Bloomberg Evaluated Pricing Service ("BVAL") Government, Supranational, Agency & Investment Grade Corporate Bonds Methodology

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1. Introduction

1.1 Bloomberg Evaluated Pricing Service ("BVAL") Overview

BVAL for fixed income securities is an independent information source that draws on market data contributed from thousands of market participants[1]. BVAL utilizes this broad global data set of market observations together with market-leading analytics to produce objective third-party valuations. BVAL also provides transparency on how each valuation was produced, providing insight into data methods and algorithmic methodologies used.

This document should be read in conjunction with the BVAL Thematic Methodology, which provides an overview of key aspects over the price methodologies used by BVAL that is thematic to all prices published by BVAL. Capitalized terms not otherwise defined in this document are contained in the BVAL Thematic Methodology.

1.2 Description of the Products

This BVAL methodology document covers Government, Supranational, Agency and Investment-grade Corporate Bonds for bullet and callable, as well as fixed and floating-rate structures.

Government Bonds are issued by a government to support public spending. The bonds typically include a commitment to pay periodic interest (coupon payments) and to repay the face value on the maturity date. This does not include U.S. Municipal bonds.

Supranational Bonds are issued by international organizations that are typically formed by two or more countries to promote growth within the economic areas.

Agency Bonds are issued by a government-sponsored enterprise or by a federal government department other than the U.S. Treasury.

Corporate Bonds are issued by companies in order to raise capital.

1.3 Price Snapshot Availability (Local Times)

Location	Price Snapshot Time	Tier 1 Delivery Time*	Tier 2 Delivery Time*
Tokyo	3:00 pm	3:45 pm	5:30 pm
	4:00 pm	4:45 pm	6:30 pm
	5:00 pm	5:45 pm	7:30 pm
Sydney	5:00 pm	5:45 pm	7:30 pm
Shanghai	5:00 pm	5:45 pm	7:30 pm
London	12:00 pm	12:45 pm	2:30 pm
	3:00 pm	3:45 pm	5:30 pm
	4:15 pm	5:00 pm	6:30 pm
New York**	3:00 pm	3:45 pm	5:30 pm
	4:00 pm	4:45 pm	6:30 pm

[1] BVAL is a valuation service provided by Bloomberg Finance L.P. ("BFLP") and its affiliates, including Bloomberg L.P. ("BLP"). BLP provides BFLP and its affiliates with operations support and service in providing the BVAL Services.

* Delivery will take place no later than the times noted above.

** BVAL follows the U.S. SIFMA recommended early close calendar. On early close days, the New York 3:00 pm snapshot will be run at 1:00 pm and the New York 4:00 pm snapshot will be run at 2:00 pm.

2. Input Data

2.1 Input Data and Source

BVAL receives data from a variety of sources including contracted data suppliers, such as exchanges, publicly available trade reporting sources, such as TRACE and MiFID data; market quotes from global and regional banks, broker-dealers and other Bloomberg terminal subscribers; as well as data provided by BVAL subscribers (e.g., through the price challenge process). Any of these types of data sources may be incorporated into our models and used to generate a BVAL price.

The following data types and sources are used in the determination of the price for the Direct Observations and Observed Comparables model.

Direct Observations and Observed Comparables

Data Inputs	Data Sources
Trades including both exchange and non-exchange reported trades	• Trade Reporting and Compliance Engine (TRACE) • Markets in Financial Instruments Directive (MIFID) II • Exchanges
Executable Bids / Asks	• Global / regional banks • Broker-dealers • Exchanges
Indicative Bids / Asks	• Global / regional banks • Broker-dealers • Exchanges

2.2 Pricing Approach

BVAL Evaluated Pricing screen – BVAL <GO>

BVAL's unique pricing transparency starts on the Terminal. **Figure 1** shows BVAL's Evaluated Pricing screen, which can be accessed via BVAL<GO>, summarizing all information used in the pricing methodology of a unique bond ("Target Bond"). The Final BVAL Price is derived using a two-pronged approach based on a combination of proprietary BVAL algorithms.

Step 1 – Direct Observations uses Trades and/or Executable and/or Indicative quotes on the Target Bond.

Step 2 – Observed Comparables uses direct observations on comparable bonds to derive a relative value price on the Target Bond when direct market observations on the Target Bond are insufficient. To corroborate the results of each algorithm, market data is run through both steps. To derive a Final BVAL Price, the results are then appropriately weighted and aggregated based on the relative strength of each algorithm.

