and 7.5% with a 90% probability.

Figure 57: Forecast confidence intervals



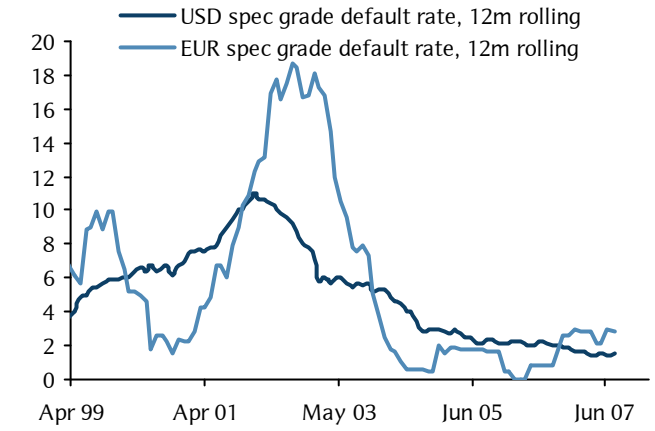
Source: Moody's, Barclays Capital

European loan officers (also) hit the brake

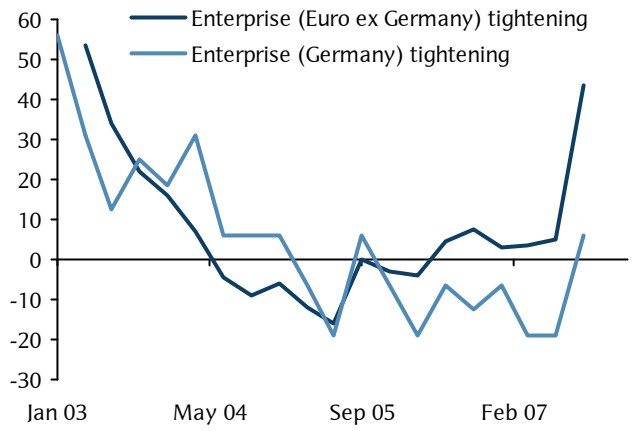
As we have argued previously, there should be a fairly strong link between the credit environments in the US and Europe. We show in Figure 58, left panel, that the US and European default cycles have generally behaved similarly, although in the most recent cycle, it is by no means a one-for-one relationship. Recent data in Europe (as tallied by the ECB's Q3 lending standards survey conducted in September) suggest that loan standards, at net 31% tightening for enterprise lending (see Figure 58, right panel), are becoming significantly stricter. Compared with the Fed's Q4 numbers, this indicates a more bearish mode in European lending. We note that there is a large degree of regional variation in these numbers. For example, Germany sees a lot less tightening than the rest of the euro area. In addition, some preliminary qualitative evidence suggests that enterprise lending standards have been tightened more sharply in areas where the property market is of particular concern.

Figure 58: Tightening standards in Europe

Correlation of the US/Europe default cycle



European lending standards: strong tightening in September data



Source: Moody's, European Central Bank, Bundesbank

9. Lending standards and default rates - Some numbers

A forecasting model for speculative grade default rates[20]

A normalisation of the current disconnect between lending standards and speculative grade default rates would, according to our calculations, imply an increase of default rates from today's 1.5% to 4.5-5.5% in four quarters. In this article, we go through the calculations to generate a prediction of where lending standards appear to be heading; and how much of an effect this will have on speculative grade default rates.

We refer to the default cycle: A lending standards perspective in the *Global Credit Strategist*, 4 October 2007, for a qualitative discussion with regards to these variables and relationships.

Stage 1: How much more C&I tightening based on commercial real-estate standards?

Based on the historical relationship between commercial real-estate standards (CRES) and C&I lending standard net tightening (CI), we calculate the following relationship

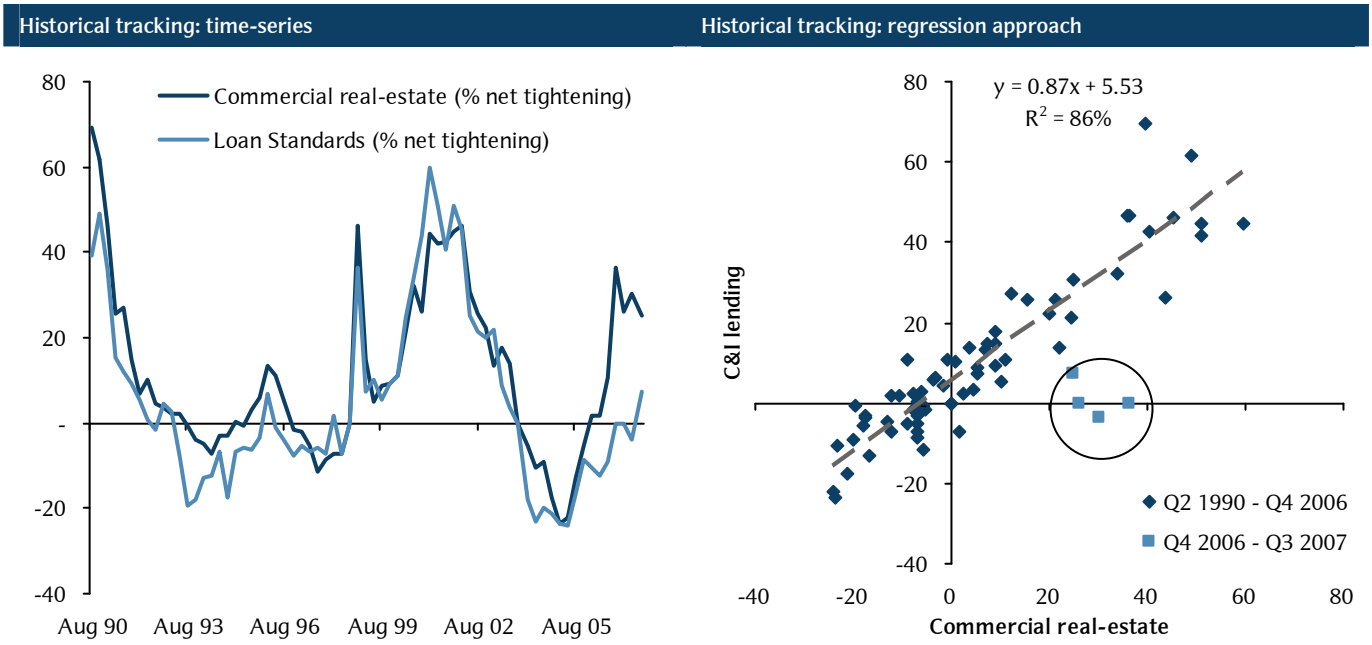
$$\mathrm{CRES}(t) - \beta \cdot \mathrm{CI}(t) = 0 \qquad (1)$$

Beta is estimated on an orthogonal basis, ie, we do not assume that either CRES or CI is the dependent variable. The orthogonal beta is estimated to be 0.93 for the sample 1990-2005 (excluding the recent divergence). On the basis of this, we forecast the number that tightening would need to go to in order to close the divergence. This calculation is based on the assumption that commercial real-estate tightening stays where it is, which seem probable given the difficulties in the US real estate market currently.

We infer that a net tightening of C&I standards of 17.5% rather than the 7.5% that we saw in the Q3 survey would have normalised the relationship. That leaves us a current divergence of around 10%.

[20] *This article was originally published as Lending standards and default rates: Some numbers, 5 October 2007.*

Figure 59: C&I and commercial real estate lending standards



Source: Federal Reserve, Barclays Capital.

Stage 2: How much more C&I tightening based on C&I tightening momentum?

We see a significant amount of momentum in C&I tightening, similar to the default cycle. This momentum can be used to forecast quarter-on-quarter increases/decreases in C&I based on the assumption *that the current trend persists*.

$$\Delta CI(t) = \alpha^{TIGHTENING} \cdot D(t) + \alpha^{EASING} \cdot [1 - D(t)] \qquad (2)$$

where D(t) is a dummy variable which takes on the value 1 when we are in a period of increasing net tightening, and 0 otherwise. We derived the periods of tightening and easing by a simple regime switching model. Figure 60 results confirm a very significant trending in standard changes.

Figure 60: Trends in tightening/easing environments.

Parameter	Coefficient	t-stat
$\alpha^{TIGHTENING}$	3.1	2.04
α^{EASING}	-4.84	-3.09

Source: Barclays Capital

Stage 3: So how much more tightening in Q4 is likely?

Bringing the results of 1 and 2 together, we have an estimate of roughly (17.5%-7.5%) = 10% plus 3.1% equals 13.1% of tightening. This would bring the total expected net tightening to **roughly 20%**.

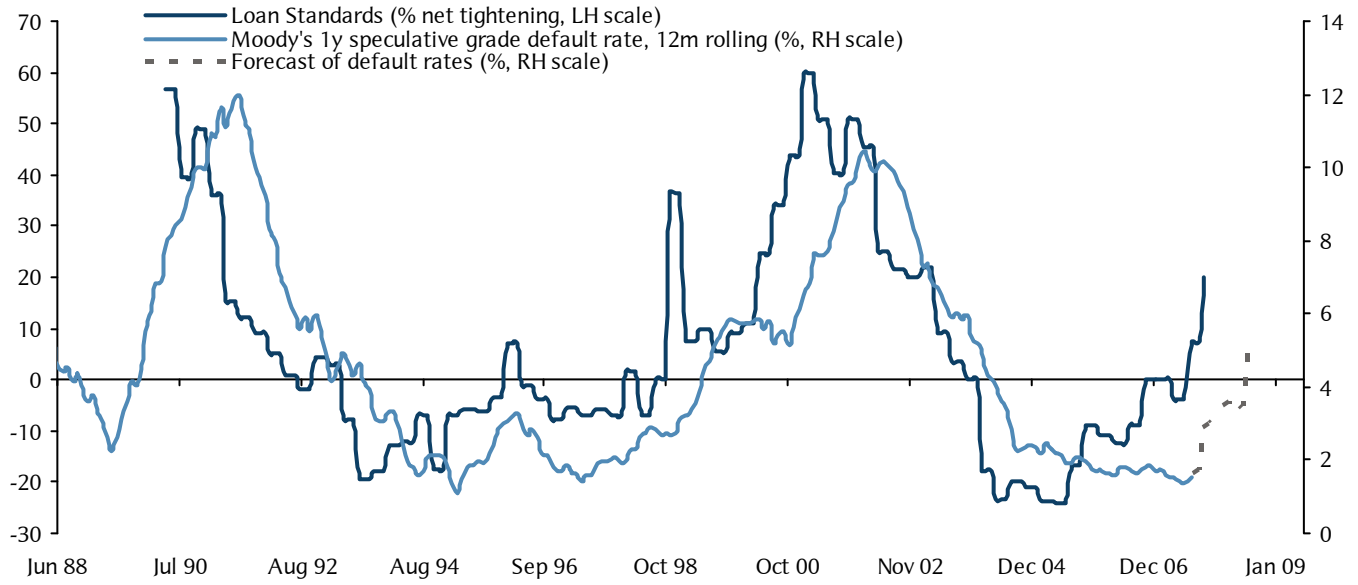
Deviations from this number should be taken as negative or positive surprises in the change of lending standards.

Stage 4: How does it translate into speculative grade default rates?

There are two components of how we think the current and forecasted C&I numbers will translate into default rates (we refer to speculative grade default rates unless otherwise stated):

- Through a normalisation between the historically close C&I standards and default rate relationship.
- Through additional tightening of lending standards, provided that commercial real-estate remains at the current tightening level.

Figure 61: Leading the cycle? C&I lending standards and high-yield default rates, realised and forecasted, 1988-2008



Source: Federal Reserve, Moody's.

Figure 61 plots the strong correlation between C&I standards and default rates. We are now at point at which the disconnect between the two is the largest that we have on record. We use the following relationship to deduce the empirical, "normal" relationship between the two:

$$\text{Default rate}(t + 4 \text{ quarters}) = \lambda \cdot \text{CI}(t) + c \qquad (3)$$

What we use here is the strong lead-lag relationship between C&I tightening and defaults, which is apparent in Figure 61. Closer statistical inspection confirms the lag relationship to roughly four quarters (Figure 56).

Figure 62: The C&I tightening/default rates relationship, equation

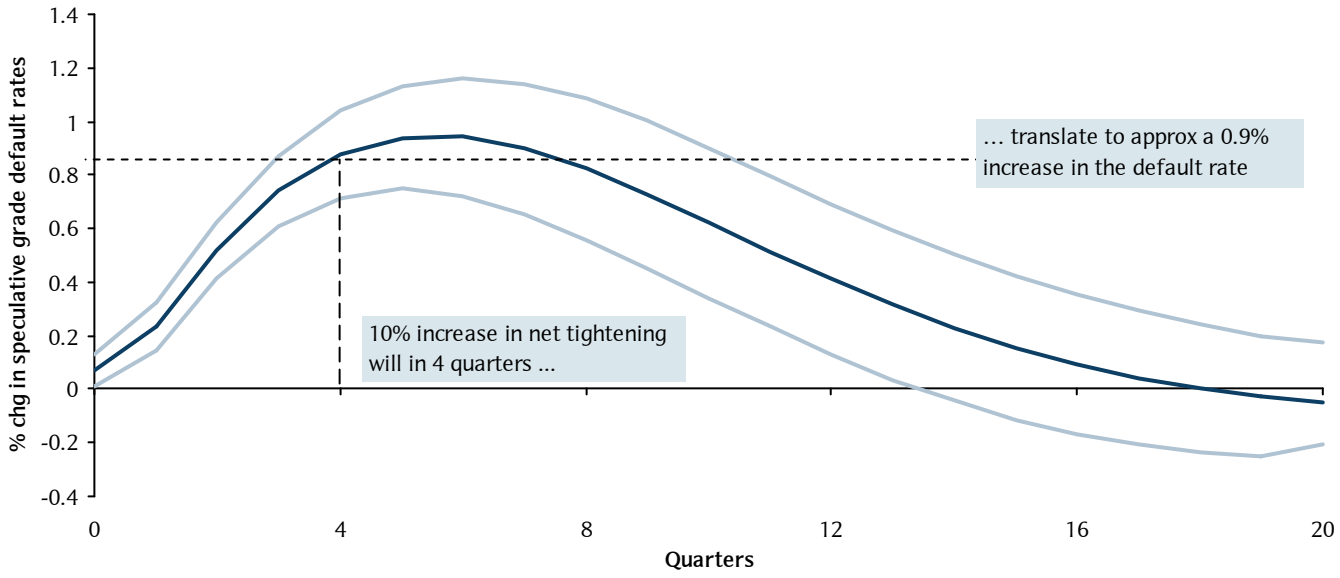
Parameter	Coefficient	t-stat
λ	0.116	9.4
c	4.07	16.1

Source: Barclays Capital.

Given a current net tightening in C&I of 7.5%, we would expect default rates in four quarters to reach 4.5%, up from today's historically low 1.5% rate.

However, we also predict an increase in C&I tightening from the current level to 20% in the next quarter. We highlight the behaviour of default rates *as a function of changes* in C&I tightening in Figure 63. The deduced impulse-response functions also allows to calculate how much our default rate forecast will change on the basis of the forecasted C&I tightening. We calculate that if C&I tightening reaches 20% in Q4, as we expect, then default rates could rise another percentage point a year down the road, to a **total of 5.5%**.

Figure 63: Effect over time of a 10% increase in tightening of lending standards, 95% confidence interval



Source: Barclays Capital

Stage 5: Conclusion

Based on our calculations, the likelihood of a substantial increase in speculative grade default rates appears quite substantial. Our estimates indicate an increase to a level of 5.5% over a four quarter period. We make to important assumptions for this: (1) there has not been a structural shift in the relationship between lending standards and default rates; and (2) the current disconnect between commercial real-estate tightening and C&I tightening will close mainly on the basis of the latter increasing. Both assumptions are valid in our opinion.

Technical notes:

We have tested extensively for non-stationarity, in the above regressions: where such is found, we run regressions on differenced variables. The calculations to generate Figure 63 are based on bivariate, stationary vector auto-regression (VAR) with two lags. The calculation for the month-on-month forecast of default rates for Figure 61 are based on a gradual (linear) closing of the current divergence over one year.

10. Implications of tightening lending standards for default rates

Corporates feel the pinch[21]

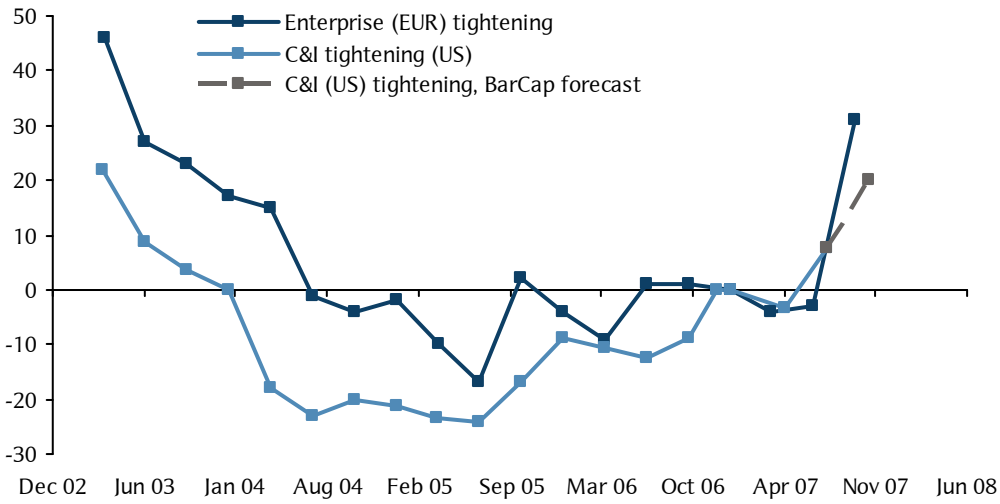
Credit standards have been tightening in Europe and the US in the aftermath of this summer's credit crunch. Having analysed the implications of this tightening in the context of the default cycle, we find a strong leading linkage between lending standards and default rates. Conditional on a persistent tightening of bank commercial and industrial lending, we forecast a substantial increase in speculative-grade default rates starting in 2008 – from 1.5% to 6.9% in the US, and from 2.9% to 7.75% in Europe, to December 2008. We also contrast the higher sensitivity of the European corporate sector to bank financing compared with the US, as well as the fact that Germany is exhibiting a much lower tightening trend than the rest of the euro area.

Smaller and medium-sized European corporates are likely to face harsher financing conditions following this summer's credit crunch, both in terms of cost and strings attached to loans. The rapid decrease in banks' risk appetite led to a significant drop in liquidity in the wholesale funding markets, among other things. And, just as risk-reduction mode kicked in quickly in the debt markets, so we expect the same to happen in general bank financing, although at a slower pace.

Lending standards for enterprises are tightening

Recent data from the central banks highlight quite a substantial change in trend globally, toward tightening of lending standards for commercial and industrial/enterprise lending. Last week, a European Central Bank survey showed a net 31% of loan officers tightening lending standards to enterprises. This was based on data collected up to 27 September. Similarly in the US, a Federal Reserve poll conducted at the end of July showed a net 7.5% tightening of lending standards in commercial and industrial (C&I) lending. Notably, the US survey showed a strong change of sentiment – net tightening for the first time since 2003 – even before the real credit market turmoil hit in the final days of July.

Figure 64: US and Euro corporate lending standards tighten



Source: Federal Reserve, European Central Bank, Barclays Capital.

Tightening corporate lending standards lead pick-up in default rates

Tighter bank lending standards are typically likely to affect mainly companies that have little alternative sources of financing. We see a strong intuitive linkage to a pick-up in default rates among these companies. In a risk sense, the company at the margin is not able to roll over bank loans anymore, so it is likely to wind up operations or default, as alternative financing paths are closed to it.

[21] *This article was originally published on 12 October 2007.*

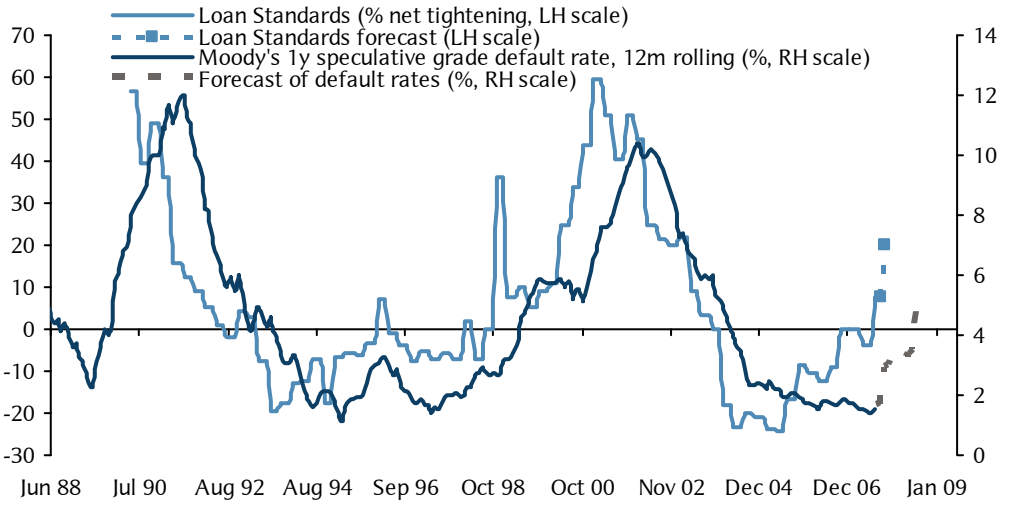
Lending standards and defaults: Empirical evidence

Looking at data from the Federal Reserve's survey, we can establish a strong relationship between C&I lending standards and forward speculative grade default rates (Figure 54). Over the past 17 years, we see a clear and distinct pattern, where each bearish part of the default cycle, ie, the upward-sloping parts of the graph where default rates are increasing, has been preceded by lending standards trending tighter, ie, the C&I graph sloping upwards. The opposite is also true of the other turning points where we switch into a regime where default rates are trending lower. As such, the C&I lending appears to have a very strong leading indicator function for the default cycle. Indeed, we quantify the purely statistical behaviour of this pattern in our recent publication *Lending standards and default rates: Some numbers,* 5 October 2007.

