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The Role of Fair Value, Model-Free Value and Risk-Neutrality

by Alex Levin

This month I decided to touch on these vital valuation concepts which, in essence, dominate many of my own consulting and development projects. Although most mortgage- and asset-backs are valued using models, I found out that many practitioners are not well-versed in some model limitations. As I will exhibit in this article, some MBS can be valued (exactly or approximately) without models. This alternative view allows for a basic validation of the outcome provided by complex computer models. In fact, successful investment steps exploring detected arbitrage opportunities and the hedging strategy can be undertaken without heavy reliance on models. I will give some examples, but will start with an explanation of the basic notions.

Main Concepts

Fair Value of a financial instrument is a value derived using a plausible valuation model reflecting (as perceived by financial engineers) relevant market laws. Fair value is therefore model-driven; the value is not more fair than the models employed for its derivation. Despite this problem, the fair value analysis is a useful method for many firms. It quantifies and "monetizes" the value of a position as a single number. For example, a mortgage company needs to know fair value, not to sell its mortgage servicing rights (MSR) business, but to assess the fundamental economics of the servicing business and hedge its exposures.

Model-Free Value is a price of a financial instrument that can be derived directly via prices of traded assets without a model. A classic example is the put-call parity for European options: cash plus call is equal to stock plus put regardless of the model for a stock's behavior. Model-free valuation is possible when the asset's cashflow can be replicated synthetically using other traded instruments. For example, in the mortgage industry, values of MSR can be approximated by values of traded IOs and POs (see further).

Risk-Neutrality is another important concept that values an asset in question relative to other assets (benchmarks) that reflect various market expectations and prices of risks. The "risk-neutral economy" is a mathematical medium where evolutions of market factors are purposely adjusted for these expectations and risks. For example, the assumption underlying any good OAS model is that the random dynamics of interest rates is adjusted to generate the observed prices of bonds or swaps and their vanilla options. OAS will be earned by the investor if the underlying asset is perfectly hedged against the interest rate risk (read April 2005 article, http://www.ad-co.com/newsletter/2005/Apr05/Valuation.htm). The assumption underlying AD&Co's prOAS model is that the random dynamics of interest rates and prepayment components (turnover-refinancing) are adjusted to yield the observed prices of bonds (swaps), their derivatives, and some MBS instruments. Hence, prOAS is earned for sure if the interest rate risk and prepayment uncertainty (model risk) are both hedged out.

It is now clear that all three notions are closely related. Suppose the asset in question can be synthetically replicated by traded assets that, coincidentally, are the benchmarks for a risk-neutral economy. Then, the model-free price can be computed and should agree with the risk-neutral fair value. In the case when a direct model-free value cannot be computed, a fair value within a properly constructed risk-neutral economy is what most models attempt to compute.

Nevertheless, risk-neutrality and model-free valuation are not identical. Risk-neutrality still relies on some form of a *risk model* that may misspecify risk factors and their dynamics. For example, OAS models value embedded-option bonds (including MBS) in an economy where the entire notion of risk is associated with interest rates and the option exercise laws are known. A deeper look suggests that the risk of not knowing the exact prepay option exercise law is usually priced by the MBS market, but not reflected in OAS models. This observation has led us to the prOAS concept, which we proved tracks historical prices, hedge ratios and relative values better than OAS.

MBS-Related Examples

IOs and TBAs. Let us assume that we employ the prOAS method and calibrate prices of risks, i.e. prepay model tunings, to a set of liquid TBA benchmarks. We then apply this risk-neutral prepayment model to IOs and, using prOAS levels reflecting the liquidity difference between IOs and TBAs (about 25-30 bps), derive fair values for IOs. We refer to the *Divide and Conquer* trilogy (part III) for details (http://www.ad-co.com/DivConTrilogyPDF.pdf). For example, on May 30, 2003 when the rates were extremely low, IOs were traded very cheap, at 1000 – 1500 bps of traditional OAS. Values derived using the prOAS method were surprisingly close to actual market prices. This is because the TBAs' prices reflected the fear of refinancing, too, and the IO market leveraged this risk properly.

