

## Freight Forward Curves: Techniques and Applications

### Background

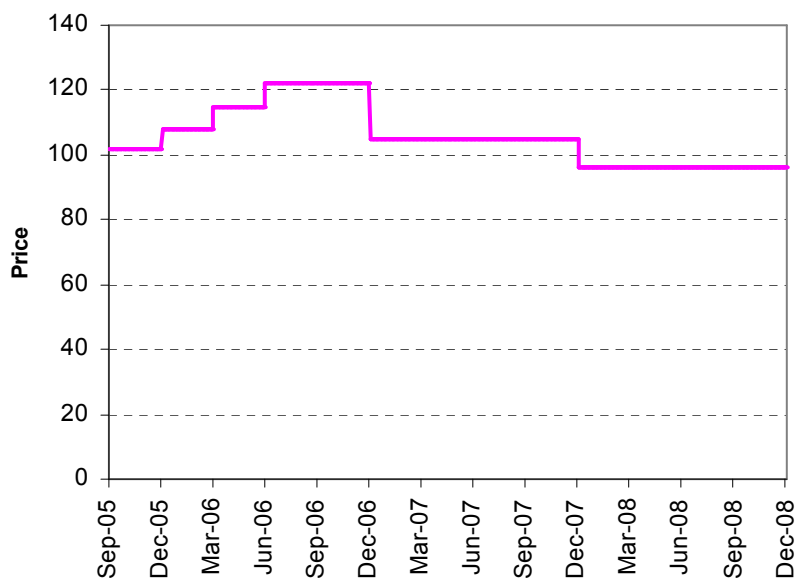
A number of market participants provide reports with daily prices for FFA contracts on a wide variety of underlying indices and forward periods. Usually this information is given in the form of a table, such as the one shown below (Table 1 contains fictitious data which will serve as the basis of our calculations in this paper).

**Table 1: FFA prices**

Spot	100.00
Q4-05	102.00
Q1-06	108.00
Q2-06	115.00
Q3Q4-06	122.00
Cal-07	105.00
Cal-08	96.00

Many people depict the above tabulated data in a graphical form to demonstrate what they refer to as the “forward curve”.

**Chart 1: “Forward curve”**



This is as far as most market participants will ever go analysing the prices from the FFA market. But is the above chart really a depiction of the true forward curve? How do we define a forward curve? What sort of information can we extract from a forward curve? Is it possible to distil more information from the FFA prices as given in the form of Table 1?

## ***Defining forward curves***

Freight is not the only market where it is possible to lock into today for buying or selling a certain quantity of the underlying asset in the future. Many other asset classes have active forward markets, such as energy, currencies, and interest rates, to name a few. So how do they interpret a forward curve in these markets?

Typically, a forward curve is designed to give a picture of the evolution of forward prices through time. In this context, the term “forward price” refers to the price quoted today for a contract with certain specifications to be paid at some future date  $T$ . Depending on the type of the underlying asset, the list of contract specifications may also include the notion of “tenor” or “time-to-maturity” (e.g. 3-month rate, 6-month rate, etc.).

For those underlyings where the notion of tenor does apply, a different type of curve which also encompasses forward price information is the so-called “term structure” of prices. This shows the current spot prices (i.e. forward prices for immediate delivery) for different tenors into the future. In the interest rate world, for instance, the term structure of interest rates is the set of yields to maturity extracted from zero-coupon bonds which is also known as the “yield curve”.

## ***Applying forward curves to freight rates***

So how would the equivalent of a forward curve or a yield curve (term structure) for freight rates look according to the previous definitions?

A freight forward curve for a certain underlying route/index would show the forward rate (or expected spot rate) for each day into the future. We would expect this to be a rather smooth function of time, providing a clear picture as to when exactly the market is expected to be in contango or backwardation in the future.

The term structure of freight rates would show the current freight rates for different maturity periods into the future. In other words, rates which apply from today to a set of different future maturity dates.

So, is the diagram in Chart 1 consistent with any of the above descriptions? Well...not really. What we observe in Chart 1 is a collection of forward prices for FFA contracts of varied maturities (one quarter, two quarters and full calendar years) which are simply sorted in chronological order. We would be much closer to the definition of a forward curve if we would at least depict prices for FFA contracts with the same maturity (e.g. single quarters only).