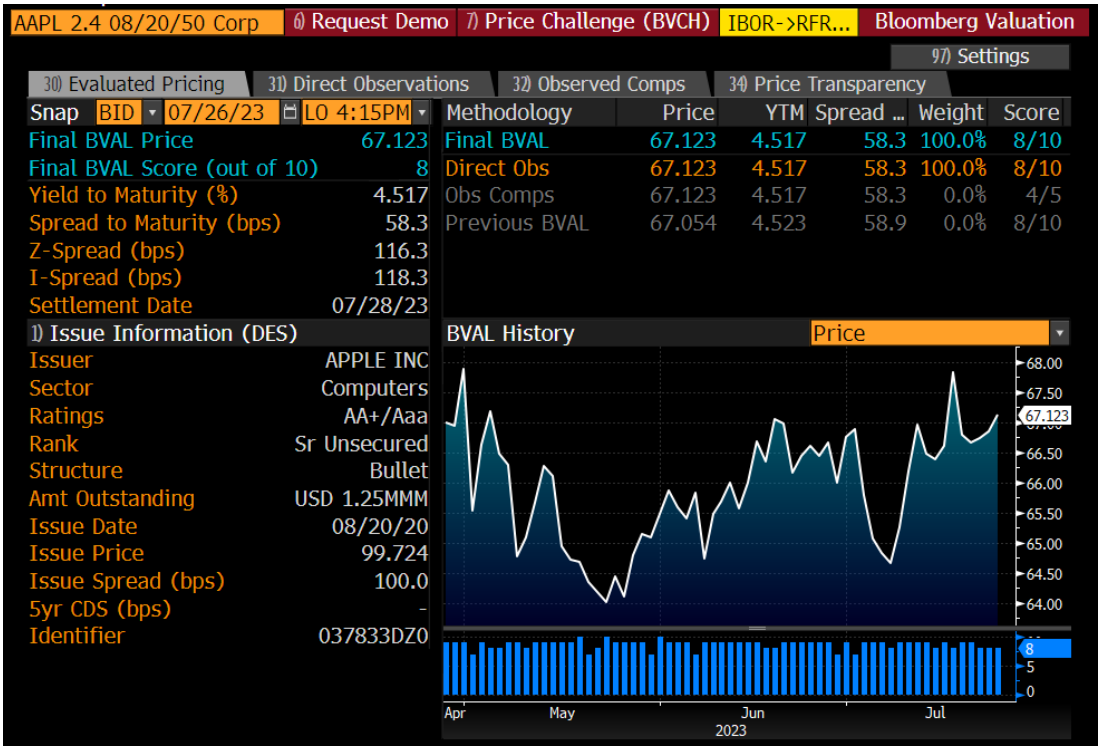

Figure 1 – BVAL Evaluated Pricing Screen – BVAL <GO>

3. Calculation Method

3.1 Direct Observations

Direct Observations uses Bloomberg's proprietary screening algorithm to analyze market data received from BVAL's data pricing providers. This sophisticated algorithm works to include exchange and non-exchange trades including TRACE and MiFid, market quotes from banks, broker-dealers, exchanges and other Bloomberg terminal subscribers. This market data is filtered and time-decayed to include quality observations; and if these observations are corroborated, they are used to compute an independent Direct Observations price. Time decay allows for the utilization of latest market data and most relevant as possible in terms of the type, size, side, and age of the observation. If trade data received meets certain thresholds as defined below, the Direct Observations price will be heavily weighted by trades.

The Direct Observations algorithm uses either price or spread over benchmark inputs according to asset-class convention to generate a bid, mid and ask price for every Target Bond.

The Final BVAL Spread to benchmark is calculated in line with YAS defaults leveraging the benchmark security's coupon frequency.

The Direct Observations spread to benchmark is calculated in line with YAS Option: Conventional yield for both bonds.

Below are the criteria for each data input of the Direct Observations model. The minimum criteria must be met to use each data input as part of the pricing process. Trades (both exchange and non-exchange reported trades) are first used if the criteria are met, then executable bids / asks and then indicative bids / asks.

