FreightMetrics

Measuring Risk of FFA Portfolios

Executive Summary

FreightMetrics proposes an integrated modeling approach for quantifying risk of FFA portfolios, which combines two different types of risk measurements. Firstly, a typical Value-at-Risk (VaR) measurement based on the potential variability of Mark-to-Market (MtM) valuation over short periods of time. Secondly, a Cash-Flow-at-Risk (CFaR) measurement driven by the uncertainty of future cash flows arising from the periodic settlement against FFA counterparties. This report lays the basic modeling principles behind FreightMetrics' approach.

Mark-to-Market VaR

The first type of risk measurement represents a typical application of the VaR modeling framework, similar to how VaR is being used by many mainstream financial institutions to quantify the risk of trading portfolios.

The risk metric estimated by VaR is the maximum potential loss in MtM terms for a given level of statistical confidence. The time span used for estimating VaR is determined to be comparable with the time that may be required to liquidate the position under normal market conditions. For reasonably liquid FFA contracts and moderate portfolio sizes this time span can be assumed not to exceed a maximum period of 2-3 days.

The underlying risk factor which drives MtM uncertainty is assumed to be the FFA price itself. The choice of the FFA price as the underlying risk factor (instead of the spot price) is warranted for two main reasons. Firstly, due to the non-storable nature of freight and the consequent lack of an arbitrage mechanism, there is no analytical model to express the dynamics of forward prices as a function of the spot price[1]. Hence, we cannot directly associate the variability in MtM with the spot price dynamics. Secondly, the volatility of FFA prices appears to vary with the time to maturity of the underlying contract. In practice, we usually find that the longer the time to maturity the lower the volatility of the FFA price[2].

[1] Unlike other types of underlying assets, such as equities, currencies or storable commodities, where the forward price is generally given by $F=Se^{b\tau}$ (with *b* denoting the cost of carry).
[2] This pattern of volatility as a function of the time to maturity is quite common in many commodity forward markets.

In other words, there is less uncertainty (over short horizons) about the MtM of a contract which expires further out in the future compared to a contract which is closer to maturity[3].

However, there is one complication with taking on FFA prices as the underlying risk factors. It is not always possible or practical to study the past price history of a given FFA contract in order to estimate the risk parameters that go into the VaR estimation. For instance, a new FFA contract that has just started trading in the market does not have a price history as yet, or the price history may be out-of-date for an old contract that is no longer being quoted in the market (because it has entered its settlement period). Our approach to deal with such problems is to use historical FFA prices to construct long continual time series in the form of "nearbys" or "constant maturity" price series. We then map each FFA contract to the closest nearby or constant maturity series[4] and use its own risk parameters for the purpose of estimating VaR for that contract.

As far as choosing an appropriate stochastic process for the underlying risk factors, our philosophy is to "keep-it-simple". By limiting the time span of the VaR estimation to small horizons of no more than 2-3 days, we can greatly relax our modeling assumptions and opt for a simple process specification such as the Geometric Brownian Motion (GBM). It is quite customary in financial risk modeling to use the GBM process for VaR estimation over small time horizons, even for markets with mean reverting or other special characteristics. Moreover, the drift term of the GBM process is usually assumed to be zero as it is the stochastic term of the model that dominates the behavior of the underlying process over such short periods of time. We adopt zero drift parameters as well.

Our choice of the GBM process is also justified by the lack of relevant research in the area of freight rate modeling to suggest a better process specification. However, given the estimation error that will inevitably be incorporated in our model, we would recommend against using a high confidence level for VaR inference (say more than 95%) and supplementing any VaR estimate with stress testing results.

As far as the practical implementation of the above model is concerned, our approach is to apply a Monte Carlo simulation algorithm which is better suited to handle options (by performing a full revaluation of the option at each simulated path for the underlying FFA price). However, for portfolios which do not contain options and involve only FFAs, the classical variance-covariance analytical technique is also acceptable.

[3] This may sound counter-intuitive at first, but it has to do with the way that new information is filtered through current FFA prices; obviously, the impact of new information on future market expectations fades out as we move further away from the date that this information becomes relevant.
[4] The mapping is performed by matching the duration of a nearby or constant maturity series with the remaining time to maturity of the contract.

Cash-Flow-at-Risk

Typically, the time horizon of shipping portfolios extends to several quarters or even years, and market participants are more concerned with the risks inherent in cash flows than changes in MtM values (especially when the portfolio combines physical positions). For example, a ship operator might be interested in the distribution of quarterly cash flows over the next three years, and how this distribution is affected by FFA transactions.