The disconnect between lending standards tightening and default rates is historically high

What is particularly interesting is that we now appear to be at a juncture where lending standards have trended tighter for some time, but default rates have remained at historical lows. In particular, the latest numbers on C&I tightening show bank lending standards firming. As we argue in the *Global Credit Strategist,* 4 October 2007, there are arguments for this tightening to continue, not least the large divergence between the very strong tightening in commercial real-estate lending and C&I lending, two variables that normally track each other very closely. We overlay our forecast of lending standards tightening in the US (20% in Q4) in Figure 54, together with our forecast of a pick-up in default rates based on this. Under our fairly innocuous assumptions, we would expect speculative-grade default rates to rise from the current 1.5% to around 4.5%/5.5% (assuming no increase in C&I tightening/our forecasted increase in C&I tightening). Please see the technical notes at the end of this article on ways to calculate this number.

Figure 65: Increasing speculative-grade default rates forecasted globally



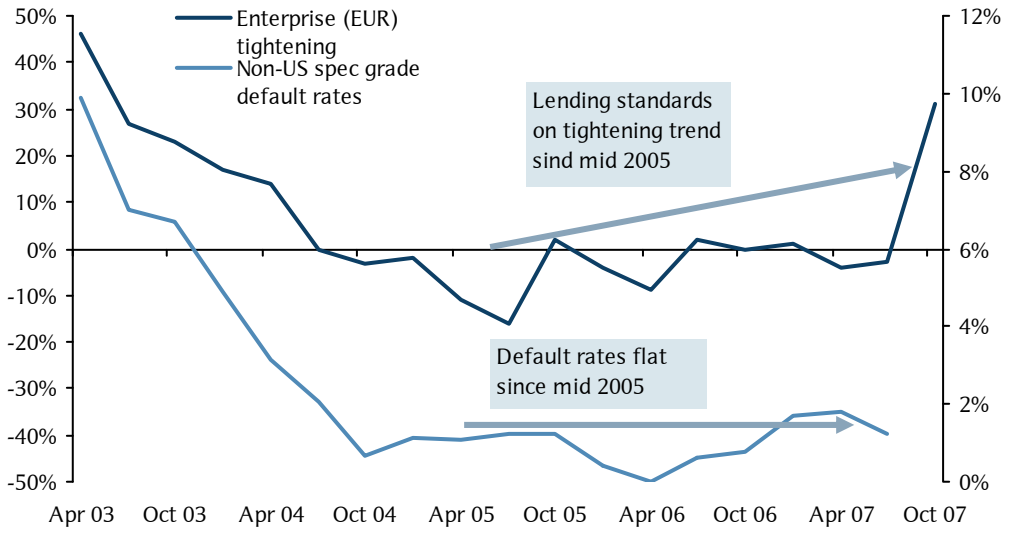
Source: Federal Reserve, Moody's, Barclays Capital

The European perspective

Europe: Lending standards tightening, HY defaults remain flat

The above analysis between default rates and C&I tightening focuses on the Fed's US data, as these have a much greater historical reach. The ECB has only done a similar survey since April 2003. We plot this time series overlaid with non-US speculative-grade default rates in Figure 66. Emerging from the 2001-2002 credit cycle downturn banks reported strongly tightening lending standards all the way into 2004. The rate of easing that followed peaked in mid-2005. Since then, we have seen fairly small numbers either to the easing or tightening side – until last week. Interestingly, the recent move to a net 31% tightening is historically quite large. We look at similar numbers in mid-2003, which was a fairly different general credit market environment than it is today.

Figure 66: Euro area enterprise lending standards and non-US speculative grade default rates

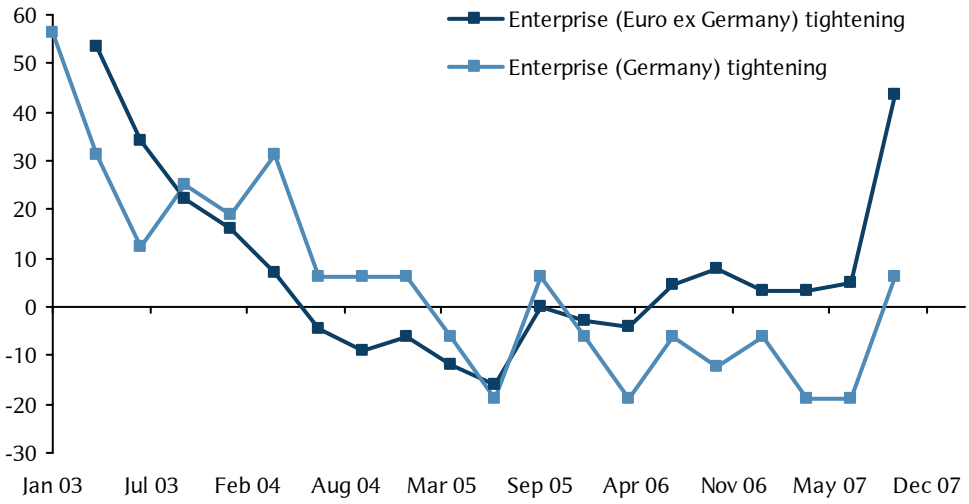


Source: European Central Bank, Moody's.

Germany shows far less tightening than the rest of the euro area

The numbers on the European lending standards are also to some extent broken down by country. Both the Bundesbank and Banque de France publish their numbers separately. Figure 67 shows the euro area ex Germany versus Germany only. It is striking how much of a dislocation we see between Germany and the rest of the euro area. The German net tightening currently stands at 6%. Assuming a one-third weight of Germany in the calculation, this implies a 43% net tightening in the remainder of the euro area. Banque de France issued its numbers on enterprise lending this week, showing a 31% net tightening. We believe these disparities in the euro area are quite significant. Although they should iron out over time, they imply potentially diverging financial stress and default rates among the euro area countries.

Figure 67: Euro tightening numbers – only moderate tightening in Germany



Source: European Central Bank, Bundesbank, Barclays Capital

The impact of tighter lending standards: Transatlantic differences and similarities

A key question is how we can translate the European tightening into a forecast of actual European default rates. We use two approaches to solve this question. First, we look at how similar the European and US default cycles are. If they are very similar, we would expect the forecast increase in US default rates to tip over into Europe, following the historical relationship. If not, we should resort to a second, more fundamental-based approach of looking at the effect of bank lending tightening on the euro area.

US/Europe default cycle correlation: Slightly different timing of peak

First, Figure 68 illustrates the default cycle correlation. Speculative-grade default rate correlation is not a simple one-for-one relationship. Although there are similarities in broad trends, there are also some notable differences. We see a peak of the cycle occurring earlier in the US, around January 2002, compared to Europe, which peaks 6-9 months later. Is this significant? It depends on the investor's perspective. Looking at historical time series of CDS spreads (see *CDX and iTraxx: Extending the horizon*, 14 March 2007, for an historical recreation of CDS indices over a full credit cycle), we can see European spreads peaking around six months after US spreads, suggesting a potentially important effect in the short term. As a general tool for looking at the default cycle, the differential in the default cycle of 2002 is not very important, in our view. European data was simply too sparse back then to make a firmer analysis. The lagging of the European credit cycle, as the data show, could simply be an artefact of idiosyncratic default risk, as well as a reflection of the differences in legal frameworks, or a true lead/lag relationship in the default cycle.

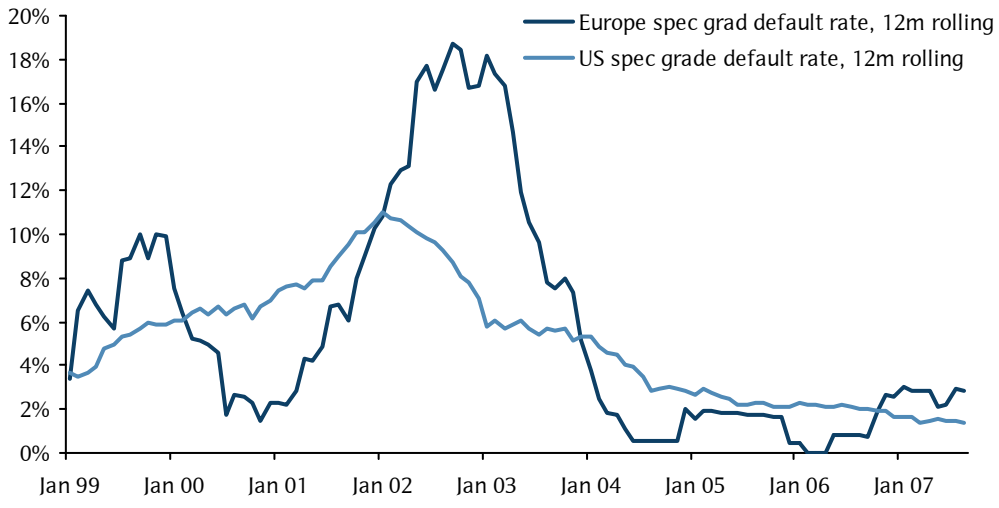
US/Europe default cycle correlation: Volatility differences

Second, the European numbers are also much more volatile than the US numbers. The business model with high-yield companies has not been as strong in Europe as it has in the US traditionally. After the telecoms/technology boom and bust in the early 2000s, we saw a lot of the start-ups in Europe enter the high-yield realm on their way to default, and our data sample on HY companies gets skewed towards technology companies for this reason. Hence, we have a quite substantially higher peak of default rates in Europe compared to the US around 2002.

On a credit asset class basis, the US and Europe default cycles are sufficiently correlated, we believe

So how much can we rely on the US historical lead/lag relationship? We believe that the arguments and data so far support a general correlation of the high-yield default cycle in the two geographical areas. Admittedly, the data samples are quite short, and we suggest that this basic correlation is not taken for granted, but critically evaluated going forward.

Figure 68: The HY default cycle, US and Europe



Source: Barclays Capital

European bank financing channel is of greater dignity than in the US

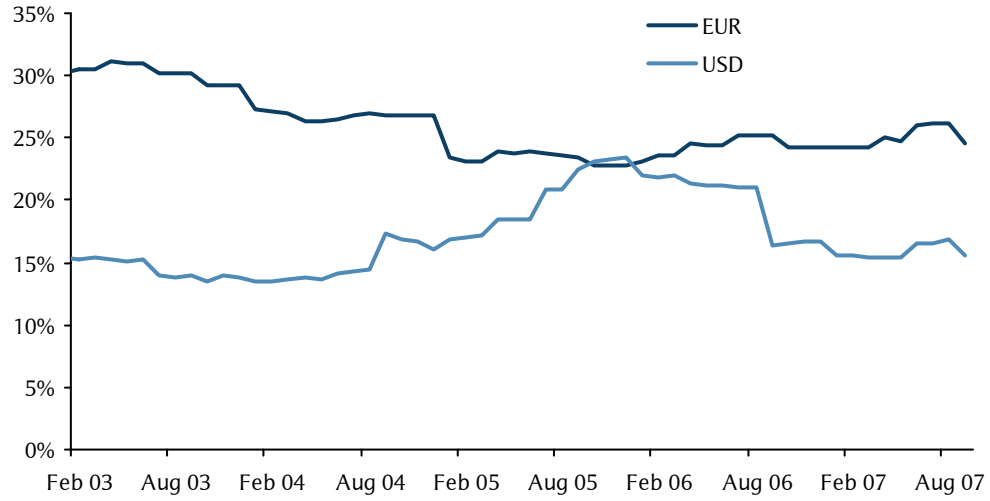
Besides default cycle correlation and in the context of lending standards, it is commonly perceived that European corporates are more dependent on banks for financing than their US counterparts (Figure 69). For one, the corporate bond market did not develop in the euro area until the late 1990s. Since then, however, European bond issuance as a total of all debt financing has outpaced that in the US. Still, anecdotal evidence suggests that European corporate debt is in bank loan form to a higher extent than what we see in the US. The exact quantification of this dependence remains a future research topic.

Short-term financing is more important in Europe: Higher sensitivity to tightening standards

Another argument concerning lending standards is that the more frequent the requirements for refinancing are, the greater are the standards' effects. The more often issuers need to roll over debt, the sooner they will feel the pain from restrictive lending criteria. Figure 69 plots short-term debt as a fraction of total debt across the euro area/US, giving a broad indication of this. Note that one could also argue for this measure to capture bank dependency to some degree, as bank credits will mostly have shorter maturities than traditional bond issuance.

The graph is based on credits with traded CDS, non-financials, and is broken up between the US and Europe. What is clear is that short-term debt has constituted a greater proportion of total debt in Europe compared to the US, with a difference of around 10 percentage points currently. We see this as another indication of the greater sensitivity of European corporates to tightening bank lending standards.

Figure 69: Short-term debt to total debt of non-financials with traded CDS



Source: Factset, Barclays Capital

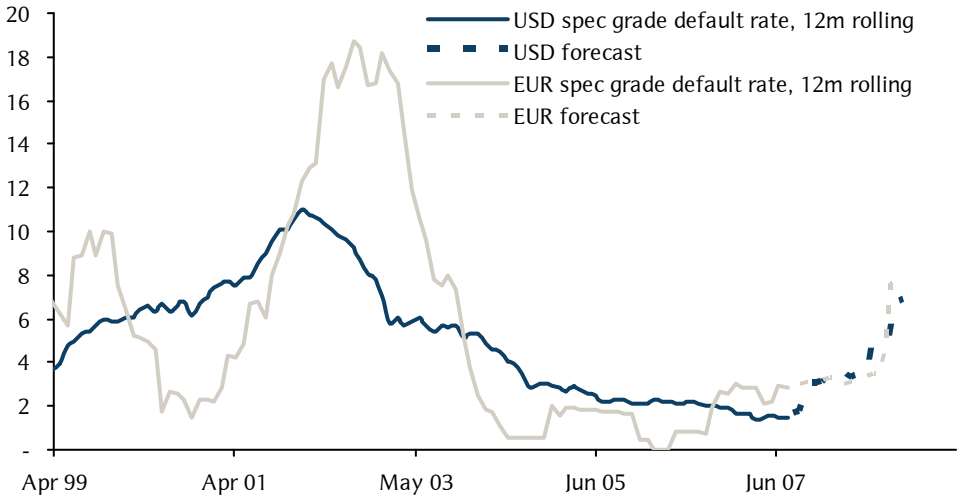
Summary: Default rate forecasts for 2008

Lastly, we use the empirical relationship and forecasts from the US to forecast speculative-grade default rates for Europe in 2008. Based on a continued tightening of bank lending standards at 20% for the US and 31% for Europe, we see a very substantial increase in default rates towards the latter half of 2008. For Europe the number is 7.75% for December 2008; for the US it is 6.9%. From current numbers (1.5% in the US, 2.9% in Europe) this is a very significant rise. Remember that this is based on a continuation of tight credit. If financing conditions are dire, as current numbers suggest, these default rates do not seem as improbable. Current figures on lending tightening appear to price in a substantial probability of a sharp slowdown in the economy, making these numbers look high compared with current default rates.

We also would like to point out that, in an historical context, current low default rates look like an anomaly rather than the forecasted numbers being particularly high. A central question to establish whether it is an anomaly or not will be to decide whether

credit markets have been structurally altered through financial innovation, demographic change and globalisation. If so, these numbers are overestimating the effect of tightening lending standards on default rates. If not, and tight lending standards persist, we are merely forecasting default rates to return to an intermediate level after being low for a few years.

Figure 70: Speculative-grade default rates, realised and forecasted



Source: Moody's, Barclays Capital.

Technical notes: Forecasting forward default rates

This disconnect between lending standards tightening and default rates is the largest that we have on record. The question is how much of a rise in default rates would we require in order for the divergence to close? We use the following model to deduce the empirical "normal" relationship between the two:

$$\text{Default rate}(t + 4 \text{ quarters}) = \lambda \cdot \text{CI}(t) + c \qquad (3)$$

What we use here is the strong lead/lag relationship between C&I tightening and defaults, which is apparent in Figure 54. Closer statistical inspection confirms the lag relationship to roughly four quarters (Figure 56).

Figure 71: The US C&I tightening/default rates relationship equation

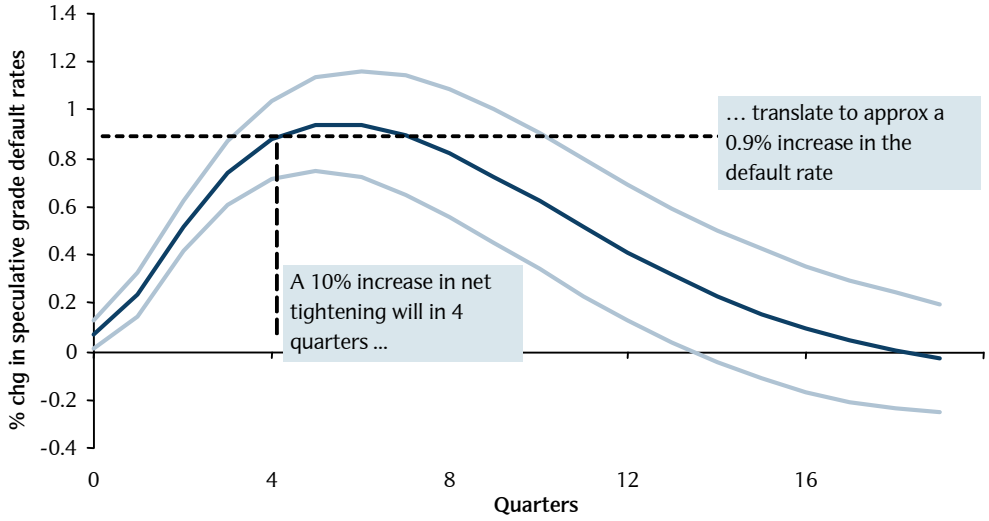
Parameter	t-stat	Coefficient
λ	9.4	0.116
c	16.1	4.07

Source: Barclays Capital.

Given a current net tightening in C&I of 7.5%, we would expect default rates in four quarters to reach 4.5%, up from today's historically low 1.5% rate.

However, we also predict an increase in C&I tightening from the current level to 20% in the next quarter. We highlight the behaviour of default rates *as a function of changes* in C&I tightening in Figure 63. The deduced impulse-response functions also allow us to calculate how much our default rate forecast will change on the basis of the forecasted C&I tightening. We calculate that, if C&I tightening reaches 20% in Q4, as we expect, then default rates could rise another percentage point a year down the road, to a total of 5.5%.

Figure 72: Effect over time of a 10% increase in tightening of lending standards, 95% confidence interval



Source: Barclays Capital

11. Rates and credit - a growing concern

Linking real interest rates to credit[22]

Ulf Erlandsson, Graham Rennison, Julie Schultz, Melody Vogelmann, Arup Ghosh, Amit Bhattacharyya

The effect of rates on credit will be key for credit investors, as Barclays Capital projects Treasury rates will return to levels not seen since the last turn of the credit cycle in 2000. We argue that in order to determine the impact this will have on credit, one must also consider the overall growth and inflation picture. We develop a model of a fundamental equilibrium between growth and credit spreads, which allows us to estimate rates' effect on credit conditional upon the growth situation.

Key findings

- The beta of credit to Treasury yields varies under different regimes of real GDP growth.
- In the current environment, where real GDP growth is still strengthening, rate changes have a weak relationship with medium-term credit performance.
- We find, however, that as real GDP growth slows, credit returns/spread tightening are positively correlated with yields.
- The model indicates that today's spreads look too tight relative to current economic growth numbers. This should impart a widening tendency to credit spreads in the medium to long term, in our opinion.
- Our rates and economic forecasts indicate, however, that we will continue on a strong growth path in 2007/8. This should be supportive for credit.
- However, if inflation picks up from the current level without a commensurate increase in growth, we will reach a point of dislocation at which the credit cycle historically has started to turn.

Credit sensitivity to rising rates

The rates/credit beta – a conundrum

Rising rates are a key theme for markets going into the third quarter. Our economists believe that the Fed is more likely to raise rates than lower them, given stronger-than-expected growth data. Robust economic expansion in other regions has also led to an almost universal trend towards higher rates. At the same time, we have seen credit markets wobble on the back of central bankers' motivation for seeking higher rates. The rates/credit conundrum has been illustrated over the past few years. From 2003 to early 2006, most rate rises were growth driven and, over the medium term, empirically positive for credit. This is reasonable, as better-than-expected growth rates should benefit corporates despite a higher interest rate trajectory. Since mid-2006, however, we have seen several pockets of inflation-concern-driven rate increases that clearly spook markets.

Three pillars of credit sensitivity to changes in rates

The potentially counteracting forces at play when Treasury yields change make the task of estimating a "beta" of credit market interest rates a non-trivial task. We identify the following three pillars of a framework for how varying rate developments can affect credit:

- Mathematical/pricing: as discount rates go up, the value of future cash flows diminishes, putting downward pressure on bond prices and upward pressure on yields.

