

Empirical OAS: A Guide To Relative Value in a Market Directional World

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What's The Problem With OAS?

Which Would You Choose?

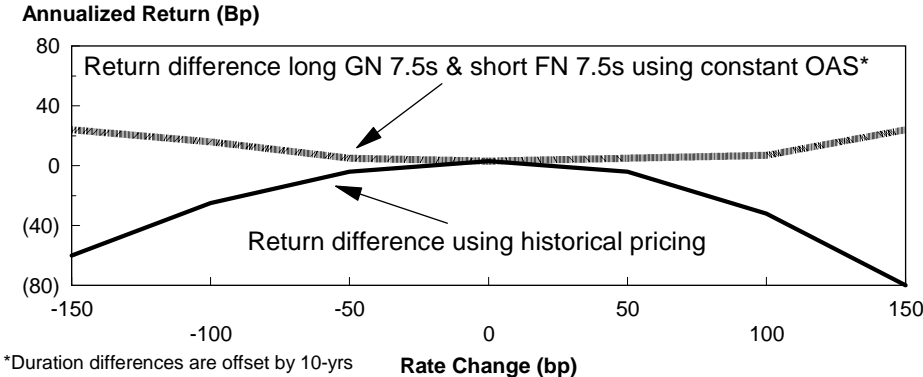
GN 7.5% with a 56 OAS or Conv 7.5% with a 48 OAS

OAS says GN 7.5s

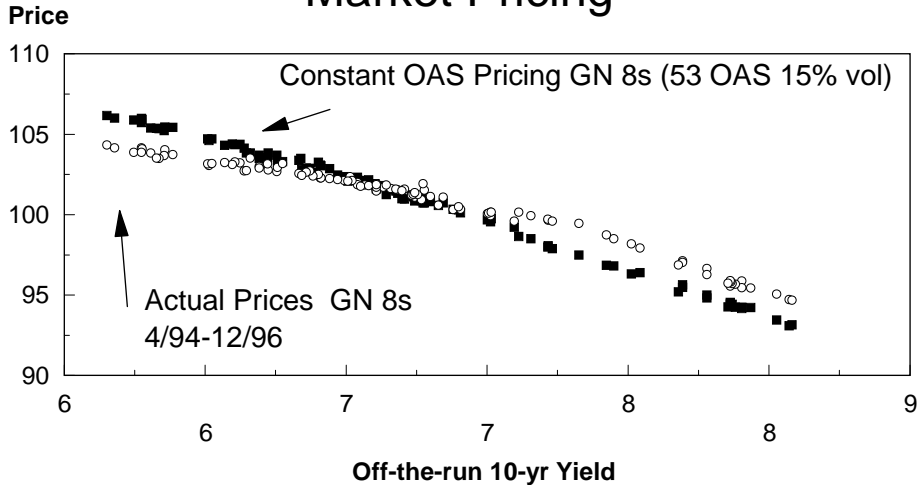
but.....

Using Only OAS Can Lead to The Wrong Conclusion Because

- If constant OAS pricing does not mirror actual mortgage price movements then you could be in trouble

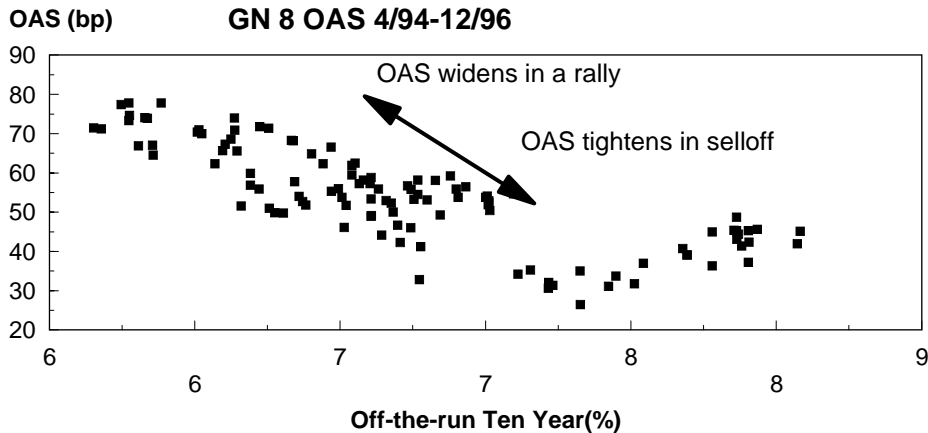


Option Adjusted Duration Does Not Reflect Market Pricing



The Problem with OAS is it is Market Directional

- OAS widens in a rally and tightens in a selloff



What Causes Directionality?

