3 The Fundamentals of Basis Trading

In this chapter we consider some further issues of basis trading and look at the impact of repo rates on an individual's trading approach.

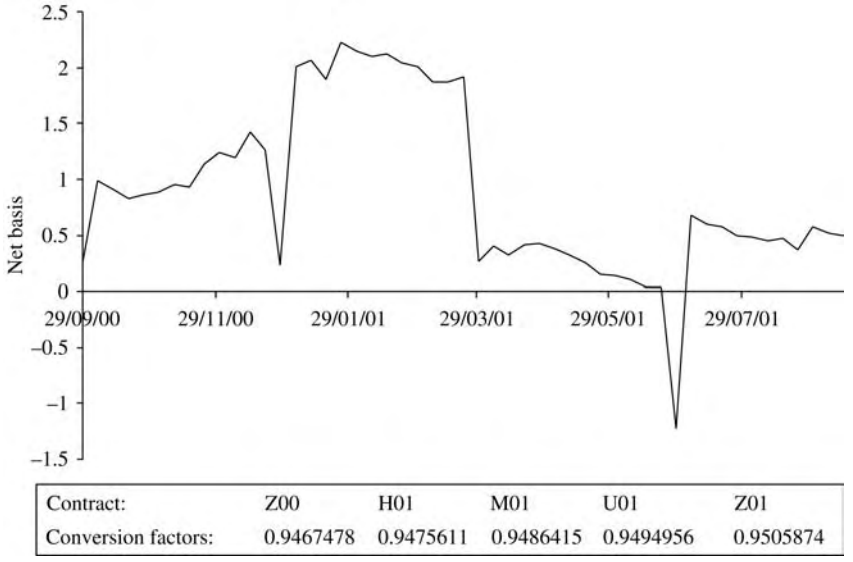
3.1 Rates and spread history

3.1.1 Net basis history

One of the first considerations for basis traders is the recent (and not so recent) history of the basis. For instance if the basis is historically high, a strategy might involve selling the basis, in anticipation that the levels will fall back to more ''normal'' levels. The trader can sell the basis of the CTD bond or another bond in the delivery basket. Let us consider one approach here, tracking the basis of the CTD in an attempt to identify trade opportunities.

By tracking the net basis for the CTD, we are able to see the impact of the delivery option possessed by the short on the level of the basis. Figures 3.1 to 3.3 illustrate the behaviour of the net basis for the 6.25% 2010 gilt during the period September 2000 to September 2001. This bond was the CTD bond during this period.

Tracking the net basis allows us to observe the value placed by the market on the short future's delivery options. For purposes of illustration we also show the futures price, cash bond price and converted bond price in Figure 3.2 and the actual market repo rate in Figure 3.3 during the same period. The net basis is measured in price decimals, just like the futures and cash price. We observe that, as expected, there is a pattern of convergence towards a zero basis as each contract approaches final delivery date. We also observe that profit can be obtained by selling the basis at times of approaching the delivery month, assuming that this bond remains the CTD throughout the period. If there is any change in the CTD status this will reduce or eliminate profits, because then instead of the trader gaining the entire net carry basis, some or all of it will have been given up. A good way of assessing a position of being short the basis is to assume one is short of an out-of-the-money option. The maximum profit is the option premium, and this is earned gradually over the term of the trade as the time value of the option decays. In this case the equivalent to the option premium is the net basis itself. As the basis converges to zero, and the futures contract approaches expiry, the net basis is gained. However, the risk is potentially high: identical to the trader who has written an option, and potentially unlimited.



Contract:	Z00	H01	M01	U01	Z01
Conversion factors:	0.9467478	0.9475611	0.9486415	0.9494956	0.9505874

Figure 3.1: Long gilt cheapest-to-deliver bond net basis history, front month contract (CTD bond is 6.25% Treasury 2010)

The same approach may be adopted when buying the basis, observing when it is historically cheap. A long position in the basis is similar to being long a call option on a bond or a bond future.

