Lakhbir Hayre
(212) 783-6349
lhayre@sbi.com

Hubert Chang
(212) 783-6632
hwchang@sbi.com

Why Empirical Durations Are Often Shorter Than Effective Durations, and Why It Often Does Not Matter

Empirical durations are commonly used as sanity checks on, or as alternatives to, effective durations. Empirical durations are often shorter than effectives, raising doubts about the usefulness of effective durations; empiricals, after all, are based on actual market moves, rather than models, and hence presumably reflect the actual price elasticity of MBSs with respect to Treasuries.

A recently published Salomon Brothers research paper[10] analyzes the relationship between effective and empirical durations, and discusses what they really measure. Empirical durations are usually obtained by regressing proportional MBS price moves against Treasury yield moves, and hence incorporate a host of assumptions about this relationship. The paper shows that the empirical duration for a given time period is equal to

(i) the current effective duration, plus

(ii) the average difference between the current effective duration and the effective durations during the time period used, plus

(iii) terms dependent on the correlations displayed over the data period between Treasury yield changes and changes in factors such as OAS, volatilities, current-coupon MBS spreads, yield curve reshaping, and so on.

In particular, if we ignore factors other than OAS changes, we obtain that, approximately,

Empirical Duration = Avg Effective Duration
+ (OAS Duration)*(Correlation between OAS and Yield Chngs)
* (Standard Deviation of OAS Chgs)/(Standard Deviation of Yield Chngs)

where the effective duration is averaged over the time period used to estimate the empirical duration, OAS duration (sometimes termed *spread duration*) refers to the effect of a change in OAS, keeping everything else fixed, and the yield refers to the Treasury being used in the estimation (typically the ten-year).

The key term in the above relationship is the correlation between OAS and yield changes. This can often be negative, especially when we are using daily data, resulting in the empirical duration being shorter than the effective. However, a negative correlation may just reflect day-to-day directionality in OASs, and may not necessarily be pertinent for longer-term hedging. As an example, consider TBA GNMA 8s between mid-May 1996 and mid-June 1996. Figure 8 shows relevant data.

[10] The piece, *Effective and Empirical Durations of Mortgage Securities*, should reach clients near the beginning of the week beginning October 7, 1996. It may also be printed from the *Yield Book*.

Figure 8. Durations on GNMA 8s, 15 May 96-14 Jun 96

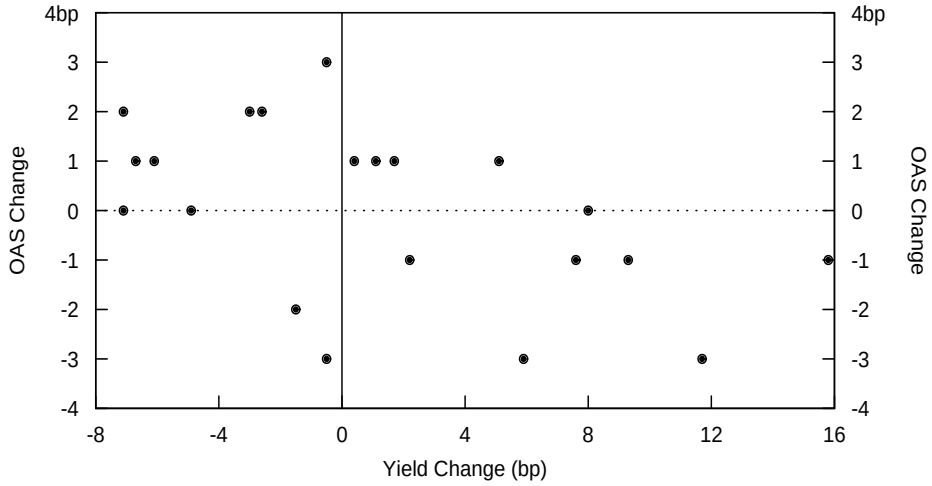
	Treasury Yields						GNMA 8%		
	1 Year	2 Year	3 Year	5 Year	10 Year	30 Year	Price	OAS	Eff. Dur.
5/15/96	5.54	5.97	6.17	6.38	6.64	6.84	101-16	61	4.5
6/14/96	5.76	6.27	6.47	6.71	6.93	7.09	100-05	61	5.0
Change	22bp	30bp	30bp	33bp	29bp	25bp	-1-11	0	0.5

Empirical Duration =4.2 (to 10 Year Treasury)
Average Effective Duration =4.72

Source: Salomon Brothers Inc.

Even though the OAS was unchanged over the period, and the yield curve shifted pretty much in parallel, the empirical duration is still much shorter than the effective. Furthermore, the actual price drop of 1-11 was close to what the effective duration of 4.5 and the 10-year change of 29bp would have predicted at the beginning of the period (101-16* 4.5 *29bp , or 1-10+). As our astute readers will suspect by now, the discrepancy results from day-to-day directionality in OAS changes, as shown in Figure 9.

Figure 9. Daily Ten-Year Treasury Yield and GNMA 8% OAS Changes, 15 May 96-14 Jun 96



Source: Salomon Brothers Inc.