Direct Observations Criteria

Data Inputs	Criteria
Trades including both exchange and non-exchange reported trades	• Trades sourced from TRACE must be ≥ $500K • Trades sourced from MiFid II and Exchanges have minimum trade size thresholds based on market conditions in relevant currencies. Some examples include[2]: EUR - 100,000 DKK – 200,000 ISK - 5000 TRY - 500,000 ZAR - 90,000 • Minimum trade size thresholds may be adjusted based on market conditions
Executable Bids / Asks	• 3 executable quotes that have to be two-sided (bid & ask) • Delivered over Bloomberg within a configurable time duration before the snapshot • Be configurable over different asset classes
Indicative Bids / Asks	• 2 pieces of corroborating data

There is an adaptive component in the weighting process that uses the observed data available at the time of pricing. Different types of observed data have a varying degree of relevance in Direct Observations algorithm. Recent trade data is weighted higher than indicative levels or older trades in the Direct Observations price. New trades are considered the most relevant, followed by indicative Bids, then Asks. Executable quotes are more stringent in their requirements for inclusion and thus considered to be of higher relevance than indicative quotes. To account for this hierarchy, a saturation process is used such that when a certain amount of data in the most relevant algorithms have been observed, additional data from weaker algorithms become irrelevant, and the less relevant algorithms are given no weight.

In order for an executable level or an indicative quote to be included in the Direct Observations algorithm, it must be corroborated by at least two other executable levels or an indicative level obtained from a different dealer. In other words, for an executable level or indicative quote to be included in the Direct Observations algorithm, there must be at least two data points from at least two different dealers and those data points must be at sufficiently proximate levels.

Figure 2 shows the BVAL Direct Observations screen, which summarizes the information used to price a Target Bond in the Direct Observations model. Key highlights include the Final BVAL Price, the Final BVAL Score (out of 10 – discussed in further detail below), the Direct Observations Price, the price and weights assigned to trades, executable bids/asks and indicative bids/asks, the number of weighted market observations used in the algorithm and their standard deviation. The market inputs used in the Direct Observations algorithm are clearly displayed in color code and time sequence for every Target Bond.

[2] Other currency minimum size levels during normal market conditions are available upon request.