[22] *This article was originally published in the Global Credit Strategist, 5 July 2007.*

- Financial risk: Investors' preferences on where they want to be on the risk-return frontier change. When risk appetite is growing, we generally see shifts from credit-risk-free assets (such as Treasuries) into riskier assets (such as corporate bonds or derivatives). At these junctures, increasing Treasury yields are suggesting that investors shift out of risk-free assets and into, for example, credit. We see increasing cash bond prices and tightening spreads.
- Macroeconomic: The yield curve contains a wealth of information about growth and inflation projections. Under a credible central bank regime, rate increases are consistent with improved growth prospects, which should improve creditworthiness and cash bond prices, and tighten spreads.

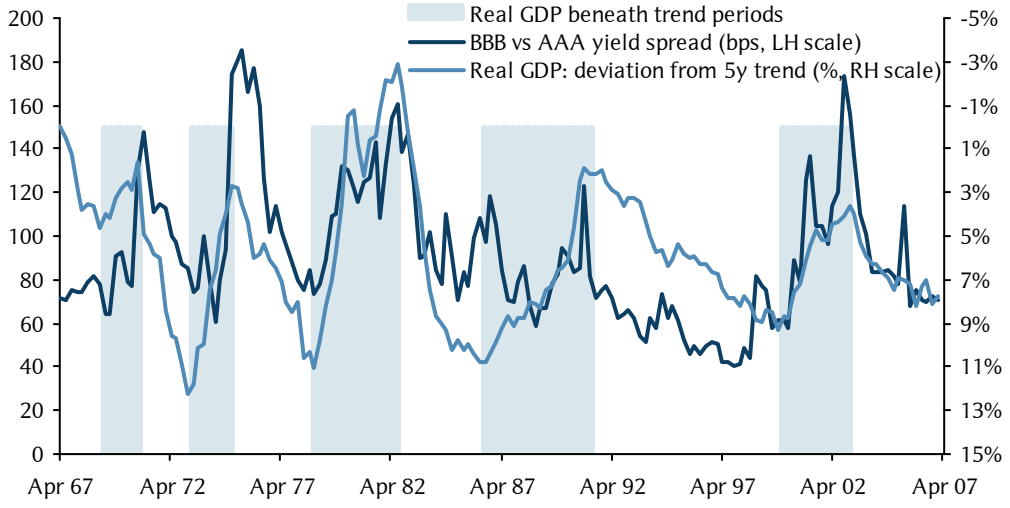
Highly contradictory effects on credit suggesting time-varying beta of credit to rates

It is difficult to discuss one of these pillars without including the others. Let us consider an example, with some similarity to the evolution of the credit market over the past few years. Solid economic growth puts upward pressure on inflation and rates. From a purely discounting point of view, rising rates lead to falling bond prices. But this simple view does not take into account the prospect that improved growth also generally means lower default rates, a development that tends to compress spreads. Also, given robust growth, investors tend to be more willing to increase their risk exposure for a given level of return. This will lead to a shift towards riskier asset classes, such as credit.

Real growth correlates well with spread levels and serves as a proxy for probability-of-default expectations

We believe that the macroeconomic pillar will always be a primary factor in how credit markets perform. In Figure 74, we plot credit spreads versus US real GDP growth from 1967 to 2007. Not surprisingly, there is a strong negative correlation between real growth and the level of credit spreads. The graph highlights the strong relationship between underlying real economic growth and credit spreads. In periods (highlighted in blue) where real GDP growth is slowing (note the inverted scale on the right hand axis), we see credit spreads widening. Similarly, spreads appear to tighten as real GDP is increasing at above-trend rates. We provide further detail on the real GDP trend number below.

Figure 73: Credit spreads and real GDP growth to trend growth, 1967-2007



Source: The Yield Book, Moody's, IMF, Barclays Capital

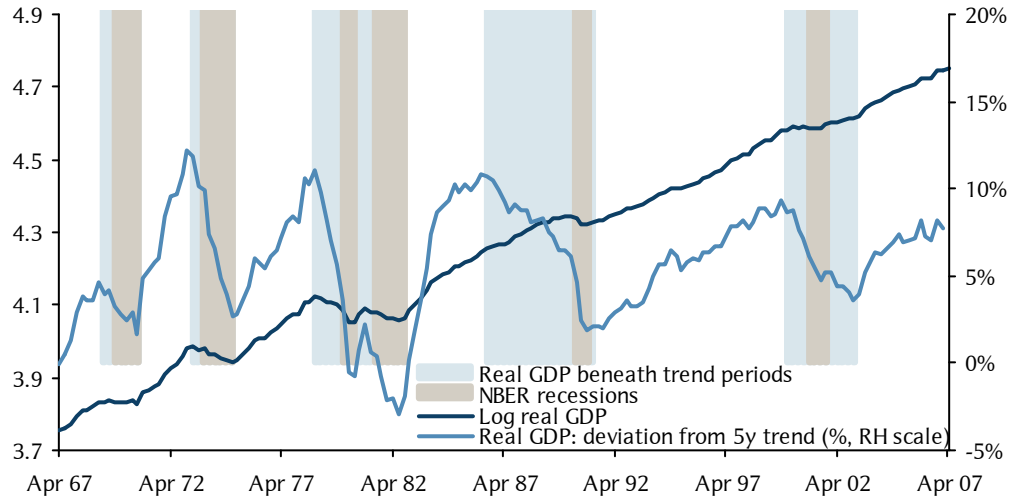
Given this strong correlation between real GDP growth and spreads, and, furthermore, the relationship between growth and interest rates, we believe an empirical analysis of a credit's beta to rates omitting the real growth situation misses important information.

Credit beta to rates: Conditional on real growth

Splitting the data into periods of positive and negative growth momentum facilitates a granular statistical analysis

To simplify our empirical analysis, we have chosen to divide the real GDP data into two types – periods where real GDP growth is above the average of the previous five years and periods where it is below the average. In this way, we are able to reflect growth momentum in terms of real GDP growth relative to its recent history. For example, if we have had five years of strong, 3% growth and the latest real growth number comes in at 2.5%, it would be flagged as weak growth momentum. In the same way, if we have just passed through a recession, a fairly moderate growth number would produce a positive growth momentum signal. We plot the relationship between real GDP, real GDP over trend and the corresponding regimes in Figure 74. As can be seen, our positive/negative growth momentum indicator is a broader indicator of growth slowdown than the traditional NBER recession indicator.

Figure 74: Credit spreads and real GDP vs trend growth, 1967-2007



Source: The Yield Book, Moody's, IMF, Barclays Capital.

Taking the macroeconomic situation into account when looking at credit/rates betas

Dividing real growth into two regimes provides a straightforward way of measuring rates' impact on credit, which takes into account the potentially different dynamics of rates' impact over the business cycle. We use the following econometric model to measure this:

$$\text{Excess credit return}_t = c + \beta^{Slowdown} \cdot D_t \cdot \Delta r_t + \beta^{Growth} \cdot (1 - D_t) \cdot \Delta r_t + \\ + \alpha \cdot \text{SpreadDisequilibrium}_{t-1} + \varepsilon_t \qquad (1)$$

This equation links changes in the 10 yr Treasury yield (Δr_t) with credit returns, conditional on the growth regimes, and takes into account whether credit looks cheap or rich relative to the fundamental macroeconomy (as measured by the variable $\text{SpreadDisequilibrium}_{t-1}$ (for more detail on the construction of this variable, see the final section).

The key points of the model are:

- Rates' impact on credit returns is dependent on the current growth regime.
- The dummy variable D_t indicates we are experiencing negative growth momentum. When it takes the value of 1, the beta of returns to rates is allowed to be different

than when we are on a positive growth path (D_t =1). Figure 74 above delineates the breakdown between positive and negative growth momentum regimes.[23]

- Consequently, the parameters $\beta^{Slowdown}$ / β^{Growth} measure credit's beta to 10 yr Treasury yield changes when we are in below- or above-trend growth periods.
- The variable $\text{SpreadDisequilibrium}_{t-1}$ captures the dislocation between credit spreads and current real growth. We develop this disequilibrium measure below. A positive value indicates either that spreads should tighten or that real growth should pick up in order to achieve equilibrium.
- The variable α shows how quickly excess returns react to the spread/growth disequilibrium. A positive value for α means that excess returns are positive, as the spread/growth disequilibrium is positive, and the larger the number, the more marked reaction one would expect to see.
- *c* is a constant that measures the average return over the period.

We calculate excess credit returns as the benchmark US Credit BIG index return. Rate sensitivity is the beta to the 10yr Treasury rate measured as the marginal excess return per basis point of change in the 10yr rate on a month-by-month basis. Estimation results are provided in Figure 75. For comparison's sake we also look at a growth-independent model, which holds the beta constant across the growth cycle.

Figure 75: Credit beta to rates – strong statistical fit when dependent on the growth regime

(i) Growth-dependent beta model, 1995-2007				(ii) Growth-independent beta, 1995-2007			
Parameter	Coefficient	s.e.	p-value	Parameter	Coefficient	s.e.	p-value
c	56.8	14.29	0.0%	c	46.6	16.37	0.7%
$\beta^{Slowdown}$	3.95	1.04	0.4%	β	1.64	0.61	1.0%
β^{Growth}	0.63	0.52	23.9%	α	0.58	0.32	7.6%
α	0.71	0.26	0.9%				
R2	56%	R2a	53%	R2	33%	R2a	30%

Notes: p-values are calculated using heteroskedasticity and auto-correlation adjusted variance-covariance matrix. The adjusted R2 measure refers to correcting the ordinary R2 for number of variables included in the model. Source: Barclays Capital.

Credit relationship with rates shows strong dependence on growth regime

The results of estimating the model are illuminating. Allowing for two different betas depending on the growth regime strongly increases the explanatory power of the model. It is also very strongly confirmed via statistical testing[24]. In terms of magnitudes, we see that for every basis point increase in the 10yr Treasury, we achieve another 4bp of excess return in credit when we are in the below-trend growth regime. On the other hand, as growth takes a positive turn, we see essentially zero direct impact in terms of excess return. The symmetric model blurs the distinction between the two states, with a 1.64bp excess return increase per basis point increase in the Treasury rate. In terms of explanatory power, the adjusted R2 increases to 53% in the growth-dependent model from 30% in the growth-independent version.

[23] *We define an above-trend growth regime as a period where real GDP over its 5 yr trend is an increasing number.*
[24] *We conduct a likelihood ratio test between the two models, which rejects the symmetric model, with a LR statistic of 20.78. This is equivalent to a p-value that is zero to the sixth decimal place using a* χ^2 *distribution with 1 degree of freedom.*

Nominal rates effect: the 2000-03 experience

So, why are *rising* rates positively correlated in the short run with credit returns when we are in the below-trend real growth part of the cycle? Let us use the example of the 2000-03 downturn in the credit market to illustrate this. The growth regime changed to below trend from above trend in Q3 99. Although for the next few quarters, growth remained healthy by normal standards, the model emphasises the slowing tendency, ie, that growth is moving toward a below-average path. On the rates side, yields were rising until the first days of January 2000, when the 10yr yield peaked at 6.7%. It then entered a period of falling yields until 2003. The real credit underperformance started in the first quarter of 2000, simultaneously with the 10yr yield falling 50bp. Similarly, in the first half of 2002 (the trough of the credit cycle), we saw 10yr yields falling to 3.1% from 4%. At this time, the Fed was cutting rates aggressively to prop up the economy. Put together, during this period we saw a large positive correlation between credit returns and 10yr yields.

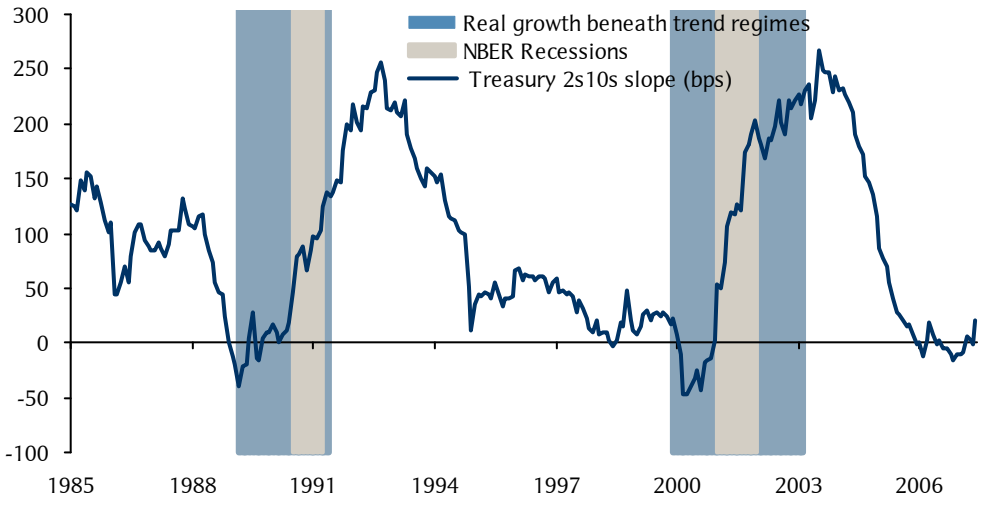
Positive rates/credit returns: a flight-to-quality/flight-to-risk interpretation

We can also illustrate the positive correlation by examining risk appetite. In a downturn, investors generally become more risk averse. This implies that the demand for risk-free assets will increase and the appetite for riskier assets, such as corporate bonds, will start to decrease. Hence, rising Treasury prices (falling Treasury yields) will be positively correlated with falling corporate bond prices (falling credit returns), as we have a flight-to-quality tendency. The reverse can be expected before and at the peak of the business cycle. Then, investors typically exhibit strong momentum for going into riskier assets – a flight to risk – which will put an upward pressure on Treasury yields at the same time as credit returns are positive.

Fed funds rate changes appear to be priced in; do not move credit in the short term

A relevant question to ask is whether these effects can be explained on the basis of flows (as the flight-to-quality/flight-to-risk hypothesis would suggest), or whether there are central bank preferences in the picture, as well. We ran the above regression again, but this time used the fed funds rate rather than the 10 yr Treasury. We see no immediate correlation between changes in the fed funds rate and excess credit returns. This is not too surprising, as on most occasions, changes in the fed funds rate already have been priced in.

Figure 76: Flattening and steepening of the Treasury curve around the turn of the cycle (%)



Source: National Bureau of Economic Research (NBER), Federal Reserve, Barclays Capital

Further dynamics: the role of the shape of the yield curve

Note, however, we still believe that anticipation of what the Fed is going to do is highly significant for credit. One could argue that the long end of the curve, such as the 10yr point, has a higher sensitivity to expected future rates. The different dynamics of the short end versus the long end of the Treasury curve have been shown to have an impact on credit. As we highlighted in *Yield curve inversions, bank credit tightening and the credit cycle*, 8 February 2007, the slope of the yield curve serves as a strong indicator of changes in the credit cycle. Specifically, inversions have historically predated a turn to a credit-negative regime, as is also shown in Figure 76. We also can see how our broader, negative-momentum regime captures both the inversions and the steepening post-inversion in the Treasury curve. This lends further support to rates having a flight-to-quality/flight-to-risk impact on credit near turning points in the cycle.

The real business cycle impact: growth/spread dislocation reversion effects are strong

Finally, the model indicates a strong pull-to-equilibrium effect, as α is significant and positive. In essence, when we are looking at above-trend real GDP growth and spreads remain high, we can expect spreads to tighten and generate extra excess return. This will generally happen when a downturn ends and lasts until some time before the peak of the business cycle. An important observation with regard to this variable is its long-run nature: it can be quite a long time before the actual mean-reversion of the disequilibrium becomes significant. Another point is that unless we allow for a growth-dependent credit beta to rates, the pull-to-equilibrium force is not significant. This appears to be a statistical effect: because the pull to equilibrium acts over a longer horizon, it will be a weaker statistical force than the rates effect, and can only be seen if the rate effect is properly modelled. An analogy would be the difficulty of understanding the sun's effect on the earth's tides without first understanding the moon's impact.

Results are repeated when a longer time series on spreads is used

The above results rely upon a fairly limited data set in credit return space. To further validate the results, we extended our sample and estimated the impact of changes in the 10yr yield on changes in credit spreads for the period between 1967 and 2007 and got similar results. Increases in the 10yr yield induce spread tightening, and the effect is stronger when real growth is below trend. We also see a strong pull-to-equilibrium tendency.

Day-to-day correlation between rates and credit: a future topic

We note that the relatively low frequency of observations – a month-by-month basis – does not take into account more sentiment-driven forces, such as the drivers of the market moves we have seen over the past few weeks (eg, subprime-related fears). High-frequency market moves and correlations will have to be the topic of future studies.

Looking ahead…

Barclays Capital forecasts suggest continued positive growth momentum

Our empirical results suggest that we are still on an above-trend growth path. If this is the case, the impact of further changes in rates should be muted for credit, according to our analysis. We outline, in Figure 77, Barclays Capital's forecasts for rates, inflation and growth over the next year. The projections emphasise continuing strong growth that tapers off slightly in 2008. At the same time, the fed funds rate is expected to rise to 6.00% during 2008 from of 5.25% currently, with similar rises in 2yr and 10yr rates.

Figure 77: Barclays Capital US GDP, inflation and rate forecasts

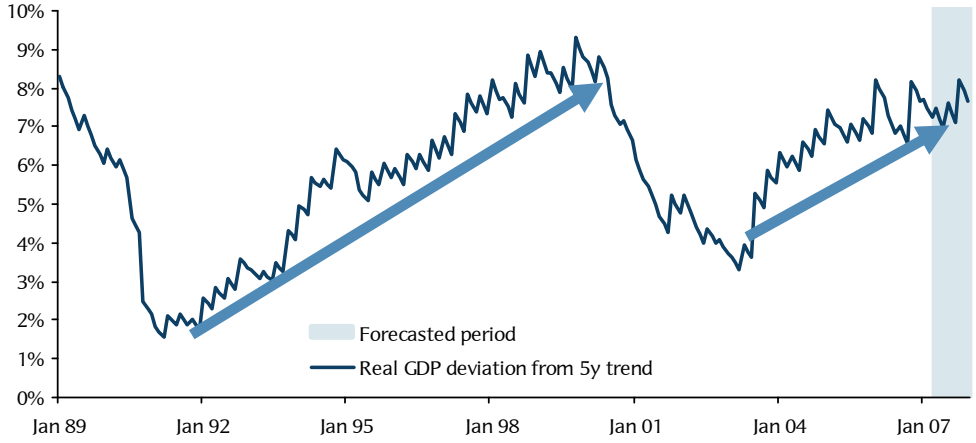
	Real GDP	Core PCE	Fed Funds	Treasury 2yr	Treasury 10yr
Q2 07	3.0	2.1	5.25	4.75	4.75
Q3 07	3.5	2.6	5.50	5.18	5.35
Q4 07	3.0	2.5	5.75	5.42	5.40
2008	2.8	2.5	6.75	5.30	5.40

Source: Barclays Capital

This outlook suggests a continuation on the positive growth trend, plotted in Figure 78. The first conclusion, if we remain on the positive growth path, is that we do not see a straightforward link between rates and credit on a month-by-month basis.

That said, as certainly has been seen over the past few weeks, there could be strong related moves in the short run.

Figure 78: Barclays Capital real GDP forecasts suggest continuing above-trend real growth – but the picture is evolving



Source: Barclays Capital.

We are in a sensitive position in the growth cycle: downward revisions could shift us into a negative trajectory

There are caveats regarding the strength of the current growth path, however. Figure 78 shows that we would not need more than a small downward revision to the nominal growth/inflation ratio in order to potentially be on a path where real GDP is moving to a slower-than-trend path. This would not necessarily mean that we automatically enter a spread-widening period, but rather that we are entering the period around the peak of the cycle, when rates typically display a strong medium-term positive correlation to credit.

The spread/growth disequilibrium model

Cointegration: a framework for long- and short-run relationships between economic variables

We have already discussed the link between credit returns and real economic growth. Formally, when we refer to the spread/growth disequilibrium, what we are considering are the joint movements of spread and real growth and any deviations from that relationship. In order to capture potential dislocations, we use a statistical methodology called cointegration. This method can measure the 'beta' between two variables in the long run, as well as the short run in a prudent way. Foremost, it will be able to – with as much certainty as statistical models allow – distinguish between meaningful (mean-reverting), long-run relationship and spurious ones.

