

our investor, by taking alternative 2 rather than alternative 1 would earn an extra 4.5 90-day bp, each worth \$25 per \$1 million.

However, the BA-bill spread is not written in stone. Another scenario could occur: either a financial or other kind of event occurs that drives up demand for liquid instruments, especially bills; that in turn drives the 3-month bill rate down to 4.165 but has no impact on the 3-month BA rate. Under this second scenario, our investor must, at the end of three months, buy back at 4.165 the 3-month bill futures he earlier sold at 4.24; doing so gives him a loss on his position in bill futures of 7.5 90-day bp:

$$4.165 - 4.24 = -0.075 = -7.5 \text{ bp}$$

At the same time, our investor sells his 6-month BAs, after holding them for three months, at the unchanged 3-month BA rate of 4.625. By being in 6-month BAs rather than in 3-month BAs, our investor has picked up 5 90-day bp,

$$4.675 - 4.625 = 0.05 = 5 \text{ bp}$$

but he's lost 7.5 90-day bp on his position in bill futures. Thus, net, by choosing a cross hedge over a straight investment in 3-month BAs, our investor has lost 2.5-day bp, or \$62.5 per \$1 million of BAs bought. In this example, our investor took on *basis risk* and put himself in the position where a widening of the BA-bill basis in the 3-month area would lower his net return. That is precisely what happened.

It might be argued that no investor is going to get involved in the above trade in the hope of picking up a mere five 90-day bp or that our investor would have done better to hedge using Eurodollar futures. Both points may be well taken. However, our purpose was simply to illustrate the nature of basis risk in a cross hedge, and our example—regardless of its realism—does that.

Also, one can imagine circumstances in which the above trade would be more attractive to an investor. The yield curve in the 3- to 6-month area is *steeper*; so our investor gets a bigger yield pickup by extending from a 3- to a 6-month maturity. In addition, our investor might reason, "The dollar is strengthening, so *the spread of BAs to bills should narrow*, which will add to my profit on the trade." That's speculating on the basis with the hope of profiting from a favorable change in the basis.

A Cash-and-Carry Trade with No Basis Risk

So far we have considered examples in which an investor with cash to invest uses bill futures as a tool to hedge absolute rate risk. There are also

various arbitrages that dealers and spec accounts can put on using bill futures that require the arbitrageur to put up little or no cash; basically, such trades, depending on their complexity, constitute a bet on one or more rate spreads.

A trade that is done in bill futures in huge volume when rates are right and that tends to link rates on cash and futures bills is one that has been dubbed the *cash-and-carry trade*. This trade could be done by many investors, but it is most commonly done by professional speculators and large dealers, who watch the relationship among cash, futures, and term repo rates and put on this trade in size whenever that relationship makes the trade profitable.

For a leveraged investor, an attractive tactic is to buy a cash bill, finance it with term repo, and cover the rate risk on the resulting tail by selling that tail in the futures market.⁴ Whether doing so will be profitable depends on the relationship among the term repo rate, the rate on the long cash bill, and the futures rate. There must be some term repo rate at which a dealer who does the above transaction will just break even; this break-even *rate* has been dubbed the *implied repo rate*. Whenever the prevailing repo rate is less than the implied repo rate, putting on a cash-and-carry trade yields a profit.

In the flat yield curve environment that prevailed in early 2006, the cash-and-carry trade was unprofitable, so to illustrate it, we use rates that prevailed in an earlier period when the interest-rate environment was much different and when liquidity in T-bills was at its peak. The example is important because it introduces a widely used concept, the implied repo rate, which we encounter again in Chapter 16.

On October 28, 1982, the March 24, 1983 bill, which was the deliverable bill for the December 1982 bill futures contract, was trading at 8.26. On the same day, the December bill contract, which expired 56 days hence, was trading at 8.28.

The repo rate is an add-on, 360-day rate. Thus, to calculate the implied repo rate on a cash-and-carry trade based on the above cash and futures rates, one must calculate the holding period yield (HPY) on a 360-day basis that an investor could have earned if he had bought the March 24, 1983 bill at 8.26 and simultaneously sold that bill at 8.28 for delivery 56 days hence in the futures market.

That calculation, worked out in Table 15.4, shows that holding period yield—the implied or break-even repo rate—was 8.51.

⁴ The concept of tails and how they are created is discussed in Chapter 10.

TABLE 15.4

Calculating the implied repo rate which equals the holding period yield earned on a 360-day basis on the bill

Step 1: On October 28, 1982, purchase \$1 million of the March 24, 1983 bill at 8.26.

$$\begin{aligned} \text{Purchase price} &= (\$1,000,000)(0.0826) \left(\frac{147}{360} \right) \\ &= \$966,271.67 \end{aligned}$$

Step 2: On March 28, 1982, simultaneously sell the December 1982 bill futures contract at 91.72, which corresponds to a yield of 8.28.

$$\begin{aligned} \text{Sale price} &= (\$1,000,000)(0.0828) \left(\frac{91}{360} \right) \\ &= \$979,070.00 \end{aligned}$$

Step 3: Calculate holding period yield (HPY), which equals the *implied repo rate*.

$$\begin{aligned} \text{HPY} = \text{implied repo rate} &= \left(\frac{\text{Sale price} - \text{Purchase price}}{\text{Purchase price}} \right) \left(\frac{\text{Annualization}}{\text{factor}} \right) \\ &= \left(\frac{\$979,070.00 - \$966,271.67}{\$966,271.67} \right) \left(\frac{360}{56} \right) \\ &= 0.0851 = 8.51\% \end{aligned}$$

Had the actual term repo rate for a 56-day repo been 8.25 on October 28, 1982, then by buying the March 24, 1983 bill, financing it for 56 days at 8.25, and selling the resulting tail in the futures market at 8.28, a trader could have picked up \$3,908.03 per \$10 million of the trade he put on (Table 15.5).