The prOAS valuation is certainly based on some risk model (in our case, a two-factor view with the refinancing scale and the turnover scale being the factors), but to a much lesser extent than the OAS method, which firmly relies on a physical prepay model and past prepay statistics. If the TBA market and the IO market agree on prices of prepayment model risks, one can construct a portfolio of IOs and TBAs which maintains steady value for a range of prepay model assumptions.

MSRs, IOs and POs Most MSR managers are certainly aware of the Trust IO market, but relatively few employ it for valuing their servicing assets. We have heard various opinions on this matter ranging from "IO is only part of MSR" to "MSR is a business, not a traded instrument." Both views are somewhat myopic, in my opinion, because all MSR cashflow components can be replicated (at least, approximately) by IOs and POs.

An MSR consists of the servicing fee stream (a fixed-rate IO) and various components of income and cost, representing (time-inflated) fixed-rate IOs and floating-rate IOs. The most important knowledge– the fixed-rate IO price– can be directly obtained from the Trust IO market. It can be used to assess the value of the servicing fee and, with some inflation, the value of fixed components of (ancillary) income and cost. The value of an IO floater that appears in earnings (escrow and float) can be synthetically presented as a perfect floater (100) minus market PO. Thus, all main components of MSR cashflows have market indications found beyond the MSR market itself. In essence, a well-constructed valuation approach (such as the prOAS model) should approximate model-free values by reflecting endogenously various pricing benchmarks.

Limited liquidity is a known issue and causes MSR to be marked at a lower price than its traded cousins. However, liquidity spread can be obtained from other segments of the MBS market such as trading of whole loan packages on a servicing-released basis. Hence, adjustments are needed to reduce an MSR value of the model-free value derived from the IO/PO market and to account for some other smaller differences (such as inflation of effective incomes and costs) and residual risks.

Mispricing and Arbitrage

A situation in which the actual market price of an asset in question doesn't match derived prices may (or may not) present an arbitrage opportunity. In fact, most hedge funds are founded and run by people who believe their understanding of the market is superior to that of most market makers and participants. An arbitrage opportunity, if any, can be exercised by effectively using the very same instruments that provided the foundation for deriving the value. For example, if the price of a European put was derived using the put-call parity, but was found to be lower in the marketplace, the arbitrage would be exercised by taking a long position in the put ("cheap asset") and stock and a short position in everything else entering the other side of the parity, which is writing the call and borrowing cash. Simple inspection reveals that all cash flow components cancel each other out at expiry no matter where the stock value is at expiry (we refer readers to John Hull's book); hence, the arbitrageur will get up-front cash and have no cash outflow.

Using the trivial example, we see that it is not enough to find the value and discover the arbitrage; it is important to synthesize the portfolio, i.e. combine the assets and hedges which would lock in the profit. With a model-free mispricing, it is rather simple to do. If the arbitrage is model-based, the residual risk is inevitable and must be assessed. Let us revisit the less trivial, MBS-related, situations.

IOs and TBAs. Suppose the Libor OAS of an IO is 500 bps, i.e. much wider than most other MBS. One might consider buying the IO and hedging out the interest rate risk using suitable interest rate derivatives that are valued at zero OAS. This strategy locks in the 500 bps of earnings but only within the risk model that underpins OAS calculations. In particular, prepay model risk remains unhedged; it is not possible to say whether 500 bps of OAS is enough to compensate for bearing the risk. Intuitively, one can add other MBS instruments (such as liquid TBAs) into the portfolio and thereby hedge the prepay model risk factors. The problem is that these mortgage instruments do carry non-zero OAS on their own; the overall result of this extended strategy needs quantification.