An analysis of the net basis history in isolation is not necessarily sufficient to formulate trade decisions however, because it would not indicate changes in the

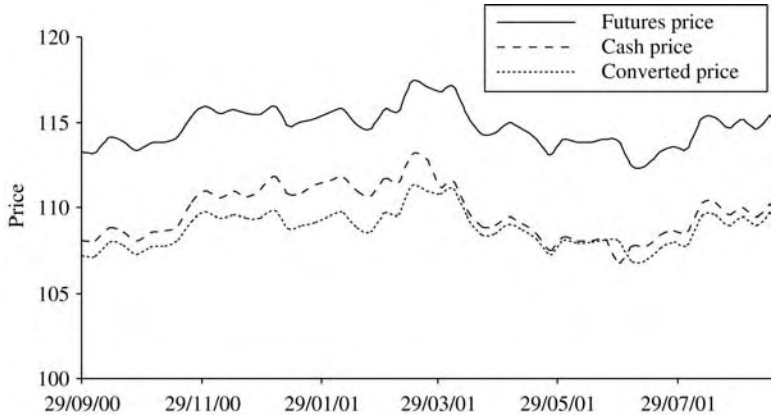


Figure 3.2: CTD bond price histories

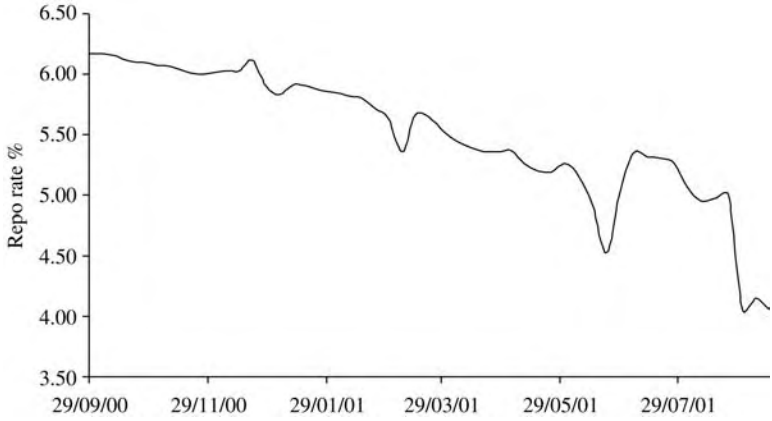


Figure 3.3: Repo rates during September 2000 to September 2001

status of the CTD bond. In itself, it merely tracks the net basis of the bond that is the CTD at that precise moment. A change in the CTD bond can have serious repercussions for the basis trader. A trade idea based on selling the basis of the CTD bond will be successful only if the bond remains the CTD during the term of the trade. So if a trader sells the basis, with the intention of running the trade to contract delivery, then as long as that bond remains the CTD then the entire basis is the theoretical profit. If there is a change in status amongst the deliverable bonds, then this profit may be reduced, wiped out or turned into a loss.

Another approach when looking at the net basis is to buy it when it is historically cheap. This anticipates a rise in the basis value, so it should not be undertaken when the futures contract has a relatively short time to expiry. Remember that a contract ceases to be the *front month* contract[1] fairly immediately once we move into the delivery month, buying the basis when it is cheap is a tactic that is often carried out before a future becomes the front month contract. A long basis position essentially is similar to a long position in an option.[2] So the downside exposure is limited to the net basis at the time the trade is put on, while the potential upside gain is, in theory, unlimited. As with a long option position, a long basis position may be put on to reflect a number of views, and can be bullish or

[1] Called the *lead contract* in the US market. This is the liquid contract traded under normal circumstances for hedging and simple speculation trading.