- Directionality could be caused by changes in prepayment risk
 - In an extended rally, OAS widens, reflecting the increasing risk from refinancing uncertainty
 - In an extended selloff, OAS again begins to widen as extension risk becomes important
- Directionality could also be caused by the directionality of volatility
 - Our OAS is based on a constant volatility assumption (15%)
 - Volatility has recently been directional, widening in rallies
 - As a result, a constant vol OAS would rise in a rally, reflecting the rising implied volatility

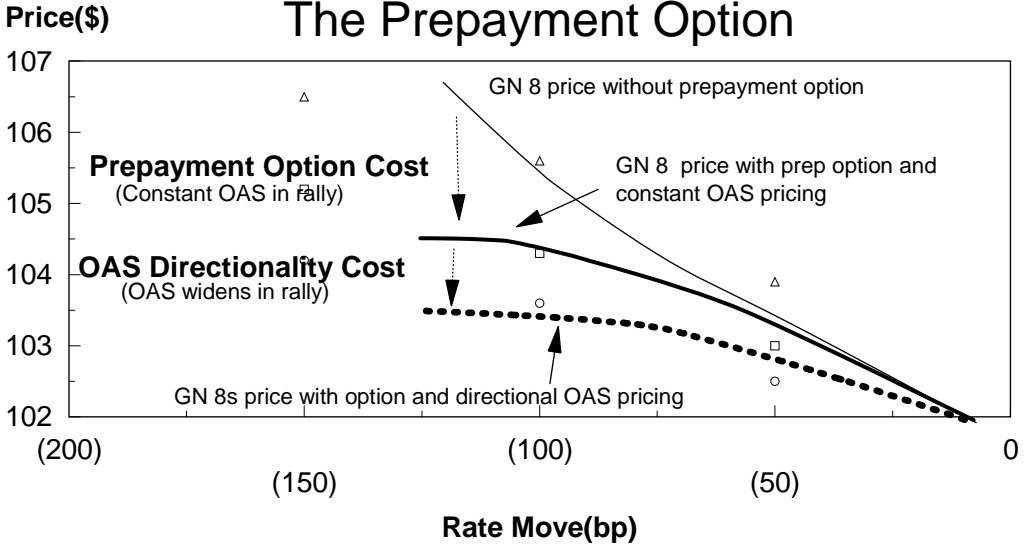
As a Result, OAS Does Not Tell The Full Story of Relative Value