Comparing the 8.25 term repo rate with the 8.51 implied repo rate suggests that this trade offers a locked-in profit of 26 bp on the amount invested for 56 days. In fact there are a few slips twixt the cup and the lip: a few things that might or will happen to alter the spread earned on the trade. First, a small commission must be paid on the futures trade.

Second, if bill rates rise sharply over the holding period, variation margin in the form of investable dollars will be paid into the trader's margin account, which—assuming he invests these dollars—will raise his return on the trade. Our trader's 26-bp profit spread would conversely be threatened by a rally in bills, which would result in margin calls that he would have to meet in cash. How much of a threat do potential margin

TABLE 15.5

Calculating the profit on a \$10 million cash-and-carry trade if rates were those shown in Table 15.4 and the term repo rate were 8.25

A: Formula:

$$\text{Profit} = (\text{HPY} - \text{term repo rate}) (\text{Amount invested}) (\text{Fraction of year invested})$$

B: Profit calculation:

$$\begin{aligned} \text{Profit} &= (0.0851 - 0.0825)(\$9,662,716.70) \left(\frac{56}{360} \right) \\ &= \$3,908.03 \end{aligned}$$

calls pose to our trader? Relatively little. Even in the unlikely event that bills rallied by 100 bp on the day the trade settled (October 28, 1982), the extra margin he would have to put up over 56 days would, assuming a 8.25 financing rate, cost him only 2¼ bp of his profit spread.

A third factor that might marginally affect the profit earned by our trader is the price at which the March 24, 1983 bills and the December bill futures contract *converge* at expiration of the futures contract. The bill futures contract is for \$1 million of a 90-day bill on which a basis point is worth \$25. The deliverable bill is in fact a 91-day bill on which a basis point is worth \$25.2777 per million. The trade thus calls for selling bills on which a basis point is worth \$25 and delivering bills on which a basis point is worth \$25.2777. If the convergence price on the trade is below the price level at which the trade is put on (i.e., if rates rise), the trader will have lost some of his profit because he will have lost on his cash position basis points worth \$25.2777 while gaining on his futures position a *like amount* of basis points worth only \$25.

Much can be made of *convergence-price risk*, but in fact if the cash and futures prices converged by 100 bp above the price level at which the trade was put on, the trader would lose only two of his 26 bp profit margin on the trade. Alternatively, if cash and futures converged at a price level well below that at which the trade was put on, the trader would add a couple of basis points to his profit margin on the trade.

A final factor affecting profit on the trade is transaction costs—back-office costs or whatever. Usually, these are so small that no one bothers to incorporate them into return calculations.

To sum up, a trader putting on a cash-and-carry trade does not lock in a certain rate of return. However, on a short trade of the sort illustrated, even a 20% rise in bill prices, which would be unheard of these days, would leave most of his profit intact.

We have been talking about the signal that the relationship between the implied repo rate and the actual term repo rate gives the leveraged trader. The strictly cash investor who is investing money into December also gets a signal from the relationship between these rates. If the implied repo rate *exceeds* the term repo rate, then the cash investor will earn more by investing in the long bill and selling December futures than he would by investing in term repo and probably more than he would by investing in the bill maturing at expiration of the futures contract. If, alternatively, the reverse is true and the leveraged cash-and-carry trade (Tables 15.4 and 15.5) is unprofitable, the short-bill trade offering the cash investor the highest return would probably be to buy the 56-day December bill and mature it.

An Unleveraged Cash-and-Carry Trade

In an example above, we noted that, for a cash investor wanting to invest short term, the structure of rates is at times such that his holding period yield will be greater if he does a cash-futures trade—buys a longer bill, sells the nearby futures contract, and makes delivery—than if he does a strictly cash-market trade: buys the short bill and matures it.

Table 15.5 illustrates such a situation: By doing the cash-futures trade, an investor, faced with this rate matrix, can pick up 95 bp more in yield than he would have if he had operated strictly in the cash market—bought the short bill and matured it.

Note that the 95-bp yield pickup is not carved in stone. All the factors that we said would or might affect the outcome of the trade described in Tables 15.5 and 15.6 come into play in this example too. Futures commissions will reduce the yield pickup slightly. Also, a rally in the bill market will cost the investor a few basis points of his yield pickup both because of margin calls and because of the cost implied by the convergence of cash and futures prices at a higher level. These factors, even if they all work to lower yield pickup, are, however, too small to alter the fact that this is a productive, attractive trade for the alert cash investor.