Cointegration models are estimated in a system of equations. For simplicity, we choose to just highlight the credit side of the model we developed for the spread/growth equilibrium:

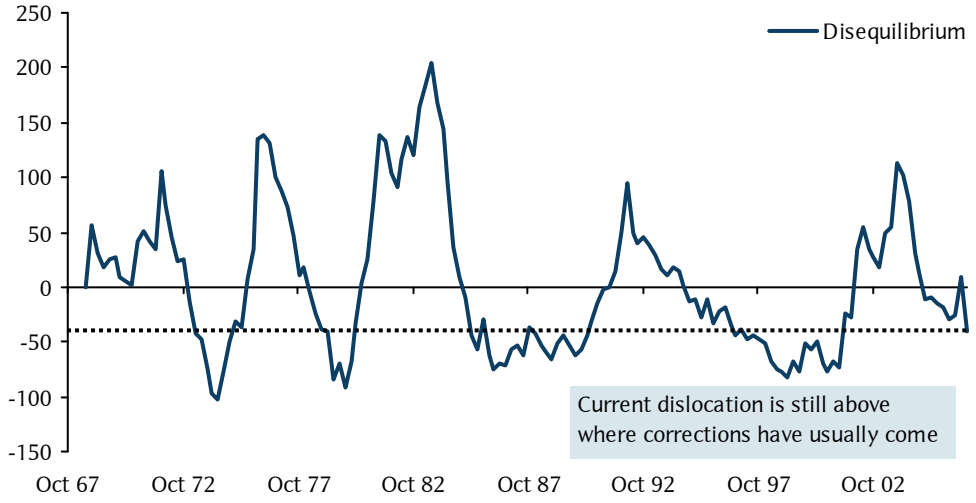
$$\Delta \text{Spread}_t = c + \underbrace{\alpha(\text{Spread}_{t-1} - \beta\tilde{Y}_{t-1})}_{\text{Equilibrium component}} + \underbrace{A(L)\Delta\text{Spread}_{t-1} + B(L)\Delta\tilde{Y}_{t-1}}_{\text{Short run dymanics}} + u_t \quad (2)$$

Here $\tilde{Y}_t$, denotes current real GDP divided by the five-year average real GDP at time *t*. The parameter α indicates how quickly spreads adjust to the spread/growth equilibrium. β is the beta of spread levels to growth levels, ie, it indicates how much spreads should move given a one-unit move in the growth number. *c* is a constant that has statistical but not practical implications. *A(L) and B(L)* are lag polynomials that indicate a certain number of lags for the following variable. These are technical components of the model that are less important for practical considerations.

We employed the model in (2) to form the following main conclusions:

- There is a significant relationship between our growth measure and credit spreads. Statistical testing confirms that the equilibrium component is significant and can be interpreted as saying that for a certain level of economic growth, spreads tend to revert towards an equilibrium level.
- The speed-of-adjustment variable, α, suggests a fairly slow but reliable pull to equilibrium between spreads and growth.
- There are short-term adjustments of spreads.

Figure 79: Current spread/growth disequilibrium – credit too tight, but still some way from historical lows



Source: Barclays Capital

The spread/growth disequilibrium: a highly cyclical nature

The pull-to-equilibrium effect can be seen in Figure 79, where we plot the deviation of the spread/growth relationship from its equilibrium level (ie, the disequilibrium). Clearly, this relationship displays cyclical and mean-reverting behaviour. Currently, the disequilibrium is negative; that is, spreads are too tight for the level of economic growth. On a historical basis, however, the disequilibrium is not so large that we would necessarily expect a reversion in the short term. In past cycles, the turn has occurred at levels of disequilibrium that are greater than what we see now[25]. The cyclicality of this series suggests that it lends itself to turning-point analysis, which remains a topic for future studies.

[25] *Note that the scaling of the disequilibrium error is not a meaningful magnitude. From a technical standpoint, this is the consequence of the cointegration vector not being uniquely identifiable.*

12. Yield curve inversions, bank credit tightening and the credit cycle

Will the credit cycle turn in 2007?[26]

With volatility and credit spreads at or close to all-time lows, and previously unseen amounts of leverage going into the credit markets, the timing of any turn in the credit cycle is a key concern for investors.

The Federal Reserve Senior Loan Officer Survey for January 2007 suggests a benign credit environment for 2007. We demonstrate how loan standards can be used as a powerful leading indicator of a potential turn in the credit cycle. We also show that the latest results, at a 0% net tightening, counterbalance the bearish sentiment signalled by the current yield curve inversion.

Our quantitative framework uses Loan Officer data and information from the yield curve to determine turning points. Using a combination of econometric techniques, we conclude the following:

- The Loan Officer survey's net-tightening standards variable is a strong predictor of credit cycle turning points.
- When used jointly with yield curve shape information, the indicator is even stronger.
- On the back of the Loan Officer tightening data and the shape of the yield curve, we calculate the probability of entering an extended spread-widening regime during 2007 to be 4-18%.
- Although lending standards seemed to ease during 2006, we believe that the recent turn in this variable to neutral, accompanied by the modest inversion of the US yield curve, would suggest that we may see a tightening of standards during 2007.
- The lag effect of curve inversion often occurs up to four quarters before credit begins to underperform.

Our macro-econometric model has consistently forecast the timing of credit underperformance jumps during 1967-2006. In this report, we describe both the methodology and robustness testing of our frameworks, finding consistently strong results.

Micro-level liquidity: The Loan Officer survey

Loan Officer survey: micro-level information on the corporate liquidity situation

Recent academic research has shown how micro-level information, such as the Federal Reserve's survey of Loan Officers, can generate strong signals on the direction of real GDP (Lown and Morgan, 2006). The survey contains a number of questions regarding the extent to which Loan Officers have adjusted their lending standards and amounts, and how they have done it. Figure 27 shows an excerpt from the survey published in January 2007.

The survey can capture dimensions of corporate creditworthiness that are not usually monitored

The survey results may illustrate a bottoms-up perspective of the perceived risk in commercial lending. Smaller-sized companies are much more dependent on bank financing, compared with larger companies that use a wide spectrum of financing options – from bonds, to loans, to asset backed securities. We believe Loan Officers may have unique insights into corporate health on a granular level. Specifically, small companies are likely to be less financially bolstered and to experience effects of a profit downturn more quickly than larger corporates. The survey will also be able to capture

[26] *This article was originally published as Yield curve inversions, bank credit tightening and the credit cycle, 7 February 2007.*

more geographic diversity, as it is conducted on a district-by-district basis. Consequently, any districts leading the cycle will be captured in the survey.

Tightening lending standards have consistently been leading recessions

In Figure 81, we plot how tightening lending standards have been leading recessions each time since inception of the data series. "Tightening standards" is defined as the ratio of senior Loan Officers at a large cross-section of US banks indicating that they have tightened Commercial and Industrial (C&I) loan standards, versus those indicating that they have relaxed standards. Hence, increasing values in the figure imply that Loan Officers are restricting lending.

Figure 80: Excerpt from the Federal Reserve Senior Loan Officer survey

January, 2007

Questions 1-6 *ask about* ***commercial and industrial*** *(C&I) loans at your bank. Questions 1-3 deal with changes in your bank's lending policies over the past three months. Questions 4-5 deal with changes in demand for C&I loans over the past three months. Question 6 asks about changes in prospective demand for C&I loans at your bank, as indicated by the volume of recent inquiries about the availability of new credit lines or increases in existing lines. If your bank's lending policies have not changed over the past three months, please report them as unchanged even if the policies are either restrictive or accommodative relative to longer-term norms. If your bank's policies have tightened or eased over the past three months, please so report them regardless of how they stand relative to longer-term norms. Also, please report changes in enforcement of existing policies as changes in policies.*

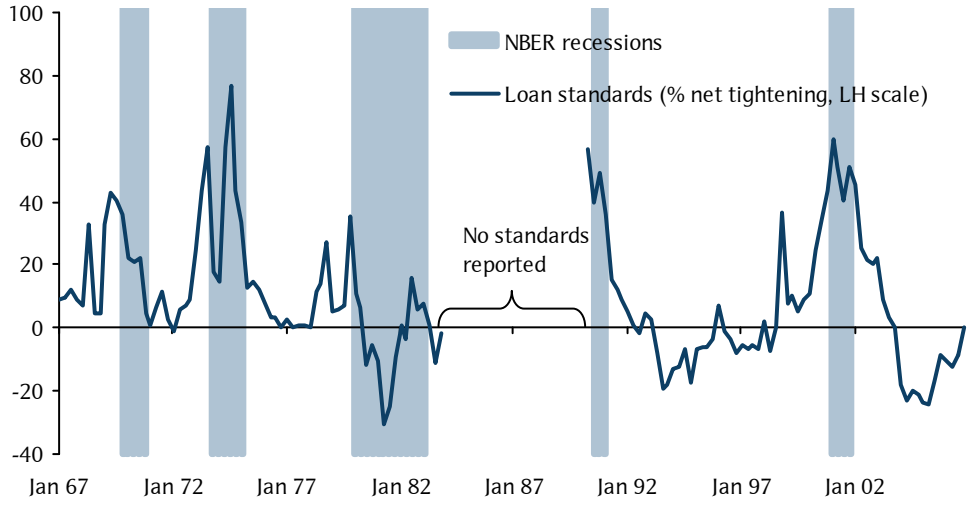
1. Over the past three months, how have your bank's credit standards for approving applications for C&I loans or credit lines--other than those to be used to finance mergers and acquisitions--to large and middle-market firms and to small firms changed? (If your bank defines firm size differently from the categories suggested below, please use your definitions and indicate what they are.)

a. Standards for large and middle-market firms (annual sales of $50 million or more):

	All Respondents		Large Banks		Other Banks	
	Banks	Percent	Banks	Percent	Banks	Percent
Tightened considerably	0	0.0	0	0.0	0	0.0
Tightened somewhat	3	5.3	1	2.7	2	10.0
Remained basically unchanged	51	89.5	34	91.9	17	85.0
Eased somewhat	3	5.3	2	5.4	1	5.0
Eased considerably	0	0.0	0	0.0	0	0.0
Total	57	100.0	37	100.0	20	100.0

Source: Federal Reserve

Figure 81: Reported tightening in lending standards preceding recessions, 1967-2006



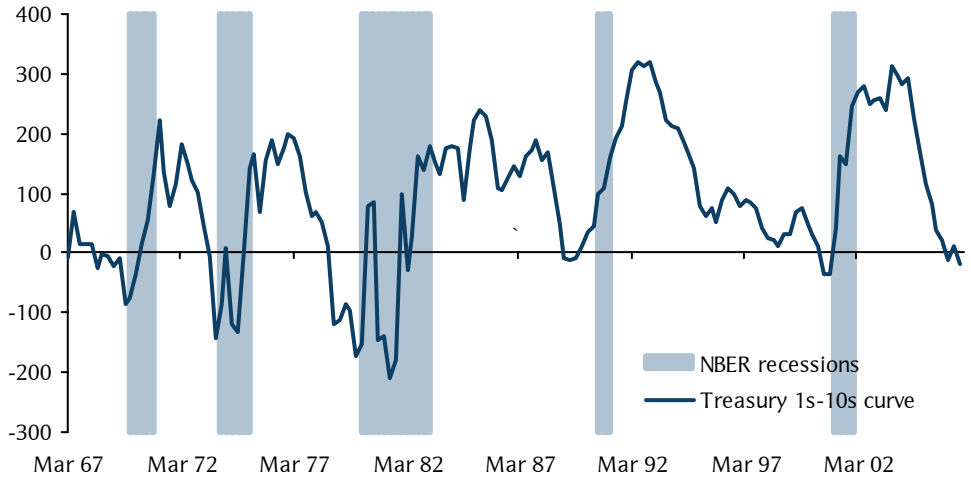
Source: National Bureau of Economic Research, Federal Reserve, Barclays Capital

Macro liquidity: The shape of the Treasury curve

The yield curve inversion effect on credit appears to have decoupled during 2006

Looking at the liquidity question from the other end of the scale involves the dynamics of the US yield curve. At the end of December 2005, the 2-10s Treasury curve inverted for the first time since 2001. This sent shudders through the investor community, as an inverted curve historically has been viewed as the harbinger of a recession (Figure 82). More than a year later, we have seen the curve steepen back to small positive levels only to invert again several times, without the economy slipping into recession. In credit, defaults have remained at historical lows – and with good issuance in terms of nominal amounts, as well as record LBOs and M&As, the usual signs of the turning of the credit cycle are not present. Thus, one could argue that the traditional link between yield curve inversions and downturns in credit has decoupled. We believe that, supported by the below quantitative analysis, these macro liquidity dynamics should be complemented by what is happening at the micro level.

Figure 82: Treasury curve inversions and recessions, 1967-2006 (bp)



Note: We use the Treasury 1-10s curve, since the data goes back to 1967 for that time series, whereas there is only 2yr data from 1977 onwards. Our analysis is not substantially altered when applying the 2yr rate in a shorter sample setting. Source: National Bureau of Economic Research, Federal Reserve, Barclays Capital

In *Yield curve regime behaviour in US Credit: Quantitative sector selection*, 26 January 2006, we developed a model of how credit performs as an asset class based on the shape of the 2-10s Treasury curve. Figure 83 presents excess returns under the different regimes, with the bottom row highlighting the (estimated) threshold between the regimes. We can see a clear pattern of credit performing better as the yield curve steepens, with marked underperformance in the inverted regime. That credit has not underperformed during the year, despite the inversion having breached our threshold, points at the need for further variables to explain the full liquidity dynamics.

Figure 83: Index excess returns, yield curve slope regimes

	Steep	P-value	Flat	P-value	Inverted	P-value
Credit index	15bp	0%	11bp	0%	-48bp	0%
Treasury curve, 2-10s monthly average	>88bp		Between -11 and 88bp		<-11bp	

Source: Yieldbook, Barclays Capital

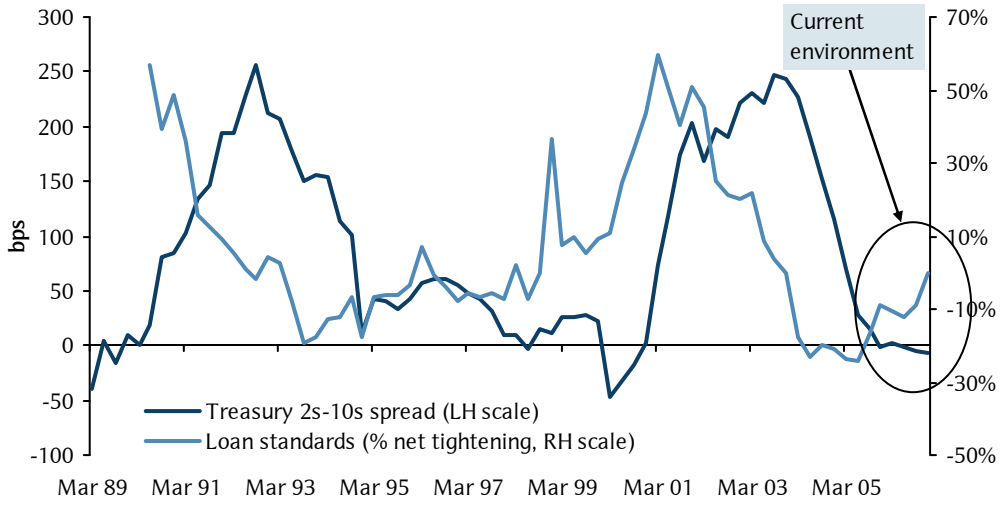
Standards and the Treasury curve inter-relationships

Treasury curve leads tightening of lending standards

These results suggest a similar pattern of substantial regime changes predating actual effects in the broader macro-economy. So, what is the relationship between the Treasury yield curve and the micro-data from the Loan Officer survey? We plot this relationship in Figure 84 for the past two credit cycles. It appears that the 2s-10s curve leads the tightening of loan standards, that is, we see the Treasury curve invert fairly close in time to the peak of the loan standards tightening.

On the surface, this is not too surprising. Bank lending usually stays in the short end of the curve, and when the relative cost of short-term loans increases, banks are less willing to lend and, thus, tighten their standards. However, that is not the whole story. Bank lending profiles have been broken down into two parts in the Fed survey: first, the standards (requirements) to get a loan, and second, the spread charged over, for example, the fed funds rate. Typically, the shape of the 2-10s curve would influence the spread charged, rather than the standards required for the loan. Hence, a main component of changes in standards would reflect fundamental views on repayment capacity, rather than the banks' financing costs.

Figure 84: Yield curve inversions appear to lead to lending standards tightening



Source: Federal Reserve

Tightening loan standards ahead?

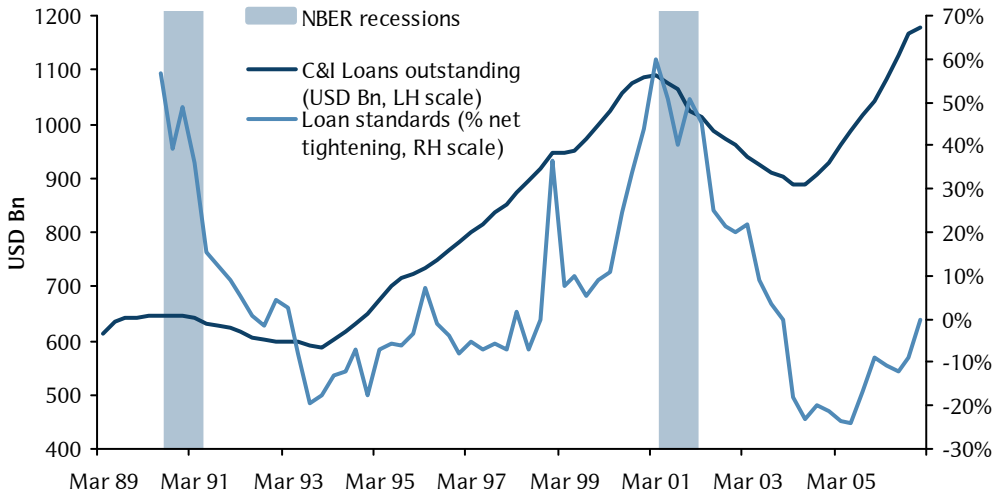
Loan standards were relaxed over 2006 but are trending toward tightening…

We note that standards have been easing during 2006. The number of officers reporting a looser loan standard has been 8% higher than those reporting a tightening standard, on average. Recently, however, there has been a shift toward tightening standards. The numbers reported at the end of January showed a 0% net tightening, meaning that we are not in a tightening environment just yet but are heading in this direction. Directionally, the change in the amount of tightening has been upward sloping from the mid 2005 trough up until now. The January number reiterated the result of the October survey and although this plateau may persist for a while due to the benign macroeconomic environment, we believe there is momentum for the standards to continue on its tightening trend.

… C&I loan growth is healthy but appears to be abating

As another component of the current market environment, we have looked at how the amount of Commercial and Industrial (C&I) lending has developed (Figure 85). In the previous credit cycles, the amount of C&I loans outstanding peaked at the same point as the tightening standards. Over the past quarter, the growth rate has subsided but still remains positive, suggesting that we may be nearing the peak in C&I lending for this cycle.

Figure 85: C&I lending enjoys a healthy growth rate, but at a slowing pace



Source: National Bureau of Economics Research, Federal Reserve

… 2s-10s inversion has marginally breached our earlier predicted credit underperformance threshold

We also highlighted in Figure 84 how the data looks in the current environment in terms of the Treasury curve. Post the initial inversion around the turn of the year in 2005/06, the 2-10s reverted to an upward sloping shape in March. The current period of an inverted curve commenced in August with a trough in late November, where the inversion was down to -15bp on a month-on-month average basis. This has eased somewhat, but we still see a monthly average inversion in excess of the -11bp threshold we estimated in 2006 for credit to start underperforming. To contrast this inversion with the latest one, in March to December 2000, the degree of inversion has been smaller. It topped -40bp in the summer of 2000. We have also seen the current inversion for a more protracted time than we did then.

Forecasting the turn of the credit cycle: A statistical framework

We now turn to integrating the data above into a quantitative framework. We employ two different types of analysis, to verify robustness of the results and to avoid model-dependency.

The first type, a regime switching model, enables us to generate quarter-on-quarter probabilities to enter a higher spread environment using yield curve and Loan Officer data. This model captures the asymmetry in different credit regimes, taking into account, for instance, the large differences in volatility between high and low spread conditions.

In our second approach, a vector auto-regression, we analyse the anticipated average effect of movements in the yield curve and the Loan Officer data in a continuous framework. This allows us to simulate the effect in yield differentials or spreads of a given movement in tightening standards or the yield curve.

Both these models corroborate the importance of the standards and yield curve data. We are able to build a robust system for leading indicators of credit cycle turn points on a historical basis.

The data

We measure credit deterioration by examining the spread between Baa and Aaa rated corporate bond yields

To obtain as many credit cycles as possible for our investigation, we use a merged sample of Moody's and the Yieldbook data on yields of seasoned Aaa, AAA/AA and Baa, BBB corporate bonds. The Moody's data set extends back to 1967, giving us 13 more years of data than the Yieldbook, which only starts in 1980. On inspection, the Yieldbook data seems more reliable than the Moody's data for the later time periods. For example, the Moody's time-series shows the utilities sector dropping out of the Aaa index in December 2001, which results in a jump that is hard to correct for, as the credit cycle was close to a turning point at that time. Consequently, we use the Moody's time-series for the run up to 1980, and the Yieldbook data thereafter.

To derive a measure of credit performance, we look at the differential between the Baa/BBB and Aaa/AAA bond yields.[27] For simplicity, we will refer to this number as the BBB/AAA yield spread.

