

Bond Portfolio Analysis Quarterly

Presenting our New Scenarios and Optimized Portfolios

Our scenarios reflect the possibility of an improving US economy, the risk of the situation in Europe deteriorating and the impact of action or inaction on the part of the Fed. They are very symmetric at the long end but biased towards higher rates in the two- to seven-year area as a result of the depressed level of rates.

We recommend our Bull Hedged portfolio, which we project to perform very well in the event that rates fall and at least match the index should rates sell off. Our analysis suggests that while carry provides a decent base of return for the portfolio, it is curve positioning and overweighting mortgages that account for its strong performance in the bullish scenarios.

We glean the following themes from the analysis of our new scenarios:

- **Duration and Curve.** Our optimized portfolios have a bias towards being short duration, underweight the two- to five-year area and overweight in the seven- to twenty-year region. We see this position in the Bull Hedged portfolio. Being short duration is an unusual choice for a portfolio optimized to outperform when rates fall, but the flattening bias more than makes up for it in the biggest bull-flattening scenario. With front-end rates rising more than falling across our scenarios, the short-duration flattener is neutral overall in the bearish scenarios but a benefit in the rallies.
- **Spread and Convexity.** Most of our optimized portfolios overweight MBS, which boosts carry and improves returns in the bullish scenarios. It is only the bearish portfolios that underweight mortgages. All of the portfolios are maximally overweight agencies, with most of the overweight coming in callables. Reflecting recent experience in the markets, agency spreads show substantially less volatility across the scenarios than mortgage spreads, which makes agencies a good source of low-risk carry.

Status Quo Hedged Portfolio Performance. Our previous recommended portfolio, the Status Quo Hedged, trailed the index by 0.07%. Overweighting high-coupon mortgages, which widened significantly, accounted for most of the shortfall. A front-end flattening bias also dragged down returns, but this was more than offset by the benefits of being long duration.

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See Appendix A-1 for Analyst Certification, Important Disclosures and non-US research analyst disclosures.

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Optimal Treasury/Agency/MBS Portfolios

- Our scenarios reflect the possibility of an improving US economy, the risk of the situation in Europe deteriorating and the impact of action or inaction on the part of the Fed.
- The range on 10-year Treasury yields in our scenarios is 117bp, which is slightly lower than the last iteration.
- We recommend our Bull Hedged portfolio for the next three months. We project it to outperform the BIG Less Credit Index by 0.09% to 0.10% in the bullish scenarios and by 0.02% in the case of a modest selloff.
- Carry is an important factor, but curve positioning and overweighting mortgages are responsible for most of the return advantage in the bullish scenarios.
- Bull Hedged is short effective duration, but its pronounced flattening bias has a bigger impact in the bullish scenarios. Overweighting spread product in callable agencies and mortgages boosts carry but makes the portfolio negatively convex.
- Our previous recommended portfolio, Status Quo Hedged, trailed the index by 0.07%. Overweighting high-coupon mortgages, which widened significantly, accounted for most of the shortfall. A front-end flattening bias also dragged down returns, but this was more than offset by the benefits of being long duration.

Playing the Curve and Wishing on the Fed

Overview

"When you come to a fork in the road, take it."

— Yogi Berra

Disappointment in the performance of the US economy and in the ability of European governments to address their financial woes drove rates to record lows over the summer. There has been a recent uptick in rates as economic data have become less disconcerting and more positive developments in Europe have moderated the mood of the markets. However, neither the US economy nor the situation in Europe is sure of a fix, and the next three months may well not decide the fates of either one. How many times over the past couple of years have optimistic signs given way to disappointment and portents of doom proven not quite so portentous?

In this topsy-turvy world, we present our new scenarios. They present the possibility of economic renewal and the danger of further deterioration in Europe. We also address the Fed's actions, should the muddle persist. On the one side, rates climb back to the upper end of the range of the past year, but on the other side they fall to dramatic new lows. Fasten your seat belts.

We project our recommended portfolio to outperform by nicely in the bullish scenarios and at least match the index in bearish scenarios.

We recommend our Bull Hedged portfolio, designed to perform well should rates fall, yet still outperform in the event of a modest selloff. Bull Hedged is projected to outperform the benchmark by 0.09% to 0.10% in our bullish scenarios and by 0.02% in a modest selloff. It matches the index should rates climb more substantially and mortgage spreads widen. The portfolio is short duration, long spread duration, and maximally negatively convex versus the benchmark; it picks up yield relative to the index.

Bull Hedged is short duration, but takes advantage of reshaping to outperform as rates fall and flatten in our scenarios.

The Bull Hedged portfolio goes short duration, which is an unusual position for a portfolio designed to outperform when rates fall. The portfolio has a big underweight in the two- to five-year part of the curve where rates rise more than they fall, and a substantial overweight in the seven- to twenty-year area. It appears that the combination of being short duration, but in a flattening position, is neutral overall in the bearish scenarios but boosts returns modestly in the bullish scenarios. The advantage of being underweight the two- to five-year area as rates rise outweighs the disadvantage when rates fall as a result of the asymmetry in our scenarios at the front end.

Bull Hedged is long spread duration and negatively convex.

The overweight in spread product not only boosts carry, but with most of the overweight in mortgages also improves returns in the bullish scenarios that have mortgages tightening. The portfolio has a slightly higher average mortgage coupon than the index, but that is largely a result of overweighting 30-year collateral. Similarly, its negative convexity is mostly a product of overweighting mortgages.

Figure 1. Differences in Projected Total Return and Risk Measures, Optimal Portfolio Versus the Index, 3-Mo. Horizon, 20 Aug 12

Difference in Return Versus Index for Each Individual Solution (In %)										
Scenario	Index		Hedged			Maximize				
	Return	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
Economy Up	-1.63	0.03	0.00	0.11	0.00	0.29	0.24	-0.33	-0.30	0.10
Status Quo	-0.16	0.03	0.02	0.03	0.05	0.09	0.12	-0.13	-0.04	0.05
Bad Euro	1.77	0.05	0.09	0.00	0.00	-0.44	-0.51	0.58	0.31	-0.20
QE3	1.11	0.06	0.10	0.00	0.08	-0.17	-0.11	0.14	0.26	-0.03
Forward	0.14	0.02	0.02	0.00	0.02	-0.02	0.01	0.01	0.01	0.03
Average	0.27	0.04	0.05	0.03	0.03	-0.06	-0.06	0.07	0.06	-0.02

Difference in Value Versus Index for Each Individual Solution										
	Index		Hedged			Maximize				
	Value	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
Yield to Worst	1.69	0.00	0.05	0.02	-0.07	-0.27	-0.30	0.40	-0.01	-0.01
Effective Duration	4.08	-0.10	-0.19	-0.24	0.12	-0.25	-0.25	0.25	0.25	-0.13
Spread Duration	1.89	0.11	0.19	-0.03	0.16	-0.13	0.00	0.18	0.19	0.19
Convexity	-0.49	-0.23	-0.25	-0.09	-0.25	0.00	-0.25	0.03	-0.24	-0.24

Over/Underweight Spread Duration Dollars (% Over/Underweight)										
			Hedged			Maximize				
		Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
Total		6	10	-2	9	-7	0	10	10	10
Agency — Bullet		-10	-9	-10	-10	-8	-10	-10	-10	-10
Agency — Callable		1917	1793	1917	1917	1710	1917	1917	1917	1917
Collateralized		5	10	-4	8	-10	-2	10	10	10

Source: Citi Research

Our new scenarios are unusually symmetric at the long end but have a modest bias towards higher rates at the front end.

Our new scenarios are well-balanced between bearish and bullish possibilities, but with rates at the front end so low, there is a bias towards higher rates in the two- to seven-year part of the curve. Changes at the long end are unusually symmetric. Averaging across the four scenarios, we get a modest bear-flattener, with 2s10s flattening 3bp (the average selloff peaks in the four-year area, so 4s10s flattens 6bp) and rates all but unchanged in the ten- to thirty-year area. Across our scenarios, the range of changes on the ten-year is 117bp, slightly less than we had

in the last set of scenarios (see Figure 2). The range in the Fed-bound two-year rate is 20bp, while the range in the 30-year area is 128bp.

Spreads widen more than they tighten in our scenarios.

Swap spreads tend toward widening in our scenarios, especially in Bad Euro which has two-year swaps widening 10bp and ten-year swaps out 5bp. The Status Quo and QE3 scenarios have swap spreads tightening modestly, and swaps widen moderately in Economy Up. Mortgage spreads are driven by prospects for further Fed action; they widen substantially in Economy Up, and tighten notably in QE3. MBS spreads move more moderately in Status Quo and Bad Euro. Agency spread moves are minimal and reasonably balanced across the four scenarios. Yield volatility moves inversely with rates, but due to big moves in rates the impacts on basis point vol can actually be in the opposite sign to the change in yield vol.