[2] As confirmed by Burghardt (*Ibid*, page 127), the basis of a bond of high-duration value acts roughly the same as a bond future or a call option on a bond, while the basis of a low-duration bond is similar in behaviour to a put option on a bond. The basis of bonds of neither high nor low duration moves like a straddle or strangle.

bearish, or may not be directional at all. A long basis trade then is an alternative to buying a call option, put option or what are known as *straddles* or *strangles*.[3]

3.1.2 The implied repo rate

In Chapter 2 we discussed how the implied repo rate measure was the best indicator of the CTD bond, with this bond having the highest IRR. It is worth bearing in mind that at the start of the delivery cycle the differences in IRRs are fairly small. Identifying one bond at this stage is only a forecast of the eventual outcome, and indeed it possible for the CTD at the start of the contract's trading to drop down to third or even fourth cheapest. We noted earlier that traders often prefer the net basis method over the IRR approach; this is because the IRR can also mislead. Remember that the IRR measures the return based on the dirty purchase price and the invoice price. In other words, it is a function of coupon income during the trade term and the cost of making delivery. As the time span to delivery decreases, small changes in the basis have a larger and larger impact on the IRR calculation. The danger of this is that a very small change in a bond's basis, while not altering its cheapest delivery status, can affect quite significantly the bond's IRR.

Figure 3.4 shows the IRR of the cheapest-to-deliver bond for the Dec01 long gilt contract. Notice how at the start of trading two bonds were vying for CTD status, and switched positions almost daily, before it settled down as the 6.25% 2010 gilt. This is perhaps good news for the basis trader, as IRR volatility is conducive to a profitable trading environment. More valuable though is the later stability of the contract's CTD status, which lowers the risk for the basis trader.

Figure 3.5 shows the historical pattern for the Sep01 contract, part of page DLV on Bloomberg.

3.2 Impact of the repo rate

Basis trading sounds excellent in theory but market participants also must take into account some practical issues that can complicate matters. Possibly the most important consideration is that of financing the trade, and the specific repo rates for the bond concerned. We consider this here.

---

[3] A straddle is a combination option position made up of a put option and a call option that have the same characteristics (that is, both options have identical strike prices, time to maturity and the same underlying asset). A long straddle is buying the put and the call option, while a short straddle is selling the put and call options. Straddles require a large shift in price of the underlying to be profitable, but gain in the meantime from a change in the implied volatility (a rise in implied volatility for a long straddle). A strangle is similar to a straddle but is constructed using options with different strike prices. There is a whole library of books one could buy on options, the author recommends Galitz's *Financial Engineering* (FT Pitman, 1995), David Blake's *Financial Market Analysis* (Wiley, 2000), and Jarrow and Turnbull's *Derivative Securities* (South-Western, 1999).

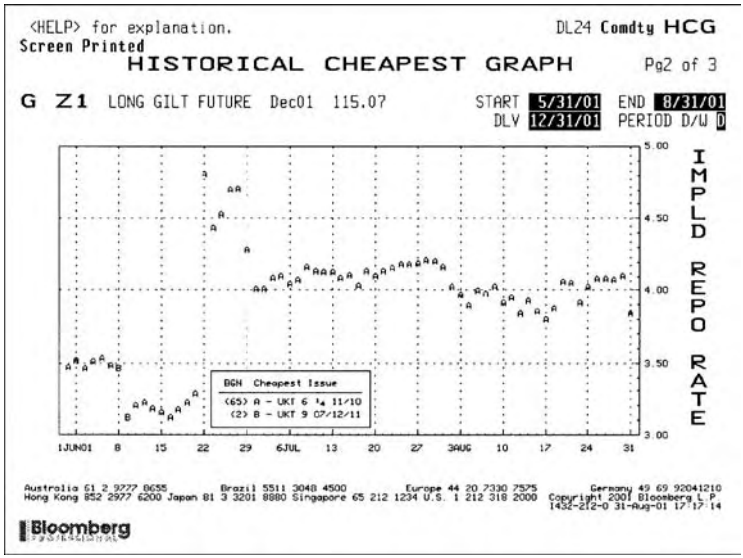


Figure 3.4: The CTD bond and implied repo rate, Bloomberg page HCG. © Bloomberg L.P. Used with permission