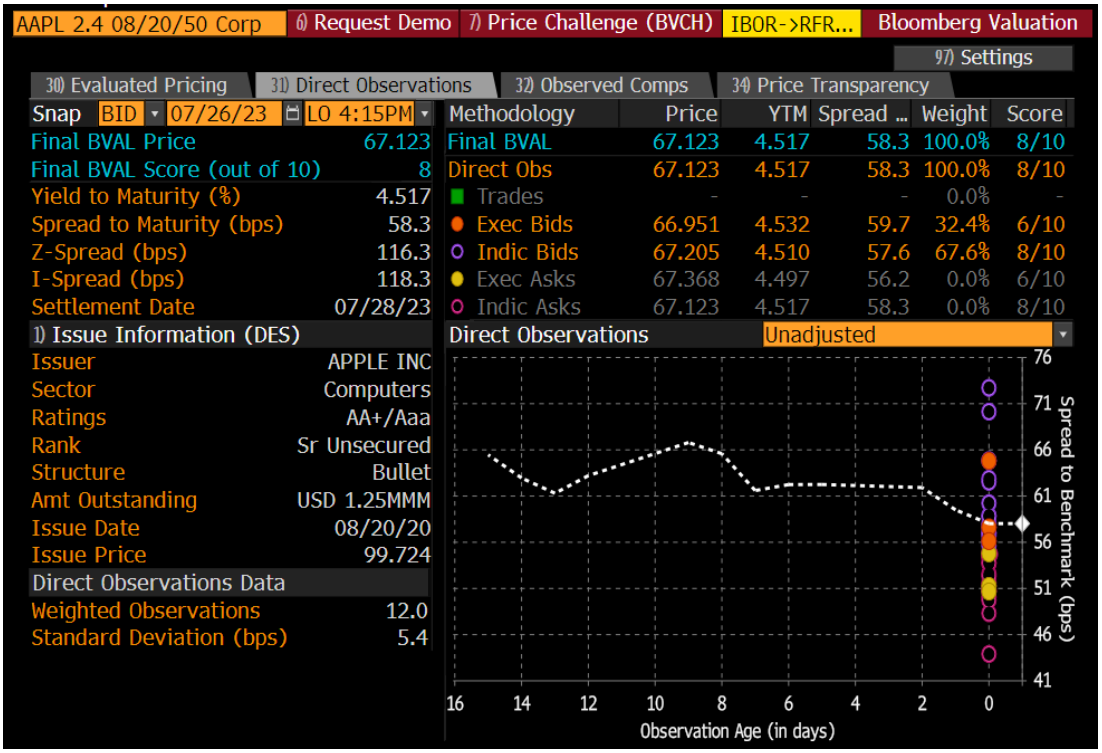

Figure 2 – Direct Observations Screen – Market Data

3.2 Observed Comparable

Observed Comparables uses Bloomberg's proprietary relative-value algorithm to price bonds with limited or no direct observations. A Target Bond with insufficient market data is priced relative to comparable liquid bonds.

In this final step, BVAL uses two different algorithmic approaches based on a Target Bond's asset class and technical characteristics.

The Final BVAL Spread to benchmark is calculated in line with YAS defaults leveraging the benchmark security's coupon frequency.

The Observed Comparable spread to benchmark is calculated in line with YAS Option: Conventional yield for both bonds.

Bullet Par Issuer Curve Model
The bullet par issuer curve model is used for investment-grade bullet bonds (fixed and floating) across government, supranational, agency and investment-grade corporate sectors. This methodology first normalizes the Target Bond for technical characteristics, namely high coupon premiums, size of issue, age in the market and not-rated status. This information is then used to derive a bullet par issuer curve based on direct market observations across an issuer's term structure. A Target Bond with no market observation is algorithmically priced.

using the appropriate maturity point on its par issuer curve. If a par issuer curve cannot be derived from direct market observations on bonds within the same issuer, then an appropriate reference curve is created using a combination of comparable liquid par peer curves within the same industry, credit quality and seniority rank in the capital structure.

Observed Comparables Screen – Bullet Par Issuer Curve Model
Figure 3 shows the Observed Comparables screen, which summarizes all the information used to price a Target Bond. Key highlights include the Observed Comparables Price, the Observed Comparables Score (out of 5 – discussed in further detail below), the weight of the Observed Comparables algorithm used in the Final BVAL Price, the bullet par issuer curve and corresponding reference curves, the derived point used to price the Target Bond, the Observed Residual and the Predicted Residual.