A summary of the four scenarios follows:

- Economy Up is a selloff with most of the steepening at the front end. It has lower yield vols, wider mortgage spreads and tighter agencies.
- Status Quo has rates edging up and vols falling. Mortgages widen and agencies tighten, with both moves smaller than in Economy Up.
- Bad Euro is a big bull-flattener with wider swap spreads and tighter MBS spreads. Agencies widen. Yield vol climbs.
- QE3 has rates falling modestly, but the big move is in significantly tighter mortgages spreads. Agencies see little change and vol remains the same.

Figure 2. Largest Changes in Bellwether Treasury Levels and Curve Shape for 3-Mo. Scenarios, Citigroup Optimal Portfolio Analyses, Dec 09–Aug 12 (In Percent)

Tenor	Rally									Backup								
	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12
Fed Funds	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Yr	-0.20	-0.27	-0.15	-0.22	-0.28	-0.05	-0.11	-0.21	-0.03	0.43	0.50	0.35	0.33	0.58	0.40	0.07	0.23	0.17
5-Yr	-0.42	-0.33	-0.34	-0.41	-0.54	-0.50	-0.46	-0.42	-0.28	0.52	0.50	0.45	0.48	0.54	0.68	0.37	0.49	0.51
10-Yr	-0.55	-0.37	-0.60	-0.45	-0.66	-0.45	-0.61	-0.60	-0.57	0.63	0.50	0.44	0.55	0.56	0.65	0.62	0.64	0.60
30-Yr	-0.50	-0.39	-0.68	-0.49	-0.49	-0.35	-0.70	-0.67	-0.64	0.64	0.50	0.35	0.50	0.51	0.50	0.83	0.48	0.64
Max	-0.55	-0.39	-0.68	-0.49	-0.66	-0.50	-0.70	-0.67	-0.64	0.64	0.50	0.44	0.55	0.58	0.68	0.83	0.64	0.64
Tenor	Flattener									Steeper								
	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12
2s10s	-0.35	-0.20	-0.45	-0.42	-0.38	-0.40	-0.54	-0.44	-0.54	0.26	0.20	0.15	0.40	0.38	0.35	0.58	0.41	0.44
10s30s	-0.17	-0.16	-0.09	-0.27	-0.10	-0.20	-0.09	-0.16	-0.07	0.10	0.00	0.01	0.20	0.18	0.10	0.31	0.11	0.05
Tenor	Spreads Narrow									Spreads Widen								
	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12	Dec 09	Mar 10	Jul 10	Nov 10	Mar 11	Jul 11	Nov 11	Mar 12	Aug 12
10-Yr Swap	-14	-10	-10	-10	-20	-10	-10	-5	-5	16	5	15	15	5	10	7	7	7

Source: Citi Research

Recommendations and Comparative Analysis

We recommend Bull Hedged.

We recommend the Bull Hedged portfolio, which is projected to outperform by 0.09% and 0.10% in Bad Euro and QE3, respectively, and by 0.02% in Status Quo. It matches the index in Economy Up. Bull Hedged is definitely in the middle tier of our portfolios in terms of our tracking error analysis, but is much closer to the top tier than the bottom tier.

Maxmin exhibits less risk, but its return profile is less appealing.

Maxmin has more uniform scenario returns than Bull Hedged, but it gives up more in the bullish scenarios than it gains in the bearish scenarios – especially in the more modest representatives. Consistent with this, Maxmin exhibits marginally

Carry is important, but it's curve and spread that differentiate our preferred Bull Hedged portfolio.

Portfolios across the board overweight callable agencies.

worse expected return but at substantially better tracking error than Bull Hedged in our tracking error analysis.

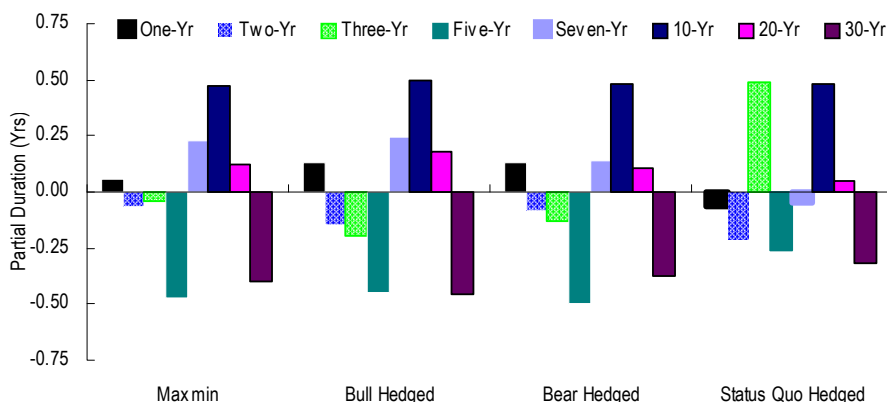
We also look at Bear Hedged and Status Quo Hedged solutions.

Carry is an important source of return for our portfolios, especially Maxmin and Status Quo Hedged. However, it is curve and spread positioning that differentiates Bull Hedged from the pack. Curve effects are the most important component of return for Bear Hedged. Most of our portfolios are long spread duration and negatively convex, boosting carry.

It is also interesting to note that the most universal position among our portfolios is an overweight in agencies, with callables responsible for the overweight. Reflecting recent market experience, our scenarios display little volatility in agency spreads, making the sector a good source of low-risk carry in this analysis.

All of our portfolios are negatively convex and benefit from falling volatility in the Economy Up and, to a lesser extent in Status Quo. This effect is most evident for the Bull Hedged, Maxmin and Status Quo Hedged portfolios that also suffer the most in Economy Up as a result of overweighting mortgages.

Figure 3. Partial Durations of Maxmin, Bull Hedged, Bear Hedge and Status Quo Hedged Portfolios, 20 Aug 12



Source: Citi Research

Bull Hedged

We recommend the Bull Hedged portfolio which we project to beat the index by 0.09 – 0.10% in the bullish scenarios, while still outperforming by 0.02% in Status Quo (see Figure 1). We judge that the improved returns in the bullish scenarios, and especially in QE3, are worth the 0.03% give-up relative to Maxmin in Economy Up. Carry provides a consistent base of returns, but curve positioning and overweighting mortgages are the most important factors in the bullish scenarios (see Figure 3).

Bull Hedged's short duration position looks unusual in a portfolio optimized to outperform in bullish scenarios. However, its curve bias more than makes up for the overall duration position. With relatively little decline in front-end rates, the portfolio's substantial underweight in the two- to five-year part of the curve does it little harm, while being net long the seven- to thirty-year area provides substantial advantage. And on the flip side, the short bias at the front end is more of an advantage in the bearish scenarios in which front-end rates climb more substantively.

The portfolio is overweight mortgages, which improves returns in the bullish scenarios. This is especially the case in QE3. Unlike with the curve positioning, the spread positioning takes away marginally more in the bearish scenarios than it gives in the bulls.

Maxmin

The Maxmin solution is a good, conservative option for investors with less risk appetite. We project it to beat the index by 0.03% in Economy Up and Status Quo and by 0.05 – 0.06% in the bullish scenarios. Maxmin has lowest tracking error of any of our solutions but a slightly lower expected return than Bull Hedged. Carry accounts for most of its return advantage relative to the index.

Maxmin employs the same broad strategies as Bull Hedge, but with more moderation. While its duration is less short than Bull Hedged's, it is also in a less extreme flattener and thus gains less from curve in the bullish scenarios. Maxmin also takes on less of an overweight in mortgages, which further smoothes out the returns across the scenarios.

Bear Hedged

Bear Hedged, understandably, is maximally long duration and in less of a flattener than Bull Hedged. This position is largely neutral in the bullish and Status Quo scenarios but improves returns substantially in Economy Up. With mortgage spreads widening in the bearish scenarios, the Bear Hedged portfolio also underweights mortgages. Between the curve positioning and the underweight in mortgages, Bear Hedged gets little roll-down return and displays a poor expected return from our tracking error analytics. Curve positioning accounts for almost all of the Bear Hedged portfolio's advantage over the index.

Status Quo Hedged

Status Quo Hedged is a carry machine, which is a sensible path to take when pursuing returns in scenarios with little movement to rates. It maximizes carry by going long duration and concentrating exposure in the three- to ten-year part of the curve where roll-down returns are very high on a duration-standardized basis. The portfolio also overweights mortgages, but not to quite the extent as Bull Hedged.

The Scenarios

Creating scenarios does not necessarily take a lot of imagination these days. We address some of the major themes buffeting markets: the fate of the US economy, Europe's debt crisis and the actions of the Fed. If the economy improves markedly, rates climb rapidly. If it holds steady, but there is no new QE, we get modestly higher rates. A deteriorating Europe causes rates to achieve new lows. In the case that conditions warrant a new QE program on the part of the Fed, rates fall a little and mortgage spreads tighten on the Fed's buying. It is worth noting that because of current depressed levels, our scenarios have front-end rates rising more than falling. The moves are more symmetric at the long end. Spreads widen more than tighten but vols fall a little more than they rise.