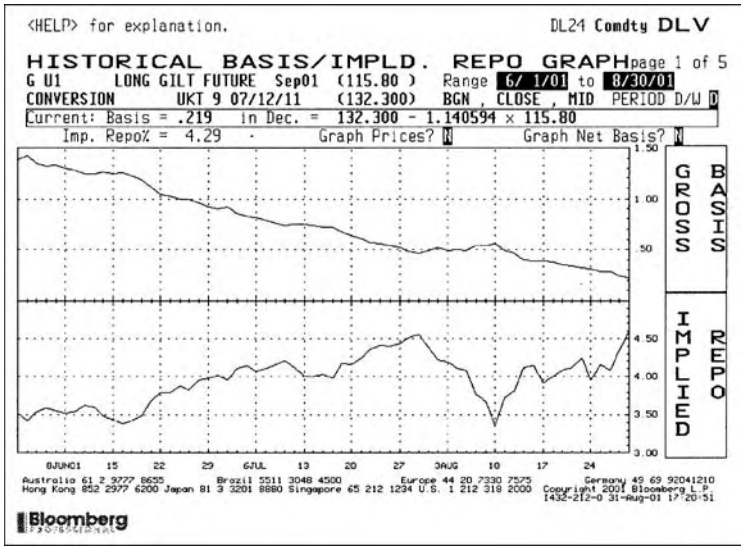


Figure 3.5: The historical basis and implied repo rate, Sep01 long gilt contract. © Bloomberg L.P. Used with permission

3.2.1 The repo rate

A key issue, possibly *the* key issue in a basis trade involves its financing. From our look at the size of the net basis, we know that the potential profit in a basis trade is usually quite small (this being the main reason that arbitrageurs undertake basis trades in very large size, $750 million being a not uncommon nominal value). Financing a trade, whether this is a long bond position or investing the proceeds of a short sale, can have a significant impact on its profitability. The trader must decide whether to fix the repo financing for the proposed term of the trade, for part of the term, or on an overnight roll basis. The financing rate is the specific repo rate for the bond traded. For virtually all applications, the closer this specific rate is to the GC rate the better. In a long bond position the repo rate is paid, so a specific rate that is special will probably render the trade uneconomic. For a short bond position, the repo rate is being received; however if this is special it would indicate that the bond itself is probably overpriced in the cash market or in danger of being squeezed or made undeliverable, which would introduce complications.

Generally traders prefer to fix the funding on the trade for a term, either part or the whole term. Financing a basis trade in the overnight does have some advantages however; for instance, if the short-term yield curve is positively sloping, overnight financing should prove cheaper than a term repo, as long as overnight rates are not volatile. The key advantage though is that if financing overnight, the trade may be unwound with much more ease. In a term repo, the trader is more or less fixed through to his original anticipated maturity date, and under changing circumstances this might be uneconomic. The risk in overnight funding is that a shift in the short-term yield curve can raise overnight rates to painful levels. If long the basis, a rise in the overnight rate will increase the funding cost of the trade and reduce its profitability. If short the basis, a fall in the overnight rate will reduce the (reverse) repo interest on the trade and so reduce profit. In addition there is the bid-offer spread to consider: someone entering into reverse repo to cover a short bond position receives the repo market-maker's offered rate, which is around 6 basis points lower than the bid rate for GC, but which may be 10–20 basis points lower for a specific repo.

Where one or more of the bonds in the delivery basket is special, it can cloud the identification of the CTD bond. Remember that one method of assessing the CTD is to pick that which has the highest implied repo rate (IRR), and if all deliverable bonds are trading close to GC this would be reasonable. However, this may not be the case if a bond is special. To remove confusion, it is better to compare each bond's IRR with its specific term repo rate, and identify the bond that has the biggest difference between its IRR and its specific repo. This bond is the CTD bond.

Uncertainty about specific repo rates can become a motivation behind a basis trade, as it also presents profit opportunities. For example, if an arbitrageur has decided that a short future/long bond basis trade is worthwhile, and their repo

desk suggests that this bond may *shortly* become special, overall profitability can be significantly enhanced when the bond is then used as collateral in a repo. Of course, the financing of the long position must be secured first, in a term repo, before it subsequently goes special.

Nonetheless the issue of financing remains a source of uncertainty in a basis trade and therefore a source of risk. The specific issues are:

- **if long the basis**: for a bond that is currently special, as the bond ceases being special and starts to trade close to GC again, as its specific repo rate rises its net basis will decline;
- **if short the basis**: for a bond that is currently trading close to GC in repo, the risk is that if it starts to trade special, the specific repo rate (reverse repo rate) will fall and therefore the bond's basis will rise.