Loan standards tightening lead peaks in the BBB/AAA yield spread

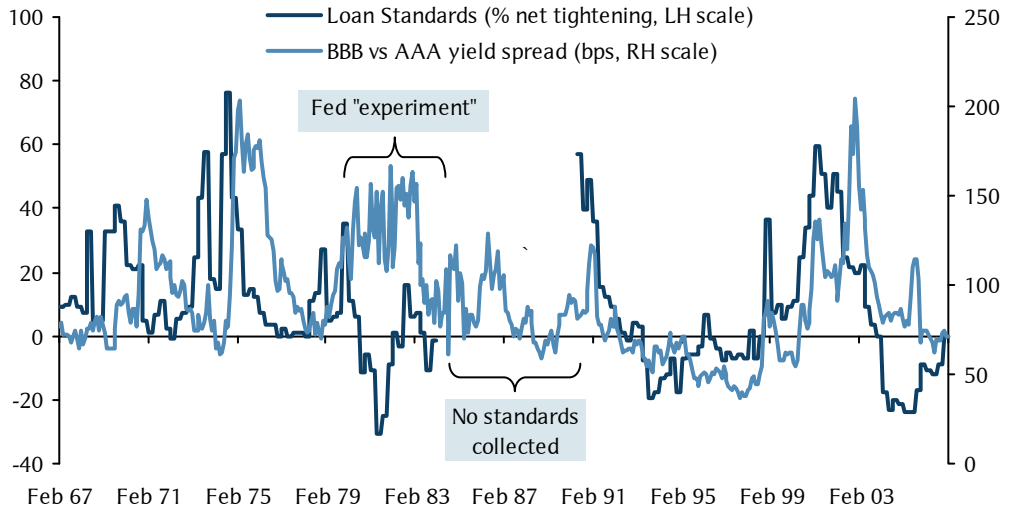
Figure 86 plots this spread between 1990 and 2006 alongside the loan standards series. We see that there is a strong leading effect of loan standards tightening prior to Baa yields increasing over AAAs in each of the significant credit downturns. Specifically, we see spikes in loan standards tightening in 1970, ahead of the 1971 spread hike, in 1974/5, ahead of the 1975-1977 increase in volatility, and in 1979, ahead of the extended high spread differential regime between 1980 and 1983. When the Fed data collection resumed in 1990, it came in at a massive 57% net tightening and was subsequently followed by a spike in spread differential in the first half of 1991.

We also see the same pattern in 2000, ahead of the 2001/02 credit downturn. Note also that the 1990 survey, the first after the 1980s break in the time-series, immediately shows a significant tightening around the time of the 1990/91 downturn. The only occasion where the relationship breaks down is in connection with the Russian crisis of 1998/9, where we see only a contemporaneous tightening of standards resulting from the credit shock. However, we would not expect a prediction of such a shock by endogenous factors such as Loan Officers' tightening standards. Another example of

[27] *As duration data is unavailable on these time series, we make the assumption that durations are similar between the two aggregates.*

tightening standards not predicting this type of idiosyncratic and short-lived shock is the US autos blow-up in early 2005. As we can see, however, these types of shocks have dissipated fairly quickly, and the yield differential has reverted in a matter of months after the shock.

Figure 86: Tightening in standards has led to increasing yield differentials between BBB and AAA corporate bonds



Source: Federal Reserve, Moody's Investor Services.

Turning points as switches between credit regimes

Deriving high spread/volatility regimes and turning points

In order to derive turning points in the credit cycle using this data, we first establish low yield differential/volatility and high differential/volatility regimes in the data by applying a regime-switching model in the spirit of Hamilton (1989). The key feature of this model is that it does not specify the characteristics of regimes subjectively but instead derives the regimes that best fit the data. The model was originally designed to capture swings in the business cycle, for which any recession classification is subjective. The dependent variable in our credit specification is the differential between Baa and Aaa bond yields:

$$y_t = \mu_1 \cdot \text{Prob}(\text{Low spread regime}) + \mu_2 \cdot \text{Prob}(\text{High spread regime}) + \varepsilon_{t,S_t} \qquad (1)$$

where the coefficients μ_1, μ_2 are the average spreads in their respective regime. We also allow for different volatilities in each regime through the state dependence of the residual ε_{t,S_t}. In other words, the residual ε_{t,S_t} is assumed to be normally distributed with volatility σ_{S_t}.

The probabilities of switching between regimes is governed by a transition matrix with elements P_{ij}. For example, given that we are certain to be in the credit benign environment today, the element P_{12} is the probability that we switch from that environment to the high spread/volatility regime. For more detail on the model, please refer to the technical notes below.

Figure 87: Parameter estimates in the regime switching model

	Quarterly data		Monthly data	
Parameter	Value	S.E.	Value	S.E.
μ_1	0.74	0.02	0.69	0.01
σ_1	0.16	0.01	0.16	0.01
P_{11}	0.95	0.16	0.98	0.12
μ_2	1.29	0.05	1.25	0.02
σ_2	0.28	0.04	0.27	0.02
P_{22}	0.88	0.32	0.95	0.19
Log likelihood	11.09		93.55	

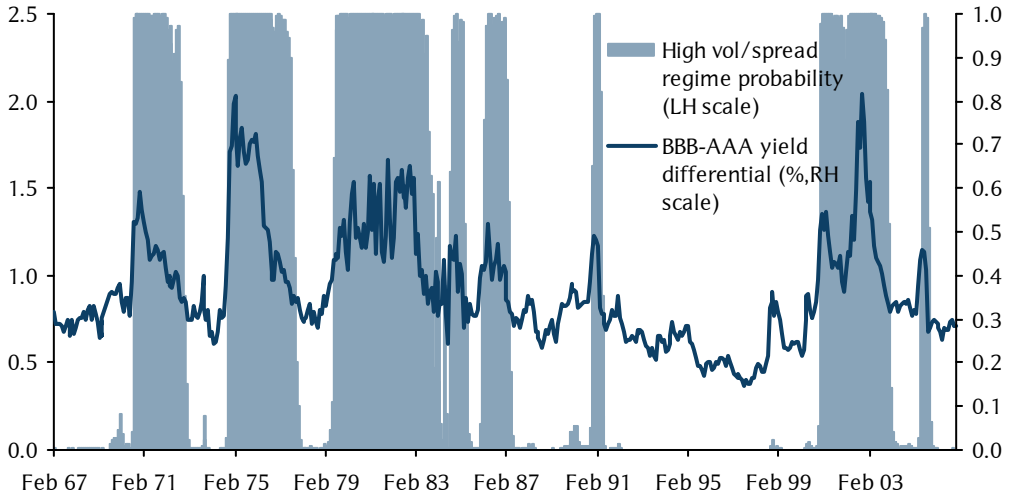
Source: Barclays Capital

Our estimated high vol regimes conform with commonly recognised periods of increased credit volatility

The output from estimating (1) is produced in Figure 88. From 1967 to 2006 we find five distinct periods when BBB yields have been significantly higher than AAA in "normal" periods. We measure the average yield difference during those periods as 1.29 (q/q volatility of 28%), compared with the low differential/volatility environment average of 0.74 (q/q volatility of 16%).

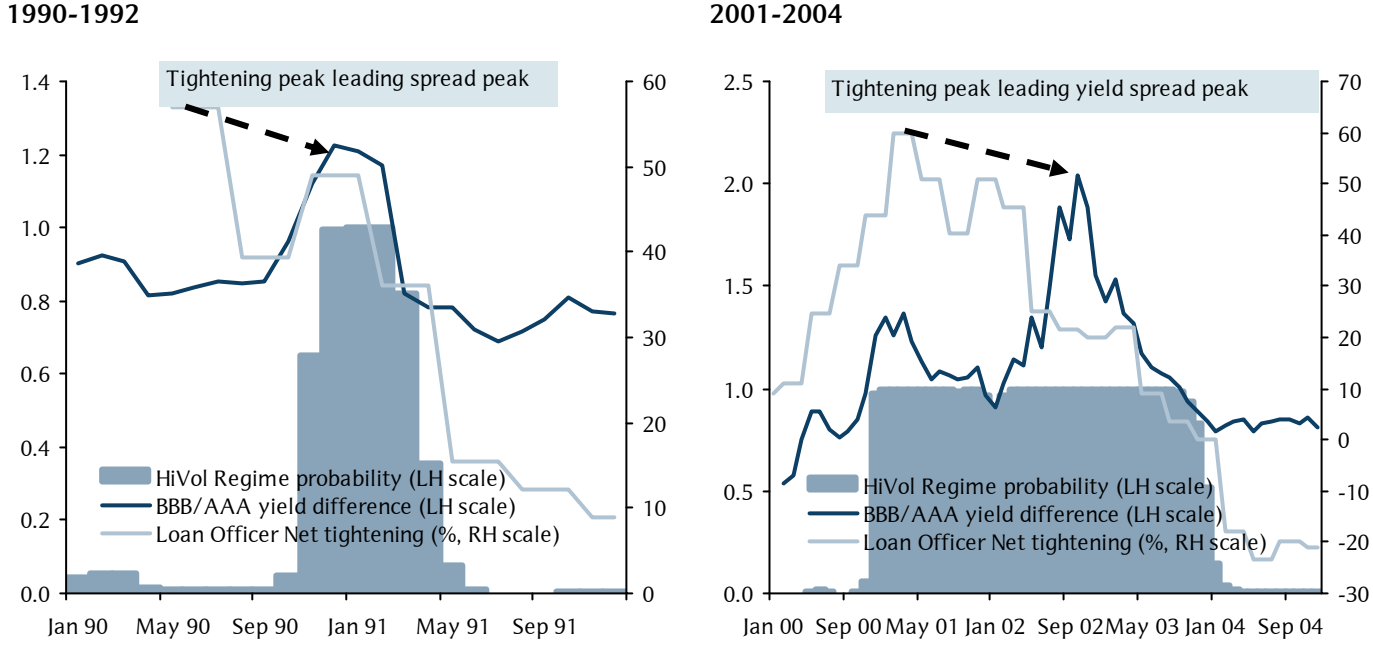
Figure 88 plots the probabilities of the high vol/spread regime versus the yield differential. We see how the model captures periods of significantly wider differentials. For example, in recent history, the model captures the 2001-2003 period as well as the short-lived volatility uptick in May 2005. The November 1990 to March 1991 spike is picked up, as well as the period during the 1970s and 1980s when AAA versus BBB yields increased dramatically. The Fed experiment, during 1980-83, shows up as a high volatility regime, with high frequency oscillation around the general yield spread trend.

Figure 88: The model produces discrete states, with the BBB/AAA differential shifting in both levels and volatility



Source: Moody's Investor Services, Barclays Capital

Figure 89: Spread differential and tightening standards during recent turns of the cycle



Source: Yieldbook, Federal Reserve, Barclays Capital

We also take a look at the dynamics of the elevated volatility regime for each of the five instances in our sample. For this, we use data sampled monthly rather than quarterly. Figure 89 shows specific developments over the two last turns of the credit cycle, October 1990 and December 2000. In the former example, the spread differential started climbing a few months earlier but in a fairly orderly manner, leading us to wait until October to identify it as a higher spread and volatility regime. The Loan Officer tightening was strong at 60% as the spread differential was increasing, and the peak of the tightening standards pre-dated the yield differential peak in December that year.

The turn of 2000/01: a double-peak turn of the cycle

The turn of the cycle in 2000/01 involved some interesting dynamics. We saw a year-long continuous widening of the BBB-AAA differential from January 2000, followed by a tightening of the differential from 135 bp to 90 bp in January 2002. During this period, the model designated the regime as high-spread/volatile. The second peak is reached in October 2002. Interestingly, we see that the Loan Officers had started increasing the rate of tightening already in 2000 and continued to do so until the first half of 2001. The height of this tightening cycle was reached approximately 18 months prior to the peak of the yield differential. It is important to note that net tightening remained positive through the whole period, until late 2003: banks kept tightening their standards, quarter after quarter.

The model: predicting turning points using the yield curve slope and loan standard variables

Our qualitative evidence on the 2-10s and Loan Officer tightening standards leading real GDP as a whole suggest that these variables could be instrumental in designing a more flexible transition probability to enter the credit-worsening regime. We could estimate such a model directly using the framework in (1), but due to the hole in the survey data, this becomes computationally difficult. Instead, we use a probit model to estimate the following model:[28]

[28] *We have evaluated which lag length yields the most information when using a single variable in the probit model. Whereas the standards variable benefits from using the most recent data, the yield curve slope gives the strongest signal when using the four quarter lag. This corroborates the findings above on the yield curve having a leading effect on tightening standards.*

$$D_{t+1} = \Phi\left[\alpha + \beta_1 \cdot Slope_{t-3}^{Treasury\ 1-10s} + \beta_2 \cdot Tightening_t\right] + u_t \qquad (2)$$

where D_{t+1} takes on the value 1 for the quarters in which we switch from benign to volatile regimes, as estimated in (1), and 0 otherwise. Equation (2) transforms the data contained in the Slope and Tightening variables into probabilities of D_{t+1} being equal to one. Hence, if the 1-10s curve and the Loan Officer net tightening data are important leaders in terms of predicting switches to a higher spread regime, the coefficients β_1, β_2 should turn out to be significant. This model directly produces a probability that we will have a shift in regime, ie, that we will experience a turning point, on the basis of the tightening and yield curve variables.

Figure 90: Turning point binary model estimates

	α_1	β_1	β_2
Value	-2.21	-1.15	3.12
Standard error	0.00	0.04	0.05
LR statistic; 2 d.f.	15.72	McFadden R^2	0.42

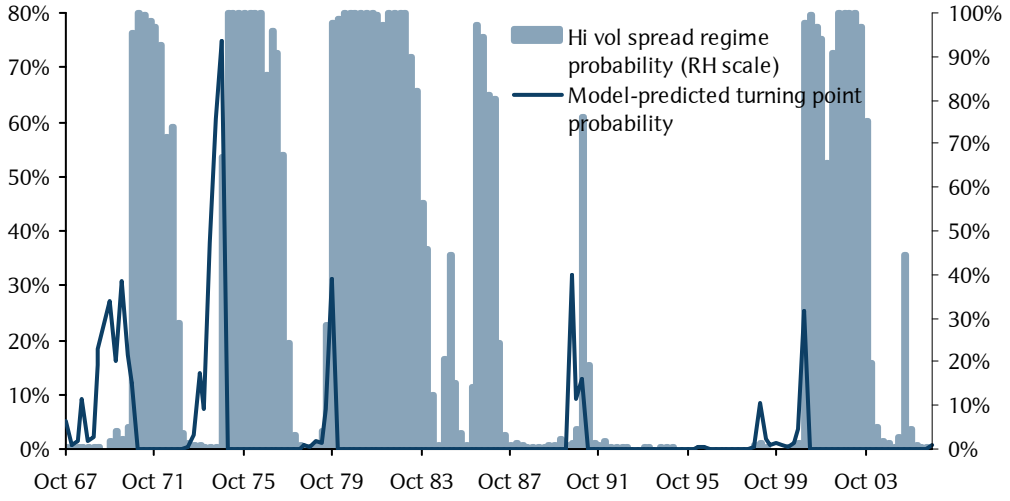
Source: Barclays Capital

The result of estimating (2) on quarterly data is presented in Figure 90. The estimated parameters have the right sign: a decrease in the 1-10s spread increases the probability of a turning point through the negative value of β_1, and an increase in tightening translates into a rise in probability through β_2 being positive. The model is jointly significant (the LR statistic translates into a probability of <0.00), and the parameters are individually significant as well. With a McFadden R^2 of 42%, summing the diagnostics together, we find quite a good model fit.

Quarterly model produces strong contemporaneous switching probabilities

Estimating (2) yields ex ante probabilities of being at the credit cycle turning point for each point in time in the sample, as we depict with the solid line in Figure 92. In the graph, we see how the forecasted probabilities of turning points are high prior to, or right at, the inception of the high volatility regimes in 1970, 1974, 1990 and 2000.

Figure 91: Turning point probabilities, quarterly data



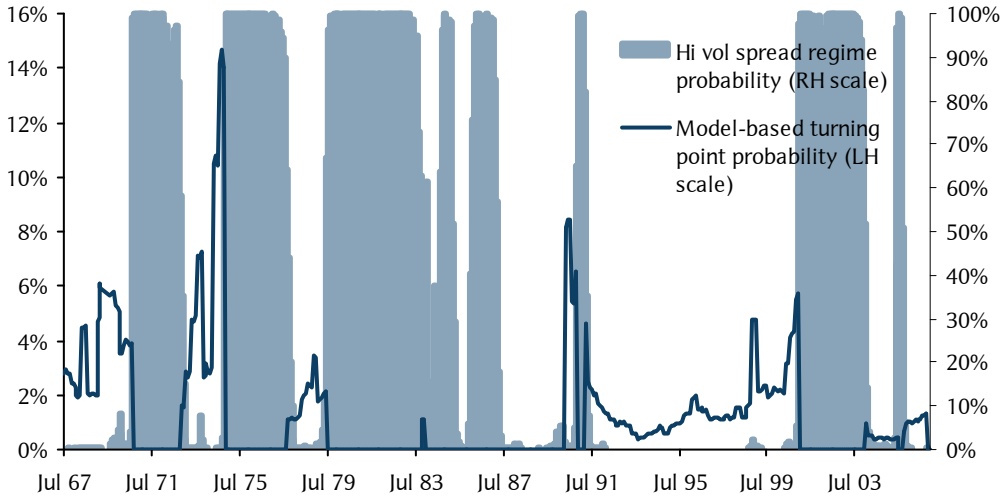
Source: Barclays Capital

The main critique of the results of the quarterly model would be that some of the probabilities appear contemporaneous rather than leading. For example, we do not appear to get a solid pick-up of the switching probability in the run-up to the turn of the cycle in 2000/01. Instead, we see a hike in the probability in the same quarter as the cycle turns.

Monthly model shows strong leading effects of turning points

Quarterly data is fairly imprecise in the sense that it does not account for the timing of data-releases in the case of loan standards, or continuous data feeds, as in the case of the Treasury slope data. Hence, we investigate the same type of dynamics using monthly data instead. For the Loan Officer data, we make it piecewise constant, ie, to each month, we assign the value of the latest data release at that time, whereas we use the real-time 1-10s slope as well as the dependent variable. The trade-off is that the statistical framework for the binary model becomes more complicated, as the dependent variable becomes much more skewed. The ratio of 1 to 0s in the sample goes from 5/79 to 6/240 and this will have a detrimental effect on the measurement of standard errors in the model.

Figure 92: Turning point probabilities, monthly data



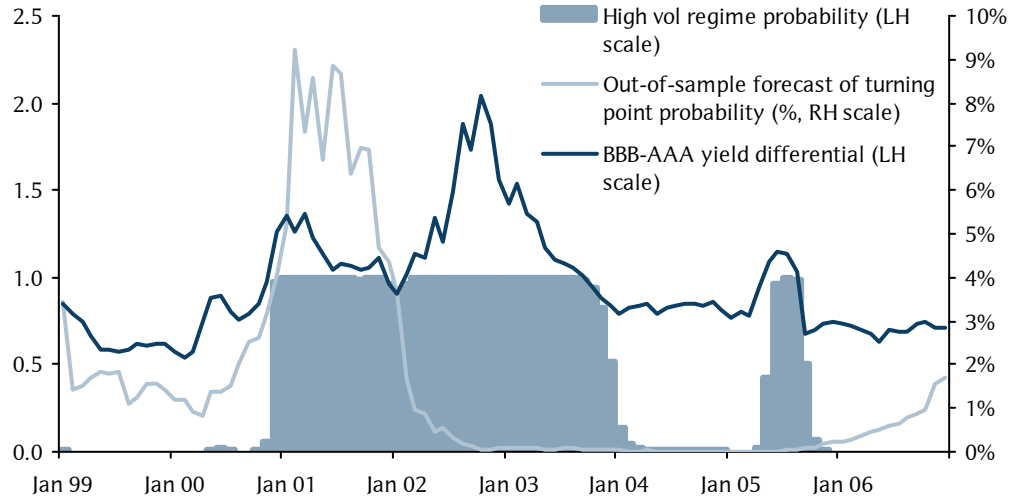
Source: Barclays Capital

Figure 92 plots the probabilities of a transition to the high volatility regime based on the monthly data. We can see that the build-up of the probabilities now is leading the switch rather than being contemporaneous with it. We also see the current forecasted probability, which amounts to 1.8% month-on-month.

Structural stability? The model retains performance in out-of-sample testing

To test the structural stability of the model, we also conduct out-of-sample testing. We conduct the following experiment: "Given the model and the information set available at 1999, would we have been able to forecast the 2000/01 turn of the cycle?" If the relationship between the yield curve, tightening standards and the yield spread we have uncovered is a statistical artefact rather than a structural relationship, out-of-sample forecasting would be poor. The out-of-sample forecasts in Figure 93 confirm, however, that there is a structural link between variables: the strong forecasting properties remain even if we have estimated the model on a reduced data-set.

Figure 93: Out-of-sample forecasts of the 2000/01 turning point of the credit cycle



Source: Barclays Capital

The bank tightening and credit link: A Vector Auto-Regression Approach

Vector Auto-Regressions study interrelations in multi-equation systems

The main drawback of the regime-switching approach is that it is limited in the number of sample points. As we only have five to six real switches into the high volatility regime, our sample size is fairly small. Another way to quantify the link between loan standards, the yield curve slope and credit relative performance is to build a system of equations where innovations in one variable can feed over into the other variables as well as into itself in a continuous fashion. A Vector Auto-Regression (VAR) is ideal for this type of analysis, which is what is employed by the original Lown and Morgan (2006) paper on the Loan Officer tightening standards. Please see the appendix for a brief technical introduction to this econometric model.

The VAR confirms the leading effects of standards and the yield curve slope on the BBB/AAA yield spread

First, we want to test the hypothesis if there is a leading effect of standards tightening or yield curve flattening on the yield differential. The tests are performed by means of a Granger causality test which is outlined in Appendix A. Results from this analysis are presented in Figure 94. To summarise, we find that standards appear not to be driven by the other variables in the system, as measured by the block exogeneity test. For the BBB/AAA yield spread, we find that there is a leading effect of both the standards and the Treasury slope variables, as signified by low/significant p-values.