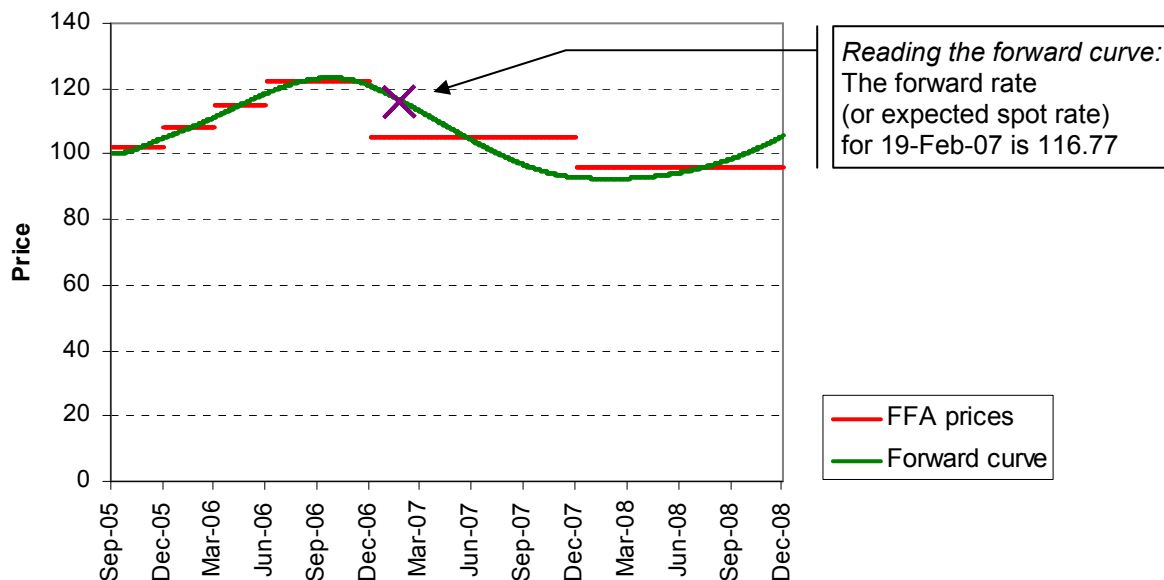
So the question which naturally arises at this point is... “can we generate a full freight forward curve from the information observed in the market (Table 1)?” Without any hesitation, the answer is an emphatic “yes!”. One would be amazed to realise the wealth of information contained in (or implied by) FFA prices and how much more could be shown other than the crude price curve in Chart 1.

## Constructing forward curves for freight rates

Using the *Forward Curve Builder* from the *Fr8Tools™* library of Excel add-ins developed by FreightMetrics, we have constructed the full forward curve and the corresponding term structure of freight rates associated with the FFA prices shown in Table 1.

The technical features of the FreightMetrics methodology for constructing these curves are described in sufficient detail at the Appendix found at the end of this report. Here we will demonstrate how to read the actual curves, while in the next section we discuss several managerial applications which involve the practical use of the information extracted from these curves.

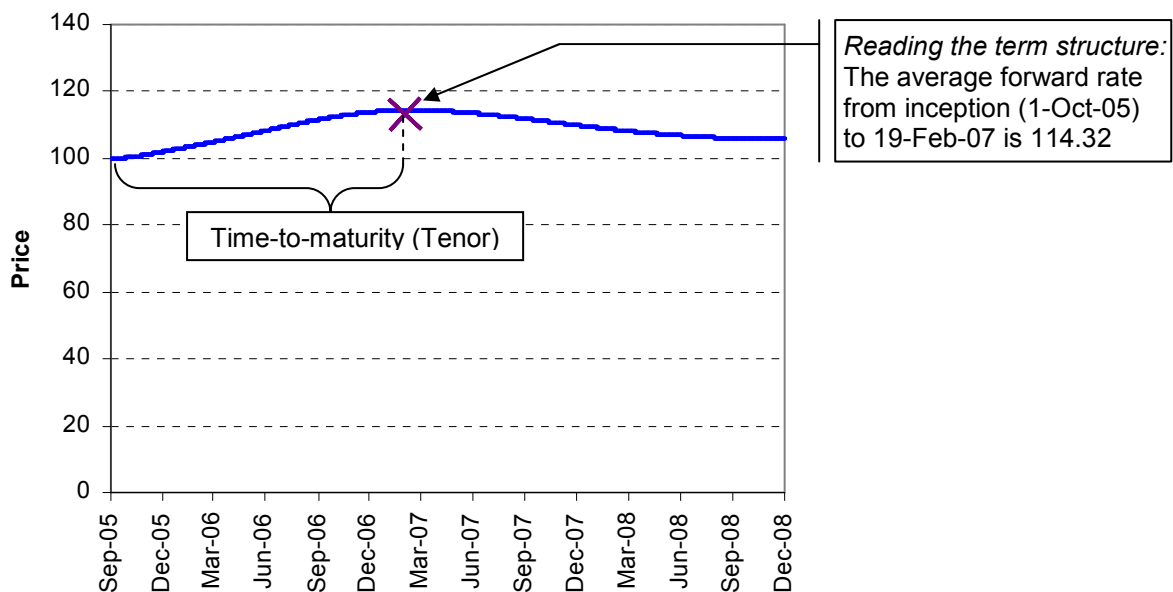
**Chart 2: Forward curve**



The above chart shows the forward curve which is implied by the set of FFA prices in Table 1. Each point on this curve expresses the forward rate (or expected spot rate) for the underlying route/index on that specific date. So different points on the curve represent the expected spot rates for different dates.