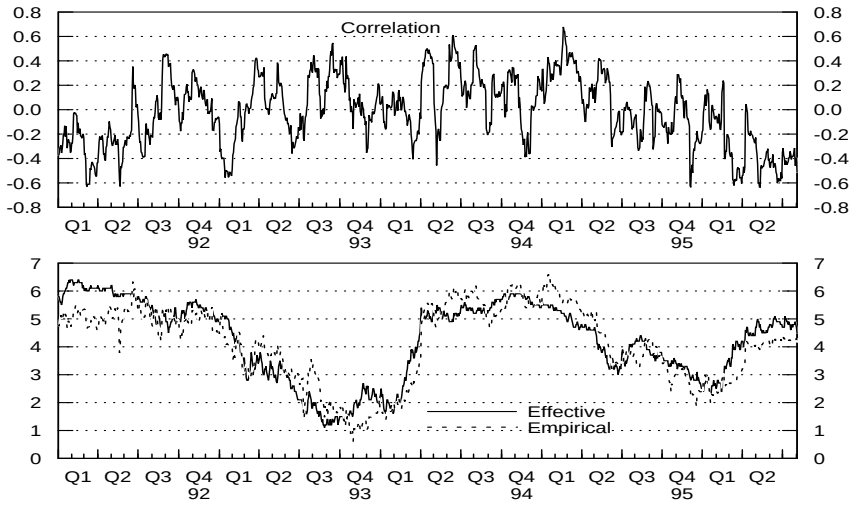
The correlation between daily ten-year yield and GNMA 8% OAS changes was -0.5 (despite the fact that the OAS was unchanged over the period). The approximate relationship between empirical and effective durations described earlier would imply that the empirical would be shorter than the effective by approximately

(OAS Dur)*(Correlation)*(std dev of OAS chgs)/(std dev of yld chgs)
= 4.8*(-.5)* 1.8 / 6.5 = - 0.66

close to the actual difference of -.52 between the empirical and the average effective durations (the remaining difference would be explained by other factors such as volatility, current-coupon spreads, and so on).

Differences between effective and empirical durations are in fact mostly explained by OAS directionality. Figure 10 shows rolling one-month correlations between changes in ten-year Treasury yields and changes in GNMA 8% OASs, along with effective and empirical durations on the GNMA 8s, from the beginning of 1992 to the present.

Figure 10. Correlations Between Ten-year Treasury Yield Changes and GNMA 8% OAS Changes (top), and Effective and Empirical Durations (bottom),1 Jan 92-3 Oct 96



Note: Correlations and Empirical Durations based on previous month of data.
Source: Salomon Brothers

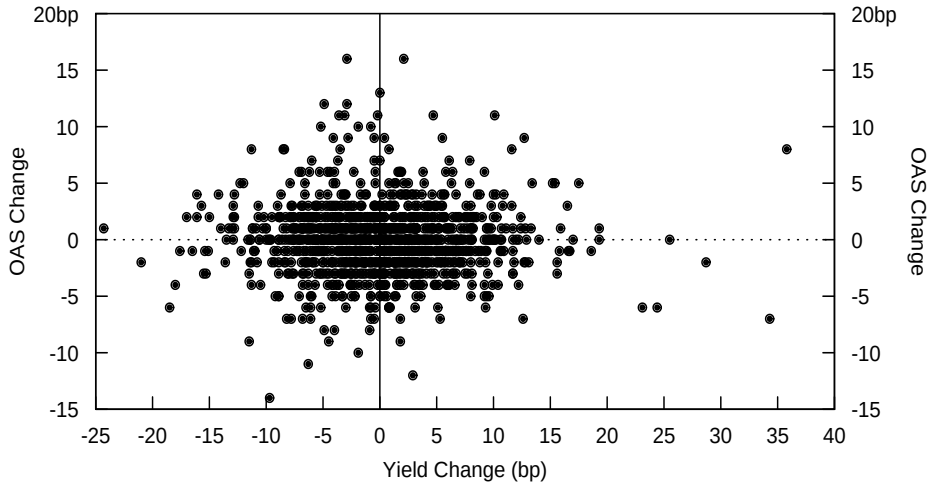
Two key points from Figure 10:

- Empirical durations tend to be shorter (longer) than effective durations when correlations between yield and OAS changes are negative (positive), confirming OAS directionality as the most important reason for discrepancies between the two.

- The correlations obtained using Salomon's OAS model tend to be unstable, and difficult to predict.

This last point is important from a hedging perspective. The example of the GNMA 8s in Figure 8 shows that daily directionality is not necessarily a concern if our hedging horizon is a longer period such as a month. However, even if we want to minimize daily fluctuations in our hedged portfolio, unstable OAS correlations may make empirical durations unreliable; in the new Salomon duration paper cited earlier, we describe historical studies that indicate that effective durations (from our model) tend to outperform empirical durations even for daily hedging. This is because *on average, over the long-term*, there has been no systematic correlations between changes in the OASs from Salomon's models and changes in Treasury yields. While this is hinted at by Figure 10, it is shown more explicitly by Figure 11, which expands Figure 9 to show ten-year yield and GNMA 8% OAS changes from the beginning of 1992 to the present.

Figure 11. Daily Changes in Ten-Year Treasury Yield and GNMA 8% OAS Changes, 1 Jan 92-3 Oct 96



Source: Salomon Brothers Inc.

The correlation for this longer period was about -0.01, or zero for practical purposes. In other words, while specific sub-periods may show significant OAS directionality, this has, at least in the past, tended to cancel out over time.