Figure 94: Standards appear to be a leading indicator in the system, monthly data – the lower the p-value, the stronger the lead lag relationship

p-values	Does the below variable lead the dependent variable?			
Dependent variable	Standards	Treasury slope	BBB/AAA yield spread	Block exogeneity
Standards	n.a.	0.33	0.10	0.09
Treasury slope	0.04	n.a.	0.00	0.00
BBB/AAA yield spread	0.02	0.00	n.a.	0.00

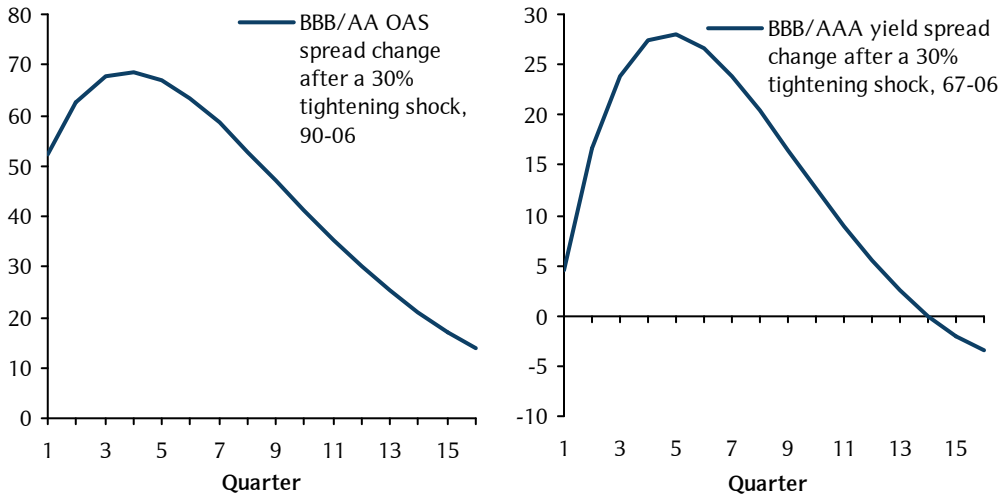
Source: Barclays Capital

The VAR also gives us a structural relationship by which we can conduct scenario analysis. We do this by "shocking" the system, ie, assuming that, for example, the

tightening variable jumps up by 30 percentage points, and deriving how this shock is transmitted in the system.

We illustrate in Figure 95 how a 30% tightening of standards translates into spread widening. We do this by deriving the impulse-response functions the VAR in which we have the tightening standards variable and the difference between BBB and AAA option adjusted spread (OAS over Treasuries) for the period 1990-2006. Details are provided in the technical appendix.

Figure 95: Effects of tightening standards on the difference between BBB and AA OAS spreads (bp)



Source: The Yieldbook, Moody's Investor Services, Barclays Capital

Scenario analysis: expected effect of tightening standards on BBB underperforming AAA/AA

We find that a 30% tightening shock would translate in BBBs widening over AAs by 26bp in the same quarter in terms of OAS spreads. Over four quarters, the effect is 34bp, ie, one year after the tightening numbers being released, we would expect the spread difference between BBBs and AAs to have widened to 34bp. This leading effect is even stronger when considering the full sample, as we do in the right hand panel of Figure 95. We see an instantaneous effect of the yield spread widening around 2bp, with a total effect of 14bp one year lagging.

Appendix A: Vector Auto-Regressions

We apply vector auto-regressions to model lead/lags and causality. A vector auto-regressive model of a vector X_t of covariance stationary variables $x_{i,t}$ can be expressed as:

$$X_t = \mu + A(L)X_t + \varepsilon_t$$

For example, in a bi-variate first order VAR, we could the structure the model as follows:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

For a bi-variate first p:th order VAR, we have:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \phi_{11}^i & \phi_{12}^i \\ \phi_{21}^i & \phi_{22}^i \end{bmatrix} \begin{bmatrix} y_{t-i} \\ z_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

From this, lead-lag effects between the variable can be inferred via the individual AR parameters ϕ_{kl}^i. For example, suppose that z has a 1 period lead effect on y: we would expect the parameter ϕ_{12}^1 to be statistically significant. A more intricate way to model these lead-lag effects is to derive impulse response functions of the VAR, in effect measuring $\partial y_t / \partial z_{t-1}$ using the full dynamics of the systems, albeit this may only be done with additional assumptions regarding the structure of the variance-covariance matrix of residuals.

Testing for the order of the VAR system boils down to evaluating the fit of the model at different lag lengths. Either one uses minimising information criteria (with the multivariate AIC and SBC being most frequently used) or testing down using likelihood ratio statistics (conditional on the distribution of the errors).

The impulse response functions derived in Figure 95 are based on a 2 variable VAR. We have tested for Granger causality, which in both cases have resulted in us not being able to reject the hypothesis that the Loan Standards variable does not Granger cause our credit performance variable. The opposite has not been true, leading to a statistical confirmation of the hypothesis that Loan Standards have a leading effect on credit performance. Our impulse response functions are calculated using the generalised impulse response function in which the ordering of the variables of the VAR does not matter for the results, see Pesaran and Shinn (1998).

Please note that the impulse response functions are based on shocks to the VAR (as in the residual of the regression) rather than the current level of the system. In our example above, these are equivalent since we are currently at a 0% net tightening level. In other circumstances, this is likely not to be true – the impulse outlined above should be read as "given a current net tightening of X%, how will spreads change if the next number comes in at X+30%".

Important concepts regarding causality are (i) block-exogeneity and (ii) Granger causality:

(i) We would like to ask the questing whether a variable is interesting for the system or not by looking at the effect of excluding it completely. If we accept block-exogeneity, the variable does not affect any other variable, nor is it affected by other variables in the system.

(ii) Granger causality refers not to causality in the ordinary sense but the possibility of forecasting one variable with the help of another. For example, a dragonfly flying low prior to rainfall obviously does not cause the actual rainfall. It does, however, Granger cause the rainfall since it is an effective predictor of future events.

Appendix B: Technical notes on regime switching

The underlying process driving the switches between regimes in equation (1) is, in this framework, assumed to be a hidden Markov process with two states with transition matrix **P**. Each i,j, element in **P** refers to the probability of switching into state j conditional on being in state j. The model is estimated via maximum likelihood.

We do not formally test for the significance of two or more separate regimes since this requires extensive Monte Carlo simulation, or similar computationally demanding procedures (see for example Cheung and Erlandsson, 2005). The likelihood ratio statistic between the single state and two state models is 159.97, which is a very large value in this context.

We have also tested the equivalent of the probit specification of turning points via a Markov regime switching model as in (1) but with a time varying transition matrix. This however requires a full data set, as the Markovian property of the underlying regimes does not allow for breaks in the data. An alternative way is to estimate this extended model separately for each sub-sample, which we have also done. Results are similar to those presented using the probit approach but with an overly large fluctuation in the estimated standard errors.

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Hamilton, J.D. (1989). A New Approach to the Econometric Analysis of Nonstationary Time Series and the Business Cycle, *Econometrica*, 57:357-384.

Lown, C. and Morgan, D.P. (2006). The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey, *Journal of Money, Credit and Banking,* 38:1575-1597.

Pesaran, H. and Shin, Y. (1998). Impulse Response Analysis in Linear Multivariate Models, *Economics Letters*, 58:17-29.

13. Yield curve regime behaviour in US credit

Quantitative sector selection[29]

The shape of the US treasury yield curve will likely be a recurring theme for US credit market investors in 2006. The impact of further rates increases on different industry sectors, as well as the implications for credit of a sustained yield curve inversion should be of particular interest. Understanding and quantifying these effects will be key to successful sector selection and overall positioning of credit portfolios, in our view.

We have developed quantitative frameworks to analyse the relationship between yield curve dynamics and credit. Using this method, we have been able to carry out detailed scenario analysis which can be combined with different yield curve views to form investment strategies for portfolios of bonds or CDS.

Summary of results

- Based on our analysis of yield curve effects on credit, combined with the Barclays Capital view of roughly stable rates and a flat curve for H1 06 turning to slowly rising 2-year rates and steepening curve in H2 06 and Q1 07:
  - We expect credit as a whole to outperform modestly in 2006.
  - We believe that lower quality (BBBs) will marginally outperform high quality (AAs/AAAs).
  - Model-based results suggest financial institutions including banks, life insurers and REITs, together with retail will outperform the market, and home builders, telecoms and transportation will underperform.
- In the event of a sustained yield curve inversion, we expect credit overall to significantly underperform, and high quality to outperform low quality credit. We also think that defensive sectors such as aerospace & defence, energy and tobacco will outperform relative to the index and cyclical sectors will underperform.
- More generally, cross-industry panel models demonstrate that most **credit sectors behave significantly differently in steep, flat and inverted yield curve regimes.**
- **To a lesser extent, many credit sectors also exhibit distinct behaviour in rising and falling rate regimes.**
- We also have found some industry sectors that show no significant relationship with the yield curve – auto & auto parts, cable & media, electric utilities and P&C insurance sectors.

2006 scenario analysis

Figure 96 outlines scenarios for the overall credit index and ratings level. The scenarios are defined based on the slope of the curve measured by the 10- to 2-year spread, and the 12-month changes in 2-year rates. See *Market, rating and broad sector analysis* on page 113 for details of methodology and testing, and Figure 104 for scenario definitions. The sample period is from January 1989 to December 2005.

Of particular interest is the stable rates and flat curve scenario, which we expect to play out in 2006. In this environment, we believe that credit will outperform modestly, and AA and AAAs will marginally underperform BBBs. The inverted curve scenario is also noteworthy. Although we do not expect a sustained inversion, if it does indeed take place, it would have severe negative implications for credit as a whole and there will likely be a strong flight-to-quality from BBBs to AAs and AAAs.

[29] *This article was originally published as Yield curve regime behaviour in US credit: Quantitative sector selection, 26 January 2006.*

Figure 96: Index & rating level recommendations

2006 Yield Curve Scenarios						
	Flat Curve Scenario	Inverted Curve Scenario	Stable Rates, Flat Curve Scenario	Rising Rates, Flat Curve Scenario	Stable Rates, Moderate Steep Curve Scenario	Rising Rates, Moderate Steep Curve Scenario
Overall Credit	Neutral	Underweight	Moderate Overweight	Overweight	Moderate Overweight	Overweight
AA/AAA Versus Index	Neutral	Overweight	Moderate Underweight	Underweight	Moderate Underweight	Underweight
BBB Versus Index	Neutral	Underweight	Moderate Overweight	Overweight	Moderate Overweight	Overweight

Source: The Yieldbook, Barclays Capital

Figure 97 uses quantitative techniques to estimate regimes at the industry level. This approach allows the data to "decide" which are the most relevant regimes for credit sectors – see *Industry level analysis* on page 10 for full details. The model-generated regime thresholds, ie, the levels of the 10- to 2-year spread and change in 12-month, 2-year rates that define the scenarios, are also specified. The sample period used is January 1990 to December 2005. For 2006, we see a combination of the flat curve and rising rates as the most relevant scenarios from Figure 97. We expect financial institutions including banks, life insurers and REITs, together with retail to outperform the market, and home builders, telecoms and transportation to underperform.

Figure 97: Industry level recommendations

Industry level recommendations – Model-based regimes			
Flat curve scenario	**Inverted curve scenario**	**Rising rates**	**Falling rates**
Overweight: Banks, Independent Finance, Life*, REITs, Retail* **Underweight**: Home Builders, Telecoms, Transportation * Note: These sectors pose significant downside risk in the event of a sustained yield curve inversion.	**Overweight**: Aerospace & Defence, Energy, Tobacco **Underweight**: Cyclical sectors, in particular Consumer, Life, Manufacturing, P&C, Retail, Transportation	**Overweight**: Chemicals, Energy, Tobacco **Underweight (Marginal)**: Banks, Life, Manufacturing	**Overweight**: Aerospace & Defence, Banks, Consumer, Home Builders, Manufacturing, REITs, Brokers, Transportation. **Underweight:** Airlines, Energy, Power
Model regime definition			
10- to 2-year slope between -11 bp and 88 bp	10- to 2-year slope less than -11 bp	12M change in 2-year yield greater than -35 bp	12M change in 2-year yield less than -35 bp

Source: The Yieldbook, Barclays Capital

Industry level results summary

Figure 98 and Figure 99 summarise results from the industry level[30] analysis carried out in *Industry level analysis* on page 117 of this article. Figure 98 reports the average excess returns over the credit index of each industry sector both overall from 1990 to 2005, and in each of the three yield curve slope regimes, steep, flat and inverted. Also indicated is whether yield curve slope regimes are statistically significant for that industry.

[30] *The sector breakdown used here is based on the Yieldbook US B.I.G. Index breakdown.*

Figure 98: Yield curve slope effects at the industry level

Industry	Overall return 1990-2005	Is the yield curve slope statistically significant?	Return in steep regimes	Return in flat regimes	Return in inverted regimes
	Exc. ret. over index (bp/month)	Yes/No	Exc. ret. over index (bp/month)	Exc. ret. over index (bp/month)	Exc. ret. over index (bp/month)
Aerospace/Defence	8	Yes	20	-8	42
Banking	7	Yes	14	0	-1
Chemicals	2	Yes	6	0	-14
Consumer	3	Yes	6	2	-20
Energy	-2	Yes	-11	3	23
Home Builders	36	Yes	48	-7	N/A
Independent Finance	4	Yes	5	4	-5
Life Insurance	-2	Yes	5	2	-86
Manufacturing	2	Yes	12	2	-72
Mortgage Banking	6	Yes	9	4	-2
Power	-101	Yes	-133	8	N/A
Real Estate Investment Trust	22	Yes	23	27	7
Retail	2	Yes	10	3	-72
Securities Broker Dealers	8	Yes	12	5	11
Service	4	Yes	14	-10	33
Telecommunications	-8	Yes	-14	-3	6
Transportation	4	Yes	13	-3	-8
Airlines	0	No	-18	16	15
Auto & Auto Parts	-6	No	1	-14	10
Cable & Media	2	No	-5	6	20
Electric Utilities	0	No	-1	0	8
Natural Gas Distributors	4	No	6	3	-3
Property & Casualty Insurance	1	No	3	0	-18
Pharmaceuticals	3	No	-1	5	18
Tobacco	7	No	5	10	10

Source: The Yieldbook, Barclays Capital

As an example, consider banking which, on average, outperforms the index by 7bp/month. The yield curve slope is significant for the banking sector. In "steep" curve regimes, banking outperforms the index by an average 14bp/month, whilst in flat or inverted regimes banking is on average flat versus the index. Therefore, banks benefit from steep curves (which are usually associated with lower rates).

Figure 99 reports the average excess returns over the credit index of each industry sector both overall from 1990 to 2005, and splits into falling and rising two-year rates regimes. Similarly to Figure 98, Figure 99 also indicates where falling/rising rates are statistically significant for that industry.

Figure 99: Falling/rising rates effects at the industry level

Industry	Overall return 1990-2005	Is the change of rates statistically significant?	Return in rising 2-year rates regimes	Return in falling 2-year rates regimes
	Exc. ret. over index (bp/month)	Yes/No	Exc. ret. over index (bp/month)	Exc. ret. over index (bp/month)
Aerospace/Defence	8	Yes	2	18
Airlines	0	Yes	19	-33
Banking	7	Yes	-1	20
Chemicals	2	Yes	5	-2
Consumer	3	Yes	0	8
Energy	-2	Yes	5	-16
Home Builders	36	Yes	20	67
Manufacturing	2	Yes	-4	14
Mortgage Banking	6	Yes	1	15
Natural Gas Distributors	4	Yes	7	-1
Power	-101	Yes	-33	-249
Real Estate Investment Trust	22	Yes	17	32
Securities Broker Dealers	8	Yes	3	19
Tobacco	7	Yes	11	2
Transportation	4	Yes	0	11
Auto & Auto Parts	-6	No	0	-16
Cable & Media	2	No	-3	10
Electric Utilities	0	No	4	-7
Independent Finance	4	No	3	5
Life Insurance	-2	No	-7	8
Property & Casualty Insurance	1	No	-2	5
Pharmaceuticals	3	No	2	4
Retail	2	No	-6	16
Service	4	No	1	8
Telecommunications	-8	No	-12	-1

Source: The Yieldbook, Barclays Capital

Again focusing on banking, we find the sector is also significantly affected by falling and rising rates regimes, with flat performance in rising regimes and strong performance versus the index in falling rates periods.

In Figure 98 and Figure 99, the sectors not significantly affected by yield curve regimes are Auto & Auto Parts, Cable and Media, Electric Utilities, P&C Insurance and Pharmaceuticals.

Credit and the yield curve

What is the situation for 2006?

Following the fleeting inversion at the end of December, and concerns over future rate rises and a more sustained inversion, the US yield curve has already featured as an important factor for credit in 2006. It is interesting to observe how the current yield curve situation compares historically – Figure 100 plots the historical trajectory of the US yield curve along the dimensions of the two-year yield level and 10- to two-year slope. The NBER official recession periods are marked with dashed lines – in each case the trajectory of falling rates and steepening curve (ie, in a north west direction) is clearly visible. Also highlighted is the Barclays Capital US Fixed Income Strategy forecast trajectory into 2006 and Q1 07 (the red line – see Appendix A for more details).

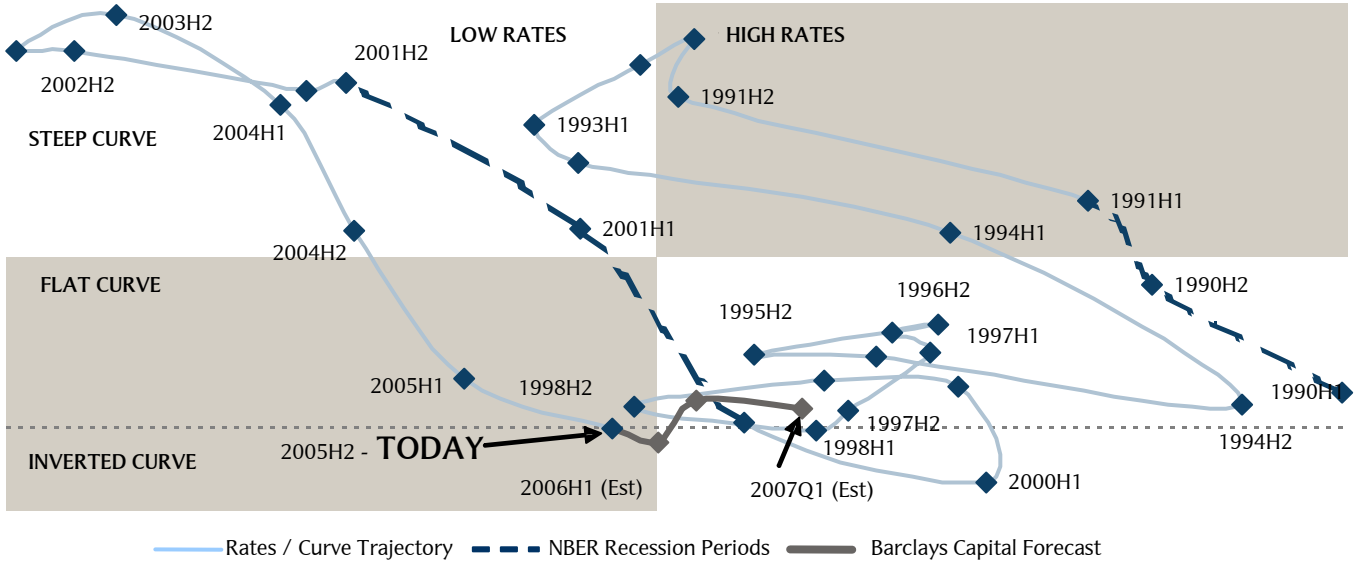
The forecast trajectory leads us to scenarios similar to pre-recession 2000 and the more stable 1995 to 1999. There are, however, significant differences between the credit market environment today and that of 2000, notably:

- Corporate liquidity is very high – rates are rising but real rates remain low;
- Vastly improved corporate balance sheets, with longer maturity debt;
- High levels of free cash-flow; and
- Continued low default rates.

The following analysis details how credit may behave in various 2006 scenarios.

Note: Figure 100 follows the trajectory of the yield curve from 1990 (in the bottom right-hand corner) to 2007, in half-yearly segments. The line moves from the right of the chart to the left as 2-year rates fall, and moves from the bottom of the chart to the top as the slope of the yield curve steepens. The dotted line near the bottom marks the slope inversion point.

Figure 100: UST rates/curve trajectory 1990–2007



Source: Barclays Capital

Market, rating and broad sector analysis

Credit index level analysis

In this section, we analyse the performance of the credit asset class, proxied by the US BIG Index from The Yieldbook[31], across the following yield curve regimes[32]:

- Low/high two-year rates;
- Falling/rising two-year rates;
- Flat/steep curve based on 10- to two-year spread; and
- Flattening/steepening curve based on 10- to two-year spread.

In low rates regimes, the average index excess return is 12bp/month versus 3bp/month in high rates. Volatility is much higher in low rates regime

Figure 101 reports average credit index excess returns and excess return volatilities during different yield curve regimes. Across the full sample from January 1989 to December 2005, the index has an average excess return of 8bp per month and an excess return volatility of 62bp per month.

Dividing the sample by the level of rates, we find the average excess return climbs to 12bp per month in low rates regimes versus 3bp per month in high rates regimes. Volatility is also much higher in the low rates regime.