- If you have a long term horizon then
 - Option adjusted duration (OAD) does not matter as much because price returns is a smaller component of returns
 - OAS correctly picks out relative value based on fundamental differences in cash flows
 - But, if you have a shorter term horizon then
 - OAD does not reflect likely future price moves because it uses a constant OAS
 - OAS does not fully reflect relative value because it does not incorporate the impact of directionality on holding period returns
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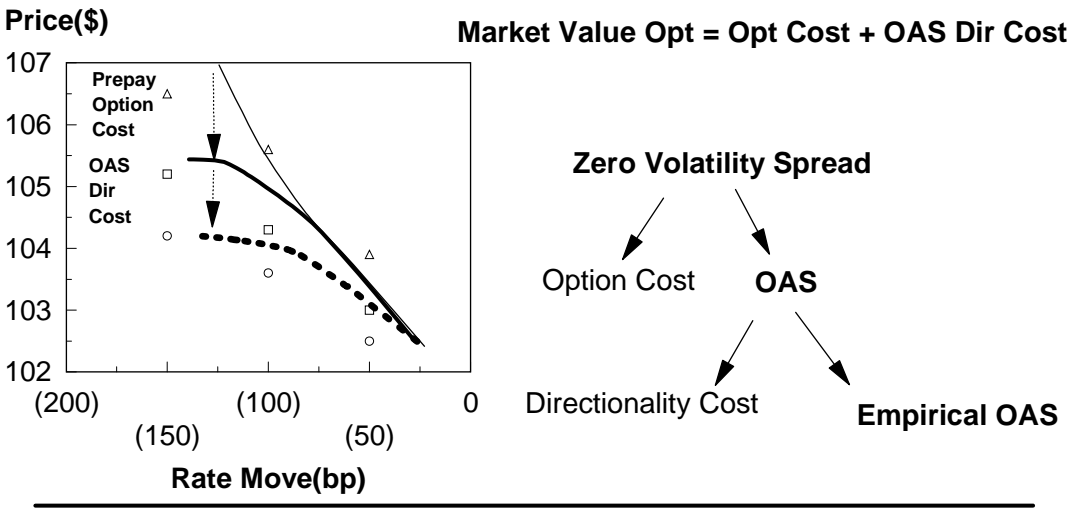
Our Solution is Empirical OAS and Duration

- We determine the empirical relationship between market levels and OAS for each security
 - Using this relationship we create
 - **Empirical OAS duration** (EOAD), which is a better hedging tool because it incorporates the impact of directionality on price movements
 - **Empirical OAS** (EOAS) , which is a better relative value tool because it is a more accurate measure of future excess returns over Treasuries
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OAS Directionality Affects the Value of The Prepayment Option



We Adjust OAS for Directionality to Create Empirical OAS



Empirical OAS Is the Expected Excess Return Over Treasuries

- OAS is the expected excess return over Treasuries

$$\begin{aligned} \text{OAS} &= \text{Expected Excess Return of MBS over same OAD Tsy} \\ &= \text{Exp Return of MBS (constant OAS)} - \text{Exp Tsy Return} \end{aligned}$$

- Empirical OAS is based on the same idea

$$\begin{aligned} \text{Emp OAS} &= \text{Expected Excess Return of MBS over same EOAD Tsy} \\ &= \text{Exp Return of MBS (Direct of OAS)} - \text{Exp Tsy Return} \end{aligned}$$

Five Steps To Create Empirical OAS

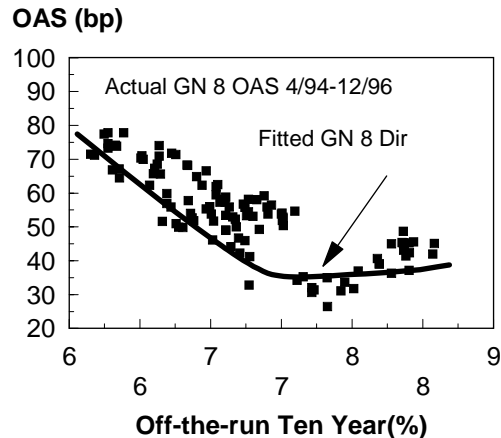
- **Step 1.** Fit OAS directionality of the mortgage
 - **Step 2.** Calculate empirical OAS duration
 - **Step 3.** Create a duration and dollar matched Treasury portfolio
 - **Step 4.** Calculate excess returns of the mortgage over the Treasury based on directionality of OAS
 - **Step 5.** Empirical OAS is the probability weighted average of these excess returns
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Step 1: Fit OAS Directionality

- Theoretical**

We fit a time weighted regression of OAS against level and level squared of the off-the-run ten year yield. We use the data over 4/94-present.

- Example GN 8s**



Step 2: Empirical OAS Duration

P is the price of the MBS, $P_{up}(OAS)$ is price of MBS in a 50 bp shift up using OAS to reprice, and $P_{dn}(OAS)$ as the MBS price in a 50 bp shift down using OAS to reprice .