In either case, this results in a mark-to-market loss. Good market intelligence for the bond forming part of a basis trade, obtained from the repo desk, is essential in the trade.

Trade opportunities can arise based on a bond's status in the repo market. As an example consider where a bond is trading special in the repo market for term trades but is still available close to GC in the *short dates*, say overnight to three days. In this case the bond's net basis will be a function of the term repo rate, which is special. An arbitrageur can sell the basis, but realise a funding gain by financing the trade in the overnight repo market.[4]

3.2.2 Short bond position squeeze

A market participant running a short position in a bond is always at risk if that bond becomes illiquid and thus unavailable for borrowing either in stock loan or in repo. A basis trader selling the basis is exposed to the same risk. We discussed the issues when a bond goes special in the previous section. The extent of funding loss when the (reverse) repo rate for a bond in which a trader is running a short goes special can be very large indeed; there is no limit to the extent of ''specialness'' and the repo rate can even go negative. If the bond becomes unavailable for borrowing and so cannot be delivered, it may be difficult to cover and also to buy the bond back and flatten out the position.

In some cases the overall market short in a particular bond issue may exceed the amount of the issue available to trade. This is known as a *short squeeze*. If the CTD bond has a small issue size, it can suffer from a squeeze precisely because arbitrageurs are putting on basis trades in the bond.

---

[4] It is rare that a bond that is special to any significant degree would still be available at GC on an overnight basis. The trade sounds good in theory though, although the risk remains that, in financing the trade on an overnight basis, if it then turns special in overnight the trade will suffer. (And so will the trader . . .)

To reduce risk of loss from short squeezes, before entering into the trade the arbitrage desk must ensure that:

- the issue size is sufficiently large;
- the stock is available for borrowing in repo and/or the securities-lending market, and is sufficiently liquid such that it should not be a problem to buy back the bond (if a short basis trade);
- both the overnight and the term repo rates are not special, that is, no more than 30–35 basis points below the GC rate. If there are special considerations involved, a specific repo rate that is, say, 50 basis points below the GC does not preclude the trade being undertaken; however, the danger with this is that it is an indication that the stock may trade much more special later.

Once the trade is put on, part of its ongoing monitoring will involve checking that the bond is not about to be squeezed. Indications of this might include:

- a falling specific repo rate, entering into special territory;
- large-size short sales of the bond elsewhere in the market. It is difficult to be aware of this until too late afterwards – a good relationship with one's inter-dealer broker might help here;
- a tightening of the bond's yield against the yield curve, that is, the bond beginning to trade expensive to the curve in the cash market. This is one indication that the bond may be going special in repo.

As part of normal discipline in a relative value trade, there should also be a stop-loss limit, beyond which the trade is unwound.[5] A common approach is to place this limit at half the expected profit on the trade.

3.3 Basis trading mechanics

Basis trading or cash-and-carry trading is putting on a combined simultaneous position in a deliverable bond and the bond futures contract. Buying the basis or going long the basis is buying the cash bond and selling the future, while selling the basis is selling the cash bond and buying the future. The trade need not be in the CTD bond, but in any bond that is in the futures delivery basket.

In this section, which is the furthest away from the general area of ''repo markets'', we consider some issues in actually trading the basis. It is still of concern to repo market participants though, because the repo desk is always closely involved with basis trading, not least as a source of market intelligence on particular bonds.

---

[5] For an introduction to relative value and yield curve bond trading, see Chapter 13 in the author's book *Bond Market Securities* (FT Prentice Hall, 2001).

3.3.1 Using the conversion factor

A basis trade is the only type of trade that uses the specific bond's conversion factor to calculate the amount of futures contracts to put on against the cash position. This is sometimes known as the ''hedge ratio'', but this term is not recommended as a hedge ratio in any other type of trade is not carried out using conversion factors.