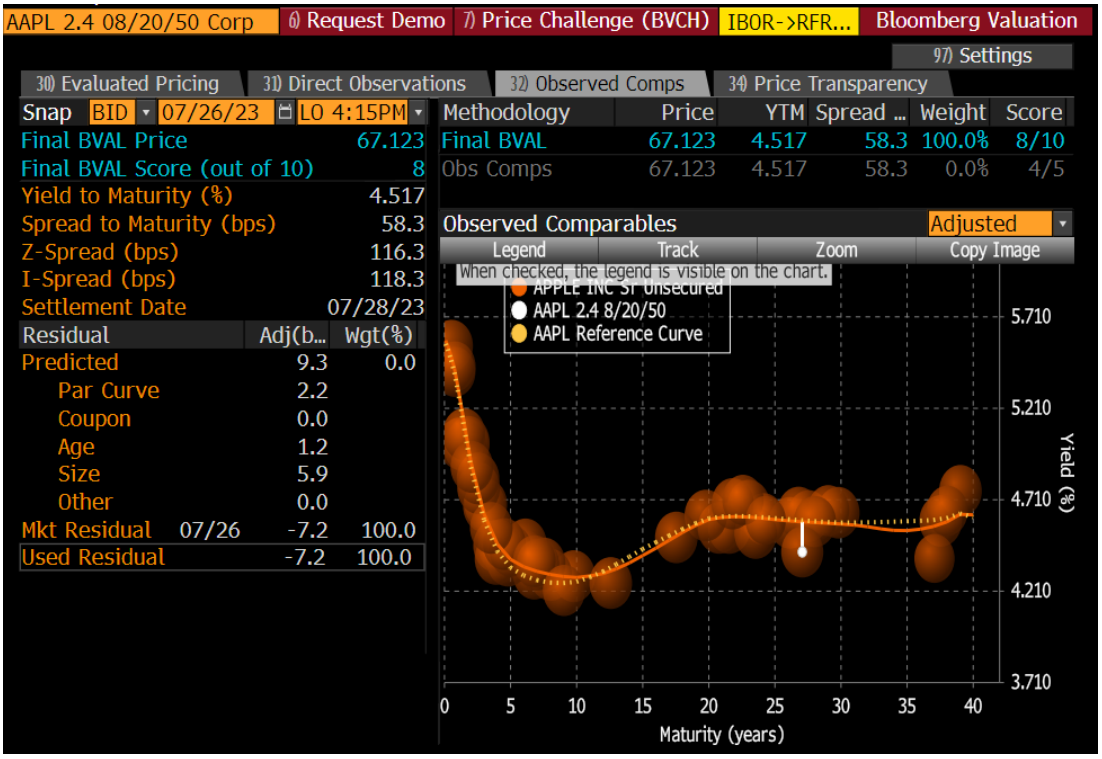

Figure 3 – Observed Comparables Screen (Investment-Grade Bullet) YTM

Callable Option-Adjusted-Spread (OAS) Model

The callable OAS model is used for agency, supranational and investment-grade callable bonds. This methodology uses the liquid bullet par issuer curve as the benchmark curve and quantitatively determines the OAS/Duration of the Target Bond. If a liquid bullet par issuer curve cannot be derived, an appropriate reference curve is created using a combination of comparable liquid peer curves within the same industry, credit quality and seniority rank in the capital structure. An OAS/Duration of the callable Target Bond is then calculated to derive an Observed Comparables price.

Observed Comparables Screen – Callable OAS Model

Figure 4 shows the Observed Comparables Screen, which summarizes the information used to price a Target Callable Bond. This is a robust two-pronged methodology that recognizes the OAS associated with a callable bond relative to an issuer's yield-to-maturity (YTM) bullet curve. To illustrate, the Observed Comparables Screen is split to show the bullet reference curve and OAS to the benchmark reference curve for a Target Callable Bond. Additional key screen highlights include the Observed Comparables Price, the Observed Comparables Score (out of 5 – discussed in further detail below), the Observed Comparables Price Weight used in the Final BVAL Price, OAS, the Observed Residual and the Predicted Residual.

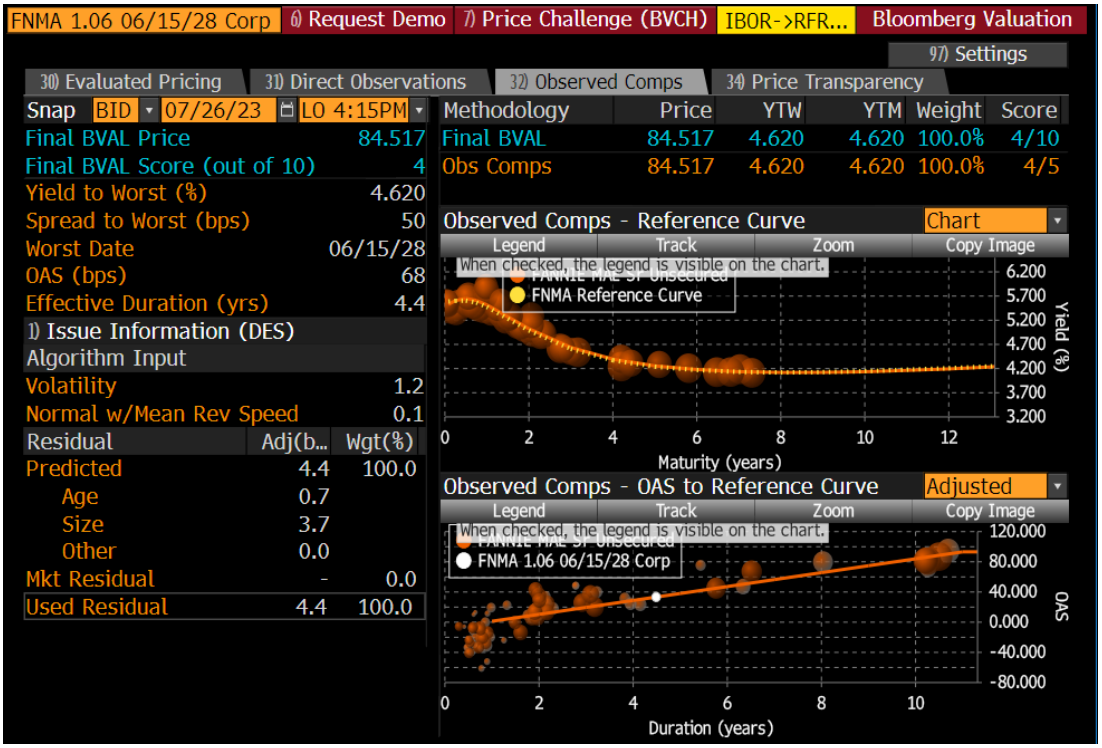

Figure 4 – Observed Comparables screen (Agency Callables) OAS to Duration

Not-rated Bonds

For bonds with no publicly available credit ratings ("Target NR Bond"), BVAL estimates credit quality using credit spreads on all comparable publicly rated bonds issued at the same time and within the same industry, region and currency.