Economy Up

The recovery gets some legs, and rates rise on the prospect. The curve steepens, with 2s10s 44bp steeper. The 30-year yield rises 64bp. Swap spreads and mortgage spreads widen substantially, but agencies tighten moderately. Yield vol drops.

Status Quo

Economic conditions don't warrant action by the Fed, but don't inspire any great exuberance. Rates rise modestly, along with mortgage spreads. Agencies tighten marginally and yield vol falls.

Figure 4. Treasury and Swap Spread Scenarios for the Next Three Months — Levels as of 20 Aug 12 (In Percent)

Parameter	20 Aug 12	Level					Change				
		Economy	Status	Bad	QE3	Forward	Economy	Status	Bad	QE3	Forward
		Up	Quo	Euro			Up	Quo	Euro		
Fed Funds ^a	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.00	0.00	0.00	0.00
3-Mo T-Bill	0.10	0.10	0.10	0.10	0.10	0.15	0.00	0.00	0.00	0.00	0.06
2-Yr Treasury Yield	0.28	0.45	0.31	0.25	0.26	0.33	0.17	0.03	-0.03	-0.02	0.05
5-Yr Treasury Yield	0.79	1.31	0.93	0.51	0.64	0.89	0.51	0.14	-0.28	-0.15	0.10
10-Yr Treasury Yield	1.81	2.41	2.00	1.24	1.61	1.90	0.60	0.19	-0.57	-0.20	0.09
30-Yr Treasury Yield	2.93	3.57	3.13	2.29	2.78	2.96	0.64	0.20	-0.64	-0.15	0.04
Fed Funds2s	0.03	0.20	0.06	0.00	0.01	0.08	0.17	0.03	-0.03	-0.02	0.05
2s5s Slope	0.51	0.86	0.62	0.26	0.38	0.56	0.35	0.11	-0.25	-0.13	0.05
5s10s Slope	1.02	1.11	1.07	0.73	0.97	1.02	0.09	0.05	-0.29	-0.05	0.00
2s10s Slope	1.53	1.97	1.69	0.99	1.35	1.58	0.44	0.16	-0.54	-0.18	0.05
10s30s Slope	1.11	1.16	1.12	1.04	1.16	1.06	0.04	0.01	-0.07	0.05	-0.06
1yr x 10yr Swaption Yield Vol	40.18	34.12	36.26	47.94	40.20	40.18	-6.06	-3.92	7.76	0.02	0.00
2-Yr swap Spread (bp)	21.3	23.3	20.3	31.3	21.3	21.3	2.0	-1.0	10.0	0.0	0.0
5-Yr swap Spread (bp)	20.3	23.3	18.9	29.9	19.4	20.3	3.0	-1.4	9.6	-0.9	0.0
10-Yr swap Spread (bp)	10.8	17.8	7.8	15.8	5.8	10.8	7.0	-3.0	5.0	-5.0	0.0

^a The actual Fed target is a range between 0% and 0.25%.

Source: Citi Research

Bad Euro

The situation in Europe deteriorates, but dissolution is still not imminent. Treasury yields drop, led by the 30-year down 64bp. 2s10s flattens 54bp. Mortgages tighten, and yield vol rises.

QE3

As the path of economic recovery remains parlous, the Fed implements a mortgage-centric QE3 program. Mortgage spreads tighten, especially for production coupons. Rates fall modestly. Agency spreads and yield volatility are little changed.

Forwards Scenario

Three-month forwards imply a modest rise in rates, with steepening at the front end and flattening at the long end. We have no change volatility or spreads.

Figure 5. Spread Change Projections by Scenario, Swaps, Bullet, Callable Agencies and Pass-Throughs, 20 Aug 12 (In Basis Points)

	Economy Up	Status Quo	Bad Euro	QE3	Forward
Swap Spreads					
2-Yr	2.0	-1.0	10.0	0.0	0.0
5-Yr	3.0	-1.4	9.6	-0.9	0.0
10-Yr	7.0	-3.0	5.0	-5.0	0.0
Agencies					
2-Yr. Bullet	-0.6	-0.6	2.0	0.2	0.0
5-Yr Bullet	-1.4	-1.6	3.0	0.4	0.0
10-Yr Bullet	-3.9	-2.7	5.0	1.4	0.0
0-3-Yr Callable	-0.6	-0.6	2.0	0.2	0.0
3-5-Yr Callable	-0.8	-1.7	2.6	-0.1	0.0
5+Yr Callable	-3.9	-2.7	5.0	1.4	0.0
Mortgages					
15yr 3%-	18.8	7.1	-9.8	-16.3	1.8
15yr 3.5%	22.4	8.9	-11.7	-21.5	1.9
15yr 4%	22.4	8.6	-11.7	-20.0	2.1
15yr 4.5%	19.5	6.7	-10.3	-13.2	2.5
15yr 5%+	10.5	3.8	-5.5	-8.3	1.1
30yr 3.5%-	17.8	6.8	-9.3	-15.3	1.7
30yr 4%	26.7	9.9	-14.0	-21.9	2.8
30yr 4.5%	20.3	8.4	-10.5	-21.1	1.4
30yr 5%	5.2	3.3	-2.5	-11.3	-0.5
30yr 5.5%+	-2.0	0.9	1.4	-7.3	-1.6

Source: Citi Research

Bull Hedged – Gotta Get the Curve and Spread Right

Bull Hedged is in a short-duration flattener, long spread duration and negatively convex.

Our chosen portfolio, Bull Hedged, benefits from carry – largely the result of overweighting mortgages – but excels in the bullish scenarios as a result of its flattening curve position and overweight in mortgages.

- **Bull Hedged is short duration and in a pronounced flattener.** (Figure 3). Bull Hedged may be substantially short duration, but its curve position – underweight the two- to five-year area and overweight the seven- to twenty-year area – is the bigger factor in the flattening, bullish scenarios. It holds only a minimal amount of two- or three-year bonds and its only principal exposure in the four- to five-year area comes from mortgages. On the other hand, Bull Hedged overweights the seven-year in agency bullets and the ten- to twenty-year areas as a result of its Treasuries. A big position in a 1.25-year Treasury and no exposure past the Feb '36 bond keep duration short.
- **The Bull Hedged portfolio is long mortgage spread exposure, and overweight 30yr collateral.** Overweighting mortgages overall improves the yield and carry of the portfolio. The mortgage exposure is not subtle. Our scenarios have spreads tightening in the bullish scenarios, substantially so in QE3. Thus, the overweight helps boost returns in Bad Euro and QE3. Conversely, spreads widen in the bearish scenarios to the detriment of the portfolio's returns. What appears to be an up-in-coupon bias to the portfolio is actually an artifact of its overweight in 30yr collateral. Within 30yr mortgages, the portfolio's average coupon is actually marginally lower than the index's. This is an expected outcome of preventing the spread-duration weight of 5.5% or higher coupons from exceeding that of the index.

Figure 6. Overweight/Underweight: Optimal Portfolio Versus the Index Spread Duration Dollars by Sector, Assuming a \$100 Million Portfolio, 3-Mo. Horizon, 20 Aug 12

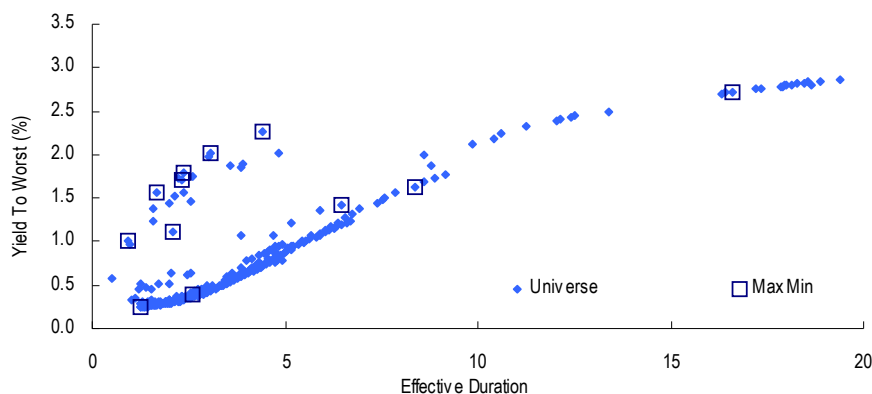
	Over/Underweight Spread Duration Dollars, 20 Aug 12 (In Basis Points)								
	Hedged				Maximize				
	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
Total	0.11	0.19	-0.03	0.16	-0.13	0.00	0.18	0.19	0.19
Treasury	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agency — Bullet	-0.03	-0.03	-0.03	-0.03	-0.02	-0.03	-0.03	-0.03	-0.03
Agency — Callable	0.06	0.05	0.06	0.06	0.05	0.06	0.06	0.06	0.06
Collateralized	0.08	0.16	-0.06	0.13	-0.16	-0.03	0.15	0.16	0.16