Figure 101: Returns and *volatilities across regimes, 1989-2005; Regimes defined by median value*

	Full Period	Low Rates	High Rates	Falling Rates	Rising Rates	Flat Curve	Steep Curve	Flattening Curve	Steepening Curve
Avg Excess Return bp/month	8	12	3	13	4	3	13	2	15
Volatility bp/month	62	80	37	82	37	54	70	47	77

Source: The Yieldbook, Barclays Capital

Figure 102 explains these findings. Low rates regimes tend to coincide with the second half of downturns and the first half of upturns in the economy – periods in which credit-worthiness may be beginning to improve and liquidity is high. Figure 102 clearly demonstrates the increased volatility during these times.

Looking at changes in rates, defined over 12-month periods, we find very similar results – credit has an average excess return of 13bp in falling rates regimes and only 4bp during rising rates periods.

Yield curve slope

In flat curve regimes, the index has an average excess return of just 3bp/month against 13bp/month in steep curve regimes.

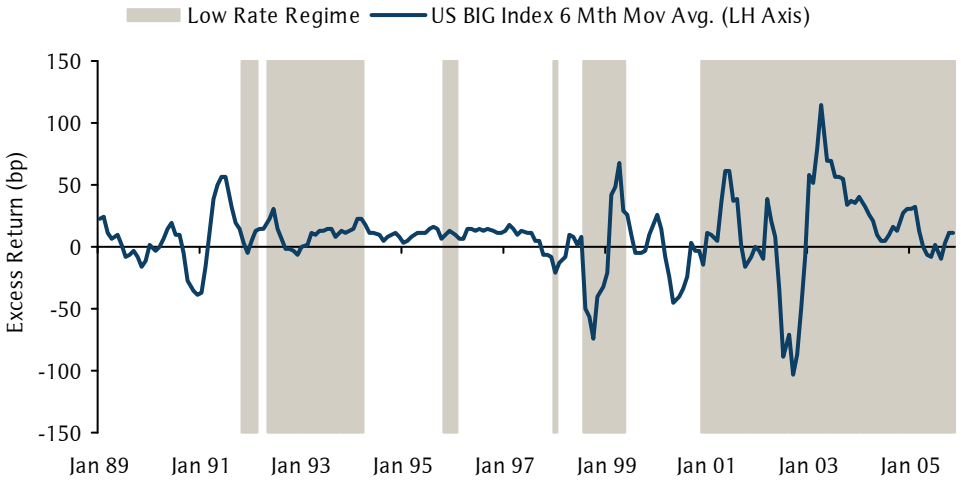
Returning to Figure 101, we find that in flat (including inverted) curve regimes, the credit index has an average excess return of just 3bp per month, while in steep curve regimes, the return is dramatically higher at 13bp per month, on average. This is consistent with steep curves tending to coincide with an improving economic outlook and also driving profitability for financial institutions. Interestingly, the differential in volatility between flat and steep periods of just 16bp is not very significant. See Figure 103.

Volatility is much lower in flattening regimes than in steepening ones.

Finally, changes in the slope, again defined over 12-month periods, provide similar results. In times of a flattening slope, the average excess return is 2bp versus 15bp during steepening periods. Volatility is much lower in flattening regimes than in steepening ones. The slope tends to be flattening in the latter stages of economic upturns when both risk-aversion and default rates are low.

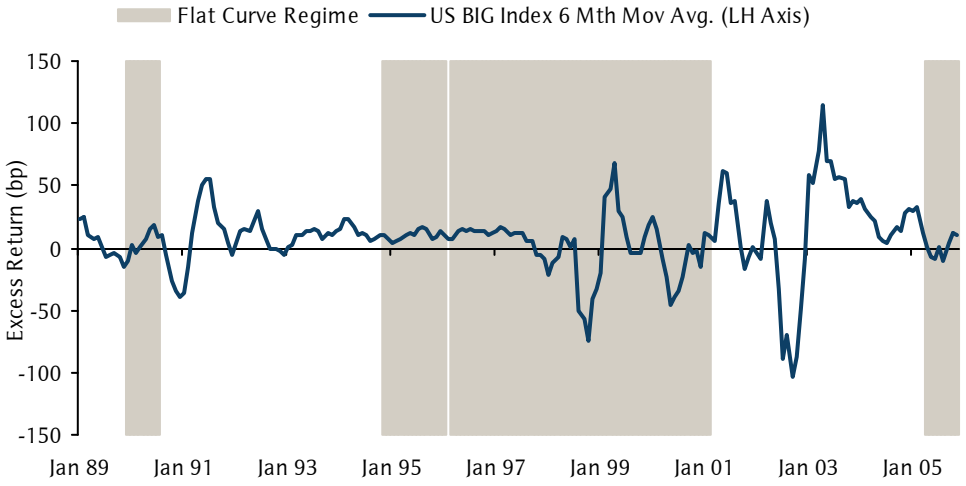
[31] *Further notes on data used can be found in Appendix D.*
[32] *In this section, all regimes are defined by cutting the sample at the median. For example, low two-year rates regime corresponds to periods in which two-year rates are below the median 2-year yield level for the whole sample.*

Figure 102: Credit market performance during low/high rates regimes



Source: The Yield Book, Barclays Capital

Figure 103: Credit market performance during flat/steep curve regimes



Source: The Yieldbook, Barclays Capital

Mixed effects

A natural extension is to quantify the mixed effects between the level of rates and the shape of the curve. Many examples of mixed effect results are given in the scenario analysis on the front page. Figure 104 provides more details of the scenarios, including excess returns and volatilities, as well as more information on regime definitions.

In stable rates and flat curve regimes, we expect credit to modestly outperform

Focusing again on the most likely scenario for 2006 of stable rates and flat curve, we find the credit index has an average excess return of 8bp/month in such times, but with relatively high excess return volatility of 60bp/month. This leads us to recommend a moderate overweight for credit in this scenario. Figure 104 also details how this regime is defined in our testing. In this case, stable rates equates to 12-month changes in two-year rates in the middle two quartiles, and flat curve corresponds to a 10- to two-year spread of greater than 0bp but less than the median of 66bp.

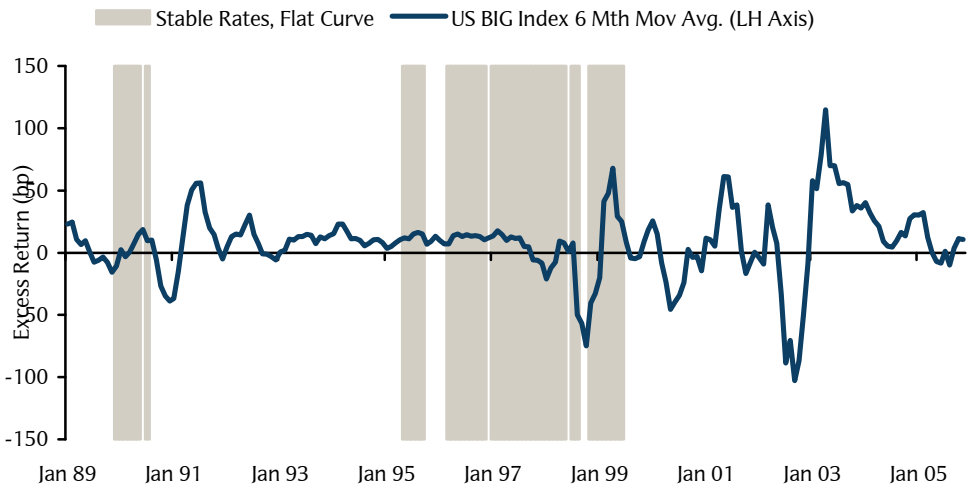
Figure 104: Mixed regime scenarios, excess returns and volatilities

Index Level Scenarios						
Scenario	Flat curve scenario	Inverted curve scenario	Stable rates, flat curve scenario	Rising rates, flat curve scenario	Stable rates, moderate steep curve scenario	Rising rates, moderate steep curve scenario
Excess return (bp/month)	9	-34	8	8	5	6
Volatility (bp/month)	54	60	60	27	32	35
Regime definition						
10- to two-year slope	Between 0bp and 66bp [75th Percentile]	Less than 0bp	Between 0bp and 66bp [50th Percentile]	Between 0 bp and 66 bp [50th Percentile]	Between 21bp [25th Percentile] and 180bp [75th Percentile]	Between 21bp [25th Percentile] and 180bp [75th Percentile]
12M change in two-year rates	All	All	Between -127bp [25th Percentile] and 57bp [75th Percentile]	Greater than 0 bp	Between -127bp [25th Percentile] and 57bp [75th Percentile]	Greater than 0bp

Source: The Yield Book, Barclays Capital

Figure 105 highlights the stable rates and flat curve periods, which roughly fall in1990 and again between 1996 and 2000.

Figure 105: Stable rates, flat curve regimes



Source: The Yieldbook, Barclays Capital

Further analysis of combinations of effects could generate interesting results but requires more sophisticated econometric techniques.

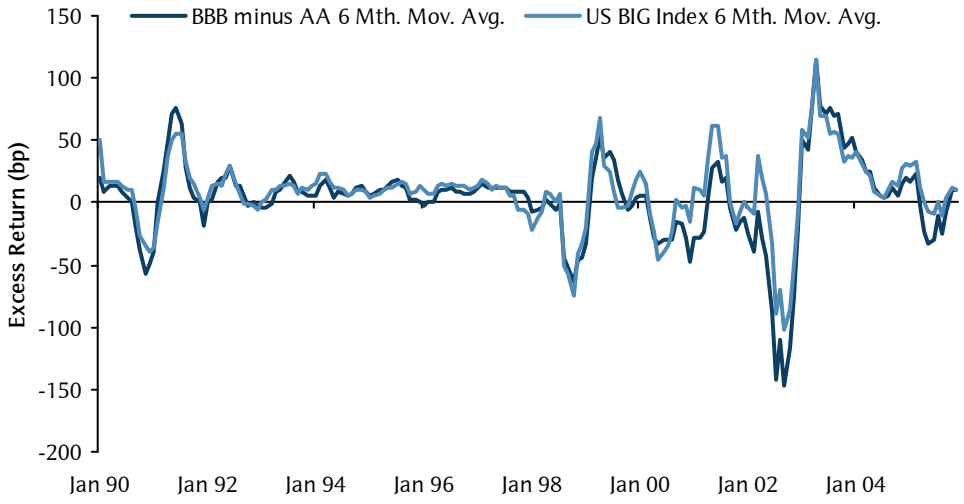
Rating category analysis

When it is desirable to take on credit risk by going long the index, it is also favourable to overweight low quality bonds and underweight high quality, in our view

The analysis of yield curve effects on ratings leads us to very similar conclusions to the credit index analysis.

We find that BBB-rated bonds outperform AA and AAA-rated bonds in the same periods that the credit index as a whole outperforms, and vice-versa. Indeed, the correlation of returns is approximately 90%, see Figure 106. In other words, whenever it is desirable to take on credit risk by going long the index, it is also favourable to overweight low quality bonds and underweight high quality, in our view.

Figure 106: BBB minus AA excess returns and credit index excess returns are closely matched historically



Source: The Yieldbook, Barclays Capital

Broad sector analysis

Figure 107 reports the average excess returns and volatilities of the broad financials, industrials and utilities sectors, across the different yield curve regimes

The main findings are:

Financials tend to perform best in low and falling rates regimes

Financial institutions outperform the credit index in most regimes but especially when rates are low or falling, which can be explained partly by the business models that rely on cheap funding for lending operations. They are also inclined to have higher volatility in these periods. Financials perform modestly better in steep and steepening curve regimes. Again, this may be clarified by the business models that fund long-term loans with short-dated borrowings. Also the steep curve regime relates to a strong economic outlook, which may benefit all credit.

Industrials perform better in steep and steepening curve regimes

In this sample, industrials appear to be largely unaffected by the level or trajectory of rates. This could be because the grouping of industrials is too coarse and may be obscuring finer industry effects. However, we find better performance for industrials in the steep and steepening curve regimes, likely due to their economic implications.

Utilities results have been dominated by 2002's power sector turmoil

The results for the utilities are skewed heavily by the power sub-sector, which experienced extreme volatility from 2002 to early 2003. This volatility, we believe, is unrelated to the yield curve and stems from a number of severe credit deteriorations within the sector. We therefore place limited weight on these results, which suggests that utilities perform best in high rates and flat curve environments.

Figure 107: Excess returns over the credit index and volatilities for broad sectors, 1990 to 2005

	Full period	Low rates	High rates	Falling rates	Rising rates	Flat curve	Steep curve	Flattening curve	Steepening curve
Financials									
Avg Excess Return bp/month	4	5	1	7	0	2	4	3	5
Volatility bp/month	30	38	18	36	17	22	36	21	37
Industrials									
Avg Excess Return bp/month	0	0	0	1	-1	-2	2	-2	2
Volatility bp/month	18	22	13	20	15	15	20	15	21
Utilities									
Avg Excess Return bp/month	-4	-7	0	-7	0	-1	-5	1	-9
Volatility bp/month	60	81	19	78	16	25	80	25	81

Source: The Yieldbook, Barclays Capital

Industry level analysis

We have broken down the analysis into industry groups due to the lack of strong effects on broad sectors.

- Most **industry sectors behave significantly differently between steep, flat and inverted yield curves regimes.**
- **To a lesser extent, many industry sectors also exhibit distinct behaviour between rising and falling rates regimes.**
- Some industry sectors show no significant relationship with the yield curve – auto & auto parts, cable & media, electric utilities and P&C insurance sectors.

To simplify the analysis and allow concise reporting of results, we have restricted our attention to two types of regime only:

- Regimes based on the yield curve slope; and
- Regimes based on the changes in rates.

Econometric methodology

At this stage, we introduce the class of regime switching models – econometric techniques that attempt to extract and quantify regimes from the data. Figure 108 lists some advantages of this type of analysis.

Figure 108: Key advantages of econometric analysis

So far, we have explicitly defined yield curve regimes, for example, by dividing variables at their medians. Regime switching models make no such assumptions and instead allow the system of data to establish whether regimes are really present and the thresholds at which they change.
We use panel estimation – a technique using all data series simultaneously, maximising data efficiency and robustness of results. This also allows easy analysis of much larger numbers of series, as is necessary with finer industry level analysis.
Using a formal model enables us to judge the "significance" of observed effects – in other words, is the effect the result of a few anomalous data points or is there evidence of a genuine pattern. Specifically: i) Do the regimes significantly affect the performance of industry sectors? ii) Are all industry sectors affected similarly? iii) Which industries have significant differentials in performance between regimes?
These models allow great flexibility for extension in future studies – eg, consider mixed effects between different types of regimes, include other variables, such as macroeconomic or equity related data, into the system, convert to predictive versions for shorter-term trading applications.

Regimes in the yield curve slope model

We have set up a regime-switching model that allows for three regimes – "steep" (upward sloping), "flat'" and "inverted" (downward sloping). However, prior to testing, we do not know whether these are meaningful names. The model expresses the excess return on each sector as the sum of:

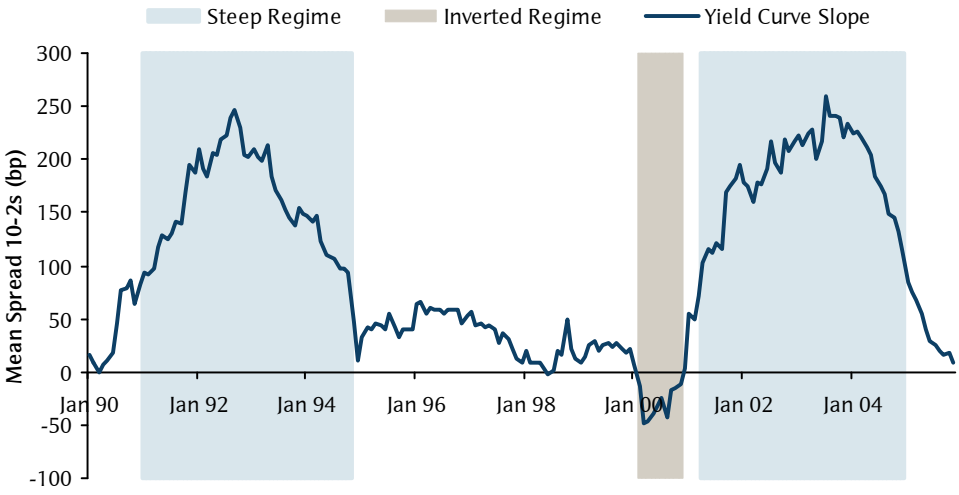
- A constant measuring the return in the "steep" curve regime;
- A constant measuring the extra return (positive or negative) in the "flat" regime;
- A constant measuring the extra return (positive or negative) in the "inverted" regime;
- The sector beta multiplied by the return on the credit index; and
- An error term with mean equal to zero and a variance specific to the sector.

Mathematically we can write:

$$r_t^i = \alpha_0^i \Pr_t^{STEEP} + \alpha_1^i \Pr_t^{FLAT} + \alpha_2^i \Pr_t^{INVERTED} + \beta^i r_t^{INDEX} + \varepsilon_t^i \qquad (1)$$

Here, r_t^i denotes excess returns of sector *I* during month *t*, α^i are the constants – or equivalently the regime specific excess returns over the index – and $\Pr_t^{REGIME}$ represents the estimated probability of being in the specific yield curve slope regime. This system is estimated in panel form across sectors with common regimes. See Figure 109. For full details please refer to Appendix B.

Figure 109: Model generated yield curve slope regimes



Source: The Yieldbook, Barclays Capital

The negative 10- to two-year spread at end-December 2005 did not constitute an inversion, as far as credit is concerned

The data supports the intuitive distinction between inverted, flat and steep regimes. One convenient feature of this analysis is that we can extract the thresholds between regimes, as shown in Figure 110. It is interesting to note that for the yield curve to qualify as inverted, **as far as credit is concerned**, the spread between 10- and two-year rates has to be below approximately -11bp. This indicates that the small inversion at the end of December 2005 was not significant for credit. Another factor is the length of time the curve is inverted – in particular, distinguishing between a fleeting inversion and a sustained inversion. We do not explicitly address this factor in this version of our model, but note that in our sample, movements into a new yield curve regime have been with a high degree of momentum, so that the regime variable has moved far beyond the threshold quite soon after passing it. As a consequence, regimes appear to be persistent and the only blip is the intermediate flat regime of a few months between the recession of 2001 and the following steep regime.

Figure 110: Yield curve slope thresholds

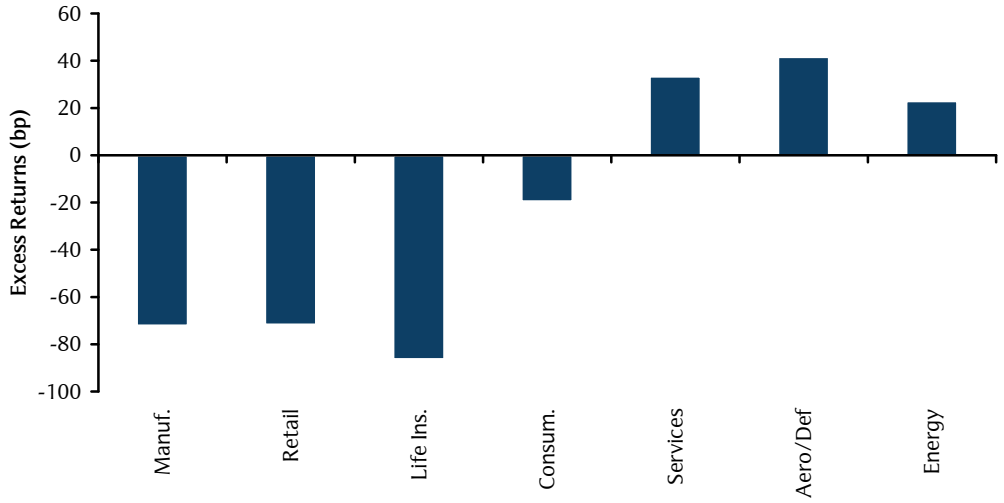
Regime	10- to two-year spread threshold
Steep	Greater than 88bp
Flat	Between -11bp and 88bp
Inverted	Less than -11bp

Source: The Yieldbook, Barclays Capital

Yield curve slope sector results

Figure 111 and Figure 112 show the average excess returns, over the index, of industry sectors in the inverted and steep regimes. Only sectors displaying statistically significant effects have been included.

Figure 111: Out/underperformance in the inverted yield curve regime, ordered by significance (up to 15%)

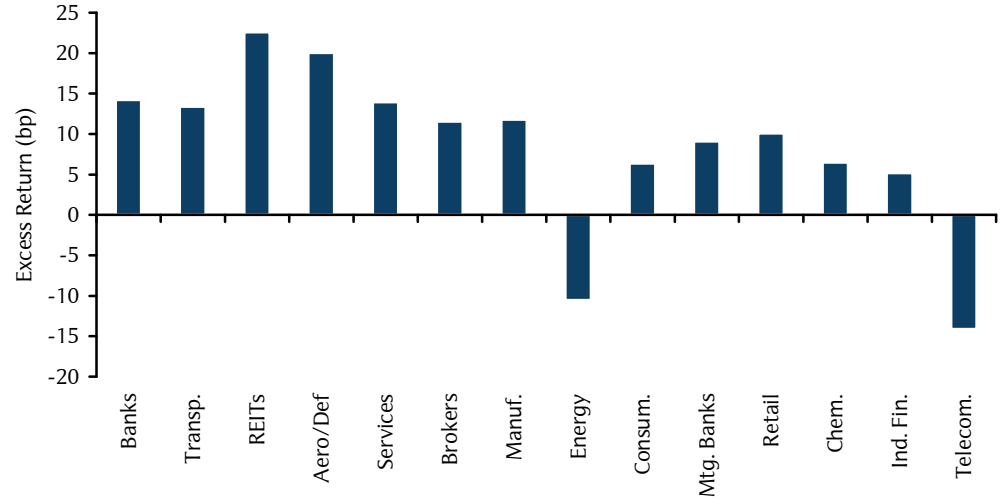


Source: The Yieldbook, Barclays Capital

Manufacturing, retail, life and consumer sectors significantly underperform in an inverted curve regime

In an inverted yield curve environment[33] we find significant underperformance in the manufacturing, retail and life sectors and to a slightly lesser extent, the consumer sector. As they are relatively cyclical industries, the inversion has been widely regarded as a signal of the impending recession. On the other side, services, and aerospace & defence outperform. Aerospace & defence performed well for reasons generally acknowledged to be unrelated to the yield curve.