BVAL then uses its proprietary pricing methodology and factors in a spread premium to reflect the less-liquid nature of a Target NR Bond versus its publicly rated peers.

3.3 Final BVAL Price

The final BVAL price is derived from the resulting prices from Direct Observations (if available) and Observed Comparable algorithms. It uses a saturation process analogous to the one that is used in Direct Observations. When a certain amount of data in the Direct Observations algorithm are available, additional data from Observed Comparables algorithm become irrelevant, and in such cases the final BVAL price is driven wholly by Direct Observations. In other situations, it is a blend of Direct Observations and/or whole use of Observed Comparables prices. The proportion of each algorithm (Direct Observations and Observed Comparables) is determined by the relative strength of each algorithm, where the strength is assessed via the amount and consistency of weighted market observations used for pricing in the respective algorithms. When sufficient market observations are not available to form a Direct Observations price, the final BVAL price is entirely driven by Observed Comparables price.

In the situation where only a single non-trade market data input is available on a target bond, Direct Observations will not generate a price. Instead, the BVAL price will be generated through the Observed Comparables algorithm. In this situation, the Observed Comparables algorithm may use the single non-trade market data input to establish a relative valuation of the target bond and comparable bonds at the time of this single non-trade market data input. The final price is derived by applying this relative valuation on the comparable bonds, as part of the Observed Comparables process.

As a result, where only a single non-trade market data input is available on the target bond, in certain instances, the BVAL price generated in the Observed Comparables algorithm may match that single non-trade market data input for the first few snapshots following the incorporation of that quote. This is more likely to happen where the data is incorporated into BVAL close in time to the next snapshot and/or when market conditions have not materially moved on the comparable bonds (e.g., in static or slowly moving markets).

Figures 5 and **6** show a sample Target Bond with no Direct Observations and 100% Observed Comparables where the Observed Comparables algorithm uses a single non-trade market data.