If we start with the prOAS concept, we employ a risk-neutral prepay model that reflects both market trends and fears about the uncertainty of the prepay option exercise. This model can be calibrated to the set of TBA benchmarks. Suppose now that, under this risk-neutral prepay model, all TBAs have a Libor prOAS of -15 bps (agency-swap spread) whereas the IO in question has a Libor prOAS of +300 bps. The question is how to construct a portfolio that exploits this arbitrage and locks in the prOAS difference.

At first glance, one can go long in the IO (cheap asset) and short in the matching-coupon TBA (rich asset). Since a single hedge usually allows neutralizing a single risk factor, such a strategy will be insufficient if both turnover and refinancing are perceived as independent risk factors. For example, slight discount, current-coupon, and even slight-premium TBAs are negatively exposed to refinancing acceleration and turnover deceleration. At the same time, IOs lose value due to prepay acceleration, regardless of the cause. This example shows that two TBA positions may be required to hedge out the two prepay risk factors. The refinancing neutrality and the turnover neutrality conditions should be resolved to find the two unknown weights. In reality, a solution for this mathematical problem may be to take a short position in a higher-coupon TBA and a long position in a lower-coupon TBA, i.e. taking a synthetic short position in "TBA IO." (Please refer to the following table).

	Weight	Position	Price	prOAS	prOAD	prOAC	Refi Dur	Turn Dur
long	100%	FNT-350 IO	21.70	300	-29.20	-15.10	-0.8	-3.3
long	466%	TBA5.0	97.17	-15	4.32	-1.37	-0.04	0.19
short	-466%	TBA6.0	101.11	-15	2.06	-2.28	-0.07	0.03
	Hedged	PORTFOLIO $$	$ 3.36	$ 0.68	$ 3.51	$ 1.26	$ (0.02)	$ 0.00
	Unhedged	PORTFOLIO $$	$21.70	$ 0.65	$(6.34)	$(3.28)	$ (0.17)	$ (0.71)

We computed the weights by minimizing the total prepay exposure while purposely keeping two TBA weights identical to one another. The resultant position requires $3.36 of investing and will return about 20% ($0.68) annually above Libor. The residual prepay risk is indeed very small. Of course, the position retains interest rate risk, which can be hedged using usual derivatives; it causes no alterations of the profitability statement.

Is this strategy a model-free lock in profit? If not, what other risks does it pose? The answer should be sought in the limitations of the prOAS model. We assumed that the entire prepay model risk can be represented by two factors affecting all MBS instruments and that the prepay model risk found in the TBA market is the one affecting IOs. Dislocation of these two markets breaks the later assumption. Dislocation of two TBAs, beyond the repay model, breaks the former one. It is enough to see that if TBA5.0 cheapens versus TBA6.0, without the IO going up in value, the investor will lose.

Normally, the price spread between two TBAs may widen if the interest rates go up (they have different effective durations) or if a refinancing risk fear cools off (a higher coupon MBS does better). In either of these scenarios, IO should gain. Hence, we are exposed to risks associated with neither the interest rates nor the refinancing fear. A slide in the refinancing S-curve can serve as an example.

MSRs, IOs and POs. The cashflow generated by an MSR can be replicated by IOs and POs as explained above. Taking a hedging position in an IO is equivalent to taking a long position in the PO and a short position in the TBA. This takes care of the servicing fee, fixed income and cost replication. Floating IOs arising in connection with escrow earnings and floats are replicated by 100 minus the PO. It, too, leads to adding PO into the hedge. Assuming that IO/PO pool is identical to that of MSR, the fully hedged MSR business can be viewed as a zero-cashflow generator (cost included!) with the up-front pay-off received when each loan is originated. This up-front pay-off should compensate for the limited liquidity of the MSR and other residual risk factors. They are risks in estimates for earnings and costs, non-hedgeable “specialness” of a particular MSR pool, but not the interest rate risk nor the prepay model risk.

A deep understanding of fair valuation, model-free valuation and risk neutrality underpins successful practice in investment, portfolio and risk management. From a financial engineer’s point of view, the fairest MBS valuation model is the one that best replicates a model-free value.