5.9.3 Example: Moving Correlation in Structured Products (Quanto's, Convertible Bonds, Hedging, Bond Spreads, Asset Allocation)

One might imagine that the only situation that does not involve correlation in trading and risk management is that of a long dated Buy&Hold position. Even then, it is sometimes the case that a correlation-matched synthetic equivalent (such as a basket or Index) may produce the same risk-adjusted returns, but with better liquidity and lower transactions costs.

Moreover, virtually all hedging strategies are based on correlation relationships.

In this light, rather a lot can be said about correlation in trading and risk management, and indeed much of this Series of books is devoted precisely to those issues. Here, however, correlation is considered in the context of moving moments and that too is only considered in the narrower perspective of statistical characterisation (for the now). This statistical characterisation is presented also to illustrate important aspects of correlation in real world trading and risk management.

As with MSDs, Moving Correlations (MCors) may arise in both investment/risk assessment context, as well as pricing of financial instruments. Here, MCors will be considered from several perspectives, including:

- Bond spread (or equivalently) bond hedging: IR vs. IR
- The perspective of pricing Convertible Bonds (CBs) or asset allocation decisions: Equity vs. IR
- The perspective of pricing Quanto's: Equity vs. FX.
- Foreign denominated bonds: IR vs. FX.

Correlations arise in valuation of financial instruments, structured products, and portfolios. As with MSDs, valuation formulas may be built on various model assumptions that require correlation parameters as inputs. Two categories of issues that arise from this are model consistency, and market business requirements. A historical or MCor may or may not be model consistent, but still be required either by market convention or simply since there may be no other source for that parameter. Additionally, there is the potential for a conflict between implied correlations extracted from, say, liquid traded instruments such as Quantos, and the correlation measured directly from market data.

Implied correlations are readily available with certain heavily traded instruments such as with Quanto's and FRAs/Curve spreads[221]. In other cases, the implied correlation may be reliable either due to liquidity issues, or due pricing formula complexity. For example, Convertible Bonds (CBs) imply a correlation between equities and IR. However, some convertible bonds are too illiquid for reliable correlation estimation (or sometimes for any implied results). Even liquid CBs may be problematic since most traded CBs are relatively complex structures with many market inputs/parameters. This means that trying to "back out" one particular parameter (where several may be "iffy" anyway) can lead to a less than reliable result.

However, even if these implied correlations are "reliable", they may not "mean" the same thing as market data statistical calculations based correlations, since implied results are both model dependant and also reflect supply/demand forces specifically affecting that structure.

Statistically calculated correlations from market histories may have certain trading "properties as well. Figure 5.9 – 7 shows the US 5-year and 10-year swap rates, and the MCor between them. The correlation relationship is highly positive and "relatively" stable, with sporadic "spikes". These spikes are generally very short dated (e.g. 1 or few data points). This is a typical result for almost[222] any two points along a (liquid) yield curve.

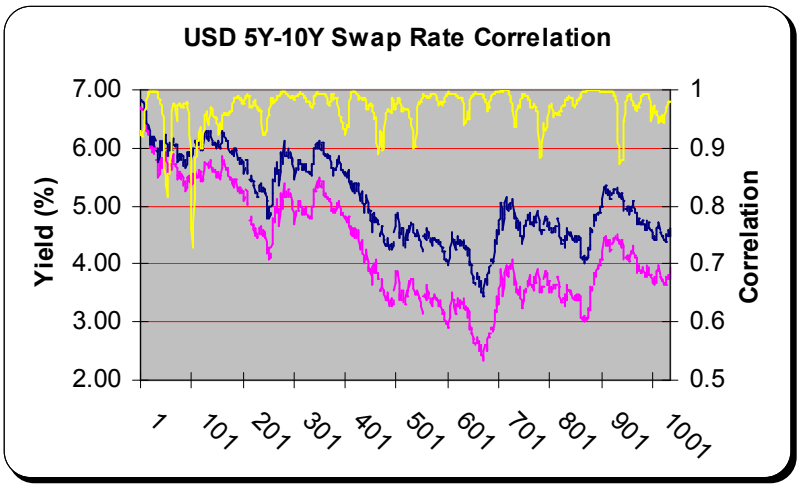

Figure 5.9 – 7. 5-year and 10-year US swap rate histories, and the history of their correlation.

