roll risks on each occasion over the life of the strategy. This may be still be less expensive compared to trading in the cash markets, but it may not. As such, it can be useful to perform PaR and similar analysis to test for the P&L effects of such dynamic strategies.

Caveat: market convention risk neutral/arbitrage free valuation methodologies do not consider any of these "problems", and so pricing/risk calculations based on those methodologies are incomplete c.f. the real world.

In addition, if you are using bond future to hedge positions that otherwise require cash bonds, and perhaps cash corporate bonds, then you will have correlation (i.e. spread) risk due to any or all of:

- Credit mismatch (e.g. corporate vs. government credit spread)
- Term mismatch (e.g. the underlying to a 10-year future may actually be a 9-year bond (and like with a duration near 7), while your target position may have a different effective maturity (or duration) and thus the net position will have rotation risk, see Chapter 15.
- Liquidity mismatch: one or more legs of your strategy may not have "comparable" liquidity. This may lead to "pushing" the market as you rebalance. That is, as you scale into your rebalance, each trade may push the bid/offer spread increasing against you.

11.8.3 Pricing a Bond Future

Bond futures prices are determined from the value of the ex-coupon delivery bond (i.e. the CTD bond without its coupon) and the holding cost. By convention, all deliverable bonds are "related" to the futures contract via a fictitious or "notional" bond (with permanent specification) via a "conversion factor". These valuation formulas are derived using the usually cash-and-carry arbitrage considerations, as shown further below.

The calculation of conversion factor and the selection of the CTD bond are detailed in the next Section. For now, assume simply that they are known.

Then, the bond futures pricing formula is:

$$\begin{aligned}\text{Price}\left[Bfuture\right] &= \frac{CTDAIP + IntCost - Coupon(s)}{Delivery\ factor}\\ &or\\ &= \frac{CTDAIP + AccrualIncome - CouponIncome}{Delivery\ factor}\end{aligned} \tag{11.23}$$

where *CTDAIP* is the "all in price" of the current CTD bond (i.e. including accrued interest).

In the case without coupons in the futures holding period, the formula has the specific form:

$$\text{Price}\left[Bfuture\right] = \frac{P_{AI}\left(1 + \dfrac{rt}{Basis_{repo}}\right) - P_{ParCTD}\, c\, \dfrac{(t+a)}{Basis_{coupon}}}{f_C} \tag{11.24}$$

where,

P_{AI} = the bond's all in price (using the usual bond quotes or formulas)
r = funding cost (e.g. repo rate)
t = days to expiration/delivery
C= the CTD's coupon rate
a = is the time to since last coupon to start of holding period
P_{ParCTD} = face value of CTD bond
f_c = conversion factor
$Basis_{repo}$ = day count convention for repo calculations, e.g. 360
$Basis_{coupon}$ = day count convention for coupon calculations, e.g. 365

For example, suppose that the current CTD bond is an 11¼ % SA US Treasury maturing in May 15, 2015, and that its current price is 140 – 24/32's, with accrued interest of 1 26/32's. Suppose that t is 77 days, while a is 58 days, with a repo rate of 5.5% and a conversion factor of 1.3033, then the futures price is:

Knowing this, one can apply the pricing formula as:

$$\begin{aligned}\text{Price}[T - BondFut] &= \frac{142\ \ 18/32\left(1 + \dfrac{.055 * 77}{365}\right) - 100 * .1125\dfrac{(77+58)}{360}}{1.3033} \\ &= 107 - 13\end{aligned} \tag{11.25}$$

where " – 13" is 13/32's.

Notice that in this formula, the futures price is a linear function of the underlying bond (i.e. the CTD) price. Thus, a change in value of the futures position is linearly related to a change in value of the CTD price. However, the CTD's price is non-linear related to yield via the usual IRR or zero-coupon based (cash) bond formulas. Thus, while there is a linear