INTEREST RATE ARBITRAGES

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Implied Repo Rate Arbitrage

Generally, a *repo rate* is the carry return earned on an asset bought at time T_1 and sold at a later time T_2, net of financing.

For example, if we bought a bond on day 0 and sold it on day 1, and we financed the purchase by borrowing at some overnight interest rate, then the difference between the price appreciation (or depreciation) of the bond and the interest we paid on the financing is the return on the "repo" or "cash and carry" trade.

To get an "implied" repo rate, we have to think in terms of buying and selling the asset in the future. Here is how it works:

Suppose we bought September 30-year Bond futures and sold December 30-year Bond futures. In effect, we have contracted into buying (accepting delivery) of a cash bond on the expiration date of the September futures and selling (delivering) this bond on the expiration date of the December futures.

If we lock in the financing of this bond by selling September Treasury Bill futures, then our return on the portfolio consisting of the Bond futures spread and the Bill futures is the implied repo rate.

The repo rate is "implied" because we are not actually buying or selling any cash bond, and we are not actually arranging any financing for the bond. We are merely betting on what will happen if we were to do all of this on a forward basis.

Mean Reversion of the Implied Repo Rate

The implied repo rate $R(t)$ at time t for a Treasury bond or note is:

$$R(t) = \frac{f_2 F_2(t) - f_1 F_1(t)}{f_1 F_1(t)} \left(\frac{365}{T_2 - T_1} \right) + \frac{C}{f_1 F_1(t)} - \frac{(100 - F_E)}{100}$$

where:

F_1 and F_2 are prices of the nearest and next nearest Treasury Bond or Note futures

f_1 and f_2 are conversion factors for the futures prices

T_1 and T_2 are the nearest and next nearest futures expiration times

C is the coupon received in between the expiration times

F_E is the price of the Treasury Bill or Eurodollar futures (formula is exact for Eurodollar futures, but only approximate for Treasury Bill futures)

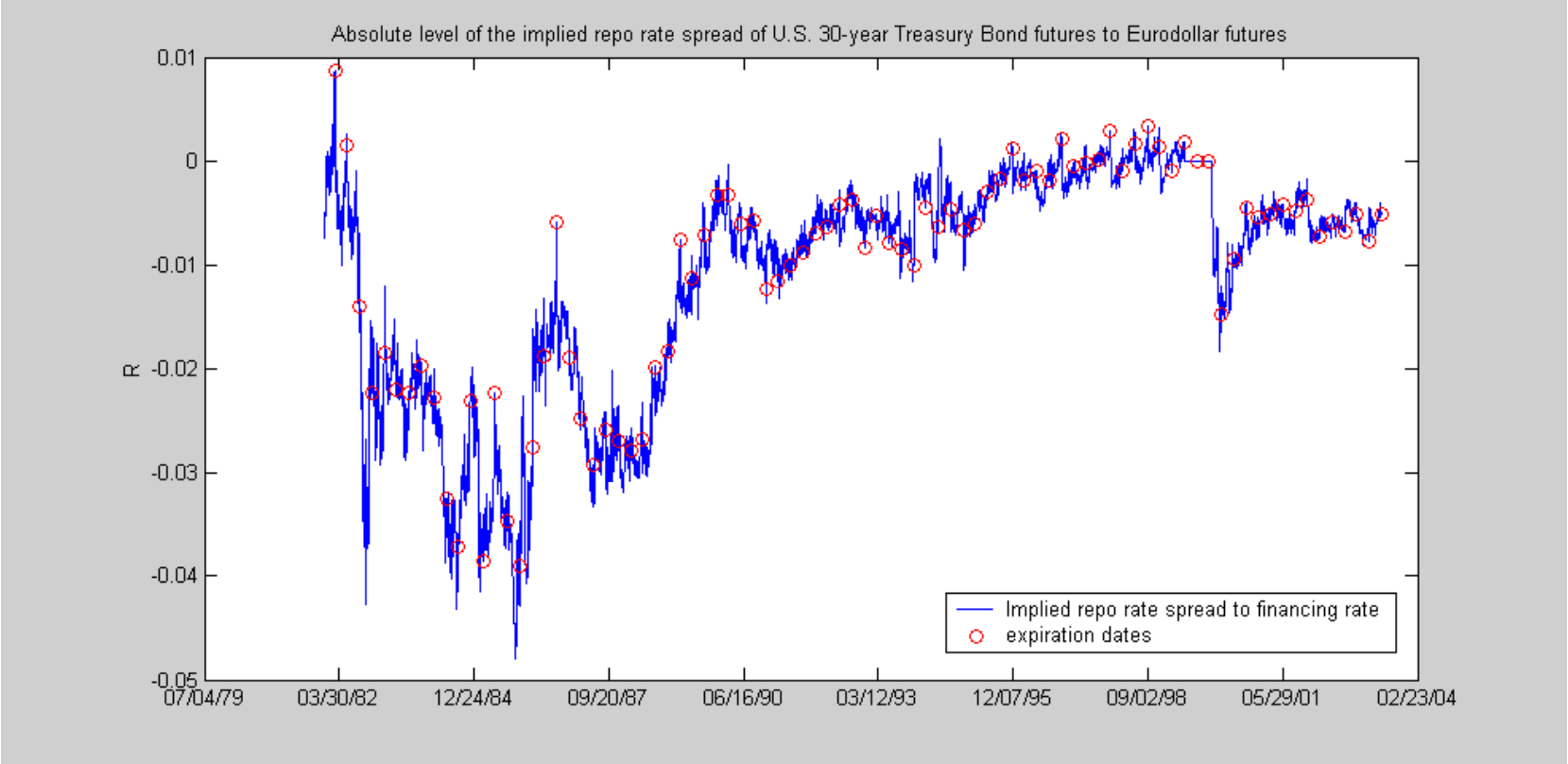
For our purposes, we can use the following approximations: $f_1 = f_2 = 1$, $C = 6$, $T_2 - T_1 = 91$.