[221] The calculation of the so-called "FRA convexity" (sometimes called "tailing" in North America) involves a correlation. Similarly, various liquid IR curve spread trades can be used to "back out" correlation implied by the spread relationship (see [1] for an introduction and [4] and [4.a] for details).

[222] The correlation increases with decreasing "term" or "time between" two yield maturities. However, keep in mind that market data is less reliable for "illiquid points" along a curve (e.g. 7-month rates are not traded as heavily as 10-year rates etc). Similarly, different "types" of IR instruments (e.g. CDs, Prime, swaps, bonds, etc) are more liquid than other types, and so there can be idiosyncratic effects in the data and the results.

From a trading and risk management perspective one may be able to show (you must do this independently) that the spikes are not material to your trading. That is, they occur occasionally and perhaps they are due to various data or other non-trading issues. If so, then the MCor can be "filtered" and the "de-spiked" MCors would be a very stable and easy to use result.

In other situations, the correlation may exhibit large "spikes" or undergo large oscillation due to fundamental market forces, in which case the "difficult events" cannot be "filtered" from the MCor. Figure 5.9 – 8 show a history of a bond price index and the S&P index, with an MCor history. This type of analysis is typical for asset allocation strategies[223] and to some extent CBs, equity swaps, and related structured products (see [12] for details).

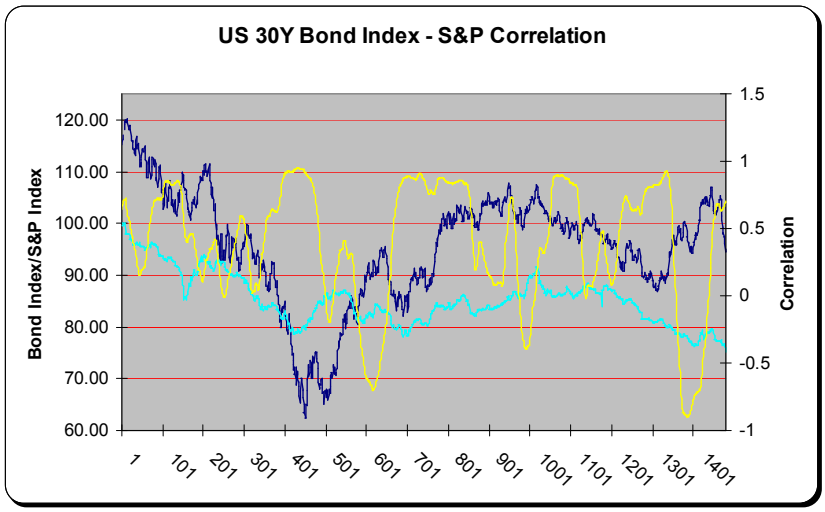

Figure 5.9 – 8. History of the US 30-year Treasury bond index and the S&P Index, and their correlation.

This is a typical result for IR/Equity-like MCors. Notice that the MCor is mostly positive[224] (since when things are going well "everything is moving up" and vice versa). However, there are large oscillations in the MCor. These spikes are materially different from those seen with the 5-10s spread above. They are relatively persistent, and reflect periods when perhaps the "asset allocators" are shifting funds between equities and IR (e.g. if equities are falling, then there is often a "flight to quality" as investors move into IR deposits and bonds). As such, these oscillations may be the points in the MCor history where the most attention is required.