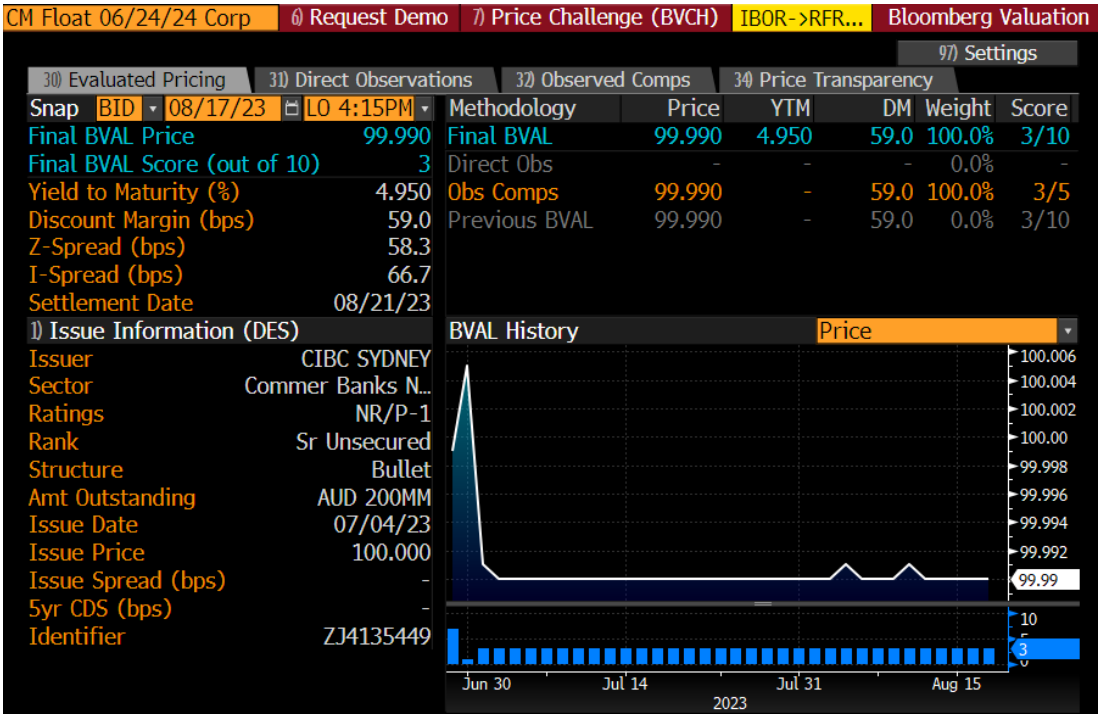

Figure 5 – Evaluated Pricing Screen for a Target Bond Where Observed Comparables Used Single Non-trade Market Data

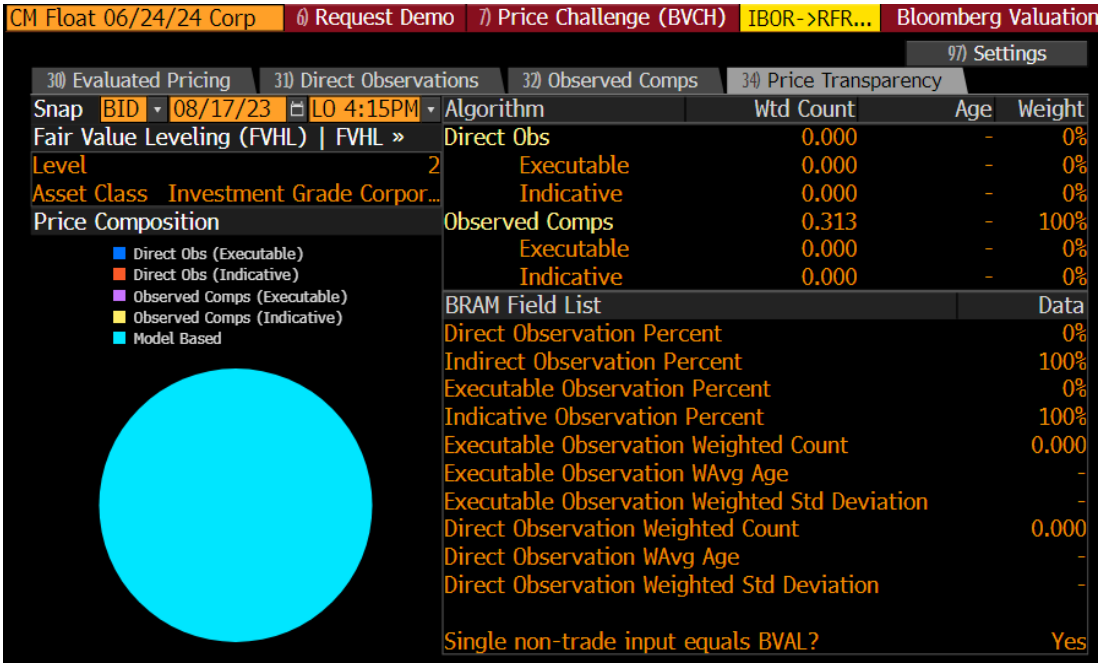

Figure 6 – Price Transparency Screen With "Single non-trade input equals BVAL?" Field Indicating "Yes"

4. Pricing Transparency

4.1 BVAL Score

The BVAL Score is a proprietary and innovative metric designed to gauge the level of market data used in constructing the Final BVAL Price. The BVAL Score measures the amount and consistency of market data used in our models. A BVAL Score is calculated for each algorithm – Direct Observations and Observed Comparables – which are then appropriately weighted to derive a Final BVAL Score. The Final BVAL Score is measured on a scale of 1 (the lowest) to 10 (the highest).

The BVAL score is a unique numerical rating that shows the relative strength of the recency, quantity and quality of market data inputs used in calculating the BVAL price for a particular security at a particular snapshot. While the score does not assess the accuracy of a BVAL price, it does provide a window into the underlying data inputs used by BVAL in arriving at that price. In other words, the higher the BVAL score the more robust the quantity and/or quality of the inputs underlying the score. Given that the BVAL Score measures the amount and consistency of market data used, the Direct Observations methodology can receive a maximum BVAL Score of 10.