	Over/Underweight Spread Duration Dollars (% Over/Underweight), 20 Aug 12								
	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
	6	10	-2	9	-7	0	10	10	10
Total	6	10	-2	9	-7	0	10	10	10
Agency — Bullet	-10	-9	-10	-10	-8	-10	-10	-10	-10
Agency — Callable	1917	1793	1917	1917	1710	1917	1917	1917	1917
Collateralized	5	10	-4	8	-10	-2	10	10	10

Source: Citi Research

- **Bull Hedged underweights the agency bullet sector but maximally overweights callables.** Agency bullet spreads are tight, especially at the front end. As a result, the optimization underweights agency bullets on a market and spread basis. However, while agencies are tight, they also have displayed very little spread volatility. Our scenarios reflect this, and Bull Hedged takes advantage of the lack of spread movement with a large spread-duration overweight in a premium 9.5nc6m. While providing a big yield pickup relative to bullets, this bond does come with a mortgage-sized negative convexity.
- **Bull Hedged is negatively convex.** Overweighting mortgages and callables agencies makes the portfolio maximally negatively convex, which improves returns as volatility falls in the Economy Up scenario. However, the same position also drags down returns in the more extreme scenarios as duration shifts out of favor.

Figure 7. Yield-to-Worst Versus Effective Duration, Securities Universe and Bonds Included in Maxmin Portfolio, 20 Aug 12



Source: Citi Research

Figure 8. Optimal Portfolio Weightings by Issue, 3-Mo. Horizon, 20 Aug 12 (In Percent)

					Hedged		Maximize						
Description	Coupon (%)	Maturity	Next Call	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward	
US Treasuries													
US Treasury	2	11/30/2013		13.6	20.0	20.0				3.7			
US Treasury	0.25	9/15/2014							5.4				
US Treasury	0.25	2/15/2015						20.0					
US Treasury	4.125	5/15/2015		16.9		12.7						20.0	
US Treasury	4.5	11/15/2015			5.6		16.6						
US Treasury	2.125	12/31/2015						20.0					
US Treasury	2.375	3/31/2016					17.3						
US Treasury	1.5	7/31/2016							13.0				
US Treasury	1	9/30/2016							20.0				
US Treasury	1	10/31/2016							8.0				
US Treasury	4.625	11/15/2016										17.4	
US Treasury	0.875	4/30/2017						14.7					
US Treasury	2.75	2/28/2018									16.3		
US Treasury	3.125	5/15/2021				14.8							
US Treasury	2.125	8/15/2021		14.2	14.8		10.7				15.0		
US Treasury	2	2/15/2022								12.0			
US Treasury	4.5	2/15/2036			5.4						5.2	8.3	
US Treasury	4.75	2/15/2037		4.9									
US Treasury	5	5/15/2037				5.0							
US Treasury	4.375	2/15/2038					4.6		4.5				
US Treasury	3.5	2/15/2039								10.5			
US Treasury	3.125	2/15/2042						3.7					
Agency Bullets													
FHLB	0.375	11/27/2013								1.0			
Freddie Mac	0.375	11/27/2013								19.3			
Fannie Mae	2.875	12/11/2013									10.5		
Fannie Mae	1.25	9/28/2016							6.5				
Freddie Mac	5.125	11/17/2017									2.6		
Freddie Mac	4.875	6/13/2018										5.0	
Freddie Mac	1.75	5/30/2019		4.1	4.1								
Freddie Mac	2.375	1/13/2022				3.1	3.1	3.1					
Agency Callables													
Fannie Mae	2.7	3/28/2022	3/28/2013	3.3	3.1		3.3		3.3			3.3	
Freddie Mac	2	7/17/2017	7/17/2013							5.1	5.1		
Freddie Mac	3	7/31/2019	7/31/2013			5.1							
Freddie Mac	0.55	2/13/2015	2/13/2014					2.8					
MBS													
Fannie Mae TBA	3	15-Year						1.7					
Fannie Mae TBA	3.5	15-Year								4.0	3.8	3.8	
Fannie Mae TBA	4	15-Year			1.8								
Fannie Mae TBA	4.5	15-Year		2.2	2.4	2.0	2.3			2.5	2.4	2.4	
Fannie Mae TBA	3.5	30-Year		5.3		4.9	5.5		4.9			5.7	
Fannie Mae TBA	4	30-Year		7.6	12.3	6.9	7.8	6.4	9.0	10.5	15.0	4.3	
Fannie Mae TBA	4.5	30-Year		12.0	13.1	11.0	12.4	9.9	11.0	13.5	12.6	12.8	
Fannie Mae TBA	5	30-Year								7.6			
Fannie Mae TBA	5.5	30-Year		9.1	9.9	8.3	9.4	7.5	8.3	10.2		9.7	
Fannie Mae TBA	6	30-Year									4.4		
Ginnie Mae TBA	3.5	30-Year						4.4					
Ginnie Mae TBA	5	30-Year		6.8	7.4	6.2	7.0	5.6	6.2		7.2	7.3	

Source: Citi Research

Tracking Error

The Maxmin, Status Quo Hedged, and Maximize Status Quo portfolios dominate the tracking error results (see Figure 9). Maxmin has the lowest projected tracking error, followed by Maximize Forward. Maximize Status Quo has the best expected return by a wide margin, but its tracking error is in the bottom half of our portfolios. Its information ratio is in a virtual tie for the top spot with Status Quo Hedged, which has the next-best expected return and the third-lowest tracking error.

Bull Hedged displays decent tracking error characteristics, with expected return and tracking error metrics coming in much closer to the best portfolios than to the worst. In contrast, Bear Hedged rates towards the bottom of the pile in most categories.

The biggest contributors to expected return were overall duration and curve positioning. Being long duration and overweighting the seven-year or ten-year parts of the curve boost expected return, while oversized weights in the short end tend to reduce the expected return. Holding seven- or ten-year agency bullets also contributes to expected return.

Figure 9. Monthly Tracking Error of Optimal Solutions, 20 Aug 12

	Tracking Error Results Versus Index for Each Individual Solution								
	Hedged				Maximize				
	Maxmin	Bull	Bear	Status Quo	Economy Up	Status Quo	Bad Euro	QE3	Forward
Expected Return (bp)	0.5	0.6	-0.3	1.3	-1.3	0.0	0.4	2.3	-0.2
Tracking Error (bp)	3.9	7.0	6.1	5.6	12.3	11.8	22.6	10.0	4.4
Expected Return/Tracking Error	0.13	0.09		0.23		0.00	0.02	0.23	
Probability of Outperformance (%)	55.9	54.2	49.0	59.8	45.7	49.8	51.1	60.2	49.8

Source: Citi Research

Notes on Methodology

We constrain the mortgage sector to more closely resemble the index than in past optimizations.

In mortgages, we retain the methodology of using betas to rates and index spreads to determine coupon-specific changes to mortgage spreads in each scenario. This causes higher coupons to outperform lower coupons when rates rise but underperform them when rates fall. In addition, because of the potential for housing policy to have dramatically different impacts on different mortgage coupons, we opt to constrain mortgage weights more severely relative to the index. In fact, we do not let the optimizations overweight the highly HARP-sensitive higher coupons.

Conclusion

Our Bull Hedged portfolio gets a boost from carry, but most of its return advantage in the bullish scenarios comes from curve positioning and overweighting mortgages. It may be short duration, but a pronounced flattening bias proves the more important factor. Underweighting the two- to five-year part of the curve improves returns more in the bearish scenarios more than it hurts returns in the bullish scenarios, as the front end of the curve rises more in the bears than it falls in the bulls. The mortgage overweight is responsible for much of the carry advantage of the portfolio and also boosts returns in the bullish scenarios, in which mortgage spreads tighten.

Optimizing a Treasury Portfolio

The Shorts Have Their Day

Martin Bernstein

- Our rates-only optimizations find that going short duration can improve portfolio characteristics, even in the case of bullish objectives.
- We recommend our short-duration Maxmin portfolio and also find the short-duration bullish solution worth consideration.
- Our portfolios tend to shorten duration and are consistently long in the ten-year partial duration bucket and short the five- and twenty- to thirty-year buckets.

To isolate the effects of duration and curve decisions from those of spread exposure, we repeat our scenario optimizations using only Treasury securities. We present duration-neutral and duration-biased solutions for each optimization theme.

Our recommendation: Stick to the Maxmin and go short duration.