To calculate how many contracts to use in a basis trade, we use (3.1)

$$Number = \frac{M_{bond}}{M_{fut}} \times CF_{bond} \tag{3.1}$$

where

M_{bond} is the nominal amount of the cash bond;
M_{fut} is the notional size of one futures contract;
CF_{bond} is the bond's conversion factor.

So for the December 2001 long gilt a basis trade in £100 million of the $6\frac{1}{4}\%$ 2010 gilt, which has a conversion factor of 0.950587, would require

$$(100,000,000/100,000) \times 0.950587$$

or 951 contracts. The number of contracts is rounded to the nearest integer although traders round up or down depending on their views on market direction.

Conversion factor ratios are used because they determine the bond's basis itself. This means that a trade calculated using a conversion factor ratio should track the basis. In some cases a trade will be constructed using a duration-based hedge ratio, particularly when trading in a bond that is not the current CTD.[6]

[6] It is important to remember that the *only* time when the conversion factor is used to structure a trade is in a basis trade. Hedge ratios for a position of two bonds or bonds and futures should be constructed using modified duration values. The author has come across suggestions that if a hedge is put on using one cash bond against another, and both bonds are deliverable bonds, then the ratio of both bonds' conversion factors can be used to calculate the relative volatility and the amount of the hedging bond required. This is not correct practice. A conversion factor is a function primarily of the bond's coupon, whereas price volatility is influenced more by a bond's term to maturity. They are not therefore substitutes for one another, and hedge ratios should always be calculated using modified duration. To illustrate, consider a bond position that is being hedged using the CTD bond, and assume that the bond to be hedged is a shorter-dated high-coupon bond, while the CTD bond is a long-dated low-coupon bond. A ratio of their modified durations would be less than one, but the ratio of their conversion factors would be higher than one. This produces two different hedge values for the CTD bond, and the one using conversion factors would not be an accurate reflection of the two bonds' relative price volatility. It is important to remember that conversion factors should not be used to measure bond price volatilities when constructing hedge positions.

3.3.2 Trading profit and loss

The size of the net basis for a bond gives an indication of the expected profit from a basis trade in that bond. Constructing the trade using the conversion factor ratio should ensure that the trade produces a profit (or loss) related to a change in the basis during the trade's term. Such a profit (loss) will occur as a result of changes in the cash bond price that are not matched by movement in the futures price; so for example a long basis trade will generate profit if the bond price increases by an amount greater than the converted bond price (futures price multiplied by conversion factor). It also gains if there is a fall in the cash price that is less than the fall in the converted bond price. A short basis trade gains in the opposite case: a rise in cash price less than the converted price or a fall in cash price that is greater than the fall in the converted price.

The other key source of profit or loss is the funding, and this sometimes outweighs the consideration arising from movement in market prices. The long basis trade has a net carry cost, comprised of coupon income minus repo interest, and this is usually positive. The short basis trade has a net carry cost comprised of repo interest minus coupon payments, and this is usually negative. This is sometimes reversed in an inverted yield curve environment. What this means is that the passage of time impacts long and short basis trades in different ways. The long basis will, in most cases, be earning net carry. This will result in profit even if there is no movement in the basis itself, or it may offset losses arising from the latter. The short basis trade will usually be incurring a financing loss, and the movement in the basis must not only be in the right direction but sufficient to offset the ongoing funding loss.

3.4 Timing the basis trade using the implied repo rate

3.4.1 The implied repo rate (again)

From the previous section we are aware how trades can be put on that generate profit from movements in the bond basis and possibly also from funding the trade in repo. The key to successful trading is often correct timing, and in this case the correct time to buy or sell the basis. The decision to enter into the trade is based on an analysis of current conditions and historical spreads, together with a combination of past experience, current market view and risk/reward taste of the individual trader. In this section we consider how observing the implied repo rate pattern can assist with market entry timing.