- Theoretical**

Determine Up/Dn OAS

up OAS = OAS + Chng of OAS up 50 bp
 dn OAS = OAS + Chng of OAS dn 50 bp

Calculated Up/Dwn Prices

$P_{up}(up\ OAS)$
 $P_{dn}(dn\ OAS)$

Calculated Empirical OAS Duration

$E\ OAD = [P_{dn}(dn\ OAS) - P_{up}(up\ OAS)]/P$

- Example using GN 8s**

up OAS = 50 = 54 - 4
 dn OAS = 61 = 54 + 7

$P_{up}(50\ OAS) = 99.64$
 $P_{dn}(61\ OAS) = 103.55$

$3.8 = (103.55 - 99.64)/101.76$

Step 3: Create Matching Treasury Portfolio

We use T as the price of the Treasury security, C as the price of cash, and P as the price of the MBS.

- **Theoretical**

Buy \$A MM of the Treasury

$$A = P * EOAD / T * \text{Dur of Tsy}$$

Buy \$B MM of Cash, where

$$B = (P - A * T) / C$$

$$\begin{aligned} \text{Tsy wtg} &= A * T / P \\ \text{Cash wtg} &= B * C / P \end{aligned}$$

- **Example using GN 8s**

Buy \$0.56 = MM of the Ten Year Tsy

$$0.56 = (101.75 * 3.8 / 100.90 * 6.9)$$

Buy \$0.46 MM of Cash

$$0.45 = (101.75 - .55 * 100.90) / 100$$

$$\begin{aligned} \text{10-yr wtg} &= 0.55 \\ \text{Cash wtg} &= 0.45 \end{aligned}$$

Step 4: Calculate Mortgage and Treasury Excess Returns (cont)

- **Theoretical**

For each rate scenario (scn)

Calculate Scenario OAS

$$\text{scn OAS} = \text{OAS} + \text{Chng OAS}(\text{scn})$$

Calculate Scenario Terminal Price

Term Price (scn OAS)

$$\text{Prc chg} = \text{Term Price} * \text{Factor}(\text{scn}) - P$$

- **Example GN 8s**

Scenario is 50 bp shift down

$$61 \text{ OAS} = 54 + 7$$

103.55

$$-1.514 = 103.55 * .968 - 101.75$$

Step 4: Calculate Mortgage and Treasury Excess Returns (cont)

- Theoretical**

For each rate scenario (scn)

Calculate Returns

$$\text{MBS Ret} = [\text{Coup \& Prin Inc}(\text{scn}) + \text{Prc Chg}]/P \quad 5.61 = (7.22 - 1.51)/101.75$$

$$\text{Tsy Port Ret} = \text{Tsy wtg} * \text{Tsy Ret} + \text{Cash wtg} * R \quad 5.19 = 0.55 * 6.96 + .45 * 6.05/2$$

Calculate Excess Return

$$\text{Excess Return} = \text{MBS Ret} - \text{Tsy Port Ret}$$

- Example GN 8s**

Scenario is 50 shift down

$$\begin{aligned} \text{Excess return} &= 0.42 = 5.61 - 5.19 \\ &= 0.84 \text{ (annualized)} \end{aligned}$$

Step 5: Calculate Empirical OAS

- Theoretical**

Set Interest rate distribution

We use a lognormal distribution centered at the forward rates, with volatility set at the current implied volatility of six month ATM options on the 10-yr Tsy

Calculate Empirical OAS

$$\text{Emp OAS} = \text{Prob}(\text{scn } 1) * \text{Excess Ret}(\text{scn } 1) + \dots + \text{Prob}(\text{scn } N) * \text{Exs Ret}(\text{scn } N)$$

- Example GN 8s**

Variable	Prob wtg Avg	scn 1	scn 2	scn 3	scn 4	scn 5	scn 6	scn 7
10 yr	6.70	-150	-100	-50	0	50	100	150
Prob*	100	2.5	9.9	20.6	26.1	21.8	13.1	6.1
GN 8 Excess Ret (bp)	49	-2.92	-0.57	-0.84	1.30	-0.96	-0.06	-1.57