We favor our short-duration Maxmin Treasury solution, which we project to outperform by 0.09% in the bearish scenarios and by 0.13 – 0.22% in the bullish scenarios (see Figure 10). It provides an attractive blend of uniformly good scenario returns and decent tracking error characteristics.

The short-duration Bull Hedged solution has the best tracking error results.

We also look at optimizations focusing separately on the bullish and bearish scenarios. The bull-hedged solutions provide substantially better projected returns in the bullish scenarios, especially Bad Euro, but at the expense of neutral returns in Economy Up. The duration-biased Bull Hedged portfolio defies expectations and goes short duration with the best tracking error characteristics of any of our solutions. This is a good solution for those willing to sacrifice returns in the Economy Up scenario. The bear-hedged solutions provide more modest improvements in their target scenarios than do the bull-hedged solutions. The duration-neutral Bear Hedged portfolio has the worst tracking error characteristics.

None of our solutions hold bonds past the ten-year area, and all have big overweights in the ten-year partial-duration bucket.

The matched-duration solutions bullet the ten-year.

The matched-duration solutions are all concentrated in the one- to ten-year part of the curve, with positions in 1.25-year, three- to four-year and 9- to 9.5-year tenors. The holdings at the long end are similar across the portfolios, but front-end weights vary more substantially. On a partial-duration basis relative to the Index, they are long ten-year area and short five- and twenty- to thirty-year buckets (see Figure 10).

The duration biased solutions are all short duration.

All of the duration-biased solutions shorten duration, reducing exposure in the three-year area, with more in shorter and longer tenors. The positive curve impact in Bad Euro from increasing the exposure at the longer end outweighs the overall duration impact. And while this same shift hurts the portfolios in Economy Up, the portfolios benefit from the shift out of the three-year area, especially the Bear Hedged portfolio.

Figure 10. Treasury Optimization Summary, 20 Aug 2012

	MaxMin		Bull Hedged		Bear Hedged	
	0	+/- .25	0	+/- .25	0	+/- .25
3-month Scenario Returns (%) versus Index						
Economy Up	0.10	0.09	0.00	0.00	0.12	0.19
Status Quo	0.10	0.09	0.07	0.05	0.12	0.11
Bad Euro	0.09	0.13	0.27	0.31	0.00	0.00
QE3	0.20	0.22	0.27	0.28	0.19	0.15
Forward	0.00	0.00	0.00	0.00	0.00	0.00
Yield / Risk Metrics versus Index						
Yield	-0.254	-0.213	-0.179	-0.167	-0.302	-0.240
Effective Duration	0.00	-0.12	0.00	-0.18	0.00	-0.25
Effective Convexity	-0.3	-0.3	-0.2	-0.2	-0.3	-0.3
Tracking Error Metrics (bp/month) versus Index						
Expected Return	3.1	3.1	3.6	3.2	3.4	2.2
Standard Deviation	9.0	5.4	6.9	4.2	11.5	5.2
Information Ratio	0.34	0.57	0.52	0.76	0.30	0.42
Prob. of Outperformance (%)	63.8	72.0	70.9	79.5	61.5	67.1
Partial Duration Exposure						
1-Yr	-0.11	0.07	0.09	0.23	-0.08	-0.01
2-Yr	-0.05	-0.29	-0.28	-0.24	-0.33	-0.02
3-Yr	0.35	0.13	-0.02	-0.58	0.60	0.08
5-Yr	-0.85	-0.77	-0.79	-0.85	-0.58	-0.86
7-Yr	-0.05	-0.04	0.03	0.83	-0.10	-0.07
10-Yr	2.71	2.77	2.95	2.41	2.47	2.62
20-Yr	-0.62	-0.62	-0.62	-0.62	-0.62	-0.62
30-Yr	-1.37	-1.37	-1.37	-1.37	-1.37	-1.37

Source: Citi Research

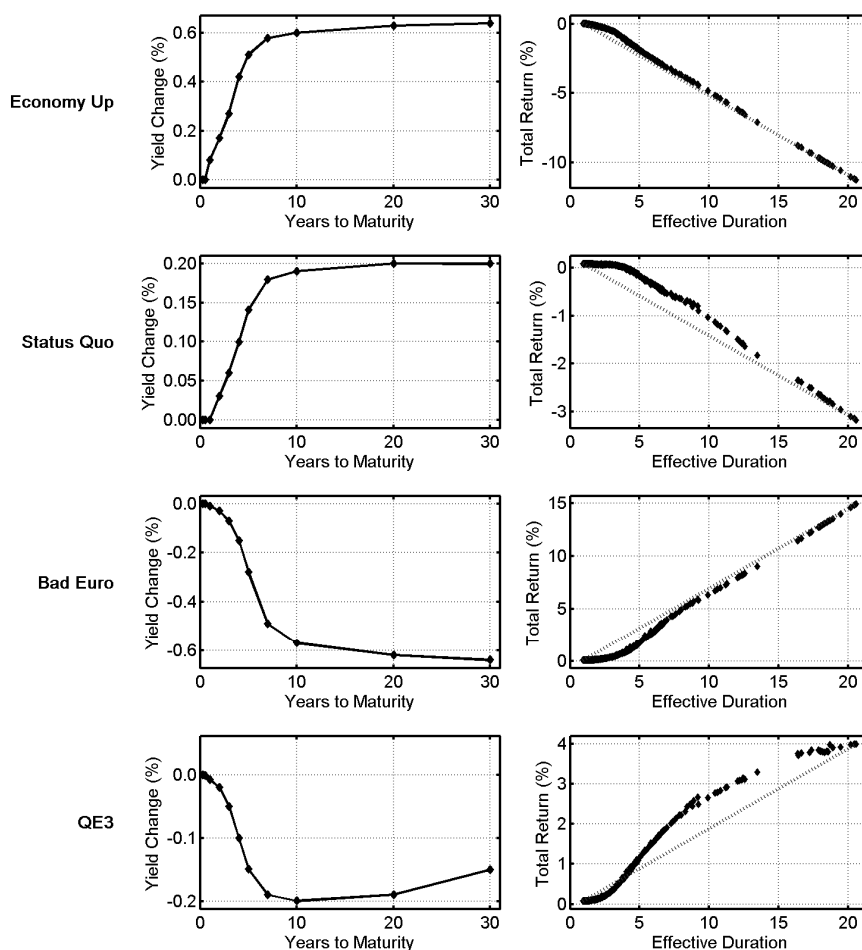
Our scenarios are biased toward bull flattening.

Our new scenarios are unusually symmetric at the long end but with a bias towards higher rates at the front end. The average shift across the ten- to thirty-year part of the curve is approximately 1bp. However, in the two- to five-year area, the average shift ranges from 4bp to 7bp. Economy Up and Bad Euro, a bear steepener and bear flattener respectively, are the two biggest scenarios (see Figure 11). They are well balance at the long end, but with front-end rates so low Economy Up sells off rather more in the two- to five-year area than Bad Euro rallies. Status Quo and QE3 are more modest scenarios.

- Across the curve, the biggest spreads in rate moves are in the 30-year area, with Economy Up and Bad Euro having the most extreme bearish and bullish moves, respectively.
- On average, 5s10s flattens 5bp and 10s30s remains unchanged.

In Figure 11, we show the yield changes (left column), along with Treasury returns versus effective duration under each scenario (see descriptions in the “Optimal Portfolio Analysis” section). The solid lines are the returns of the individual securities, while the dashed lines correspond to barbells.

Figure 11. Yield Changes and 3-Mo. Total Returns of Treasuries in Our Scenarios, 20 Aug 2012



Source: Citi Research

Maxmin – A Little Shortening

The matched-duration Maxmin optimization is projected to outperform the index by 0.09 – 0.10% in Economy Up, Status Quo and Bad Euro and by 0.20% in QE3 (see Figure 13). The solution has 49% and 46% weights in three- and 9.5-year securities, respectively, with a modest allocation in a one-year (see Figure 12). The massive weight in the ten-year area is great for roll-down return, and the expected return in our tracking analytics is 3.1bp/month. However, with no long-end holdings, the tracking error is 9.0bp, giving the portfolio an information ratio (expected return divided by standard deviation) of 0.34. The projected probability of outperformance is 64%.

When we allow the duration to vary from index duration, returns in the Economy Up and Status Quo scenarios decline 0.01%, but this is offset by 0.04% and 0.01% improvements in Bad Euro and QE3, respectively. This solution shortens duration by 0.12-years, moving some of the three-year exposure into the one- and 9.5-year Treasuries. The more barbelled position improves returns in the flatteners. Diversifying the curve exposure reduces the tracking error substantially, with corresponding increases in the information ratio and probability of outperformance. The change in returns is modest, but the reduced risk makes shortening duration worthwhile.