We know that three different values measure the relationship between the current (spot) price of the cash bond and its (implied) price for forward delivery given by the current futures price. These are the gross basis, the gross basis adjusted for net carry or net basis, and the implied repo rate. We also suggested that the net basis was perhaps the preferred measure used in the market to identify the value of the short future's delivery option, and hence also the CTD

bond. Figure 3.6 illustrates the three measures for the 9% Treasury 2008, the CTD bond for the long gilt contract from March 1998 through to December 1999. The gross basis and the net basis follow a rough convergence towards zero, while the IRR does not follow such a convergence. The pattern of the IRR also exhibits a certain degree of volatility, apparently uncorrelated to the time to delivery of each contract. The volatility of the IRR has been compared to the implied volatility of an option contract.[7] Plotting the basis against the IRR of the CTD will also show a relationship between the two; generally, a fall in the IRR occurs simultaneously with a rise in the basis, with peaks and troughs for the one being balanced by the opposite for the other. Further, a peak in the IRR indicates a basis value that is relatively low, while a trough in the IRR suggests a relatively high basis. We say ''relative'' because the basis is usually measured across several contracts, and a ''low'' basis in March can be ''high'' by June. However, the general relationship holds true.

Therefore the IRR is a most useful measure for the basis trader because it provides an indication of a bond's basis but unrelated to the convergence over time. It also provides ''real'' values, not relative ones, as a high IRR is high at any stage of the cycle. Similarly, a ''low'' IRR can be viewed as a true low value, irrespective of the time of the year that it is observed, or whether we are approaching a delivery period or not. When we speak of high or low values for the IRR, we mean high or low against the actual market repo rate. Figure 3.7 shows the

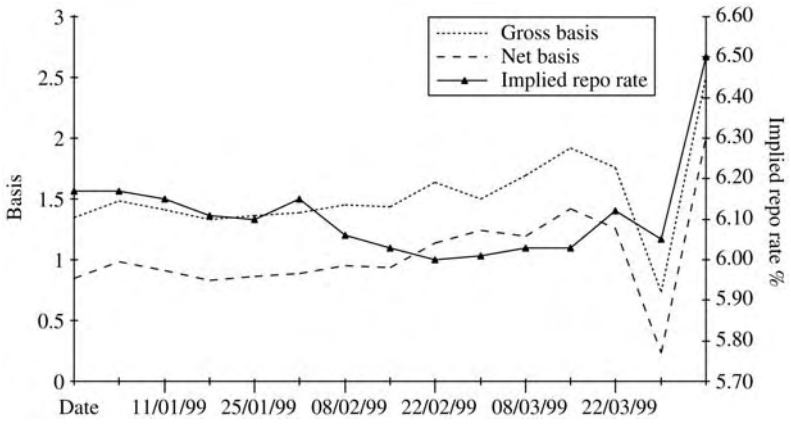


Figure 3.6: Gross basis, net basis and implied repo rate for cheapest-to-deliver bond (9% Treasury 2008), towards contract delivery.
Source: Bloomberg

[7] See for instance Plona (*Ibid*), page 290ff.

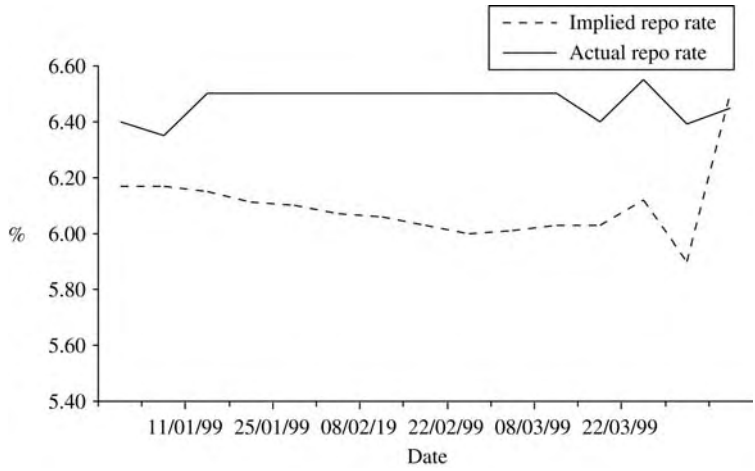


Figure 3.7: The CTD bond implied repo rate and specific market repo rate. Source: Bloomberg

IRR for the 9% 2008 bond shown in Figure 3.6, this time plotted against the specific overnight repo rate (mid-rate) for that bond.