A BVAL score between 6 and 10 reflects that the BVAL price was generated by the Direct Observations model, using recent direct observations on the target bond such as trades, and/or with high corroboration across multiple executable or indicative data.

A BVAL score of 5 or lower means the BVAL price was generated by the Observed Comparables model and/or by the Direct Observation model but with aged data. This would mean that the BVAL price was generated more heavily weighting the Observed Comparables model, by using data on comparable securities and/or data on the target bond that is aged and/or weakly corroborated. Observed Comparables derives a price using comparable bond observations and can, therefore, receive a maximum BVAL Score of 5.

4.2 Transparency Screen

Figure 7 shows the 'Price Transparency' tab on the BVAL <GO> screen. This screen provides a breakdown of the portion of the price which is derived from Direct Observations and Observed Comparables relative value model, breaking each of these categories down further by whether those inputs are indicative or executable.

In the top left hand portion, you will find fair value leveling information based on market consensus leveling rules created by Bloomberg, where securities are categorized as Level 1, 2 or 3 based on the significance of unobservable inputs. IFRS 13 and ASC 820 accounting standards require the disclosure of levels in the notes to the financial statements. The pricing transparency fields are calculated using a standard set of formulas created and maintained by Bloomberg. To create your own custom leveling rules, please ask your Bloomberg Sales Representatives about FVHL <GO>.

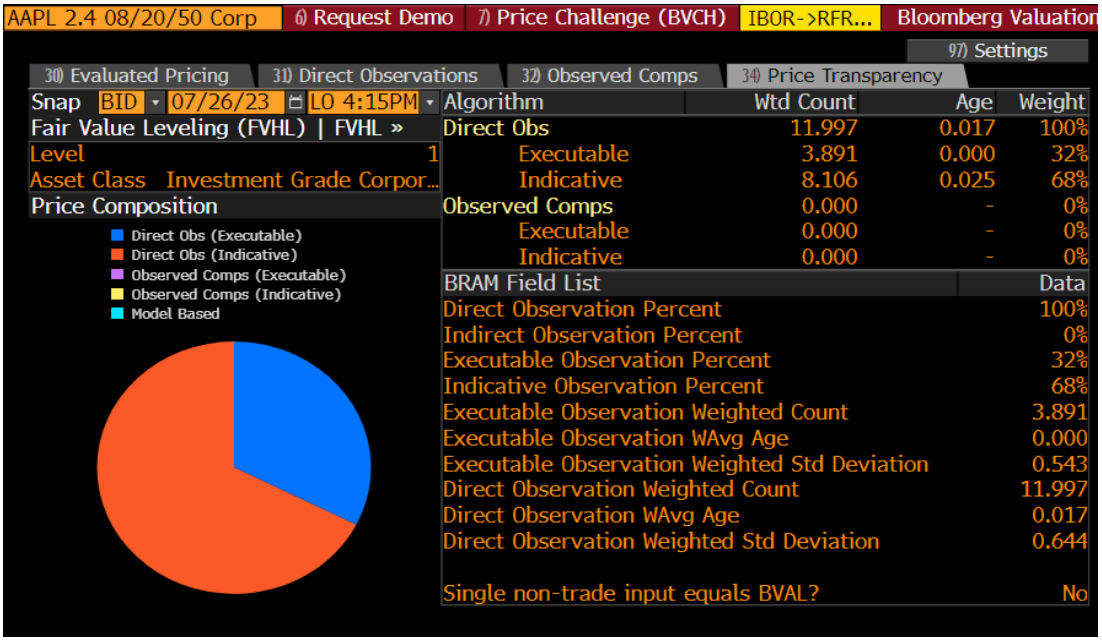

Figure 7 - Price Transparency Screen

In the top right hand portion, you will see the respective weights of direct observations versus observed comparables for the cusip, age, and weight of the input data for each output.

In the bottom right hand portion, you will find a list of Bloomberg Transparency Fields including whether a Single non-trade input equals the Final BVAL Price.

When the BVAL price is generated using the Observed Comparables algorithm and is based on a single non-trade market data input on the target bond and the BVAL snapshot valuation is identical (to the second decimal place) to that single non-trade market data input, the transparency screen indicates "Yes".

For further information please refer to the BVAL Thematic Methodology document and BVAL Methodology FAQ at BVLI <GO>.

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