Figure 12. Market Value Weights of the Issues in the Optimal Maxmin Treasury Portfolio, 3-Mo. Time Horizon, 20 Aug 2012

Coupon (%)	Maturity	Market Weight Versus Allowable Duration Difference	
		0	±0.25
2	Nov-13	4.7	25.0
4.125	May-15	44.9	
4.5	Nov-15	4.2	28.0
2	Feb-22	46.2	47.0
Total		100	100
Index			
Effective Duration	5.52	0.00	-0.12

Source: Citi Research

Figure 13. 3-Mo. Projected Performance of the Optimal Maxmin Treasury Portfolios Versus the Citigroup Treasury Index as a Function of Duration, 20 Aug 2012

Allowable Duration Difference	Total ROR Pickup Under Scenarios (%)				
	Economy Up	Status Quo	Bad Euro	QE3	Forward
0	0.10	0.10	0.09	0.20	0.00
±0.25	0.09	0.09	0.13	0.22	0.00

ROR: Rate of Return

Source: Citi Research

Bull Hedged — Defying Expectations

The duration-matched Bull Hedged solution holds most of the same bonds as the short-duration Maxmin solution, but with more at the wings. It outperforms the index by 0.27% in the bullish scenarios, as a result of the larger long-end position, and by 0.07% in Status Quo. It only matches the index in Economy Up (see Figure 15). Bull Hedged holds 28% in the one-year and 50% in the 9.5-year, having reduced its weight in the three-year to 22% (see Figure 14). Its tracking error analytics are intermediate between the two Maxmin solutions.

The duration-biased Bull Hedged portfolio shortens duration by 0.18 years and goes into the most extreme barbell of any of our solutions. It holds 56% of its weight in the nine-year and 44% in the one-year, with no three-year exposure. More long-end exposure allows it to take more advantage of the flattening bullish scenarios, despite shortening duration overall. Getting out of the three-year area helps more in Economy Up than it hurts in Bad Euro. This solution has the lowest tracking error risk of any of our solutions, with the best information ratio and probability of outperformance.

Figure 14. Market Value Weights of the Issues in the Optimal Bull Hedged Treasury Portfolio, 3-Mo. Time Horizon, 20 Aug 2012

Coupon (%)	Maturity	Market Weight Versus Allowable Duration Difference	
		0	±0.25
2	Nov-13	27.8	43.8
4.5	Nov-15	22.2	
2.125	Aug-21		56.2
2	Nov-21	3.7	
2	Feb-22	46.3	
Total		100	100
Index			
Effective Duration	5.52	0.00	-0.18

Source: Citi Research

Figure 15. 3-Mo. Projected Performance of the Optimal Bull Hedged Treasury Portfolio Versus the Citigroup Treasury Index as a Function of Duration, 20 Aug 2012

Allowable Duration Difference	Total ROR Pickup Under Scenarios (%)				
	Economy Up	Status Quo	Bad Euro	QE3	Forward
0	0.00	0.07	0.27	0.27	0.00
±0.25	0.00	0.05	0.31	0.28	0.00

ROR: Rate of Return

Source: Citi Research

Bear Hedged — Going Short, Whole-hog

The duration-matched Bear Hedged portfolio improves projected returns by 0.02% in Economy Up and Status Quo relative to the duration-matched Maxmin, but at the expense of a neutral return in Bad Euro (sees Figure 17). It accomplishes this by shifting a little out of the long end into the short end and offsetting the duration by extending the three-year exposure out to the four-year area (see Figure 16). This solution has the worst tracking error characteristics of any of the solutions.

As expected, the duration-biased Bear Hedged solution shortens duration by 0.25-years to further improve projected return in Economy Up by 0.07%. It gives up a little in QE3 relative to its duration-matched counterpart. It moves out of the five-year area altogether, with 19% in the 1.5-year area, 36% in a three-year bond and 45% at 9.5-year tenor. Eschewing the five-year decreases roll-down return and reduces the tracking error expected return metric. However, this position reduces tracking error risk and produces a better information ratio than the duration-matched Bear Hedged solution.

Figure 16. Market-Value Weights of the Issues in the Optimal Bear Hedged Treasury Portfolio, 3-Mo. Time Horizon, 20 Aug 2012

Coupon (%)	Maturity	Market Weight Versus Allowable Duration Difference	
		0	±0.25
2	Nov-13	8.3	
1.75	Jan-14		18.9
4.125	May-15		36.1
4.5	Nov-15	34.5	
5.125	May-16	14.2	
2	Feb-22	43.0	45.0
Index			
Effective Duration	5.52	0.00	-0.25

Source: Citi Research

Figure 17. 3-Mo. Projected Performance of the Optimal Bear Hedged Treasury Portfolio Versus the Citigroup Treasury Index as a Function of Duration, 20 Aug Mar 2012

Allowable Duration Difference	Total ROR Pickup Under Scenarios (%)				
	Economy Up	Status Quo	Bad Euro	QE3	Forward
0	0.12	0.12	0.00	0.19	0.00
±0.25	0.19	0.11	0.00	0.15	0.00

ROR: Rate of Return

Source: Citi Research

Optimal Treasury/Agency Portfolios

Stick to Maxmin

- We provide optimized portfolios for two additional popular indexes: the Treasury/Agency 1–10 Year and the Treasury/Agency 1–5 Year.
- We recommend the maxmin solutions for both Treasury/Agency indexes.

Martin Bernstein

In addition to our core optimizations, which are designed to outperform the Citi BIG Less Credit Index, we created portfolios for two additional indexes: the Treasury/Agency 1–10 Year and 1–5 Year indexes. For each index we compare “maxmin” and “bull-hedged” strategies. The maxmin optimizations strive to “maximize the minimum return” across all scenarios. The bull hedged portfolios maximize returns in the Bad Euro and QE3 scenarios while at least matching the benchmark in the Economy Up and Status Quo scenarios.

We recommend the Maxmin solutions for the Treasury/Agency indexes. The 1–10 Year Treasury/Agency Maxmin solution is projected to return 0.08% in Bad Euro and 0.02% in the other scenarios. We project 0.01% returns in all four scenarios for 1-5 Year Maxmin. The bull hedged solutions might gain more in the bullish scenarios than they lose in the bearish scenarios, but the maxmin solutions are better-positioned for roll-down return. In addition, for both indexes, our tracking error analytics project higher expected returns and lower risk for the maxmin solutions relative to their bull hedged counterparts.

Figure 18. Differences in Portfolio and Index Returns and Risk Measures, 3-Mo. Horizon, 20 Aug 12

	BIG Less Credit		Tsy/Agency 1-10 Year		Tsy/Agency 1-5 Year	
	Maxmin	Bull Hedged	Maxmin	Bull Hedged	Maxmin	Bull Hedged
Return Versus Index Scenario (in %)						
Economy Up	0.03	0.00	0.02	0.00	0.01	0.00
Status Quo	0.03	0.02	0.02	0.00	0.01	0.00
Bad Euro	0.05	0.09	0.08	0.14	0.01	0.05
QE3	0.06	0.10	0.02	0.03	0.01	0.02
Forward	0.02	0.02	0.01	0.01	0.01	0.01
Index Exposure						
Effective Duration	4.08		3.60		2.55	
Convexity	-0.5		0.2		0.1	
Macro Exposure Versus Index						
Effective Duration	-0.10	-0.19	0.05	-0.05	-0.01	-0.16
Spread Duration	0.11	0.19	0.03	0.03	0.03	0.03
Convexity	-0.2	-0.3	-0.1	-0.1	0.0	-0.1
Tracking Error Metrics (bp/month) Versus Index						
Expected Return	0.5	0.6	0.6	0.3	0.6	0.2
Standard Deviation	3.9	7.0	3.8	6.5	2.5	4.7
Information Ratio	0.13	0.09	0.16	0.05	0.24	0.04
Prob. of Outperformance (%)	55.9	54.2	55.9	51.6	58.7	51.5
Sector Allocation: Spread (Effective for Treasuries) Duration Dollars Versus Index						
Treasury	-6	-9	0	-3	-2	-9
Agency	10	10	10	10	10	10
Mortgage	5	10				

Source: Citi Research

Figure 19. Partial Duration Differences of the Supplemental Maxmin and Bull Hedged Portfolios Versus Respective Indexes, 20 Aug 12

Treasury/Agency 1-10yr							
Portfolio	Eff. Dur.	Partial Durations					
		1yr	2yr	3yr	5yr	7yr	10yr
Maxmin	0.05	0.07	-0.33	0.49	-0.50	-0.18	0.50
Bull Hedged	0.04	0.07	-0.34	0.50	-0.23	-0.47	0.50

Treasury/Agency 1-5yr							
Portfolio	Eff. Dur.	Partial Durations					
		1yr	2yr	3yr	4yr	5yr	
Maxmin	-0.01	0.11	-0.45	0.38	-0.08	0.02	
Bull Hedged	0.03	0.08	-0.46	0.50	0.01	-0.10	

Source: Citi Research

Maxmin Solutions

- The Treasury/Agency 1–10 Year Maxmin solution is projected to outperform the index by 0.08% in Bad Euro and by 0.02% in the other scenarios. We project that the 1–5 Year Maxmin should beat the index by a meager 0.01%.
- Carry and rolldown are important factors, while curve positioning boosts returns in Bad Euro for the 1–10 Year solution.
- The 1–10 Year Maxmin is 0.05 years long duration relative to the index, while the 1–5 Year version is 0.01 years short. Both are modestly long spread duration and negatively convex relative to the indexes.
- In curve exposure, the 1–10 Year solution overweights the three- and ten-year partial duration buckets, with a small overweight in the one-year area. The 1–5 Year is long the one-year and four-year buckets. Like the BIG Less Corporate Maxmin, they both avoid the five-year area.
- Both Maxmin solutions are substantially overweight callable agencies on a market and spread-duration basis. In both cases, they opt for premium callables at their longest allowed maturities.
- Both are maximally underweight agency bullets. The 1–10 Year Maxmin holds a small position in the ten-year Freddie Mac, while the 1–5 Year Maxmin splits its exposure between a 1.5-year bond and a five-year bond.