Using the actual repo rate as a benchmark for comparison, we can check when the IRR is indeed at high levels and use this to plan a trade. From visual observation of Figure 3.7 we note that the IRR is almost, but not quite, always within a range that is 80–90% of the overnight repo rate. It only rarely outside this range, whether approaching the overnight rate or below the bottom part of the range. (Of course, we would be more scientific if undertaking actual analysis preparatory to a trade, and calculate the actual range of the IRR from recorded values rather than just look at the graph!). Bearing in mind that a high implied repo rate indicates a low gross basis, identifying a high IRR would suggest that the basis has fallen to a lower level than would be ''normal'' at this stage of the convergence cycle. In other words, this is a possible point to buy the basis. If the analysis is proved correct, the basis will rise over the following days and the trade will produce profit.

3.4.2 The implied repo rate across futures contracts: Bloomberg illustration

The implied repo rate for the CTD can be used in association with the actual repo rates across three contracts on Bloomberg page CBSD. This is illustrated at Figure 3.8, which calculates the swap yield spread at which the long future delivered bond is swapped into a bond that is the *new* CTD and delivered into a short future. Thus

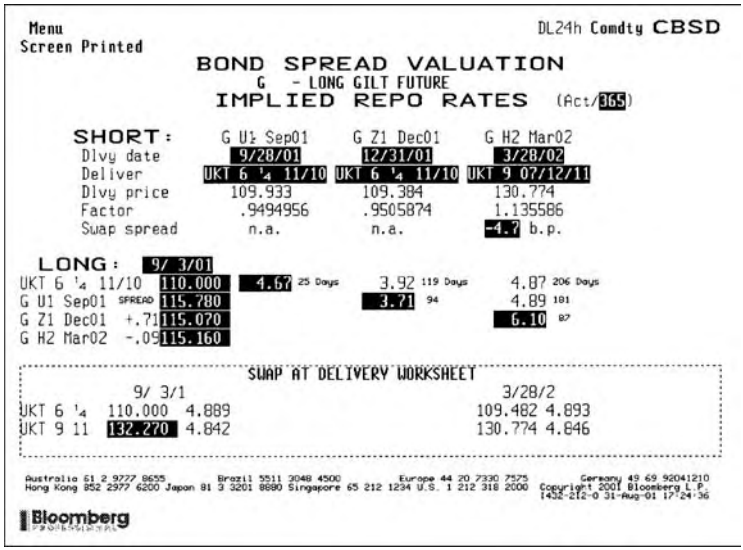


Figure 3.8: Bond spread valuation and implied repo rate, Sep01–Mar02 long gilt future, 24 August 2001. ©Bloomberg L.P. Reproduced with permission

this analysis can be carried out whenever the CTD for one contract is not the same as that for the next contract. The swap spread is user-defined but starts off as the current yield spread between the two bonds. We see from Figure 3.8 that the ''Deliver'' bond is the CTD for each contract; the converted price is given as ''Dlvy price''.

The contracts listed under ''LONG'' are the long positions in the implied repo analysis, while the actual market repo rates are indicated alongside as user-specified rates. These represent the basis trade return (or cash-and-carry return) for the number of days to contract expiry. In other words, the return generated from buying the basis, that is shorting the future, buying the CTD bond, holding this bond for the number of days shown and then delivering this bond into the short futures contract on the delivery date.

The implied repo rate indicates the relative richness of cheapness of the bond to the future, but using page CBSD we identify whether the near-dated futures contract is cheap relative to the far-dated contract. This is indicated when the IRR is relatively low or high, with the former suggesting that the near contract is expensive compared to the far contract. Here then we are using the IRR as part of a futures spread strategy. In such a trade, we sell the far-dated contract and simultaneously purchase the near-dated contract. On expiration of the front month contract, the long will be delivered into, with this bond being held and

funded in repo until the second contract expiry. We calculate the funding rate that would allow us to run the position at positive carry using the page as shown in Figure 3.8, from market repo rates.