Then we have $$R(t) \approx \frac{4(F_2(t) - F_1(t)) + 6}{F_1(t)} - \frac{(100 - F_E)}{100}$$

Strictly speaking, the repo rate is just the carry return on the bond or note. Thus what we call the implied repo rate here should be called the "**implied repo rate spread to financing rate**".

Mean Reversion of the Implied Repo Rate

As one might expect, the implied repo rate spread to financing rate is a highly mean reverting quantity.



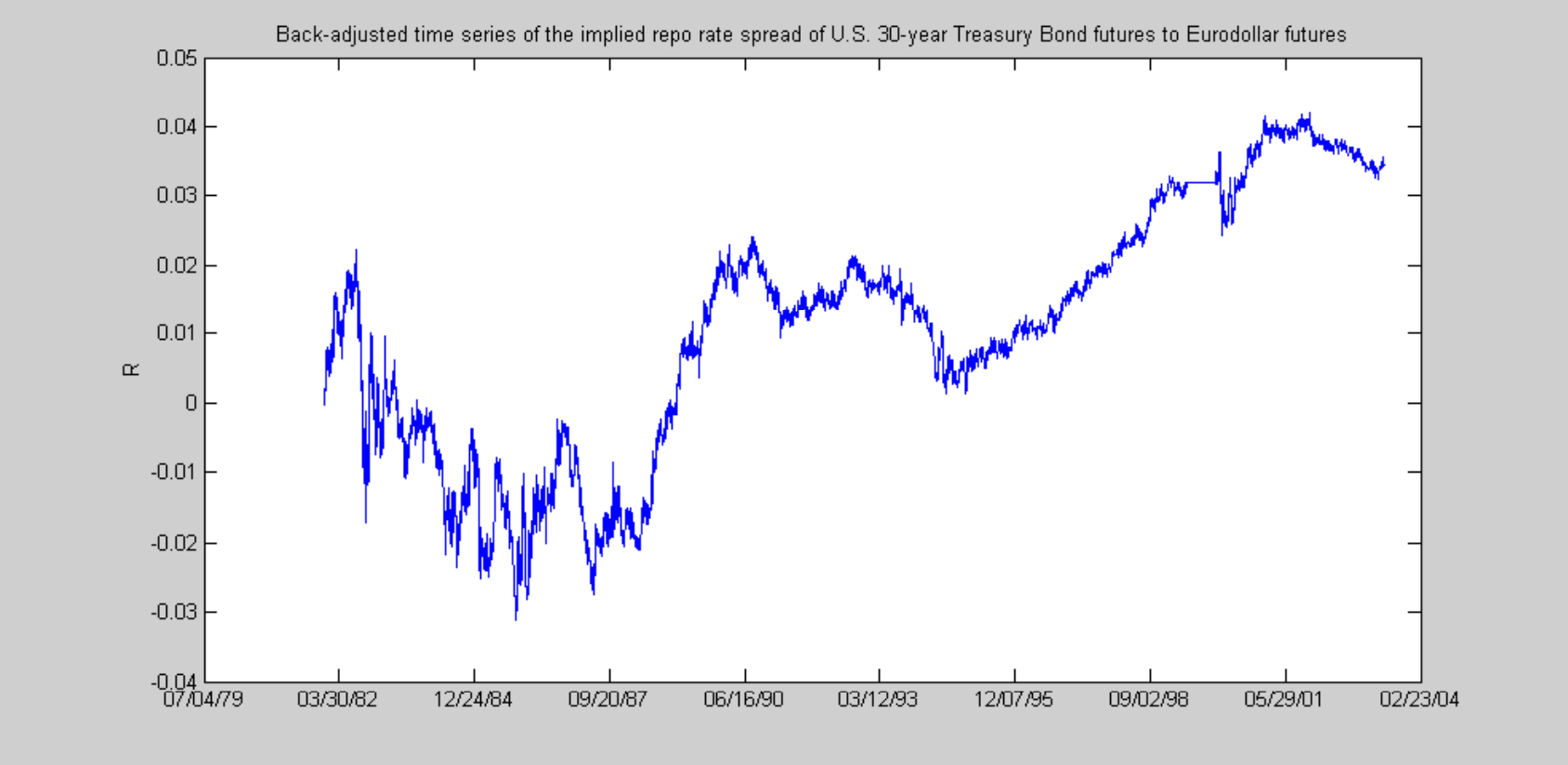
The jumps in the graph occurring at expiration are artificial (i.e. they have no P/L consequence) and are due to the rates being calculated from a new set of futures instruments after each expiration. The two expiration months immediately prior to the change in notional coupon of the U.S. 30-year Bond futures from 8% to 6% in early 2000 was omitted from the graph.

Mean Reversion of the Implied Repo Rate

From the graph, the implied repo rate spread to financing rate moves in a range of only a few tens of basis points and has a very high noise to signal (trend) ratio.

This means almost any simple mean reverting strategy will work on the time series.

If the jumps in the graph are removed, we get a back-adjusted time series that looks like this:



Historical Performance

By requiring the Bond spread and Eurodollar futures combination position to have zero P/L if the implied repo rate spread is unchanged, it can be shown that the appropriate weights are:

Eurodollar futures weight = 1

Nearest Bond futures weight = $\frac{1000}{F_1}\left(\frac{F_2}{F_1}+\frac{2}{F_1}\right)$