The forward curve is constructed in such a way to exactly recover the same market rates being quoted for the underlying FFA contracts. For example, if we averaged all the forward rates from the above forward curve over the whole year of 2007 we would obtain the exact Cal-07 FFA price as quoted in Table 1. This means that the forward curve is not created by arbitrarily “fitting” a line through a given set of FFA prices, but it is so constructed to respect certain logical and financial rules.

**Chart 3: Term structure of freight rates**



The above chart shows the term structure of freight rates which is implied by the set of FFA prices in Table 1. Each point on this curve expresses the applicable forward rate for the period starting from today to the date which corresponds to that particular point. So different points on this curve represent the applicable forward rates for different maturity periods (tenors) into the future.

One would immediately suspect that the term structure and the forward curve are related to each other. Indeed, in order to prevent arbitrage opportunities it must be the case that each point on the term structure of freight rates is equal to the average of the forward rates taken from the corresponding forward curve over the same period (i.e. from inception to the time-to-maturity signified by that point).

### ***Making use of freight forward curves***

Having the information of the full forward curve available we are in a position to exploit the role of FFAs as a price mechanism and make useful inferences about current market beliefs.

- When is the market expected to be in contango (backwardation)?
- When is the forward curve downward (upward) sloping? When is it the steepest?
- When is the market expected to reach its peak (trough) during the next shipping cycle? At what price level?

To the extent that our own subjective beliefs differ from those of the market, represented by the current forward curve, we are able to identify potential trading opportunities.

Furthermore, we can use the forward curve to estimate the “fair value” rate for any future period by averaging the forward rates over the corresponding set of dates. For instance, if a market maker receives a quote request from a client for a customised contract (e.g. a Oct05-Feb06 contract or a 12-month contract starting from Oct05), he is able to use the information from the forward curve to formulate a price which is consistent with current FFA prices quoted for nearby standardised contracts (and then add perhaps a liquidity premium as well).

By the same token, one could use the latest forward curve information to obtain consistent prices for marking-to-market (MTM) an FFA portfolio, as it may not always be possible to obtain a direct price quotation for a given FFA contract from the market. This may occur either because there is no longer liquidity in the market for that contract or because the contract has entered its settlement period. Similarly, it is possible to use forward curve data to decompose current FFA prices into their equivalent implied monthly or quarterly forward rates. This kind of information might be useful for detecting potential arbitrage opportunities or for making optimal chartering decisions.

In addition to the above uses, we can benefit from the full forward curve information to perform more complicated calculations such as pricing an option or measuring risk. For instance, one could use the information extracted from the forward curve to price options on freight more accurately via Monte Carlo simulation. Options on freight belong to the Asian-class of options which means that they are highly path-dependent. By simulating off the full forward curve, we can exploit the information content of current FFA prices with respect to the likely path of future freight rates and hence produce option prices which are consistent with current market beliefs. (For further discussion on this approach, please refer to our article “Option Pricing: Mind the Curve”) An implementation of the above model is included in the *Option Pricing Calculator* of the *Fr8Tools™* library of Excel add-ins developed by FreightMetrics.

Another potential use of the information contained in a forward curve is to measure Cash-Flow-at-Risk (CFaR) via Monte Carlo simulation. This technique is based on generating a large number of potential price scenarios by drawing random future rates around the current forward curve. For each price scenario we estimate the resulting settlement amounts which may arise through time. Thus we construct the full distribution of future cash flows from which we can infer CFaR for a given level of statistical confidence. We believe that CFaR is a valuable tool for revealing future cash flow requirements and potential credit exposure against counterparties. To rely solely on MTM measures, we think it is misleading and potentially dangerous. A “closed” position in a certain contract may result in a “locked-in” profit (or loss) in MTM terms, but it does not mean that it is risk-less. 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 his contract when required to perform can pose significant cash flow requirements on the overall portfolio.

---

© FreightMetrics 2005

All rights reserved. This document is intended for sole use only and may only be printed for personal use. No part of this document may be reproduced, stored in or introduced into any retrieval system, or transmitted, in any form or by any means – electronic, photocopying, recording or otherwise – without the prior written permission of the authors. For permission to reuse this document, please e-mail [k.attikouris@freightmetrics.com](mailto:k.attikouris@freightmetrics.com)

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](http://www.freightmetrics.com) or contact us:

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