Bull Hedged Solutions

- We project substantially better returns in Bad Euro for both bull-hedged solutions, but at the cost of neutral returns in Economy Up and Status Quo. We project modest improvements in QE3. They rely less on rolldown than the maxmins.
- Counter intuitively, the bull-hedged solutions go short duration. However, this is in line with optimizations for the BIG Less Corporate and Treasury Indexes.
- The bull-hedged solutions reduce their long exposure in middle maturities to increase their long exposure at the wings, relative to the maxmin portfolios. This boosts returns in the flattening Bad Euro scenario, despite shortening duration.
- The bull-hedged solutions hold the same callables as their maxmin counterparts, and the 1–10 Year Bull Hedged portfolio also holds the same bullet. The 1–5 Year

version still holds the five-year bond but moves some of the 1.5-year exposure into a four-year bond.

Figure 20. Optimal Portfolio Weightings by Issue, 3-Mo. Horizon, 20 Aug (in Percent)

Tsy/Agency 1–10 Year					
Description	Coupon (%)	Maturity	Next Call	Maxmin	Bull Hedged
US Treasuries					
US Treasury	2	11/30/2013		20.0	20.0
US Treasury	0.75	12/15/2013		6.3	7.5
US Treasury	4.5	11/15/2015		20.0	
US Treasury	4.5	2/15/2016		20.0	
US Treasury	2.625	4/30/2016			2.8
US Treasury	5.125	5/15/2016		6.7	20.0
US Treasury	1.75	5/31/2016			20.0
US Treasury	1.5	6/30/2016			11.4
US Treasury	4.5	5/15/2017		4.4	
US Treasury	1	6/30/2019		3.2	
US Treasury	2.125	8/15/2021		12.8	3.9
US Treasury	2	11/15/2021			7.7
Agency Bullets					
Freddie Mac	2.375	1/13/2022		3.2	3.2
Agency Callables					
Freddie Mac	2.7	3/28/2022	3/28/2013	3.5	3.5
Tsy/Agency 1–5 Year					
Description	Coupon (%)	Maturity	Next Call	Maxmin	Bull Hedged
US Treasuries					
US Treasury	2	11/30/2013		20.0	20.0
US Treasury	0.75	12/15/2013		3.0	4.9
US Treasury	4.5	11/15/2015		20.0	20.0
US Treasury	2.125	12/31/2015		6.1	12.0
US Treasury	4.5	2/15/2016		20.0	20.0
US Treasury	4.5	5/15/2017		10.6	6.4
Agency Bullets					
Fannie Mae	2.875	12/11/2013		12.9	7.5
Fannie Mae	1.25	9/28/2016			1.8
Freddie Mac	1.25	5/12/2017		2.1	2.1
Agency Callables					
Freddie Mac	2	7/17/2017	7/17/2013	5.4	5.4

Source: Citi Research

Portfolio Update

Period Returns

- Our recommended portfolio, Status Quo Hedged, trailed the index by 0.07%. Maxmin and Forward lost by 0.16% and 0.09%, respectively.
- Over the past twelve months, the Maxmin portfolios have trailed the index by 0.21%, and the Aggressive and Forward portfolios have underperformed by 0.12% and 0.20%, respectively.

Martin Bernstein

Since their introduction in April, we have tracked three optimized solutions: our recommended portfolio, Status Quo Hedged, as well as the Maxmin portfolio and a Forward portfolio. All three portfolios trailed the index. Status Quo Hedged turned in the best performance, underperforming the index by 0.07%, while Maxmin was down 0.16% and Forward lost 0.09%.

Looking back at our quarterly report from April,¹ the Oil Shock scenario most closely resembled the actual rate move experienced. Oil Shock had the general magnitude of the shift right, but underestimated the decline in the ten-year area and had a little too much of a rally at the long end. At the late-July peak of the rally, however, rates at the long end were some 25bp lower than on 27 August.

Yield volatility climbed 5.8%, in line with the Oil Shock scenario, and with the big fall in rates, basis point vol fell 10.9bp. In spreads, mortgages widened, especially at higher coupons. This was a big departure from Oil Shock, which had mortgages tightening. Agency bullet spreads mostly tightened. Swap spreads widened for the first half of the period but then tightened, with two- and five-year spreads ending the period tighter and ten-year spreads wider.

The biggest factor influencing returns over the period was mortgage spreads. All three portfolios were overweight high coupons, which widened significantly during the period and dragged down returns for our portfolios. Curve reshaping reduced returns for Status Quo Hedged and Maxmin but benefited Forward. Status Quo Hedge spent much of the period long duration and made up some ground as a result of the big decline in Treasury rates.

The Maxmin portfolios have trailed the index by 0.16% over the past twelve months, and the Aggressive and Forward portfolios have underperformed by 0.07% and 0.09%, respectively.

Figure 21. Contributions of Curve, Spread and Vol Factors to Portfolio Returns Versus Index, 31 Mar 12 – 27 Aug 12 (Returns in Percent)

Portfolio	Yield Curve				Spread			Vol + Convexity	Total Return
	Parallel Shift	Curve Reshape	Other	Total	Change	Other	Total		
Status Quo Hedged	0.14	-0.07	0.00	0.07	-0.11	0.02	-0.08	-0.06	-0.07
Maxmin	0.02	-0.06	-0.01	-0.06	-0.09	0.05	-0.05	-0.05	-0.16
Forward	0.00	0.07	-0.06	0.00	-0.04	0.00	-0.04	-0.05	-0.09

Source: Citi Research

¹ "Bond Portfolio Analysis Quarterly", 2 April 2012

Curve Returns

As mentioned above, the curve move during the period was a substantial bull-flattener. The ten-year yield fell 61bp, with 2s and 5s down 9bp and 36bp, respectively. The 30-year yield declined 58bp.

Status Quo Hedged started the period maximally long duration, and while it shortened during the period, it still gained 0.14% from parallel shift return as a result of the big rally. The Maxmin and Forward portfolios were little changed by parallel shift, having started with smaller long biases and ending the period short duration.

Reshaping at the front end was substantial, with 2s10s flattening 52bp and 5s10s flattening 25bp. Status Quo Hedged and Maxmin, both of which spent much of the period net long in the two- to five-year part of the curve, lost 0.06 – 0.07% from reshaping. The Forward portfolio was net short at the front end and gained 0.07% from reshaping. With minimal reshaping from 10s to 30s, curve exposure at the long end was not a factor.

Spread Advantage Returns

Spread effects dragged down returns for all three portfolios, with Status Quo Hedged losing 0.14% and Maxmin and Forward down 0.09%. Overweighting spread product overall helped the portfolios, and they gained ground from the resulting carry advantage. However, issue selection within the mortgage and agency sectors proved less helpful.

Most of the portfolios' spread shortfall resulted from issue selection within the mortgage sector. The portfolios were overweight 30yr 5s, 5.5s and 6s, all of which widened significantly more than the index as a whole. The Forward portfolio had the smallest up-in-coupon bias and lost the least from mortgage issue selection.

However, Forward also lost ground from issue selection in the agency bullet sector as a result of holding short agency bullets rather than the seven-year bonds in Status Quo Hedged and Maxmin. While the spread of the Forward portfolio's 1.5-year agency tightened modestly more than the sector as a whole, its short duration prevented it from taking full advantage of the tightening. The seven-year bonds held by Status Quo Hedged and Maxmin performed in line with the sector.