* 17% volatility, centered on the 10-yr yield of 6.61%

We Are Closer to Answering Our Original Question... But

January 10, 1997

Security	Zero Vol Sprd	Option - Cost	= OAS	OAS Dir Cost	Empirical = OAS	OAS Dir per 10 bp	OAS Dur	Emp OAS Dur
FN 6.5	71	29	42	39	3	-0.3	5.4	5.6
FN 7.0	79	36	43	40	3	0.1	5.1	5.0
FN 7.5	93	51	42	24	18	0.4	4.5	4.3
FN 8.0	107	67	40	20	20	1.0	3.9	3.4
FN 8.5	114	95	30	43	-13	1.9	2.9	2.2
GN 6.5	67	28	39	59	-20	-0.6	6.3	6.6
GN 7.0	78	35	43	81	-38	-0.2	6.0	6.0
GN 7.5	92	44	48	46	2	0.3	5.3	5.0
GN 8.0	108	54	54	5	49	1.5	4.7	3.8
GN 8.5	120	78	42	39	3	2.4	3.4	2.3

Adjusted Sharpe Ratios Are The Key To Relative Value

- As with OAS, empirical OAS should be compared on a risk-adjusted basis to determine relative value
 - A lower OAS can be transformed into a higher OAS by leverage, which increases risk
- We create an adjusted Sharpe ratio which calibrates empirical OAS by the standard deviation of excess returns
 - Adj Sharpe Ratio = EOAS/SD
 - SD= Standard deviation of excess returns

We Can Now Answer Our Original Question: Buy FN 7.5s and Sell GN 7.5s

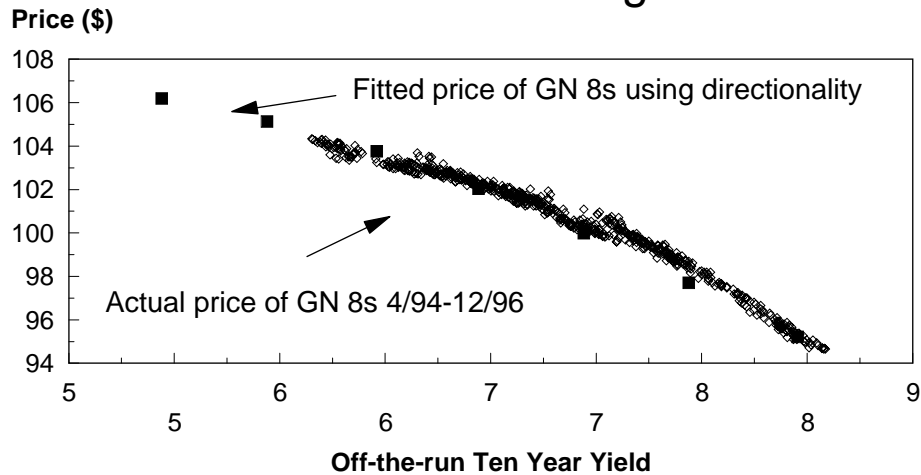
January 10, 1997

Security	Zero Vol Sprd	Option - Cost	= OAS	OAS Dir Cost	Empirical = OAS	Std Dev	Adj Sharpe Ratio
FN 6.5	71	29	42	39	3	33	0.1
FN 7.0	79	36	43	40	3	40	0.1
FN 7.5	93	51	42	24	18	42	0.4
FN 8.0	107	67	40	20	20	47	0.4
FN 8.5	114	95	30	43	-13	63	-0.2
GN 6.5	67	28	39	59	-20	43	-0.5
GN 7.0	78	35	43	81	-38	60	-0.7
GN 7.5	92	44	49	46	2	51	0.0
GN 8.0	108	54	54	5	49	40	1.2
GN 8.5	120	78	42	39	3	65	0.1

Questions About Empirical OAS

- **Does it work? Yes,**
 - because it reflects historical price and likely future behavior
- **Why not fit prices? No,**
 - fitting OAS market directionality gives more consistent results
- **Could OAS directionality be caused by volatility directionality? Yes,**
 - but it does not matter
- **Does this mean OAS is dead? No,**
 - it is still the best measure of long-term fundamental value of mortgages