Moreover, we at FreightMetrics believe that there is a significant danger in relying on VaR alone. Although a “closed” position in a certain contract may result in a “locked-in” profit (or loss) in MTM terms, and hence produce zero VaR, it does not mean that the position is riskless. It can still carry substantial risk in cash flow terms due to the uncertainty surrounding the final settlement of each leg of the total position with each counterparty. The failure by one counterparty to honor its contract when required to perform can pose significant cash flow requirements on the overall portfolio.

For the above reasons we propose a second type of risk metric, the Cash-Flow-at-Risk (CFaR). This metric measures the maximum potential cash flow deficit as a result of future periodic settlements against each counterparty for a given level of statistical confidence. CFaR is measured over much longer time horizons, which will extend over the entire life of a contract up to its final maturity date.

The underlying risk factor which drives future cash settlements, and therefore CFaR, is the spot price. More specifically it is the actual path of the spot price over a certain period, by way of taking the average of the actual spot prices recorded on a specific set of dates during the life of the contract. Due to the “path-dependent” nature of freight derivatives, our approach to measure CFaR is based on a Monte Carlo simulation algorithm which is designed to generate a large number of likely scenarios (random paths or realizations) for the evolution of future spot prices. For each simulated path of future spot prices, we estimate the likely settlement of each contract and thus we construct the entire distribution of future cash flows.

As far as choosing an appropriate stochastic process for generating the above scenarios, we maintain the same philosophy of “keeping-it-simple”. At the same time, the presence of a forward curve provides a critical piece of information which is a “forecast” of the future path of the spot price, as implied from current FFA prices[5].

[5] Due to the non-storable nature of freight, FFA prices are not determined by the usual “no arbitrage” argument and so they are regarded as a pure reflection of future market expectations. Hence the characterization of the forward curve as a “forecast” of future spot prices.

We have hence opted for a process specification which is simple, yet adaptable to the information contained in the forward curve. This process is the GBM with time-dependent drift parameters. The latter feature means that the drift coefficients are “calibrated” to fit the latest FFA prices so that the model is able to capture the current contango or backwardation in the forward market. In other words, the simulation algorithm generates random price paths that are scattered around the current forward curve (i.e. they are consistent with current market expectations).

As in the case of VaR, we would again recommend using a conservative confidence level for CFaR inference (no more than 95%) and supplementing CFaR estimates with stress testing results.

Concluding Remarks

The above discussion served as a non-technical introduction to the FreightMetrics’ approach for measuring risk of FFA portfolios, consisting of two separate types of risk measurement, MtM VaR and CFaR. The two measurements are complementary to each other, producing an integrated framework of risk management (please refer to the table in the following page for a summary of the two models).

However, each type of measurement may have more relevance to specific risk applications. For instance, the MtM VaR might be more useful for determining margin requirements under a short-term margin trading facility or a margin account in an organised exchange. Also, it might serve as a yardstick for evaluating the performance of different FFA traders on a risk-adjusted basis.

On the other hand, the CFaR measurement is better suited for measuring the potential credit exposure against an FFA counterparty over a longer time horizon. In addition, it might be helpful in projecting potential receivables and payables associated with future settlements.

Both measurements are implemented by using Monte Carlo simulation which is able to incorporate cross-correlations amongst risk factors and thus capture potential diversification effects. In addition, it offers the flexibility of "what-if" analysis by examining the effect of potential changes in certain input parameters (e.g. examine what happens to the level of risk if volatility rises or if the forward curve steepens, flattens, or shifts upward or downward).

Summary Table

Model	*Value-at-Risk (VaR)*	*Cash-Flow-at-Risk (CFaR)*
Risk metric	Mark-to-Market valuation	Settlement cash flow
Time horizon	Short (1 day - 1 week)	Long (up to expiration)
Risk factor(s)	Forward rates based on "nearby" or "constant maturity" series generated from historical FFA prices	Spot rate
Stochastic process	GBM with zero drift parameters	GBM with time-dependent drift parameters calibrated to the current forward curve
Methodology	Monte Carlo simulation (Analytic approach is also possible)	Monte Carlo simulation
Input requirements	- Forward rate volatilities - Correlation matrix	- Current forward curve - Spot rate volatility - Correlation matrix
Output	Distribution of future MtM valuations as a result of fluctuations in FFA market prices.	Distribution of future cash flow requirements as a result of periodic settlements with each FFA counterparty.

FreightMetrics is a leading provider of software solutions and advisory services for risk measurement and management in shipping. For more information about us, our products and services, please visit our website www.freightmetrics.com or contact us:

Address: FreightMetrics Ltd.
Dragatsi 2-4, 5th Floor
Piraeus 185 35,
Greece
Tel: (+30) 210 422 4488
Fax: (+30) 210 422 6801
E-mail: info@freightmetrics.com