Figure 112: Out/underperformance in the steep yield curve regime, ordered by significance (up to 15%)



Source: The Yieldbook, Barclays Capital

Banks, independent finance, REITs and brokerage perform well in steep curve regimes

Many sectors show strong returns in the steep yield curve environment. Financial institutions such as banks, mortgage banking, independent finance, REITs and brokerage performed well. The remaining sectors here are mostly highly cyclical, benefiting from the steep yield curve's positive signal for the economy. The results for

[33] *Note that, although the inverted curve regime is statistically justified, the fact that it occurs only once in the sample means that a certain degree of caution should be used when extrapolating the sector-specific results to form forecasts of future excess returns.*

both energy and telecoms are questionable – as they both experienced extreme volatility in 2002 (during the second steep curve regime) with many downgrades and defaults unrelated to the yield curve.

Figure 113 reports the full parameter estimates from the model. For each sector, the three columns provide the average excess return parameters given the regime in the second top row. The light blue highlighting indicates sectors with a consistent pattern of increasing excess returns with the steepening of the curve. Grey rows specify sectors with a consistent pattern of decreasing performance with the steepening of the yield curve.

The light blue shaded industries include many financials, such as banks, with business models clearly benefiting from steep curves, as well as other cyclical sectors, which gain from the positive signals for the economy embedded in the steeper curves. The grey shaded industries are more mixed in interpretation – certainly pharmaceuticals and tobacco are non-cyclical and therefore outperform others in the inverted regime. Electric, energy and power could also be argued as being less cyclical. Cable & media and telecoms results are less meaningful due to the turbulent credit periods that coincided with the rate regimes.

Figure 113: Yield curve slope regime switching model parameter estimates – Light blue/grey highlighting indicates cyclical/counter-cyclical pattern respectively

Sector	Average excess returns over index		
	Steep	Flat	Inverted
Aerospace/Defence	20.02	-7.82	41.63
Airlines	-18.15	16.01	15.31
Auto & Auto Parts	0.93	-14.02	10.48
Banking	14.24	0.23	-1.20
Cable & Media	-4.91	6.36	19.70
Chemicals	6.48	0.47	-13.98
Consumer	6.38	2.18	-19.56
Electric Utilities	-0.85	0.13	8.43
Energy	-10.51	2.70	22.94
Home Builders	48.28	-7.48	n.a.
Independent Finance	5.20	3.51	-4.84
Life Insurance	4.63	2.11	-86.37
Manufacturing	11.78	1.61	-72.20
Mortgage Banking	9.10	3.75	-1.55
Natural Gas Distributors	5.57	3.42	-3.39
Property & Casualty Insurance	3.29	0.24	-18.42
Pharmaceuticals	-0.54	4.71	18.19
Power	-133.34	7.70	n.a.
Real Estate Investment Trust	22.58	26.50	7.35
Retail	10.07	2.98	-71.75
Securities Broker Dealers	11.55	4.88	11.48
Service	13.94	-9.52	33.40
Telecommunications	-14.13	-3.00	5.70
Tobacco	4.61	9.91	10.16
Transportation	13.40	-3.45	-8.13

Source: The Yieldbook, Barclays Capital

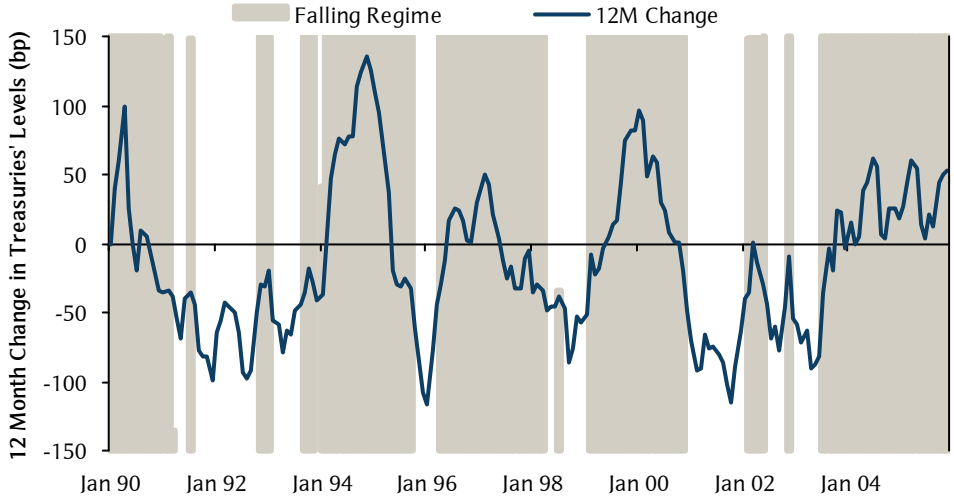
Regimes in the level of the treasury curve model

In the second set of tests, we set up a similar specification to the above to investigate possible rate level effects on sector returns:

$$r_t^i = \alpha_0^i \Pr_t^{RISING} + \alpha_1^i \Pr_t^{FALLING} + \beta^i r_t^{INDEX} + \varepsilon_t^i \qquad (2)$$

The probability associated with rising/falling rates regimes is governed by the 12-month moving average of the change in the average rate across the Treasury curve, to isolate and avoid possible curve shape effects. Figure 114 plots the resulting regimes.

Figure 114: Twelve-month changes in 2yr, 5yr and 10yr Treasuries and the corresponding sector excess return regimes.



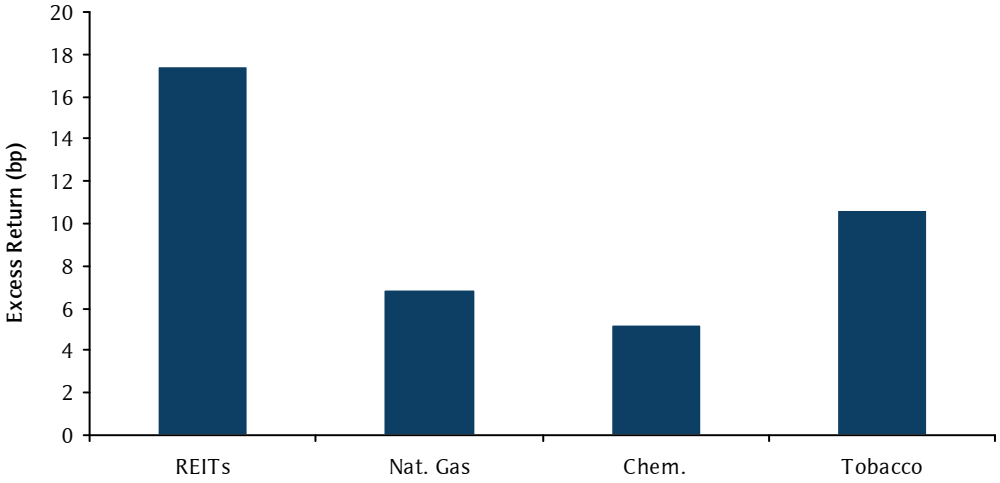
Source: The Yieldbook, Barclays Capital

The estimated threshold that defines rising rates regimes is a 12-month change in two-year rates of approximately -35bp or greater. A change of less than -35bp constitutes a falling rates regime. We would expect a threshold closer to 0bp to define rising and falling. The explanation for the significantly negative value is that two-year rates have trended downward throughout the 1990 to 2005 sample. The mean and median changes are therefore negative.

REITs, natural gas, energy and chemicals sectors outperform in rising rates periods

As in the previous section, Figure 115 and Figure 116 show the average excess returns over the index of sectors with considerable returns in the regimes. We find that only a small number of sectors – REITs, natural gas, energy and chemicals – have significant performance in the rising rates regime. Increasing rates tend to coincide with a strong economy, which explains the presence of REITS in particular.

Figure 115: Out/underperformance in the rising rates regime, ordered by significance (up to 15%)

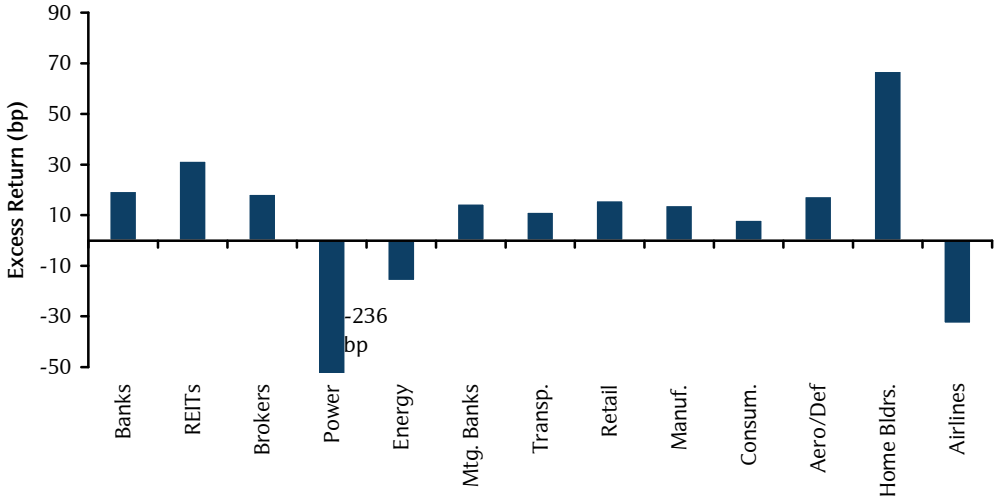


Source: The Yieldbook, Barclays Capital

Financials, home builders, manufacturers and transportation companies benefit from falling rates

In the falling rates regime, we find many more sectors, including banks, mortgage banks and brokers that clearly gain from falling rates, as well as manufacturing and transportation that may be benefiting from the increased liquidity. REITs is present again as an outperforming sector – in fact, REITs outperformed the index throughout the sample period (see average excess returns in Figure 99). The power sector numbers have been significantly affected by the Enron event occurring in a falling rate environment.

Figure 116: Out/underperformance in the falling rates regime, ordered by significance (up to 15%)



Source: The Yieldbook, Barclays Capital

Further details of parameter estimates and significance levels for all models can be found in Appendix C.

Further investigations

The frameworks developed here are conveniently open to extension in a variety of manners. Some of the more interesting avenues of possible further research include:

- More complex modelling of regimes, including combinations of regimes, to allow detailed scenario analysis;
- Investigate lead-lag effects, and develop predictive models for forecasting short- to medium-term sectors returns;
- Equity market signals at the sector level; and
- Macro-economic and other financial market signals at the sector level.

Appendix A: US rates views

Figure 117: Yield curve forecasts

	Q1 06	Q2 06	Q3 06	Q4 06	Q1 07
Two-year yield forecast	4.75%	4.65%	4.80%	4.85%	5.40%
10- to two-year slope forecast	0 bp	-10 bp	+5 bp	+15 bp	+10 bp

Source: Barclays Capital US Fixed Income Strategy

Appendix B: Econometric specification

The general regression equation used for the yield curve slope regression

$$r_t^i = \alpha_0^i + \alpha_1^i \Pr_t^{FLAT} + \alpha_2^i \Pr_t^{INVERTED} + \beta^i r_t^{INDEX} + \varepsilon_t^i \quad (3)$$

where *i* denotes individual sectors (either industry-level or broad-sector level) and *t* is a time index. Hence, in the most general specification, we allow all excess returns, market betas and series specific variances (through $\varepsilon_t^i \sim N(0, \sigma_i^2)$) to vary across sectors.

The probability variables $\Pr_t^{FLAT}$ and $\Pr_t^{INVERTED}$ are indicators for the flat and inverted yield curve regimes. Hence, α_j^i are here to be interpreted as marginal effects, although all values in the paper have been converted into their traditional, level counterparts as in the equation (1). Note that equation (1) has been transformed into levels for readability: it has to be estimated in the form of (3) to avoid perfect multicollinearity.

A number of constraints can be put upon (1) to test cross-section dynamics. For example, to investigate whether β s are common or different across sectors, one can constrain $\beta^i = \beta^j$, $\forall i, j$, and examine the significance of the constraint by most standard statistical tests. An especially interesting analysis as reported above is:

$$r_t^i = \alpha_0 + \alpha_1 \Pr_t^{FLAT} + \alpha_2 \Pr_t^{INVERTED} + \beta^i r_t^{INDEX} + \varepsilon_t^i \quad (4)$$

Specifically, to examine the excess returns depending on the regimes of the yield curve slope in the panel as a single entity. The advantage of conducting this test is the marked increase in its power to distinguish between the alternative hypotheses.

We estimate (3) as a pooled (panel) regression model, with the slope probabilities estimated simultaneously via a three-state, ordered probit model with a constant and

the slope of the treasury curve (2-10s) as independent variable. The non-linear nature of the model requires it to be estimated with a (quasi)-maximum likelihood method. Note that the simultaneous estimation of (3) and the probit specification allows regimes to be defined by dynamics in bond sector returns, rather than being imposed exogenously. If the regimes outlined by the underlying regime variable, in this case the slope series, does not have a meaningful influence on the bond spreads, the resulting probability series will flatline.

We have tested conditional heteroskedasticity/more leptokurtic distributions' effects on the data as well. Although these results are in general statistically significant, their relative value impact is small and comes at a considerable computational cost. We have hence opted out from using them in the above results to retain a parsimonious representation of the model and computational feasibility.

Appendix C: Regime switching parameter estimates

Using the regimes generated in the industry panel-model, we can revisit the credit index level analysis and measure average excess returns across the regimes, see Figure 118 and Figure 119. These results are similar to Figure 98. Significance is measured through the probability value (p-value) of each excess return parameter. The p-value of a parameter is the statistical probability from the model that the parameter in fact equals zero. As a result, a low p-value indicates that the parameter is not likely zero and therefore significant.

Figure 118: Index excess returns, yield curve slope regimes

	Steep	P-value	Flat	P-value	Inverted	P-value
Credit index	15bp	0%	11bp	0%	-48bp	0%

Source: The Yieldbook, Barclays Capital

Figure 119: Index Excess returns, rising/falling rates regimes

	Rising	p	Falling	P
Credit index	10bp	0%	13bp	0%

Source: The Yieldbook, Barclays Capital

Furthermore, we estimate the regime switching model on the system of excess returns of different ratings categories. The division of regimes is identical to that obtained previously – indicating that the regimes are likely meaningful in a statistical manner. Here, the excess returns are measured as the return offered over the broad corporate index excess return, ie, we estimate a beta towards the broad market. Note that estimates have been obtained by constraining the beta across sectors to obtain the effect in a relative value (AA versus A/BBB) setting.

Figure 120: Excess return in rating categories, yield curve slope regimes

Rating category	Steep	P-value	Flat	P-value	Inverted	P-value
AA/AAA	-2bp	53%	1bp	45%	15bp	1%
A	4bp	6%	1bp	30%	-1bp	83%
BBB	9bp	11%	0bp	93%	-28bp	5%

Source: The Yieldbook, Barclays Capital

Not surprisingly, higher quality paper offers higher excess returns in the inversion regime than lower quality, and vice versa for the steep yield curve regime. It also appears that the rate changes regimes are not particularly influential in terms of rating bucket returns (see Figure 121).

Figure 121: Excess return in rating categories, rising/falling rates regimes

Rating category	Rising	p	Falling	p
AA/AAA	0bp	90%	1bp	75%
A	0bp	51%	6bp	2%
BBB	42bp	24%	1bp	92%

Source: The Yieldbook, Barclays Capital

Figure 122 reports the full parameter estimates from the model based on the finer industrial level. For each sector, the first three columns display the average excess return parameters in the given regimes with their associated probability value in the next three columns. Finally, we also report industry specific betas to the main index. These betas corroborate that the power industry is subject to firm-specific effects: a beta of this magnitude (4.18) indicates very high volatility compared to more mainstream industries.

Figure 122: Slope regime switching model parameter estimates

	Average excess returns over index			P-values			Beta	Beta P-value
Sector	Steep	Flat	Inverted	Steep	Flat	Inverted		
Aerospace/Defence	20.02	-7.82	41.63	**0%**	26%	**6%**	0.91	0%
Airlines	-18.15	16.01	15.31	31%	36%	78%	1.71	0%
Auto & Auto Parts	0.93	-14.02	10.48	93%	15%	73%	1.43	0%
Banking	14.24	0.23	-1.20	**0%**	96%	93%	0.73	0%
Cable & Media	-4.91	6.36	19.70	54%	43%	43%	1.59	0%
Chemicals	6.48	0.47	-13.98	**9%**	90%	23%	0.83	0%
Consumer	6.38	2.18	-19.56	**5%**	49%	**5%**	0.58	0%
Electric Utilities	-0.85	0.13	8.43	87%	98%	60%	0.93	0%
Energy	-10.51	2.70	22.94	**2%**	55%	**10%**	1.12	0%
Home Builders	48.28	-7.48	N/A	2%	84%	N/A	1.05	0%
Independent Finance	5.20	3.51	-4.84	**12%**	29%	64%	0.67	0%
Life Insurance	4.63	2.11	-86.37	58%	80%	**0%**	1.04	0%
Manufacturing	11.78	1.61	-72.20	**2%**	75%	**0%**	0.91	0%
Mortgage Banking	9.10	3.75	-1.55	**6%**	43%	92%	0.68	0%
Natural Gas Distributors	5.57	3.42	-3.39	24%	47%	82%	0.73	0%
Property & Casualty Insurance	3.29	0.24	-18.42	54%	96%	27%	1.03	0%
Pharmaceuticals	-0.54	4.71	18.19	90%	27%	17%	0.76	0%
Power	-133.34	7.70	N/A	1%	93%	N/A	4.18	0%
Real Estate Investment Trust	22.58	26.50	7.35	**0%**	**0%**	64%	0.56	0%
Retail	10.07	2.98	-71.75	**6%**	58%	**0%**	0.88	0%
Securities Broker Dealers	11.55	4.88	11.48	**2%**	31%	45%	0.68	0%
Service	13.94	-9.52	33.40	**1%**	**9%**	**5%**	0.92	0%
Telecommunications	-14.13	-3.00	5.70	**14%**	75%	85%	1.48	0%
Tobacco	4.61	9.91	10.16	57%	22%	69%	0.63	0%
Transportation	13.40	-3.45	-8.13	**0%**	37%	50%	0.70	0%

Source: The Yieldbook, Barclays Capital

Our final set of estimates in Figure 123 relate to sensitivities of excess returns over the index for specific industries based on the 12M average change in Treasury levels.

Figure 123: 12M Change in treasury level regime switching model parameter estimates

	Average excess returns over index		P-values		Beta	Beta p-value
	Rising	Falling	Rising	Falling		
Aerospace/Defence	2.39	17.65	70%	3%	0.92	0%
Airlines	18.59	-32.97	22%	10%	1.68	0%
Auto & Auto Parts	-0.04	-15.69	100%	16%	1.44	0%
Banking	-0.55	19.56	87%	0%	0.74	0%
Cable & Media	-2.58	9.55	71%	30%	1.57	0%
Chemicals	5.20	-2.28	11%	60%	0.84	0%
Consumer	-0.01	8.24	100%	3%	0.59	0%
Electric Utilities	4.32	-7.30	32%	21%	0.93	0%
Energy	5.32	-16.04	17%	0%	1.10	0%
Home Builders	20.36	66.99	35%	3%	1.10	0%
Independent Finance	2.95	5.44	30%	15%	0.68	0%
Life Insurance	-6.96	8.15	34%	40%	1.08	0%
Manufacturing	-4.28	14.13	35%	2%	0.95	0%
Mortgage Banking	1.04	14.67	80%	1%	0.69	0%
Natural Gas Distributors	6.87	-0.92	9%	86%	0.73	0%
Property & Casualty Insurance	-1.74	4.90	70%	42%	1.04	0%
Pharmaceuticals	2.40	4.01	51%	41%	0.75	0%
Power	-32.98	-249.21	52%	0%	4.03	0%
Real Estate Investment Trust	17.44	31.61	1%	0%	0.57	0%
Retail	-5.53	16.00	25%	1%	0.92	0%
Securities Broker Dealers	2.61	18.54	52%	0%	0.68	0%
Service	1.19	8.40	81%	20%	0.92	0%
Telecommunications	-11.51	-1.06	16%	92%	1.46	0%
Tobacco	10.61	1.82	13%	84%	0.62	0%
Transportation	0.10	11.41	98%	1%	0.71	0%

Source: The Yieldbook, Barclays Capital

Appendix D: Notes on data used in empirical analysis

The close tie between yield curve regimes and the macro-economy and business cycle means that long time periods need to be looked at to see examples of all regimes. For this reason, we focus the empirical work on USD corporate bond data back to 1989, and at the sector level, back to 1990. Many of the results and conclusions may be extendable to the CDS space and, with a little further analysis, euro corporate bonds and CDS.

All reported returns are market-value-weighted excess returns over duration matched treasuries.

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