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[223] "Asset allocators" are traders who aim to time or balance their investments between equity-based positions and bond- or IR-based positions in an effort to "optimise" the risk/return profiles between these two asset classes (see [1] for an introduction to and [2] for detailed treatment of "trader styles").

[224] The Bond price index is a special normalised version of bond price. If the data were in terms of bond yield, then the correlation would be "flipped" since there is an inverse relationship between price and yield. Moreover, the relationship between price and yield in non-linear and so there are additional subtle effects. Finally, don't forget that if you are to compare histories on a "returns basis", then that is not exactly the same as a "bond yield-basis" (e.g. daily returns are not the same thing as 10-year IRR etc).

There may be other, possibly subtle, market issues as well. For example, one may find a particular correlation relationship between currencies and interest rates. However, there is also a well-known result in finance called Interest Rate Parity (see [1] for an introductions and [4] and [10] for detailed treatment). IRP shows that FX and IR are dependent in deterministic ways. Therefore, a direct correlation measure of important FX and IR histories may require IRP adjustment to "orthogonalise" (i.e. remove the interdependence) between the two histories (see Section 5.6.4). This is a kind of "de-trending of interdependence" so that the correlation measure shows "just the correlation" and not other effects[225]. One approach for testing for such interdependencies is introduced in Chapter 17 on Principal Component Analysis (PCA). However, this relationship may arise in complex ways due to term structure issues[226].

Figure 5.9 – 9 shows a 30-year bond price index history along with USD/GBP (along right axis) and the MCor between them.

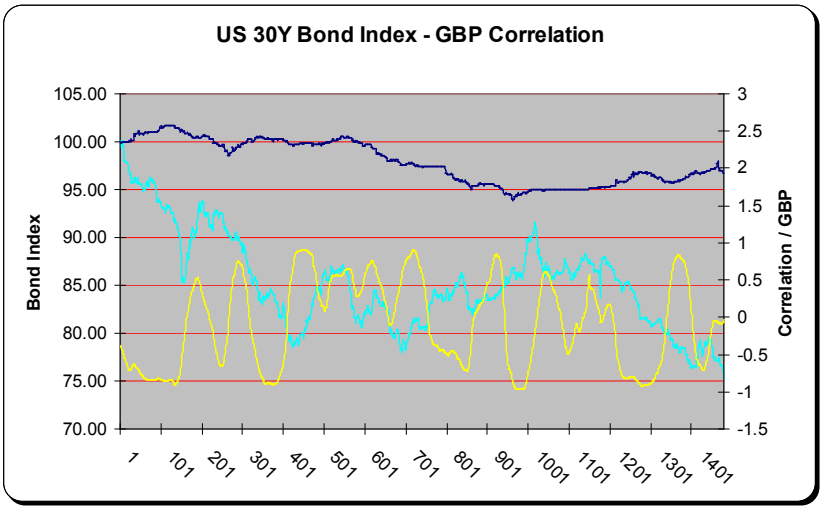

Figure 5.9 – 9. History of the US 30-year Treasury bond index and GBP/USD FX rates, and their correlation.

Here, the MCor averages around zero, and seems to oscillate quite periodically and persistently. This seems to suggest that the 30-year bond price and the FX are independent

[225] This is a particular important and subtle issue in certain risk assessment situations. For example, it is common to report risk based on variability or some fixed size increment of market movement. For example, VaR reporting relies on variances and covariances. A portfolio composed of interrelated products, such as interest rate products in various currencies, and outright currency exposure as well, should be adjusted for these interrelationships. Traditionally, the vast majority of risk and capital reporting systems have ignored many such relationships, resulting in overstatement of variances and covariances (i.e. the statistical measures imply a larger variability risk than actually exists). Methods and treatment of these types of matters is introduced in [1], and detailed throughout the TG2 "trading" books, and [14].

[226] As introduced in [1], and detailed in [4] and [11], IRP is derived with very specific structuring assumptions relating FX and IR points along their respective term-structures.