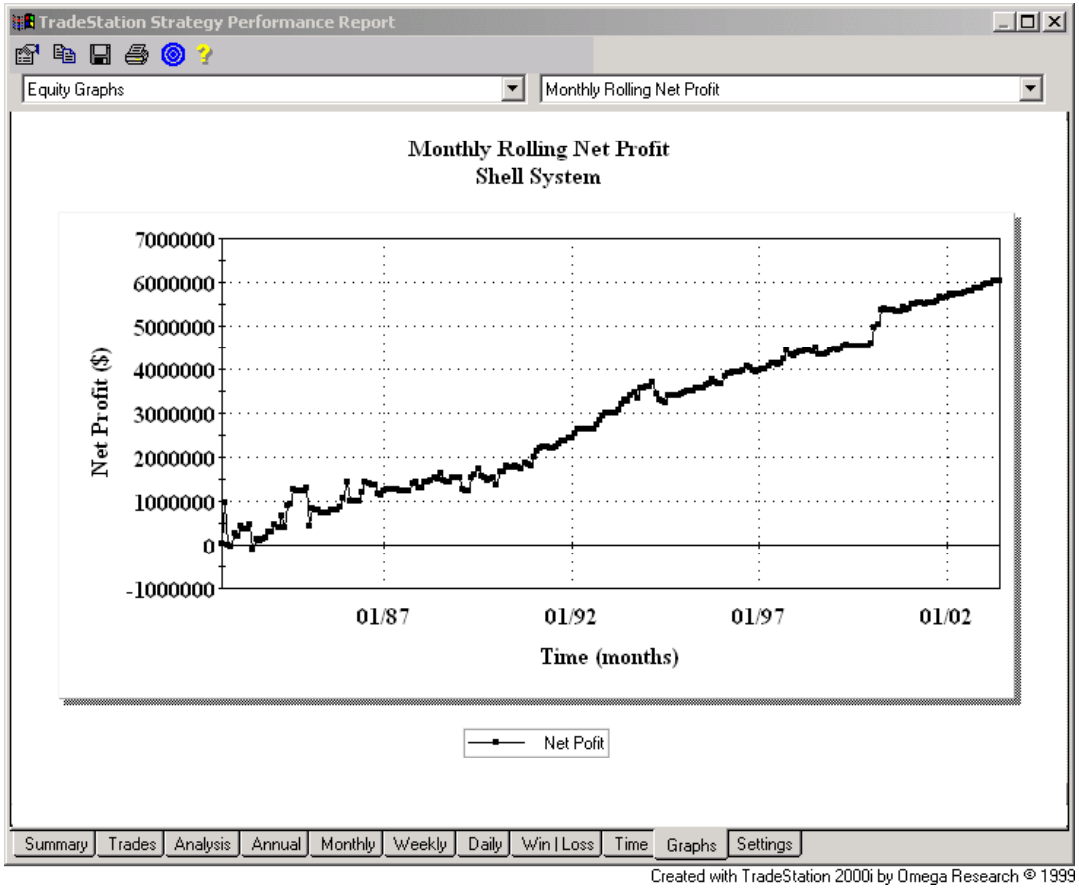
Next nearest Bond futures weight = $\frac{1000}{F_1}$

These weights correspond to approximately 8 Bond spreads for every Eurodollar futures that we put on.

Historical Performance

If we trade 100 Bond spreads against 12 Eurodollar futures, we will have approximately $10 million of face value to which the implied repo rate spread is applied. This means that if the rate spread moves by 10 basis points, we have a P/L of $10,000.

If we apply a simplified version of the mean reversion strategy that is used by my equity program, we get the following historical performance:



Here we assume that we can build the position up to 1000 Bond spreads and that a transaction cost of 1 bond tick ($31.25) is charged each time a bond spread is bought or sold.

The total profit is about $6 million over 22 years or about $270,000 per year, net of transaction costs.

Historical Performance

A performance summary from Tradestation is shown below:

TradeStation Strategy Performance Report

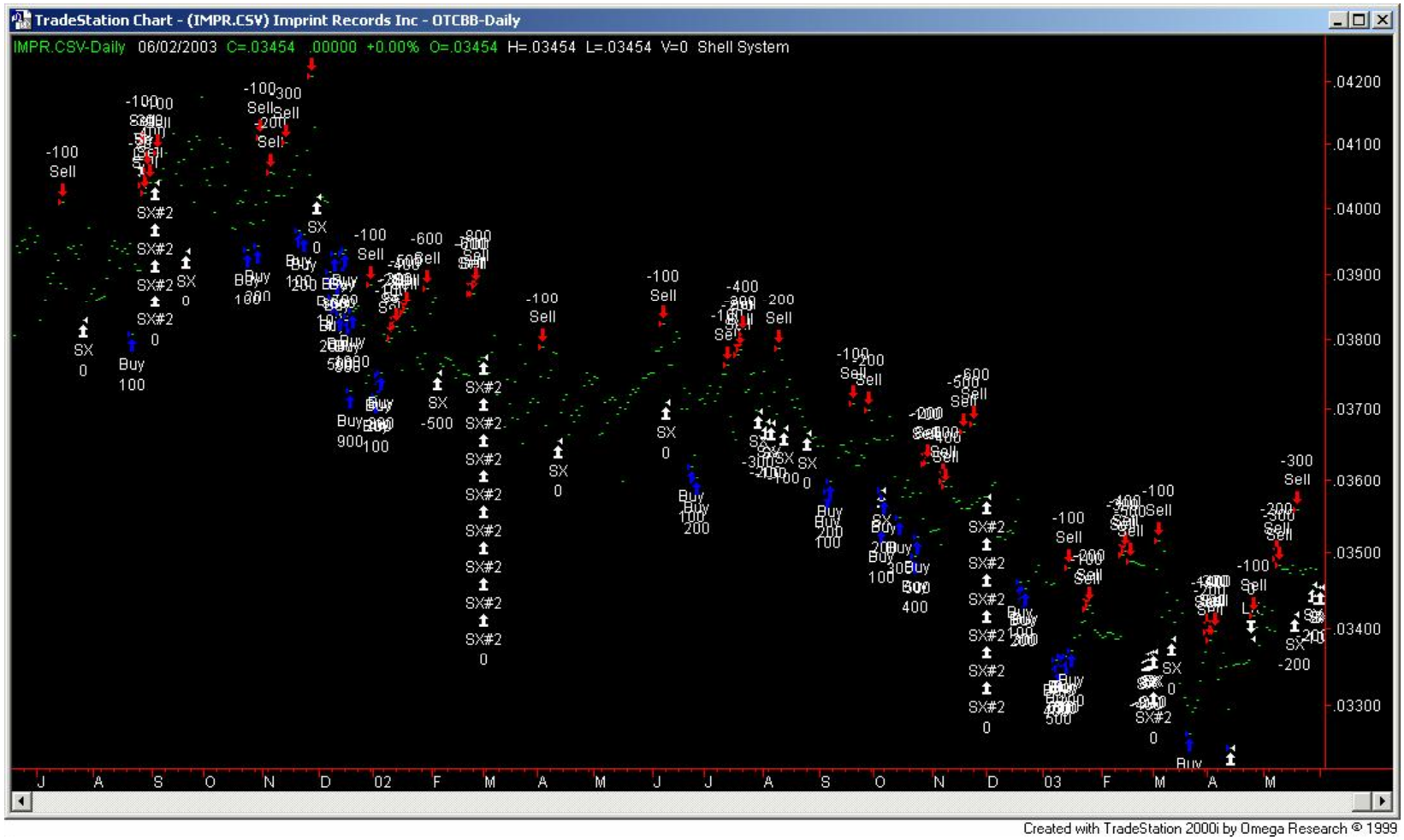
TradeStation Strategy Performance Report - Shell System IMPR.CSV-Daily (12/10/1981-6/2/2003)

Performance Summary: All Trades

Total Net Profit	$6,029,450.00	Open position P/L	$0.00
Gross Profit	$11,768,825.00	Gross Loss	($5,739,375.00)
Total # of trades	950	Percent profitable	66.84%
Number winning trades	635	Number losing trades	315
Largest winning trade	$157,775.00	Largest losing trade	($144,425.00)
Average winning trade	$18,533.58	Average losing trade	($18,220.24)
Ratio avg win/avg loss	1.02	Avg trade (win & loss)	$6,346.79
Max consec. Winners	36	Max consec. losers	20
Avg # bars in winners	11	Avg # bars in losers	15
Max intraday drawdown	($38,654,869,504.00)		
Profit Factor	2.05	Max # contracts held	1,000
Account size required	$38,654,869,504.00	Return on account	0.02%

Historical Performance

A picture of the recent trades is shown below:



Note that each trade corresponds to a Bond spread plus Eurodollar futures combination.

Conclusion

The arbitrage configuration involving the implied repo rate spread can in principle be applied to Euro Bunds versus Euro Libor, Japanese Government Bonds versus Euroyen, as well as U.S. Treasury notes versus Eurodollar futures.

The research I did in the past indicates that the most successful configuration is the one involving U.S. 30-year bonds and Eurodollar futures.

The profit potential in terms of dollars is not very high (unless one is willing to trade tens of thousands of bond spreads). However, the profitability is consistent and the trade is relatively easy to execute.