Does it Work? Yes, Because It Mirrors Historical Pricing

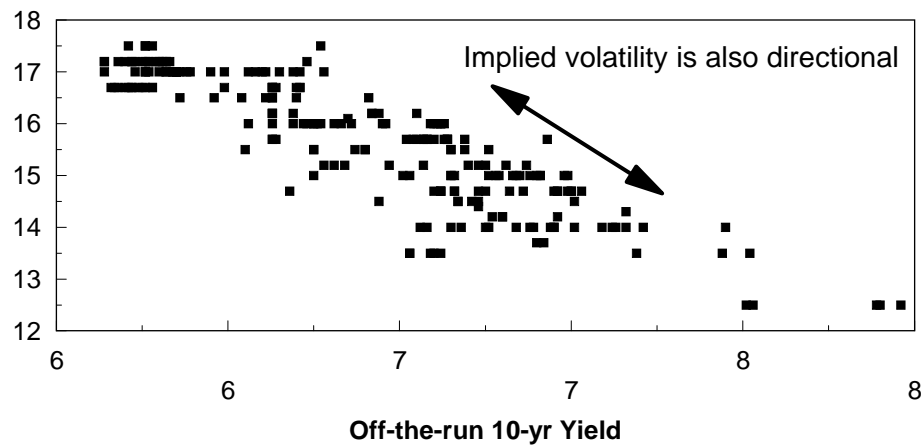


Why Not Just Fit Prices Instead of OAS? No, Fitting OAS is Better

- Which do you choose:
 - Empirical Duration, which is based on a fit of prices and market levels
 - Empirical OAS Duration which is based on a fit of OAS and market levels
- We choose the latter because a fit of OAS and market level is a better future predictor of price changes
 - It reflects changes in WALA
 - It reflects all of the complexities of prepayment behavior

Couldn't OAS Directionality Just Be a Reflection of Directionality of Volatility?

Implied Volatility of 3 yr into 7yr Swaption



Yes, Directionality of Volatility is a Factor But....

- The recent market directionality of implied volatility could give rise to the directionality of OAS because we use a constant volatility assumption of 15%
- However, we have found that not all the OAS directionality can be explained by the directionality of volatility
 - A volatility adjusted OAS continues to have a high correlation with interest rates
 - A constant volatility OAS has been directional even in periods in which implied interest rate volatility has not

Implied Volatility of Rates Has Only Recently Been Directional....

Correlations

	1992	1993	1994	1995	1996
OAS of GN 7 with 10yr	0	80	78	3	23
OAS of GN 8 with 10yr	16	83	0	75	79
OAS of GN 9 with 10yr	61	7	54	85	31
Vol of 7yr/3yr swaption with 10yr	NA	NA	NA	86	73
Vol of 5 yr cap with 2yr	8	12	50	66	82
Avg 2 yr Yield	4.80	4.05	5.96	6.15	5.86
Avg 10yr Yield	7.18	6.02	7.20	6.67	6.53

But The Real Answer is it Does Not Matter As Long As You Fit Some Directionality

- A constant OAS pricing even using market levels of volatility would still be flawed
 - OADs will be wrong because it assumes that volatility is constant across rate moves, which it hasn't been.
 - Example,

	Dur	-50	0	50
Constant OAS, constant vol (15%)	4.6	103.94	101.75	99.29
Cont OAS, market vol (21%)	4.5	103.92	101.75	99.34
Historical pricing	3.8	103.51	101.75	99.66

Is OAS Dead? No, it Still Provides the Best Guide For Looking at Fundamental Value

- Market directionality only affects short term analysis
 - In the long run, price changes do not matter, only cash flows
 - Over a long run horizon, such as a held-to-maturity position, OAS continues to identify cheap cash flows across mortgages
 - In the short run, OAS is still a good starting point because its cash flows are still important
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Empirical OAS and Duration Are a Roadmap in The Market Directional World

- OAS is still alive and well, particularly using our new prepayment model, but
 - Market directionality of OAS has greatly complicated the art form of mortgage relative value
 - Empirical OAS and duration provides a guide through these complexities to arrive at a more accurate picture of relative value
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