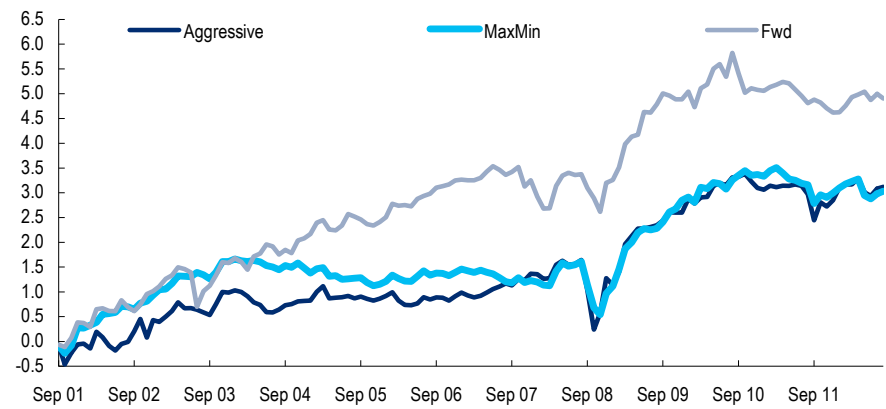
Callable agencies had little impact on returns for the period.

Figure 22. Returns Versus Index, Aug 11 – 27 Aug 12 (In Percent)

Portfolio	Yield Curve				Spread			Vol + Convexity	Total Return
	Parallel Shift	Curve Reshape	Other	Total	Change	Other	Total		
Aggressive	0.08	-0.13	0.09	0.04	-0.04	0.04	0.00	-0.15	-0.12
Maxmin	0.04	-0.10	0.06	-0.01	-0.06	0.05	-0.01	-0.18	-0.21
Forward	-0.07	0.11	-0.15	-0.12	0.04	0.12	0.16	-0.24	-0.20

Source: Citi Research

Figure 23. Cumulative Return Versus Index, Sep 01– 27 Aug 12 (Returns in Percent)



Source: Citi Research

Appendix

Optimization Methodology

We continue to employ the flexible expected return methodology we unveiled in March 2006 (see Bond Portfolio Analysis Quarterly, March 1, 2006). We used probability-weighted expected returns to arrive at our hedged portfolios. Figure 24 shows the weights we used for the expected return optimizations and lays out the set of optimizations from which we chose the Maxmin and Hedged portfolios.

- In the first set of portfolios (Maximize), we maximize returns in one scenario without regard for returns in other scenarios. All of these are included in our analysis.
- The second set shows the traditional Maxmin solution and an alternative Maxmin that employs the expected return methodology. The Maxmin solution we track is shaded.
- We arrived at the third set of portfolios by maximizing expected returns using equal weights for all four scenarios. The first portfolio (MaxER) has no lower bound on returns for individual scenarios, and the subsequent portfolios have increasingly lower bounds.

In the remaining sets of portfolios, we try to find compelling hedged solutions:

- Each hedged solution focuses on a subset of the scenarios while limiting the downside in the other scenarios. First, we look at simple hedged solutions for each scenario, maximizing returns in one scenario and ensuring at least index returns in the other scenarios.
- Next we look at a Maxmin solution, in which we “Maxmin” returns relative to the benchmark for the target scenarios while keeping neutral (or modestly negative) or better returns in the other two scenarios.
- Then we start looking at solutions that maximize the expected returns using different weights, with and without neutral (or modestly negative) lower bounds for returns in the scenarios that we are not maximizing.
- We shade the portfolios that we selected to highlight.

Figure 24. 3-Mo. Returns Relative to the Treasury/Agency/MBS Index for Candidate Portfolios, 20 Aug 12

	3-Mo. Returns Relative to the Index						Weights				
	Economy Up	Status Quo	Bad Euro	QE3	Forward	Avg.	Wgt. Avg.	Economy Up	Status Quo	Bad Euro	QE3
Maximize											
Economy Up	0.29	0.09	-0.44	-0.17	-0.02	-0.061					
Status Quo	0.24	0.13	-0.51	-0.11	0.01	-0.063					
Bad Euro	-0.33	-0.13	0.58	0.14	0.01	0.067					
QE3	-0.30	-0.04	0.31	0.26	0.01	0.057					
Forward	0.09	0.05	-0.20	-0.02	0.03	-0.020					
Maxmin											
Maxmin	0.03	0.03	0.03	0.06	0.02	0.040					
MaxminER	0.03	0.03	0.05	0.06	0.02	0.043	0.043	0.25	0.25	0.25	0.25
Maximize Expected Return											
MaxER	-0.29	-0.08	0.51	0.21	0.02	0.087	0.087	0.25	0.25	0.25	0.25
MaxER0	0.00	0.01	0.12	0.09	0.02	0.054	0.054	0.25	0.25	0.25	0.25
MaxER1	0.01	0.01	0.11	0.08	0.02	0.052	0.052	0.25	0.25	0.25	0.25
MaxER2	0.02	0.02	0.08	0.08	0.01	0.049	0.049	0.25	0.25	0.25	0.25
MaxER3	0.03	0.03	0.05	0.07	0.02	0.046	0.046	0.25	0.25	0.25	0.25
MaxER3d	0.03	0.03	0.05	0.06	0.02	0.043	0.043	0.25	0.25	0.25	0.25
In a Range -- Status Quo Hedged											
Status Quo Hedged	0.00	0.05	0.00	0.08	0.02	0.033					
MaxMin	0.00	0.05	0.00	0.08	0.02	0.033					
ER	0.00	0.05	0.00	0.09	0.02	0.034	0.069	0.00	0.50	0.00	0.50
ER	0.00	0.03	0.07	0.10	0.02	0.048	0.056	0.10	0.40	0.10	0.40
QE3 Hedged	0.00	0.02	0.09	0.10	0.02	0.052					
Bears – Bear Hedged											
Economy Up Hedged	0.11	0.02	0.00	0.00	0.00	0.031					
MaxMin	0.05	0.04	0.00	0.05	0.02	0.036					
ER	0.11	0.03	0.00	0.00	0.00	0.033	0.066	0.50	0.50	0.00	0.00
ER	0.09	0.04	0.00	0.02	0.01	0.036	0.053	0.40	0.40	0.00	0.20
Status Quo Hedged	0.00	0.05	0.00	0.08	0.02	0.033					
Bulls – Bull Hedged											
Bad Euro Hedged	0.00	0.00	0.15	0.05	0.01	0.051					
MaxMin	0.00	0.01	0.10	0.10	0.01	0.053					
ER	0.00	0.00	0.13	0.09	0.01	0.054	0.108	0.00	0.00	0.50	0.50
ER	0.00	0.02	0.09	0.10	0.02	0.052	0.064	0.00	0.40	0.20	0.40
QE3 Hedged	0.00	0.02	0.09	0.10	0.02	0.052					

Source: Citi Research

The Universe

The universe of bonds from which we construct our portfolio consists of the following:

- One- to 30-year Treasury bullets (excluding higher-coupon bonds with low outstanding amounts);
- Liquid agency bullets with US\$3 billion or more outstanding (excluding TAPs);
- Recent agency callables with lockouts greater than six months and at least US\$500 million outstanding;
- 30-year FNMA TBAs and more liquid seasoned paper with coupons in the range of 3.5–6%;
- 30-year GNMA 3.5–5% TBAs; and

- 15-year FNMA TBAs and more liquid seasoned paper with coupons in the range of 3.0–4.5%.

Constraints for Optimization

To create realistic results, we constrain all portfolio solutions relative to our index.

Duration and convexity measures are constrained as follows:

- Effective duration ± 0.25 year versus the benchmark (± 0.10 for Maxmin);
- Spread duration ± 0.50 year versus the benchmark;
- Effective convexity ± 0.25 year versus the benchmark; and
- We keep partial durations to within ± 0.50 year of the index. In addition, we keep exposure in the 20- and 30-year partial duration buckets to at least 75% of the index value.

We also keep sector weights constrained relative to the index:

- Market weight (duration-weighted) $\pm 10\%$ of the benchmark for major sectors (Treasuries, agency bullets, and collateralized debt). Callable agencies have become such a small component of the index that we expanded the constraint for the sector up to 20% of the total agency spread duration exposure.
- Mortgage market weights are constrained using coupon, term and seasoning sectors.

Rebalancing Rule

If the 10-year Treasury moves through our most extreme scenario in either direction for a substantive period of time, we reserve the option to rebalance the portfolio.

Relative Value Overlay

In addition to reoptimizing the portfolios based on the rebalancing rule, we are going to periodically suggest relative value trade ideas within the portfolio. For example, if between rebalancings a newly issued seven-year Treasury looks attractive, and we feel that rates are going to rise, we may shorten duration by switching from a 10-year Treasury from our portfolio into the seven-year Treasury mid-period. We will report both the returns of the original, static portfolio along with the returns of the “overlay portfolio.”

Appendix A-1

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